# ANEJOS A LA MEMORIA

# ANEJO Nº 1.- PRINCIPALES CARACTERÍSTICAS. FICHA TÉCNICA

**1. INTRODUCCIÓN Y OBJETO DEL PRESENTE ANEJO..... 1**

**2. PRINCIPALES CARACTERÍSTICAS ..... 1**

## 1. INTRODUCCIÓN Y OBJETO DEL PRESENTE ANEJO

Se recogen en el presente anejo las principales características de las actuaciones definidas en el "PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)"

## 2. PRINCIPALES CARACTERÍSTICAS

1. Título del Anteproyecto: "PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)"

2. Localización: TT.MM. de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta (HUESCA)

3. Superficie afectada: 2.714,53 has
   - Superficie Piso Bajo: 2.339,96 ha
   - Superficie Piso Alto: 374,57 ha

4. Obra de toma: Nueva toma en el Canal de Monegros. Control de caudal en coordenadas (UTM ETRS89, H30):
   X: 705.564
   Y: 4.645.153

5. Balsa Inferior Sur:
   - Caudal máximo de Llenado: 2.521 l/s
   - Cota de Coronación: 389 m.s.n.m
   - Cota N.A.M.O.: 388,4 m.s.n.m
   - Cota de fondo: 384 m.s.n.m
   - Talud interior: 2,5 H – 1 V
   - Talud exterior terraplén: 2 H – 1 V
   - Talud exterior desmonte 1 H – 1 V
   - Ancho coronación 4 m
   - Capacidad (NAMO): 67.803,83 $m^3$
   - Movimientos de Tierra en Desmonte: 56.416,68 $m^3$
   - Movimientos de Tierra en Terraplén: 12.568,22 $m^3$

6. Balsa Inferior Norte
   - Caudal de Llenado: 1.260 l/s
   - Cota de Coronación: 389 m.s.n.m
   - Cota N.A.M.O.: 388,3 m.s.n.m
   - Cota de fondo: 384 m.s.n.m
   - Talud interior: 2,5 H – 1 V
   - Talud exterior terraplén: 2 H – 1 V
   - Talud exterior desmonte 1 H – 1 V
   - Ancho coronación 4 m
   - Volumen de Agua a N.A.M.O.: 77.858 $m^3$
   - Movimientos de Tierra en Desmonte: 65.789,18 $m^3$
   - Movimientos de Tierra en Terraplén: 6.764,56 $m^3$

7. Balsa Intermedia:
   - Caudal de Llenado: 2.173 l/s
   - Cota de Coronación: 429 m.s.n.m
   - Cota N.A.M.O.: 428 m.s.n.m
   - Cota de fondo: 422 m.s.n.m
   - Talud interior 2,5 H – 1 V
   - Talud exterior terraplén 1,5 H – 1 V
   - Talud exterior desmonte: 1 H/ 1V

- Ancho coronación 5 m
- Capacidad (NAMO): 180.793 $m^3$
- Movimientos de Tierra en Desmonte: 142.663 $m^3$
- Movimientos de Tierra en Terraplén: 28.969 $m^3$

8. Balsa Elevada:

- Caudal de Llenado: 348 l/s
- Cota de Coronación: 445 m.s.n.m
- Cota N.A.M.O.: 444,25 m.s.n.m
- Cota de fondo: 440 m.s.n.m
- Talud interior 2,5 H – 1 V
- Talud exterior terraplén 1,5 H – 1 V
- Talud exterior desmonte: 1 H/ 1V
- Ancho coronación 4 m
- Capacidad (NAMO): 28.540,15 $m^3$
- Movimientos de Tierra en Desmonte: 21.416 $m^3$
- Movimientos de Tierra en Terraplén: 8.048 $m^3$

9. Estación de bombeo:

Edificio de nueva construcción, con dimensiones en planta de 18 x 42,7 m.

En las instalaciones proyectadas se prevé la instalación de los siguientes equipos:

- Bombeo a Balsa Intermedia:
  - 3 bombas de cámara partida capaces de proporcionar 543 l/s a una altura de 44,5 m.c.a., accionados mediante motor eléctrico de 315 kW, 50 Hz 400 V. Accionamiento con variador de frecuencia.
  - 1 bomba de cámara partida capaz de proporcionar 362 l/s a una altura de 44,5 m.c.a., accionado mediante motor eléctrico de 200 kW, 50 Hz 400 V. Accionamiento con variador de frecuencia.
  - 1 bomba de cámara partida capaz de proporcionar 181 l/s a una altura de 44,5 m.c.a., accionado mediante motor eléctrico de 110 kW, 50 Hz 400 V. Accionamiento con variador de frecuencia.
- Bombeo a Balsa Elevada:
  - 3 bombas de cámara partida capaces de proporcionar 117 l/s a una altura de 62 m.c.a., accionados mediante motor eléctrico de 110 kW, 50 Hz 400 V. Accionamiento con variador de frecuencia.

Instalación fotovoltaica

- Potencia: 1.695 kWp
- Instalación mediante paneles fijos.

Costes energéticos (con impuesto e IVA)

- Bombeo 1:
  - 71.549,43 €/año
  - 31,53 €/ha
  - 0,01294 €/m3
- Bombeo 2:
  - 14.149,96 €/año
  - 41,02 €/ha
  - 0,01929 €/m3
- (Ponderado B1 + B2):
  - 32,79 €/ha
  - 0,01377 €/m3

10. Impulsiones:

- Impulsión a Balsa Intermedia:
  - Diámetro: 1400 mm
  - Material: PRFV PN10
  - Longitud: 914 m.

- Impulsión a Balsa Elevada:
  - Diámetro: 700 mm
  - Material: PRFV PN10
  - Longitud: 1.969 m.

11. Redes de tuberías:

Redes de riego hasta hidrante (realizadas en PVC y PRFV):

- Materiales
  - Hasta DN ≤ 500 mm PVC PN 10-16
  - Mayor DN ≥ 500 mm PRFV PN 6-10

- Longitud total
  - Red Piso Bajo: 52.237 m
  - Red Piso Alto: 9.769 m

- Red terciaria,
  - Longitud, 12.521 m
  - Material, PEAD de 75 a 140 mm

- Hidrantes. 193 hidrantes de las siguientes características:
  - 6 ud de 3” (5 individuales y 1 compartido)
  - 133 ud de 4” (99 individuales y 34 compartidos)
  - 43 ud de 6” (40 individuales y 3 compartidos)
  - 10 ud de 8” (individuales)
  - 1 ud especial

12. Media Tensión

- Centro Seccionamiento
- Línea eléctrica enterrada MT, 3x1x95 mm2, 406m
- Centro Transformación, 1000 kVA, 15/0,4 Kv

13. Presupuesto de ejecución material: 13.462.008,96 €.

14. Presupuesto de ejecución por contrata: 16.019.790,66 €.

15. Presupuesto subvencionable: 19.383.946,70 €.

# ANEJO Nº 2.- RELACIÓN DE PARCELAS Y SUPERFICIES

**ANEJO 2.- RELACIÓN DE PARCELAS Y SUPERFICIES ..... 1**

**1 INTRODUCCIÓN Y OBJETO DEL ANEJO ..... 1**

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**3.1 LISTADO DE PARCELAS ..... 1**

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# ANEJO 2.- RELACIÓN DE PARCELAS Y SUPERFICIES

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

Mediante la información recogida en el presente anejo se pretende dar a conocer el Listado de parcelas y superficies considerado como definitivo para el dimensionamiento de las instalaciones de riego planteadas, indicando el polígono, parcela y superficie, así como el número de hidrante desde el que se dará servicio.

Dado que la zona de estudio se encuentra inmersa en un proceso de concentración, se ha trabajado con las superficies de riego correspondientes para cada lote indicados en los listados de las bases de concentración parcelaria.

## 2 DELIMITACIÓN DE LA ZONA REGABLE

La zona incluida en la transformación supone una superficie neta de 2.714,5256 ha pertenecientes a los Términos Municipales de Almuniente, Torres de Barbués, Senés de Alcubierre, Tardienta y Torralba de Aragón, todos ellos de la provincia de Huesca. La superficie regable se distribuye en los términos municipales indicados según se cita a continuación:

- Almuniente: 1.062,1451 ha
- Torres de Barbués: 464,5578 ha
- Senés de Alcubierre: 54,0364 ha
- Tardienta: 18,9320 ha
- Torralba de Aragón: 1.114,0128 ha

Como se ha indicado anteriormente, la superficie considerada, para cada parcela, ha sido suministrada por la Subdirección de Agricultura y Ganadería a partir de los listados de las bases de Concentración parcelaria. Para las zonas no incluidas en la concentración, se ha trabajado con las superficies proporcionadas por la Comunidad de Regantes y cotejada con la información catastral.

## 3 LISTADO DE PARCELAS

A continuación, se presentan tres listados. En primer lugar, se presenta un listado de las parcelas incluidas en la modernización con la indicación de término municipal, polígono, superficie e hidrante que le corresponde. El segundo listado se ordena por hidrante, indicando las parcelas que riega cada hidrante, identificando de las mismas el municipio, polígono, parcela y superficie. Por último, se presenta un listado por propietario.

## 3.1 LISTADO DE PARCELAS

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Almuniente | 503 | 001 | 0 | 4,4378 | RODRIGUEZ GUALLARTE, ALBA | 1 | 113 | |
| Huesca | Almuniente | 503 | 003 | 0 | 1,9236 | RODRIGUEZ GUALLARTE, ALBA | 1 | 113 | |
| Huesca | Almuniente | 503 | 004 | 0 | 0,1470 | MASA COMUN | 1 | 113 | Sin Toma |
| Huesca | Almuniente | 503 | 005 | 0 | 3,8028 | BARRIO FAULO, URBANO | 1 | 120 | |
| Huesca | Almuniente | 503 | 008 | 0 | 9,6035 | RODRIGUEZ GUALLARTE, ALBA | 1 | 141 | |
| Huesca | Almuniente | 503 | 009 | 0 | 8,7143 | SARVISE MORCATE, DANIEL | 1 | 142 | |
| Huesca | Almuniente | 503 | 010 | 0 | 14,0949 | SARVISE ABADIA, ANTONIO FRANCISCO | 1 | 144 | |
| Huesca | Almuniente | 503 | 012 | 0 | 2,3411 | RODRIGUEZ RODRIGUEZ, BENJAMIN | 1 | 141 | |
| Huesca | Almuniente | 503 | 013 | 0 | 8,5350 | REVUELTA ABADIA, JOSE MIGUEL Y HNOS | 1 | 143 | |
| Huesca | Almuniente | 503 | 015 | 0 | 5,5065 | REVUELTA ABADIA, JOSE MIGUEL Y HNOS | 1 | 143 | |
| Huesca | Almuniente | 503 | 017 | 0 | 1,0883 | ABADIA LIENAS, JULIAN | 1 | 145 | |
| Huesca | Almuniente | 503 | 018 | 0 | 9,9880 | NOGUES SEN, JUAN CARLOS Y MARIA LOURDES | 1 | 145 | |
| Huesca | Almuniente | 503 | 019 | 0 | 10,7404 | LAGUNA MORCATE, FRANCISCO JAVIER | 1 | 147 | |
| Huesca | Almuniente | 503 | 020 | 0 | 1,2492 | ASESIO ORUS, FE CORAZON | 1 | 136 | |
| Huesca | Almuniente | 503 | 021 | 0 | 10,5224 | ASESIO ORUS, FE CORAZON | 1 | 136 | |
| Huesca | Almuniente | 503 | 022 | 0 | 2,4285 | LATORRE ESCARTIN, LUIS ANTONIO | 1 | 135 | |
| Huesca | Almuniente | 503 | 023 | 0 | 10,0773 | AGRICOLA MAZANA S.L.U. | 1 | 137 | |
| Huesca | Almuniente | 503 | 025 | 0 | 8,9801 | DELGADO OSUNA, FRANCISCO | 1 | 138 | |
| Huesca | Almuniente | 503 | 027 | 0 | 1,9717 | DELGADO OSUNA, FRANCISCO | 1 | 138 | |
| Huesca | Almuniente | 503 | 028 | 0 | 1,8078 | MOLINA ZAFRA, JOSE MARIA | 1 | 140 | |
| Huesca | Almuniente | 503 | 029 | 0 | 7,0507 | MOLINA ZAFRA, JOSE MARIA | 1 | 140 | |
| Huesca | Almuniente | 503 | 030 | 0 | 2,0393 | MOLINA ZAFRA, JOSE MARIA | 1 | 140 | |
| Huesca | Almuniente | 503 | 031 | 0 | 3,9150 | BOLEA ALCUBIERRE, CARMELO | 1 | 139 | |
| Huesca | Almuniente | 503 | 032 | 0 | 2,0209 | BOLEA ALCUBIERRE, CARMELO | 1 | 139 | |
| Huesca | Almuniente | 503 | 033 | 0 | 4,5205 | LAGUNA MORCATE, FRANCISCO JAVIER | 1 | 147 | |
| Huesca | Almuniente | 503 | 034 | 0 | 3,6979 | LOPEZ LAFUENTE, ANTONIO JOSE Y HNAS | 1 | 146 | 1 |
| Huesca | Almuniente | 505 | 001 | 0 | 3,7237 | TORRECILLA BURON, JOSE | 1 | 30 | |
| Huesca | Almuniente | 505 | 004 | 0 | 4,1201 | PERTUSA DOTO, GERMAN | 1 | 36 | 1 |
| Huesca | Almuniente | 505 | 005 | 0 | 10,1114 | GUALLAR GUTIERREZ, ANA BELEN | 1 | 37 | |
| Huesca | Almuniente | 505 | 006 | 0 | 0,4000 | SANJUAN GOMEZ, ELIAS Y JESUS | 1 | 37 | |
| Huesca | Almuniente | 505 | 007 | 0 | 1,9793 | MASA COMUN | 1 | 36 | 2 |
| Huesca | Almuniente | 505 | 008 | 0 | 7,2139 | OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 35 | |
| Huesca | Almuniente | 505 | 009 | 0 | 0,9194 | MORA DURAN, JOSE Y HNAS | 1 | 33 | 1 |
| Huesca | Almuniente | 505 | 010 | 0 | 0,8106 | TORRECILLA ALCUBIERRE, ROSA MARIA | 1 | 26 | |
| Huesca | Almuniente | 505 | 011 | 0 | 0,2141 | GANADOS JIMENEZ CAMBRA, S.L. | 1 | 25 | |
| Huesca | Almuniente | 505 | 012 | 0 | 1,4744 | GIRON PABAN, SARA | 1 | 32 | |
| Huesca | Almuniente | 505 | 014 | 0 | 2,0720 | NOVALES BOLEA, FRANCISCO | 1 | 33 | 2 |
| Huesca | Almuniente | 505 | 015 | 0 | 1,4579 | NOVALES BOLEA, FRANCISCO | 1 | 33 | 2 |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Almuniente | 505 | 016 | 0 | 9,6253 | CLAVERIA REVUELTA, FRANCISCO | 1 | 34 | |
| Huesca | Almuniente | 505 | 017 | 0 | 0,4802 | APARICIO CONTE, SERGIO | 1 | 41 | |
| Huesca | Almuniente | 505 | 018 | 0 | 3,8679 | APARICIO FUSTERO, JESUS | 1 | 41 | |
| Huesca | Almuniente | 505 | 019 | 0 | 0,2225 | AYUNTAMIENTO DE SENES DE ALCUBIERRE | 1 | 41 | |
| Huesca | Almuniente | 505 | 020 | 0 | 1,1916 | MASA COMUN | 1 | 44 | 1 |
| Huesca | Almuniente | 505 | 021 | 0 | 0,7831 | APARICIO FUSTERO, JESUS | 1 | 41 | |
| Huesca | Almuniente | 505 | 022 | 0 | 0,1127 | APARICIO FUSTERO, JESUS | 1 | 41 | |
| Huesca | Almuniente | 505 | 023 | 0 | 8,4362 | BARRIO FAULO, URBANO | 1 | 42 | |
| Huesca | Almuniente | 505 | 025 | 0 | 0,8737 | DESCONOCIDO | 1 | 44 | 2 |
| Huesca | Almuniente | 505 | 026 | 0 | 3,7616 | BIARGE ASIN, JOSE ANTONIO | 1 | 43 | |
| Huesca | Almuniente | 505 | 027 | 0 | 1,4140 | PARDO BIARGE, BASILIO JAVIER | 1 | 43 | |
| Huesca | Almuniente | 505 | 028 | 0 | 4,8297 | ASIN DURANGO, PABLO | 1 | 47 | |
| Huesca | Almuniente | 505 | 029 | 0 | 12,3240 | ASIN MENDOZA, FRANCISCO | 1 | 47 | |
| Huesca | Almuniente | 505 | 031 | 0 | 10,3861 | BARRIO LORENQUE, MIGUEL ANGEL | 1 | 48 | |
| Huesca | Almuniente | 505 | 033 | 0 | 4,0215 | ABADIA PUYAL, MANUEL RAMON | 1 | 49 | |
| Huesca | Almuniente | 505 | 034 | 0 | 2,7793 | ABADIA PUYAL, MANUEL RAMON | 1 | 49 | |
| Huesca | Almuniente | 505 | 035 | 0 | 0,3327 | CERVERA ANZANO S.L. | 1 | 50 | |
| Huesca | Almuniente | 505 | 036 | 0 | 5,3134 | CERVERA ANZANO S.L. | 1 | 50 | |
| Huesca | Almuniente | 505 | 037 | 0 | 1,9916 | ITURRE HUARTE, JAVIER ANGEL | 1 | 51 | |
| Huesca | Almuniente | 505 | 038 | 0 | 3,0277 | ITURRE HUARTE, JAVIER ANGEL | 1 | 51 | |
| Huesca | Almuniente | 505 | 041 | 0 | 1,2815 | ABADIA PUYAL, MANUEL RAMON | 1 | 49 | |
| Huesca | Almuniente | 505 | 042 | 0 | 0,5800 | ABADIA PUYAL, MANUEL RAMON | 1 | 49 | |
| Huesca | Almuniente | 505 | 043 | 0 | 1,2758 | ABADIA PUYAL, MANUEL RAMON Y ESPOSA | 1 | 49 | |
| Huesca | Almuniente | 505 | 044 | 0 | 4,4828 | ASIN MENDOZA, JESUS MARIANO | 1 | 54 | |
| Huesca | Almuniente | 505 | 045 | 0 | 3,1472 | ASIN MENDOZA, JESUS MARIANO | 1 | 54 | |
| Huesca | Almuniente | 505 | 046 | 0 | 2,5302 | MORENO RECIO, IRENE | 1 | 53 | |
| Huesca | Almuniente | 505 | 047 | 0 | 10,9901 | ASIN DURANGO, PABLO | 1 | 52 | |
| Huesca | Almuniente | 505 | 049 | 0 | 1,4720 | MALLADA GRACIA, PEDRO Y HNAS | 1 | 46 | 1 |
| Huesca | Almuniente | 505 | 050 | 0 | 0,5919 | LOPEZ BARLUENGA, RAMON | 1 | 46 | 2 |
| Huesca | Almuniente | 505 | 051 | 0 | 2,3268 | DOTO LOPEZ, GUSTAVO JAIME | 1 | 46 | 2 |
| Huesca | Almuniente | 505 | 052 | 0 | 2,4504 | LOPEZ LAGUNA, CONCEPCION | 1 | 46 | 2 |
| Huesca | Almuniente | 505 | 053 | 0 | 0,8010 | LOPEZ LAGUNA, CONCEPCION E HIJO | 1 | 46 | 2 |
| Huesca | Almuniente | 505 | 054 | 0 | 10,0200 | ALLUE ALCUBIERRE, MARIO ANTONIO Y MARIA JESUS | 1 | 45 | |
| Huesca | Almuniente | 505 | 055 | 0 | 5,4903 | LABORDA SANCHEZ, ANGEL | 1 | 40 | 1 |
| Huesca | Almuniente | 505 | 056 | 0 | 9,9835 | GAYAN LORENTE, VICENTE | 1 | 39 | |
| Huesca | Almuniente | 505 | 057 | 0 | 4,5733 | APARICIO CONTE, SERGIO | 1 | 41 | |
| Huesca | Almuniente | 505 | 058 | 0 | 1,8248 | ASESIO ORUS, FE CORAZON | 1 | 40 | 2 |
| Huesca | Almuniente | 505 | 059 | 0 | 9,9390 | GOMEZ LANUZA, FRANCISCO | 1 | 38 | |
| Huesca | Almuniente | 505 | 060 | 0 | 7,9201 | GIRON PABAN, SARA | 1 | 32 | |
| Huesca | Almuniente | 505 | 061 | 0 | 0,4013 | PABAN GIRON, JOSE LUIS Y JOAQUIN | 1 | 32 | |
| Huesca | Almuniente | 505 | 062 | 0 | 1,1501 | OTAL BETRAN, VALENTIN | 1 | 31 | 1 |
| Huesca | Almuniente | 505 | 063 | 0 | 1,6974 | MASA COMUN | 1 | 31 | 2 |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Almuniente | 005 | 00150 | 0 | 6,0644 | HIDALGO BERGUA, ANTONIO | 1 | 69 | |
| Huesca | Almuniente | 005 | 00151 | 0 | 2,0439 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00152 | 0 | 6,6163 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00154 | 0 | 9,8594 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00155 | 0 | 3,9368 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00156 | 0 | 5,3297 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00157 | 0 | 3,1893 | ESCARTIN SERAL, CARMEN | 1 | 70 | |
| Huesca | Almuniente | 005 | 00158 | 0 | 0,3275 | ESCARTIN SERAL, CARMEN | 1 | 70 | |
| Huesca | Almuniente | 005 | 00159 | 0 | 5,4432 | ESCARTIN SERAL, CARMEN | 1 | 70 | |
| Huesca | Almuniente | 005 | 00160 | 0 | 2,6542 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00161 | 0 | 1,7590 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00162 | 0 | 1,4143 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00163 | 0 | 6,1951 | ESCARTIN SERAL, CARMEN | 1 | 70 | |
| Huesca | Almuniente | 005 | 00164 | 0 | 2,8315 | CACHO BAILO, ANGEL | 1 | 71 | |
| Huesca | Almuniente | 005 | 00165 | 0 | 10,1801 | CACHO BAILO, ANGEL | 1 | 71 | |
| Huesca | Almuniente | 005 | 00167 | a | 3,9375 | HNOS ARRUEGO VICENTE S.C. | 1 | 67 | |
| Huesca | Almuniente | 005 | 00167 | b | 7,9769 | HNOS ARRUEGO VICENTE S.C. | 1 | 67 | |
| Huesca | Almuniente | 005 | 00168 | 0 | 3,8426 | HNOS ARRUEGO VICENTE S.C. | 1 | 67 | |
| Huesca | Almuniente | 005 | 00169 | 0 | 8,6479 | HNOS ARRUEGO VICENTE S.C. | 1 | 67 | |
| Huesca | Almuniente | 005 | 00170 | 0 | 11,7005 | GARCIA CRUZ, VICENTE | 1 | 66 | |
| Huesca | Almuniente | 005 | 00171 | 0 | 6,9274 | ESTEBAN MARISCAL, FRANCISCO | 1 | 65 | |
| Huesca | Almuniente | 005 | 00172 | 0 | 3,3088 | ESTEBAN MARISCAL, FRANCISCO | 1 | 65 | |
| Huesca | Almuniente | 005 | 00173 | 0 | 9,6409 | MONTESINOS PLO, ALVARO | 1 | 64 | |
| Huesca | Almuniente | 005 | 00176 | a | 7,4844 | MAIRAL LAIGLESIA, MARIANO | 1 | 62 | |
| Huesca | Almuniente | 005 | 00176 | b | 1,9028 | MAIRAL LAIGLESIA, MARIANO | 1 | 62 | |
| Huesca | Almuniente | 005 | 00176 | c | 1,2532 | MAIRAL LAIGLESIA, MARIANO | 1 | 62 | |
| Huesca | Almuniente | 005 | 00177 | 0 | 10,4736 | CACHO BAILO, ANGEL | 1 | 63 | |
| Huesca | Almuniente | 005 | 00178 | a | 7,9803 | COTELA SANTOS, FELIX | 1 | 61 | |
| Huesca | Almuniente | 005 | 00178 | b | 0,5843 | COTELA SANTOS, FELIX | 1 | 61 | |
| Huesca | Almuniente | 005 | 00179 | 0 | 1,8050 | COTELA SANTOS, FELIX | 1 | 61 | |
| Huesca | Almuniente | 005 | 00295 | a | 52,1180 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | d | 0,8174 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | f | 10,0814 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | g | 14,4901 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | h | 2,5840 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | i | 8,0982 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | k | 10,7595 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | l | 3,2462 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | n | 3,7021 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00295 | p | 10,3417 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00296 | a | 4,8883 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00297 | a | 11,4602 | MONTEFRULA | 1 | 60 | |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Almuniente | 005 | 00297 | b | 13,7968 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00298 | a | 28,7764 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00298 | b | 8,3537 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00298 | c | 13,0034 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00298 | d | 1,6875 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00298 | e | 2,6328 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00299 | a | 3,9310 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00299 | b | 5,6501 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00299 | c | 7,5966 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00299 | d | 5,1984 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | a | 7,2468 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | b | 19,9266 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | c | 0,5325 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | d | 4,3862 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | f | 9,8388 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | g | 10,9069 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | h | 36,6144 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | i | 0,0078 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00301 | j | 5,9677 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00596 | 0 | 0,4922 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00597 | 0 | 0,1299 | S.A.T. ASGI | 1 | 68 | |
| Huesca | Almuniente | 005 | 00600 | 0 | 4,7311 | ESCARTIN SERAL, CARMEN | 1 | 70 | |
| Huesca | Almuniente | 005 | 00601 | 0 | 0,5500 | ESCARTIN SERAL, CARMEN | 1 | 70 | |
| Huesca | Almuniente | 005 | 00602 | 0 | 0,3340 | CACHO BAILO, ANGEL | 1 | 71 | |
| Huesca | Almuniente | 005 | 00603 | 0 | 1,8950 | HNOS ARRUEGO VICENTE S.C. | 1 | 67 | |
| Huesca | Almuniente | 005 | 00605 | 0 | 0,4722 | ESTEBAN MARISCAL, FRANCISCO | 1 | 65 | |
| Huesca | Almuniente | 005 | 00606 | 0 | 3,1499 | MAIRAL LAIGLESIA, MARIANO | 1 | 62 | |
| Huesca | Almuniente | 005 | 00607 | 0 | 1,2858 | COTELA SANTOS, FELIX | 1 | 61 | |
| Huesca | Almuniente | 005 | 00638 | a | 12,3212 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00638 | b | 4,6436 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00638 | c | 6,8041 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00639 | a | 16,3641 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00640 | 0 | 9,5287 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00642 | a | 16,3966 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00642 | b | 5,3578 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00643 | a | 3,7615 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00643 | b | 0,5975 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00643 | c | 0,8140 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00644 | a | 5,3776 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00644 | b | 14,8747 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00646 | a | 13,7496 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00646 | b | 4,1257 | MONTEFRULA | 1 | 60 | |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Almuniente | 005 | 00646 | e | 0,1711 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00649 | 0 | 0,2245 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00650 | 0 | 4,4363 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00651 | 0 | 1,2237 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00652 | a | 0,3383 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00653 | a | 7,1159 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00653 | b | 2,1540 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00658 | 0 | 2,2874 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00659 | 0 | 14,2592 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00675 | a | 23,8245 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00675 | b | 17,1530 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00675 | c | 1,5988 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00675 | d | 2,9331 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00676 | a | 5,4816 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00676 | c | 3,1971 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00679 | a | 13,9464 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00680 | a | 16,3390 | MONTEFRULA | 1 | 60 | |
| Huesca | Almuniente | 005 | 00683 | a | 7,3465 | MONTEFRULA | 1 | 60 | |
| | **Total Almuniente** | | | | 1.062,1451 | | | | |
| Huesca | Barbués | 502 | 100 | 0 | 4,8625 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 109 | |
| Huesca | Barbués | 502 | 101 | 0 | 8,9983 | SAUCO DOTO, MARIA ANGELES | 1 | 108 | |
| Huesca | Barbués | 502 | 105 | 0 | 8,8634 | BARRIO FAULO, URBANO | 1 | 107 | 1 |
| Huesca | Barbués | 502 | 106 | 0 | 0,2160 | GRACIA MARTIN, MIGUELA E HIJOS | 1 | 118 | 1 |
| Huesca | Barbués | 502 | 107 | 0 | 0,2265 | CREMALLET LABORDA, JOSE | 1 | 118 | 2 |
| Huesca | Barbués | 502 | 108 | 0 | 1,0195 | OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 118 | 3 |
| Huesca | Barbués | 502 | 109 | 0 | 0,5565 | OLIVA GUALLAR, PEDRO | 1 | 118 | 3 |
| Huesca | Barbués | 502 | 110 | 0 | 0,2145 | SALAMANCA LEON, JOSE | 1 | 118 | 4 |
| Huesca | Barbués | 502 | 114 | 0 | 0,1838 | PAULES SESE, ANDRES | 1 | 116 | |
| Huesca | Barbués | 502 | 115 | 0 | 0,4191 | IBAÑEZ IBAÑEZ, JOSE | 1 | 116 | |
| Huesca | Barbués | 502 | 117 | 0 | 0,4006 | GALINO ALTAFAJ, ALVARO | 1 | 116 | |
| Huesca | Barbués | 502 | 120 | 0 | 0,5460 | SARVISE MORCATE, DANIEL | 1 | 116 | |
| Huesca | Barbués | 502 | 121 | 0 | 0,7653 | RAMON CUBERO, ANTONIO | 1 | 116 | |
| Huesca | Barbués | 502 | 122 | 0 | 0,4005 | MASA COMUN | 1 | 116 | |
| Huesca | Barbués | 502 | 123 | 0 | 0,2433 | ACIN BERCERO, VICENTE | 1 | 116 | |
| Huesca | Barbués | 502 | 124 | 0 | 0,2339 | SEBASTIAN DELGADO, ISMAEL Y RAQUEL | 1 | 116 | |
| Huesca | Barbués | 502 | 126 | 0 | 8,5843 | ROMEO OLIVAN, CARLOS | 1 | 117 | |
| Huesca | Barbués | 502 | 128 | 0 | 0,4347 | REVUELTA ABADIA, JOSE MIGUEL | 1 | 107 | 2 |
| Huesca | Barbués | 502 | 130 | 0 | 9,7779 | BOROBIA MICHELENA, YOLANDA | 1 | 106 | |
| Huesca | Barbués | 502 | 131 | 0 | 4,2513 | PUEYO CALVO, JUSTO Y HNAS | 1 | 102 | |
| Huesca | Barbués | 502 | 132 | 0 | 1,2859 | MASA COMUN | 1 | 112 | 2 |
| Huesca | Barbués | 502 | 133 | 0 | 9,8699 | REVUELTA ABADIA, JOSE MIGUEL | 1 | 114 | |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Barbués | 502 | 135 | 0 | 9,0456 | DOTO OTO, FRANCISCA MARIA CARMEN | 1 | 115 | |
| Huesca | Barbués | 502 | 137 | 0 | 8,2880 | LISA GOMEZ, ABEL JOSE | 1 | 122 | |
| Huesca | Barbués | 502 | 138 | 0 | 0,4677 | LISA BERNAD, RODOLFO FAUSTINO | 1 | 122 | |
| Huesca | Barbués | 502 | 139 | 0 | 8,2583 | SANJUAN MILLAN, JESUS | 1 | 129 | |
| Huesca | Barbués | 502 | 140 | 0 | 0,2044 | REVUELTA LOPEZ, PEDRO CARLOS | 1 | 123 | 4 |
| Huesca | Barbués | 502 | 141 | 0 | 0,2091 | GRACIA ROBERT, JOSE | 1 | 123 | 5 |
| Huesca | Barbués | 502 | 142 | 0 | 0,1952 | CALLE GARCIA, VALENTIN | 1 | 123 | 6 |
| Huesca | Barbués | 502 | 143 | 0 | 0,2324 | PABAN GIRON, JOSE LUIS | 1 | 123 | 7 |
| Huesca | Barbués | 502 | 144 | 0 | 0,2764 | SAUCO DOTO, ANA ISABEL | 1 | 123 | 8 |
| Huesca | Barbués | 502 | 145 | 0 | 0,5475 | RODRIGUEZ GUALLARTE, ALBA | 1 | 123 | 2 |
| Huesca | Barbués | 502 | 146 | 0 | 0,1466 | RODRIGUEZ GARCIA, JOSE | 1 | 123 | 2 |
| Huesca | Barbués | 502 | 148 | 0 | 0,3260 | PUERTOLAS BERDUN, EUGENIO | 1 | 123 | 3 |
| Huesca | Barbués | 502 | 149 | 0 | 0,2084 | DELGADO OSUNA, FRANCISCO | 1 | 123 | 3 |
| Huesca | Barbués | 502 | 150 | 0 | 0,2414 | SANJUAN GOMEZ, ELIAS Y ANA MARIA | 1 | 129 | |
| Huesca | Barbués | 502 | 151 | 0 | 8,1096 | SANJUAN GOMEZ, ELIAS Y JESUS | 1 | 129 | |
| Huesca | Barbués | 502 | 152 | 0 | 0,4801 | MASA COMUN | 1 | 128 | 9 |
| Huesca | Barbués | 502 | 153 | 0 | 0,2225 | NOGUES SEN, JUAN CARLOS Y MARIA LOURDES | 1 | 128 | 7 |
| Huesca | Barbués | 502 | 154 | 0 | 0,2153 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 128 | 8 |
| Huesca | Barbués | 502 | 155 | 0 | 2,2954 | SANJUAN GOMEZ, ELIAS Y JESUS | 1 | 129 | |
| Huesca | Barbués | 502 | 158 | 0 | 9,5440 | REVUELTA LOPEZ, JOSE PASCUAL | 1 | 121 | |
| Huesca | Barbués | 502 | 159 | 0 | 7,8536 | REVUELTA LISA, ANTONIO JOSE | 1 | 121 | |
| Huesca | Barbués | 502 | 160 | 0 | 7,6150 | BARRIO FAULO, URBANO | 1 | 120 | |
| Huesca | Barbués | 502 | 001 | 0 | 2,1303 | MASA COMUN | 1 | 159 | 1 |
| Huesca | Barbués | 502 | 002 | 0 | 13,7013 | SANTOS SESE, JESUS | 1 | 158 | |
| Huesca | Barbués | 502 | 003 | 0 | 6,1967 | CABREJAS LAORDEN, LUIS | 1 | 157 | |
| Huesca | Barbués | 502 | 004 | 0 | 3,3904 | LORAQUE RODRIGO, BERNABE | 1 | 156 | |
| Huesca | Barbués | 502 | 005 | 0 | 4,1153 | BARRIO FAULO, URBANO | 1 | 150 | |
| Huesca | Barbués | 502 | 007 | 0 | 0,2522 | BARRIO FAULO, URBANO | 1 | 150 | |
| Huesca | Barbués | 502 | 008 | 0 | 0,2199 | BARRIO LORAQUE, MIGUEL ANGEL | 1 | 150 | |
| Huesca | Barbués | 502 | 009 | 0 | 9,4315 | REVUELTA LOPEZ, PEDRO CARLOS | 1 | 161 | |
| Huesca | Barbués | 502 | 010 | 0 | 11,5912 | CASTAN LUNA, FELIX ANTONIO | 1 | 162 | |
| Huesca | Barbués | 502 | 011 | 0 | 9,5215 | BENEDI MURO, MANUEL | 1 | 163 | |
| Huesca | Barbués | 502 | 012 | 0 | 7,5594 | MONESMA MAZA, BONIFACIO LUIS | 1 | 164 | |
| Huesca | Barbués | 502 | 013 | 0 | 3,2900 | MONESMA MAZA, BONIFACIO LUIS | 1 | 164 | |
| Huesca | Barbués | 502 | 014 | 0 | 8,8464 | MONESMA MAZA, BONIFACIO LUIS | 1 | 164 | |
| Huesca | Barbués | 502 | 015 | 0 | 12,4067 | SARVISE ANDREU, ANGEL FELIX | 1 | 160 | |
| Huesca | Barbués | 502 | 016 | 0 | 1,4228 | CLAVER BALDOVINOS, MARIA CRUZ | 1 | 159 | 2 |
| Huesca | Barbués | 502 | 017 | 0 | 2,9308 | GUALLAR MAVILLA, DOMINGO | 1 | 167 | |
| Huesca | Barbués | 502 | 018 | 0 | 3,0469 | GUALLAR MAVILLA, DOMINGO | 1 | 167 | |
| Huesca | Barbués | 502 | 019 | 0 | 2,5281 | ARBUENS FERRANDO, MARIA JESUS | 1 | 159 | 3 |
| Huesca | Barbués | 502 | 020 | 0 | 6,5279 | REVUELTA LISA, ALBERTO | 1 | 170 | |
| Huesca | Barbués | 502 | 021 | 0 | 9,7698 | SESE SANTOLARIA, VICTORIA  E HIJO | 1 | 169 | |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Barbués | 502 | 022 | 0 | 9,4861 | GRIMAL CUBERO, JESUS | 1 | 166 | |
| Huesca | Barbués | 502 | 023 | 0 | 9,4579 | LISA GOMEZ, ABEL JOSE | 1 | 165 | |
| Huesca | Barbués | 502 | 024 | 0 | 5,5812 | BARRIO FAULO, URBANO | 1 | 150 | |
| Huesca | Barbués | 502 | 025 | 0 | 8,5012 | GALINO ALTAFAJ, ALVARO | 1 | 151 | |
| Huesca | Barbués | 502 | 026 | 0 | 7,7561 | BARRIO FAULO, URBANO | 1 | 150 | |
| Huesca | Barbués | 502 | 027 | 0 | 7,9637 | SANCHEZ LACASA, GUADALUPE | 1 | 171 | |
| Huesca | Barbués | 502 | 028 | 0 | 11,2569 | MUÑOZ LACAMPA, MARIA TERESA Y ANTONIO | 1 | 172 | |
| Huesca | Barbués | 502 | 029 | 0 | 7,6499 | MUÑOZ LACAMPA, ANTONIO MANUEL Y OTROS | 1 | 173 | |
| Huesca | Barbués | 502 | 031 | 0 | 5,2981 | ORUS MIRANDA, PATROCINIO Mª MAGDALENA | 1 | 174 | |
| Huesca | Barbués | 502 | 032 | 0 | 3,8930 | GARCES POBO, MARIA PILAR E HIJO | 1 | 175 | |
| Huesca | Barbués | 502 | 033 | 0 | 6,1156 | LACAMPA ABAD, MARIA CARMEN | 1 | 176 | |
| Huesca | Barbués | 502 | 035 | 0 | 11,4225 | EXPLOTACIONES GANADERAS VALDEMORO S.L.U. | 1 | 177 | |
| Huesca | Barbués | 502 | 036 | 0 | 0,6808 | OTISAR SOCIEDAD LIMITADA | 1 | 179 | 1 |
| Huesca | Barbués | 502 | 037 | 0 | 2,6005 | OTIN ORUS, MARIA DOLORES | 1 | 179 | 1 |
| Huesca | Barbués | 502 | 038 | 0 | 1,7501 | BARRIO FAULO, URBANO | 1 | 179 | 2 |
| Huesca | Barbués | 502 | 039 | 0 | 10,2861 | NAVARRO RUBIO, ANTONIA | 1 | 180 | |
| Huesca | Barbués | 502 | 041 | 0 | 5,6940 | SANCHEZ COSANO, MARIA CONCEPCION | 1 | 181 | |
| Huesca | Barbués | 502 | 043 | 0 | 7,5678 | REVUELTA MONESMA, PEDRO CARLOS | 1 | 178 | |
| Huesca | Barbués | 502 | 045 | 0 | 1,1433 | LIESA USON, AGUSTIN | 1 | 182 | |
| Huesca | Barbués | 502 | 046 | 0 | 25,5104 | MAZANA PIENSOS COMPUESTOS S.L. | 1 | 132 | |
| Huesca | Barbués | 502 | 047 | 0 | 3,9430 | LIESA PISA, JOAQUIN | 1 | 134 | |
| Huesca | Barbués | 502 | 050 | 0 | 4,6729 | LIESA PISA, JOAQUIN | 1 | 134 | |
| Huesca | Barbués | 502 | 052 | 0 | 7,0911 | SANJUAN GOMEZ, ELIAS Y NATIVIDAD | 1 | 133 | |
| Huesca | Barbués | 502 | 053 | 0 | 11,0194 | CASTEL CANALIS, ANTONIO | 1 | 131 | |
| Huesca | Barbués | 502 | 054 | 0 | 6,6925 | CASTAN LUNA, FELIX ANTONIO | 1 | 130 | |
| Huesca | Barbués | 502 | 055 | 0 | 0,2400 | GARCES TORRABIAS, PEDRO Y JORGE | 1 | 128 | 1 |
| Huesca | Barbués | 502 | 056 | 0 | 0,2556 | LUCAS AROCA, DESIDERIO | 1 | 128 | 2 |
| Huesca | Barbués | 502 | 057 | 0 | 0,2240 | CADENAS CAMON, SANTIAGO | 1 | 128 | 3 |
| Huesca | Barbués | 502 | 058 | 0 | 0,1962 | ROPERO ORTIZ, PRIMITIVO | 1 | 128 | 3 |
| Huesca | Barbués | 502 | 059 | 0 | 0,1500 | BOROBIA MICHELENA, EDURNE | 1 | 128 | 4 |
| Huesca | Barbués | 502 | 060 | 0 | 0,2600 | CORREAS OTIN, EMERITA | 1 | 128 | 5 |
| Huesca | Barbués | 502 | 061 | 0 | 0,1330 | OCA BAGUENA, PEDRO JAVIER Y EVA MARIA | 1 | 128 | 6 |
| Huesca | Barbués | 502 | 062 | 0 | 0,1341 | GAYAN GALVEZ, ALVARO | 1 | 127 | 1 |
| Huesca | Barbués | 502 | 063 | 0 | 0,2356 | FORTES BARRANQUERO, ANTONIO | 1 | 127 | 2 |
| Huesca | Barbués | 502 | 064 | 0 | 0,1889 | LAFUENTE DOTO, BENITO | 1 | 127 | 3 |
| Huesca | Barbués | 502 | 065 | 0 | 0,1509 | MOLINA ZAFRA, JOSE MARIA | 1 | 127 | 4 |
| Huesca | Barbués | 502 | 066 | 0 | 0,1965 | MAZA ACEBILLO, JOSEFA Y OTROS | 1 | 127 | 5 |
| Huesca | Barbués | 502 | 067 | 0 | 0,2018 | GOMEZ LANUZA, FRANCISCO | 1 | 127 | 6 |
| Huesca | Barbués | 502 | 068 | 0 | 0,1862 | LAGUNA MORCATE, FRANCISCO JAVIER Y HNOS | 1 | 127 | 7 |
| Huesca | Barbués | 502 | 069 | 0 | 0,1680 | LATORRE MAGALLON, ALEJANDRO | 1 | 127 | 8 |
| Huesca | Barbués | 502 | 070 | 0 | 0,3376 | LOPEZ BARREDO, MANUEL | 1 | 123 | 1 |
| Huesca | Barbués | 502 | 071 | 0 | 7,7947 | MIRANDA CAPISTROS, JORGE MANUEL | 1 | 124 | |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Barbués | 502 | 072 | 0 | 0,7603 | OLIVAN ESCAR, DIONISIO | 1 | 126 | 1 |
| Huesca | Barbués | 502 | 073 | 0 | 2,4015 | OLIVA BIARGE, BASILIO ANTONIO | 1 | 126 | 1 |
| Huesca | Barbués | 502 | 074 | 0 | 2,3012 | PALACIO BRUN, GLORIA CARMEN | 1 | 126 | 2 |
| Huesca | Barbués | 502 | 075 | 0 | 0,6399 | MASA COMUN | 1 | 126 | 3 |
| Huesca | Barbués | 502 | 077 | 0 | 2,4896 | PAULES SESE, ANDRES | 1 | 125 | 1 |
| Huesca | Barbués | 502 | 079 | 0 | 4,9993 | PAULES SESE, ANDRES | 1 | 125 | 2 |
| Huesca | Barbués | 502 | 081 | 0 | 4,2757 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 109 | |
| Huesca | Barbués | 502 | 083 | 0 | 0,2745 | AYUNTAMIENTO DE TORRES DE BARBUES | 1 | 118 | 5 |
| Huesca | Barbués | 502 | 084 | 0 | 0,2143 | ASENSIO PEREZ, TIRSO | 1 | 118 | 6 |
| Huesca | Barbués | 502 | 085 | 0 | 0,1670 | OBISPADO DE HUESCA | 1 | 118 | 7 |
| Huesca | Barbués | 502 | 086 | 0 | 0,1935 | LISA BERNAD, RODOLFO FAUSTINO | 1 | 118 | 8 |
| Huesca | Barbués | 502 | 087 | 0 | 0,2877 | DOTO OTO, FRANCISCA MARIA CARMEN | 1 | 119 | 1 |
| Huesca | Barbués | 502 | 088 | 0 | 0,1371 | PIRACES LAIRLA, EMILIO | 1 | 119 | 1 |
| Huesca | Barbués | 502 | 089 | 0 | 0,2307 | DURANGO GAYAN, FRANCISCO | 1 | 119 | 2 |
| Huesca | Barbués | 502 | 090 | 0 | 0,2158 | SESE SANTOLARIA, VICTORIA E HIJO | 1 | 119 | 3 |
| Huesca | Barbués | 502 | 091 | 0 | 0,4064 | ROMERO CALVO, FRANCISCO | 1 | 119 | 4 |
| Huesca | Barbués | 502 | 092 | 0 | 0,4084 | GRASA ARA, ROMAN | 1 | 119 | 5 |
| Huesca | Barbués | 502 | 093 | 0 | 0,3110 | BARRIO LORAQUE, MIGUEL ANGEL | 1 | 119 | 6 |
| Huesca | Barbués | 502 | 094 | 0 | 0,2491 | BARRIO FAULO, URBANO | 1 | 119 | 6 |
| Huesca | Barbués | 502 | 095 | 0 | 0,2514 | HIGUERA FERNANDEZ, FELIX | 1 | 119 | 7 |
| Huesca | Barbués | 502 | 096 | 0 | 0,5472 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 109 | |
| Huesca | Barbués | 502 | 098 | 0 | 2,4937 | PASCUAL BOLEA, MARIA JOSE | 1 | 88 | |
| | **Total Barbués** | | | | 464,5578 | | | | |
| Huesca | Senés | 503 | 001 | 0 | 0,1095 | BERCERO ABRIL, MARIANO | 2 | 227 | 1 |
| Huesca | Senés | 503 | 005 | 0 | 2,7961 | SUBIAS SUBIAS, JOAQUINA | 2 | 229 | |
| Huesca | Senés | 503 | 007 | 0 | 0,6981 | SUBIAS SUBIAS, JOAQUINA | 2 | 229 | |
| Huesca | Senés | 503 | 008 | 0 | 12,9519 | ABARDIA CONTE, JOSE MANUEL Y CARLOTA | 2 | 229 | |
| Huesca | Senés | 503 | 009 | 0 | 9,8415 | ABADIA PAÑO, MARIA JESUS | 2 | 228 | |
| Huesca | Senés | 503 | 011 | 0 | 0,3650 | CASTILLO PICAPEO, FRANCISCO | 2 | 227 | Sin Toma |
| Huesca | Senés | 503 | 013 | 0 | 0,3108 | PUYOL MASIAS , JOSE CARMELO | 2 | 227 | Sin Toma |
| Huesca | Senés | 503 | 014 | 0 | 0,6015 | ALLUE OTAL, JOSE MANUEL | 2 | 231 | |
| Huesca | Senés | 503 | 015 | 0 | 6,0907 | MUR POMAR, LUIS FERNANDO | 2 | 231 | |
| Huesca | Senés | 503 | 016 | 0 | 9,6817 | PUERTOLAS VAL, MARIA PILAR | 1 | 17 | |
| Huesca | Senés | 503 | 016 | 0 | 9,6817 | PUERTOLAS VAL, MARIA PILAR | 2 | 230 | |
| Huesca | Senés | 503 | 017 | 0 | 0,4043 | ALCUBIERRE GARCIA, JOAQUIN | 1 | 17 | |
| Huesca | Senés | 503 | 018 | 0 | 0,1098 | ARNAL CABREJAS, LUIS | 1 | 17 | |
| Huesca | Senés | 503 | 019 | 0 | 0,3939 | GANADOS JIMENEZ CAMBRA, S.L. | 1 | 25 | |
| | **Total Senés** | | | | 54,0364 | | | | |
| Huesca | Tardienta | 504 | 002 | 0 | 0,8164 | PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | |
| Huesca | Tardienta | 504 | 003 | 0 | 4,2907 | PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | |
| Huesca | Tardienta | 504 | 004 | 0 | 0,6117 | TORNE BOLEA, ANTONIO | 1 | 95 | 1 |
| Huesca | Tardienta | 504 | 005 | 0 | 0,9004 | ALCUBIERRE SAURAS, JOSE | 1 | 95 | 2 |

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|---|---|---|---|---|---|---|---|---|---|
| Huesca | Tardienta | 504 | 006 | 0 | 1,7034 | MASA COMUN | 1 | 94 | 1 |
| Huesca | Tardienta | 504 | 007 | 0 | 0,7573 | BARLUENGA ORTIZ, ANTONIO Y HNAS | 1 | 94 | 2 |
| Huesca | Tardienta | 504 | 008 | 0 | 0,4325 | ALADREN OLIVA, FRANCISCO | 1 | 94 | 3 |
| Huesca | Tardienta | 504 | 009 | 0 | 0,5395 | AYUNTAMIENTO DE TARDIENTA | 1 | 94 | 4 |
| Huesca | Tardienta | 504 | 010 | 0 | 1,2250 | BARLUENGA ALCUBIERRE, PEDRO Y ESPOSA | 1 | 94 | 5 |
| Huesca | Tardienta | 504 | 011 | 0 | 1,4561 | EL HASNAOUI ALLAL, HAMID Y MENANA | 1 | 95 | 3 |
| Huesca | Tardienta | 504 | 012 | 0 | 0,7524 | MAZA ALCUBIERRE, JESUS ANTONIO | 1 | 95 | 4 |
| Huesca | Tardienta | 504 | 013 | 0 | 1,0983 | BAILO BOLEA, DIEGO | 2 | 216 | |
| Huesca | Tardienta | 504 | 014 | 0 | 2,5285 | BAILO BOLEA, DIEGO | 2 | 216 | |
| Huesca | Tardienta | 504 | 015 | 0 | 0,3315 | TORRECILLA VIÑAS, YOLANDA Y CESAR | 2 | 211 | |
| Huesca | Tardienta | 504 | 016 | 0 | 0,3361 | ABADIA BUIL, PEDRO LUIS | 2 | 212 | |
| Huesca | Tardienta | 504 | 018 | 0 | 1,1522 | SANZ BIELSA, ANTONIO | 2 | 212 | |
| | **Total Tardienta** | | | | 18,9320 | | | | |
| Huesca | Torralba | 501 | 102 | 0 | 4,3204 | BOROBIA MICHELENA, ENRIQUE | 1 | 103 | |
| Huesca | Torralba | 501 | 104 | 0 | 4,5176 | PUEYO CALVO, JUSTO | 1 | 102 | |
| Huesca | Torralba | 501 | 105 | 0 | 0,7859 | PUEYO CALVO, JUSTO | 1 | 102 | |
| Huesca | Torralba | 501 | 106 | 0 | 9,6901 | PUEYO CALVO, JUSTO Y HNAS | 1 | 102 | |
| Huesca | Torralba | 501 | 109 | 0 | 1,1188 | LISA PLO, MARIA CARMEN | 1 | 112 | 1 |
| Huesca | Torralba | 501 | 110 | 0 | 5,1524 | REVUELTA LOPEZ, JOSE PASCUAL | 1 | 112 | 1 |
| Huesca | Torralba | 501 | 112 | 0 | 6,7648 | TORRECILLA ALCUBIERRE, ROSA MARIA | 1 | 110 | |
| Huesca | Torralba | 501 | 113 | 0 | 5,3168 | GARCÍA LABAT, NICOLAS Y FRANCISCO | 1 | 104 | |
| Huesca | Torralba | 501 | 115 | 0 | 7,6710 | GARCIA LABAT, NICOLAS JOSE | 1 | 104 | |
| Huesca | Torralba | 501 | 116 | 0 | 14,9080 | TORRECILLA VIÑAS, YOLANDA Y CESAR | 1 | 111 | |
| Huesca | Torralba | 501 | 002 | 0 | 10,0509 | ACIN BERCERO, VICENTE | 1 | 153 | |
| Huesca | Torralba | 501 | 003 | 0 | 8,5233 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 152 | |
| Huesca | Torralba | 501 | 004 | 0 | 12,3773 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 152 | |
| Huesca | Torralba | 501 | 006 | 0 | 5,8267 | PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | |
| Huesca | Torralba | 501 | 007 | 0 | 0,3147 | PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | |
| Huesca | Torralba | 501 | 008 | 0 | 0,6612 | PELEATO PELEATO, FRANCISCO | 1 | 155 | |
| Huesca | Torralba | 501 | 009 | 0 | 4,7786 | ORUS ABADIA EUGENIA Y OTROS | 1 | 154 | |
| Huesca | Torralba | 501 | 010 | 0 | 5,3497 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 152 | |
| Huesca | Torralba | 501 | 011 | 0 | 1,2679 | GALINO ALTAFAJ, ALVARO | 1 | 151 | |
| Huesca | Torralba | 501 | 013 | 0 | 2,2203 | GAVIN MARTINEZ, MARIANO Y OTROS | 1 | 93 | 1 |
| Huesca | Torralba | 501 | 014 | 0 | 2,9122 | CORZ PLO, MARIA TERESA | 1 | 93 | 2 |
| Huesca | Torralba | 501 | 017 | 0 | 20,0005 | BAYOD CALVO, JOSE ALFREDO | 1 | 90 | |
| Huesca | Torralba | 501 | 019 | 0 | 37,2570 | GANADOS JIMENEZ CAMBRA, S.L. | 1 | 85 | |
| Huesca | Torralba | 501 | 022 | 0 | 1,7839 | PASCUAL BOLEA, MARIA JOSE | 1 | 88 | |
| Huesca | Torralba | 501 | 023 | 0 | 1,1929 | PASCUAL BOLEA, MARIA JOSE | 1 | 88 | |
| Huesca | Torralba | 501 | 024 | 0 | 5,8349 | PASCUAL BOLEA, MARIA JOSE | 1 | 88 | |
| Huesca | Torralba | 501 | 025 | 0 | 2,6724 | ALCUBIERRE RODELLAR, LUIS MANUEL | 1 | 89 | |
| Huesca | Torralba | 501 | 026 | 0 | 1,9673 | ALCUBIERRE GARCIA, LUIS MANUEL | 1 | 89 | |
| Huesca | Torralba | 501 | 027 | 0 | 8,6980 | ALCUBIERRE RODELLAR, CARLOS | 1 | 89 | |

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|---|---|---|---|---|---|---|---|---|---|
| Huesca | Torralba | 501 | 028 | 0 | 2,1139 | BAYOD CALVO, JOSE ALFREDO | 1 | 90 | |
| Huesca | Torralba | 501 | 029 | 0 | 7,7662 | MARTINEZ PEREZ, NEMESIO AGUSTIN JESUS | 1 | 91 | |
| Huesca | Torralba | 501 | 030 | 0 | 1,3090 | CABRERO MARTINEZ, RUBEN | 1 | 91 | |
| Huesca | Torralba | 501 | 032 | 0 | 0,6046 | MUR CATON, LORENZO | 1 | 92 | 1 |
| Huesca | Torralba | 501 | 033 | 0 | 1,8972 | MASA COMUN | 1 | 92 | 2 |
| Huesca | Torralba | 501 | 034 | 0 | 0,9284 | PELEATO PELEATO, FRANCISCO | 1 | 92 | 3 |
| Huesca | Torralba | 501 | 037 | 0 | 34,5687 | BAILO BOLEA, DIEGO | 2 | 216 | |
| Huesca | Torralba | 501 | 039 | 0 | 24,8692 | BAYOD CALVO, JOSE ALFREDO | 1 | 84 | |
| Huesca | Torralba | 501 | 040 | 0 | 33,8796 | GANADOS JIMENEZ CAMBRA, S.L. | 2 | 215 | |
| Huesca | Torralba | 501 | 042 | 0 | 13,4148 | BAYOD CALVO, JOSE ALFREDO | 1 | 83 | |
| Huesca | Torralba | 501 | 043 | 0 | 5,2239 | IZUEL GASTON, JOSE ANTONIO | 2 | 217 | |
| Huesca | Torralba | 501 | 044 | 0 | 0,7860 | TORRECILLA GRASA, JOSE LUIS | 1 | 82 | |
| Huesca | Torralba | 501 | 046 | 0 | 17,3334 | TORRECILLA GRASA, JOSE LUIS | 1 | 82 | |
| Huesca | Torralba | 501 | 048 | 0 | 1,4302 | MASA COMUN | 2 | 219 | 1 |
| Huesca | Torralba | 501 | 052 | 0 | 4,2588 | LISA BERNAD, ANTONIO JAVIER | 2 | 220 | |
| Huesca | Torralba | 501 | 056 | 0 | 3,0445 | BAYOD CALVO, JOSE ALFREDO | 2 | 219 | 2 |
| Huesca | Torralba | 501 | 057 | 0 | 4,9932 | ABADIA ORUS, PEDRO | 2 | 218 | |
| Huesca | Torralba | 501 | 059 | 0 | 6,6195 | ABADIA ORUS, PEDRO | 2 | 218 | |
| Huesca | Torralba | 501 | 060 | 0 | 1,9602 | LISA BERNAD, ANTONIO JAVIER Y MARIA EUGENIA | 2 | 220 | |
| Huesca | Torralba | 501 | 061 | 0 | 3,1367 | LISA BERNAD, ANTONIO JAVIER | 2 | 220 | |
| Huesca | Torralba | 501 | 062 | 0 | 0,5263 | PUEYO CORVINOS, JESUS ANGEL | 2 | 220 | |
| Huesca | Torralba | 501 | 064 | 0 | 7,6959 | TORRECILLA GRASA, JOSE LUIS | 1 | 82 | |
| Huesca | Torralba | 501 | 065 | 0 | 2,0671 | PUEYO CORVINOS, JESUS ANGEL | 1 | 81 | |
| Huesca | Torralba | 501 | 066 | 0 | 27,6965 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 81 | |
| Huesca | Torralba | 501 | 069 | 0 | 25,0526 | GANADOS JIMENEZ CAMBRA, S.L. | 1 | 86 | |
| Huesca | Torralba | 501 | 071 | 0 | 9,5741 | ROBA HUGUET, PILAR E HIJA | 1 | 87 | |
| Huesca | Torralba | 501 | 074 | 0 | 0,6702 | ABADIA BUIL, MARIA TERESA Y OTRA | 1 | 105 | |
| Huesca | Torralba | 501 | 075 | 0 | 1,0542 | BOROBIA MICHELENA, YOLANDA | 1 | 106 | |
| Huesca | Torralba | 501 | 077 | 0 | 3,6066 | ABADIA BUIL, MARIA TERESA Y OTRA | 1 | 105 | |
| Huesca | Torralba | 501 | 082 | 0 | 7,9314 | BOROBIA MICHELENA, ENRIQUE | 1 | 103 | |
| Huesca | Torralba | 501 | 083 | 0 | 2,2291 | PUEYO CALVO, JUSTO Y HNAS | 1 | 102 | |
| Huesca | Torralba | 501 | 085 | 0 | 7,2427 | MARTINEZ ARAGONCILLO, BASILIO E HIJO | 1 | 101 | |
| Huesca | Torralba | 501 | 086 | 0 | 1,4263 | MARTINEZ MATEO, LUIS MIGUEL | 1 | 101 | |
| Huesca | Torralba | 501 | 087 | 0 | 2,7645 | MARTINEZ CABEZUDO, MIGUEL ANGEL | 1 | 101 | |
| Huesca | Torralba | 501 | 089 | 0 | 3,7599 | NOVALES CASTERAD, MIGUEL | 1 | 80 | |
| Huesca | Torralba | 501 | 093 | 0 | 34,2184 | NOVALES ASCASO, FRANCISCO JAVIER | 1 | 80 | |
| Huesca | Torralba | 501 | 095 | 0 | 1,5944 | LISA BERNAD, ANTONIO JAVIER | 2 | 220 | |
| Huesca | Torralba | 501 | 098 | 0 | 18,5167 | ALCUBIERRE PUERTOLAS, JOSE MARIA | 1 | 100 | |
| Huesca | Torralba | 502 | 101 | 0 | 0,1344 | ORUS ABADIA EUGENIA Y OTROS | 1 | 6 | 3 |
| Huesca | Torralba | 502 | 102 | 0 | 2,3704 | ABADIA ORUS, PEDRO | 1 | 6 | 4 |
| Huesca | Torralba | 502 | 103 | 0 | 0,1075 | PUEYO CALVO, JUSTO Y HNAS | 1 | 6 | 5 |
| Huesca | Torralba | 502 | 104 | 0 | 1,3472 | TORRECILLA GRASA, JOSE LUIS | 1 | 6 | 6 |

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|---|---|---|---|---|---|---|---|---|---|
| Huesca | Torralba | 502 | 106 | 0 | 0,7535 | TORRECILLA BURON, JOSE | 1 | 1 | 1 |
| Huesca | Torralba | 502 | 107 | 0 | 0,4003 | AYUNTAMIENTO DE TORRALBA DE ARAGON | 1 | 1 | 2 |
| Huesca | Torralba | 502 | 108 | 0 | 3,3361 | PUEYO CALVO, JUSTO Y HNAS | 1 | 1 | 3 |
| Huesca | Torralba | 502 | 109 | 0 | 0,9560 | PALACIOS LOPEZ, JOSE IGNACIO | 1 | 1 | 4 |
| Huesca | Torralba | 502 | 110 | 0 | 0,3008 | PAÑO PUEYO, FRANCISCA | 1 | 1 | 5 |
| Huesca | Torralba | 502 | 111 | 0 | 4,5644 | AYUNTAMIENTO DE TORRALBA DE ARAGON | 2 | 201 | 1 |
| Huesca | Torralba | 502 | 112 | 0 | 1,7716 | ALCUBIERRE GARCIA, ANTONIO SILVESTRE | 2 | 201 | 2 |
| Huesca | Torralba | 502 | 120 | 0 | 0,5383 | MORLANS BOLEA, GONZALO | 2 | 221 | |
| Huesca | Torralba | 502 | 122 | 0 | 3,4448 | MORLANS BOLEA, GONZALO | 2 | 221 | |
| Huesca | Torralba | 502 | 124 | 0 | 17,2741 | LOPEZ ABAD, MARIA BEGOÑA | 2 | 222 | |
| Huesca | Torralba | 502 | 128 | 0 | 3,5991 | LOPEZ ABAD, MARIA BEGOÑA | 2 | 227 | 1 |
| Huesca | Torralba | 502 | 131 | 0 | 1,8603 | BERCERO ABRIL, MARIANO | 2 | 227 | 2 |
| Huesca | Torralba | 502 | 132 | 0 | 0,1559 | BERCERO ABRIL, MARIANO | 2 | 227 | 2 |
| Huesca | Torralba | 502 | 133 | 0 | 2,6867 | LOPEZ ABAD, MARIA BEGOÑA | 2 | 227 | 1 |
| Huesca | Torralba | 502 | 134 | 0 | 2,6803 | LOPEZ ABAD, MARIA BEGOÑA | 2 | 227 | 1 |
| Huesca | Torralba | 502 | 136 | 0 | 6,9760 | ARNAL CABREJAS, ROBERTO JESUS | 2 | 226 | |
| Huesca | Torralba | 502 | 137 | 0 | 5,7233 | GARCIA PAÑO, JOSE ANTONIO | 2 | 223 | |
| Huesca | Torralba | 502 | 138 | 0 | 6,8631 | LOPEZ ABAD, MARIA BEGOÑA | 2 | 222 | |
| Huesca | Torralba | 502 | 139 | 0 | 1,3307 | ALONSO ORUS, JOSE IGNACIO | 1 | 4 | |
| Huesca | Torralba | 502 | 140 | 0 | 4,9129 | LACAMBRA PAÑO, PEDRO FERNANDO | 1 | 3 | |
| Huesca | Torralba | 502 | 141 | 0 | 0,9707 | LACAMBRA PAÑO, PEDRO FERNANDO | 1 | 3 | |
| Huesca | Torralba | 502 | 142 | 0 | 0,5163 | GARCIA BALLARIN, JUAN CARLOS Y HNOS | 1 | 2 | 1 |
| Huesca | Torralba | 502 | 143 | 0 | 0,3347 | GARCIA BALLARIN, JUAN CARLOS | 1 | 2 | 1 |
| Huesca | Torralba | 502 | 144 | 0 | 1,7485 | FERRER BOLEA, JOSEFINA Y PASCUAL | 1 | 2 | 2 |
| Huesca | Torralba | 502 | 148 | 0 | 0,5624 | PAÑO LERIN, MIGUEL | 1 | 2 | 3 |
| Huesca | Torralba | 502 | 149 | 0 | 0,1404 | PAÑO ABADIA, JOSE | 1 | 2 | 4 |
| Huesca | Torralba | 502 | 151 | 0 | 2,2155 | LACAMBRA PAÑO, PEDRO FERNANDO | 1 | 3 | |
| Huesca | Torralba | 502 | 154 | 0 | 1,9403 | ALCUBIERRE SERAL, ROBERTO | 1 | 5 | 1 |
| Huesca | Torralba | 502 | 155 | 0 | 0,7204 | ALCUBIERRE PUYOL, MARIA DEL CARMEN | 1 | 5 | 1 |
| Huesca | Torralba | 502 | 156 | 0 | 3,2666 | NOVALES CASTERAD, MIGUEL | 1 | 5 | 2 |
| Huesca | Torralba | 502 | 157 | 0 | 3,0965 | NOVALES CASTERAD, MIGUEL | 1 | 5 | 2 |
| Huesca | Torralba | 502 | 158 | 0 | 11,7745 | PUYOL JUSTES, MARIA PILAR | 1 | 15 | |
| Huesca | Torralba | 502 | 159 | 0 | 16,3174 | GARCIA LABAT, NICOLAS JOSE Y HNO | 1 | 14 | |
| Huesca | Torralba | 502 | 160 | 0 | 6,5666 | GARCIA GARCIA, JESUS | 1 | 14 | |
| Huesca | Torralba | 502 | 161 | 0 | 1,6508 | CABREJAS LAORDEN, LUIS | 1 | 18 | 1 |
| Huesca | Torralba | 502 | 163 | 0 | 3,4902 | NOVALES CASTERAD, MARIA TERESA | 1 | 19 | |
| Huesca | Torralba | 502 | 164 | 0 | 2,6785 | BERCERO ALCUBIERRE, PASCUAL | 1 | 19 | |
| Huesca | Torralba | 502 | 165 | 0 | 1,9062 | BERCERO ALCUBIERRE, PASCUAL | 1 | 19 | |
| Huesca | Torralba | 502 | 166 | 0 | 4,3623 | ALCUBIERRE SERAL, ROBERTO | 1 | 20 | 1 |
| Huesca | Torralba | 502 | 168 | 0 | 5,7703 | BERCERO NOVALES, ANTONIO | 1 | 19 | |
| Huesca | Torralba | 502 | 170 | 0 | 4,0869 | BERCERO ALCUBIERRE, PASCUAL | 1 | 19 | |
| Huesca | Torralba | 502 | 171 | 0 | 7,2457 | OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | |

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|---|---|---|---|---|---|---|---|---|---|
| Huesca | Torralba | 502 | 172 | 0 | 4,0092 | OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | |
| Huesca | Torralba | 502 | 174 | 0 | 3,2431 | MASA COMUN | 1 | 29 | 2 |
| Huesca | Torralba | 502 | 175 | 0 | 11,9517 | TORRECILLA BURON, JOSE | 1 | 30 | |
| Huesca | Torralba | 502 | 179 | 0 | 13,6271 | ALCUBIERRE GARCIA, PASCUAL | 1 | 24 | |
| Huesca | Torralba | 502 | 180 | 0 | 2,0043 | OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | |
| Huesca | Torralba | 502 | 182 | 0 | 2,7184 | ALCUBIERRE PUYOL, MARIA DEL CARMEN | 1 | 20 | 2 |
| Huesca | Torralba | 502 | 183 | 0 | 3,5180 | GRACIA VIÑUALES, CLEMENTE | 1 | 21 | 1 |
| Huesca | Torralba | 502 | 186 | 0 | 3,6778 | MASA COMUN | 1 | 21 | 2 |
| Huesca | Torralba | 502 | 187 | 0 | 0,3759 | LERI BOLEA, JOAQUIN | 1 | 21 | 3 |
| Huesca | Torralba | 502 | 189 | 0 | 4,2194 | ABRIL BERCERO, EVARISTO | 1 | 23 | |
| Huesca | Torralba | 502 | 190 | 0 | 0,2359 | ABRIL ABRIL, TOMAS EVARISTO | 1 | 23 | |
| Huesca | Torralba | 502 | 192 | 0 | 1,9216 | MASA COMUN | 1 | 29 | 1 |
| Huesca | Torralba | 502 | 193 | 0 | 9,4021 | ESTEBAN GALVEZ, PASCUAL E HIJOS | 1 | 28 | |
| Huesca | Torralba | 502 | 194 | 0 | 11,2809 | ABADIA BUIL, MARIA TERESA Y OTRA | 1 | 27 | |
| Huesca | Torralba | 502 | 195 | 0 | 3,5230 | TORRECILLA GRASA, JOSE LUIS | 1 | 26 | |
| Huesca | Torralba | 502 | 196 | 0 | 2,6223 | TORRECILLA ALCUBIERRE, ROSA MARIA | 1 | 26 | |
| Huesca | Torralba | 502 | 197 | 0 | 0,2799 | NOVALES BOLEA, FRANCISCO | 1 | 33 | 2 |
| Huesca | Torralba | 502 | 198 | 0 | 47,7455 | GANADOS JIMENEZ CAMBRA, S.L. | 1 | 25 | |
| Huesca | Torralba | 502 | 199 | 0 | 7,4183 | ARNAL CABREJAS, LUIS | 1 | 18 | 1 |
| Huesca | Torralba | 502 | 200 | 0 | 9,5562 | CABREJAS LAORDEN, LUIS | 1 | 18 | 2 |
| Huesca | Torralba | 502 | 201 | 0 | 4,6687 | NOVALES CASTERAD, MIGUEL | 1 | 5 | 2 |
| Huesca | Torralba | 502 | 202 | 0 | 2,2630 | GARCIA LABAT, NICOLAS JOSE Y HNO | 1 | 14 | |
| Huesca | Torralba | 502 | 203 | 0 | 13,9969 | GARCIA LABAT, NICOLAS JOSE Y FCO JAVIER | 1 | 14 | |
| Huesca | Torralba | 502 | 204 | 0 | 14,2432 | PUEYO CORVINOS, JESUS ANGEL | 2 | 224 | |
| Huesca | Torralba | 502 | 205 | 0 | 6,9973 | TORRECILLA GRASA, JOSE LUIS | 2 | 225 | |
| Huesca | Torralba | 502 | 206 | 0 | 4,1622 | ALCUBIERRE PUERTOLAS, JOSE MARIA | 1 | 17 | |
| Huesca | Torralba | 502 | 207 | 0 | 14,8073 | ALCUBIERRE GARCIA, JOAQUIN | 1 | 17 | |
| Huesca | Torralba | 502 | 207 | 0 | 14,8073 | ALCUBIERRE GARCIA, JOAQUIN | 2 | 230 | |
| Huesca | Torralba | 502 | 003 | 0 | 7,2307 | BAYOD CALVO, JOSE ALFREDO | 2 | 210 | |
| Huesca | Torralba | 502 | 004 | 0 | 7,0797 | TORRECILLA VIÑAS, YOLANDA Y CESAR | 2 | 211 | |
| Huesca | Torralba | 502 | 005 | 0 | 1,0132 | ABADIA BUIL, PEDRO LUIS | 2 | 212 | |
| Huesca | Torralba | 502 | 006 | 0 | 0,3794 | SIRON IRIONDO, FILOMENO | 2 | 212 | |
| Huesca | Torralba | 502 | 007 | 0 | 3,5258 | SANZ BIELSA, ANTONIO | 2 | 212 | |
| Huesca | Torralba | 502 | 008 | 0 | 9,4393 | ABADIA ORUS, PEDRO | 2 | 212 | |
| Huesca | Torralba | 502 | 009 | 0 | 0,9146 | ABADIA BUIL, PEDRO LUIS | 2 | 212 | |
| Huesca | Torralba | 502 | 010 | 0 | 7,2009 | OLONA MALLADA, JOAQUIN | 2 | 213 | |
| Huesca | Torralba | 502 | 012 | 0 | 0,6893 | OLONA ALAGON, ERNESTO | 2 | 213 | |
| Huesca | Torralba | 502 | 014 | 0 | 32,4010 | BAYOD CALVO, JOSE ALFREDO | 2 | 214 | |
| Huesca | Torralba | 502 | 015 | 0 | 11,7365 | GARCIA ARTERO, ROSA MARIA Y M PILAR | 2 | 209 | |
| Huesca | Torralba | 502 | 018 | 0 | 2,2452 | GANADOS JIMENEZ CAMBRA, S.L. | 2 | 208 | |
| Huesca | Torralba | 502 | 021 | 0 | 21,4396 | GANADOS JIMENEZ CAMBRA, S.L. | 2 | 208 | |
| Huesca | Torralba | 502 | 022 | 0 | 1,8878 | LISA BERNAD, ANTONIO JAVIER | 2 | 220 | |

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|---|---|---|---|---|---|---|---|---|---|
| Huesca | Torralba | 502 | 024 | 0 | 1,4744 | BAYOD CALVO, JOSE ALFREDO | 2 | 207 | 2 |
| Huesca | Torralba | 502 | 028 | 0 | 0,3819 | AYUNTAMIENTO DE TORRALBA DE ARAGON | 2 | 207 | 1 |
| Huesca | Torralba | 502 | 030 | 0 | 0,1300 | LOPEZ ABAD, MARIA BEGOÑA | 2 | 206 | 2 |
| Huesca | Torralba | 502 | 031 | 0 | 0,0500 | TORRECILLA GRASA, JOSE LUIS | 2 | 206 | 3 |
| Huesca | Torralba | 502 | 032 | 0 | 0,0500 | TORRECILLA ALCUBIERRE, ROSA MARIA | 2 | 206 | 3 |
| Huesca | Torralba | 502 | 033 | 0 | 0,0758 | BAYOD CALVO, JOSE ALFREDO | 2 | 206 | 4 |
| Huesca | Torralba | 502 | 034 | 0 | 0,0250 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 2 | 206 | 5 |
| Huesca | Torralba | 502 | 035 | 0 | 0,0250 | PUEYO CORVINOS, JESUS ANGEL | 2 | 206 | 5 |
| Huesca | Torralba | 502 | 036 | 0 | 0,0700 | GRACIA LAFUENTE, RAUL Y OTRA | 2 | 206 | 6 |
| Huesca | Torralba | 502 | 037 | 0 | 0,1220 | NOVALES ALLUE, ENRIQUE | 2 | 206 | 7 |
| Huesca | Torralba | 502 | 038 | 0 | 0,0450 | ALCUBIERRE GARCIA, JOAQUIN | 2 | 206 | 8 |
| Huesca | Torralba | 502 | 039 | 0 | 0,0450 | ALCUBIERRE PUERTOLAS, JOSE MARIA | 2 | 206 | 8 |
| Huesca | Torralba | 502 | 040 | 0 | 0,0450 | PUERTOLAS VAL, MARIA PILAR | 2 | 206 | 8 |
| Huesca | Torralba | 502 | 041 | 0 | 0,1464 | MARTINEZ BANDRES, ANTONIO | 2 | 205 | 2 |
| Huesca | Torralba | 502 | 042 | 0 | 2,1306 | AYUNTAMIENTO DE TORRALBA DE ARAGON | 2 | 205 | 1 |
| Huesca | Torralba | 502 | 044 | 0 | 0,8978 | AZNAREZ GASTON, JAIME Y HNOS | 2 | 206 | 1 |
| Huesca | Torralba | 502 | 047 | 0 | 1,1042 | MORLANS LASTANAO, CONCEPCION | 2 | 203 | 2 |
| Huesca | Torralba | 502 | 051 | 0 | 8,5651 | PUEYO CORVINOS, JESUS ANGEL | 2 | 204 | |
| Huesca | Torralba | 502 | 053 | 0 | 0,1254 | PUEYO CORVINOS,JESUS ANGEL Y ESPOSA | 2 | 204 | |
| Huesca | Torralba | 502 | 057 | 0 | 0,1517 | LACAMBRA PAÑO, PEDRO FERNANDO | 2 | 203 | 4 |
| Huesca | Torralba | 502 | 059 | 0 | 0,8515 | GRACIA VIÑUALES, CLEMENTE | 1 | 10 | 1 |
| Huesca | Torralba | 502 | 064 | 0 | 5,5832 | PUERTOLAS VAL, MARIA PILAR | 2 | 202 | |
| Huesca | Torralba | 502 | 065 | 0 | 1,4669 | GANADOS JIMENEZ CAMBRA, S.L. | 2 | 203 | 3 |
| Huesca | Torralba | 502 | 067 | 0 | 0,6920 | TORRECILLA GRASA, JOSE LUIS | 1 | 10 | 2 |
| Huesca | Torralba | 502 | 069 | 0 | 0,1840 | NOVALES CASTERAD, MIGUEL | 1 | 10 | 3 |
| Huesca | Torralba | 502 | 070 | 0 | 0,1481 | PASCUAL BOLEA, MARIA JOSE | 1 | 10 | 4 |
| Huesca | Torralba | 502 | 071 | 0 | 0,0644 | ALLUE VALLE, MARIA BEGOÑA Y MARIA ELENA | 1 | 10 | 5 |
| Huesca | Torralba | 502 | 072 | 0 | 0,0979 | ALLUE PAÑO, MAXIMO | 1 | 10 | 6 |
| Huesca | Torralba | 502 | 074 | 0 | 0,5598 | GARCIA LABAT, NICOLAS JOSE Y HNO | 1 | 8 | Tubería sin toma |
| Huesca | Torralba | 502 | 076 | 0 | 3,0918 | AYUNTAMIENTO DE TORRALBA DE ARAGON | 1 | 11 | 1 |
| Huesca | Torralba | 502 | 077 | 0 | 1,1822 | ALLUE PAÑO, MAXIMO | 1 | 11 | 2 |
| Huesca | Torralba | 502 | 078 | 0 | 0,8121 | ALLUE PAÑO, FERMIN | 1 | 11 | 2 |
| Huesca | Torralba | 502 | 079 | 0 | 2,2248 | ALONSO ORUS, MARIA ISABEL | 1 | 13 | |
| Huesca | Torralba | 502 | 080 | 0 | 0,4619 | GRACIA TRULLENQUE, FELIX | 1 | 13 | |
| Huesca | Torralba | 502 | 081 | 0 | 3,2347 | GRACIA TRULLENQUE, FELIX | 1 | 13 | |
| Huesca | Torralba | 502 | 083 | 0 | 20,5275 | BARRIO FAULO, URBANO | 1 | 12 | |
| Huesca | Torralba | 502 | 084 | 0 | 0,9427 | BAYOD CALVO, ANTONIO | 1 | 9 | |
| Huesca | Torralba | 502 | 085 | 0 | 22,2264 | BAYOD CALVO, JOSE ALFREDO | 1 | 9 | |
| Huesca | Torralba | 502 | 086 | 0 | 8,7073 | ALCUBIERRE GARCIA, PASCUAL | 1 | 16 | |
| Huesca | Torralba | 502 | 087 | 0 | 0,6538 | ALCUBIERRE OTAL, PASCUAL | 1 | 16 | |
| Huesca | Torralba | 502 | 089 | 0 | 8,0158 | OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | |

| PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA |
|---|---|---|---|---|---|---|---|---|---|
| Huesca | Torralba | 502 | 090 | 0 | 0,3382 | BAYOD CALVO, JOSE ALFREDO Y ANTONIO | 1 | 7 | |
| Huesca | Torralba | 502 | 091 | 0 | 6,7218 | BAYOD CALVO, JOSE ALFREDO | 1 | 7 | |
| Huesca | Torralba | 502 | 092 | 0 | 2,2435 | FERRER BOLEA, JOSEFINA Y PASCUAL | 1 | 7 | |
| Huesca | Torralba | 502 | 095 | 0 | 3,0540 | GARCIA GARCIA, JESUS | 1 | 8 | |
| Huesca | Torralba | 502 | 098 | 0 | 0,2108 | ALONSO ORUS, MARIA ISABEL | 1 | 6 | 1 |
| Huesca | Torralba | 502 | 099 | 0 | 0,0852 | SIRON IRIONDO, FILOMENO | 1 | 6 | 2 |
| Huesca | Torralba | 002 | 403 | 0 | 0,1258 | GARCIA BALLARIN, JUAN CARLOS | 2 | 203 | 1 |
| Huesca | Torralba | 002 | 404 | 0 | 0,0658 | BERCERO NOVALES, ANTONIO | 2 | 203 | 2 |
| Huesca | Torralba | 003 | 409 | 0 | 0,1693 | FEDIUC, MARIANA | 2 | 205 | 3 |
| | **Total Torralba** | | | | 1.114,0128 | | | | |
| Huesca | Valfonda | 502 | 164 | 0 | 0,8415 | LIESA USON, AGUSTIN | 1 | 182 | |
| | **Total Valfonda** | | | | 0,8415 | | | | |
| | **Total general** | | | | 2.714,5256 | | | | |

## 3.2 LISTADO DE HIDRANTES

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | Huesca | Torralba | 502 | 106 | 0 | 0,7535 | TORRECILLA BURON, JOSE |
| 1 | 1 | 2 | Huesca | Torralba | 502 | 107 | 0 | 0,4003 | AYUNTAMIENTO DE TORRALBA DE ARAGON |
| 1 | 1 | 3 | Huesca | Torralba | 502 | 108 | 0 | 3,3361 | PUEYO CALVO, JUSTO Y HNAS |
| 1 | 1 | 4 | Huesca | Torralba | 502 | 109 | 0 | 0,9560 | PALACIOS LOPEZ, JOSE IGNACIO |
| 1 | 1 | 5 | Huesca | Torralba | 502 | 110 | 0 | 0,3008 | PAÑO PUEYO, FRANCISCA |
| | **Total 1** | | | | | | | 5,7467 | |
| 1 | 2 | 1 | Huesca | Torralba | 502 | 142 | 0 | 0,5163 | GARCIA BALLARIN, JUAN CARLOS Y HNOS |
| 1 | 2 | 1 | Huesca | Torralba | 502 | 143 | 0 | 0,3347 | GARCIA BALLARIN, JUAN CARLOS |
| 1 | 2 | 2 | Huesca | Torralba | 502 | 144 | 0 | 1,7485 | FERRER BOLEA, JOSEFINA Y PASCUAL |
| 1 | 2 | 3 | Huesca | Torralba | 502 | 148 | 0 | 0,5624 | PAÑO LERIN, MIGUEL |
| 1 | 2 | 4 | Huesca | Torralba | 502 | 149 | 0 | 0,1404 | PAÑO ABADIA, JOSE |
| | **Total 2** | | | | | | | 3,3023 | |
| 1 | 3 | | Huesca | Torralba | 502 | 140 | 0 | 4,9129 | LACAMBRA PAÑO, PEDRO FERNANDO |
| 1 | 3 | | Huesca | Torralba | 502 | 141 | 0 | 0,9707 | LACAMBRA PAÑO, PEDRO FERNANDO |
| 1 | 3 | | Huesca | Torralba | 502 | 151 | 0 | 2,2155 | LACAMBRA PAÑO, PEDRO FERNANDO |
| | **Total 3** | | | | | | | 8,0991 | |
| 1 | 4 | | Huesca | Torralba | 502 | 139 | 0 | 1,3307 | ALONSO ORUS, JOSE IGNACIO |
| | **Total 4** | | | | | | | 1,3307 | |
| 1 | 5 | 1 | Huesca | Torralba | 502 | 154 | 0 | 1,9403 | ALCUBIERRE SERAL, ROBERTO |
| 1 | 5 | 1 | Huesca | Torralba | 502 | 155 | 0 | 0,7204 | ALCUBIERRE PUYOL, MARIA DEL CARMEN |
| 1 | 5 | 2 | Huesca | Torralba | 502 | 156 | 0 | 3,2666 | NOVALES CASTERAD, MIGUEL |
| 1 | 5 | 2 | Huesca | Torralba | 502 | 157 | 0 | 3,0965 | NOVALES CASTERAD, MIGUEL |
| 1 | 5 | 2 | Huesca | Torralba | 502 | 201 | 0 | 4,6687 | NOVALES CASTERAD, MIGUEL |
| | **Total 5** | | | | | | | 13,6925 | |
| 1 | 6 | 1 | Huesca | Torralba | 502 | 098 | 0 | 0,2108 | ALONSO ORUS, MARIA ISABEL |
| 1 | 6 | 2 | Huesca | Torralba | 502 | 099 | 0 | 0,0852 | SIRON IRIONDO, FILOMENO |
| 1 | 6 | 3 | Huesca | Torralba | 502 | 101 | 0 | 0,1344 | ORUS ABADIA EUGENIA Y OTROS |
| 1 | 6 | 4 | Huesca | Torralba | 502 | 102 | 0 | 2,3704 | ABADIA ORUS, PEDRO |
| 1 | 6 | 5 | Huesca | Torralba | 502 | 103 | 0 | 0,1075 | PUEYO CALVO, JUSTO Y HNAS |
| 1 | 6 | 6 | Huesca | Torralba | 502 | 104 | 0 | 1,3472 | TORRECILLA GRASA, JOSE LUIS |
| | **Total 6** | | | | | | | 4,2555 | |
| 1 | 7 | | Huesca | Torralba | 502 | 090 | 0 | 0,3382 | BAYOD CALVO, JOSE ALFREDO Y ANTONIO |
| 1 | 7 | | Huesca | Torralba | 502 | 091 | 0 | 6,7218 | BAYOD CALVO, JOSE ALFREDO |
| 1 | 7 | | Huesca | Torralba | 502 | 092 | 0 | 2,2435 | FERRER BOLEA, JOSEFINA Y PASCUAL |
| | **Total 7** | | | | | | | 9,3035 | |
| 1 | 8 | Tubería sin toma | Huesca | Torralba | 502 | 074 | 0 | 0,5598 | GARCIA LABAT, NICOLAS JOSE Y HNO |
| 1 | 8 | | Huesca | Torralba | 502 | 095 | 0 | 3,0540 | GARCIA GARCIA, JESUS |
| | **Total 8** | | | | | | | 3,6138 | |
| 1 | 9 | | Huesca | Torralba | 502 | 084 | 0 | 0,9427 | BAYOD CALVO, ANTONIO |
| 1 | 9 | | Huesca | Torralba | 502 | 085 | 0 | 22,2264 | BAYOD CALVO, JOSE ALFREDO |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| | **Total 9** | | | | | | | 23,1691 | |
| 1 | 10 | 1 | Huesca | Torralba | 502 | 059 | 0 | 0,8515 | GRACIA VIÑUALES, CLEMENTE |
| 1 | 10 | 2 | Huesca | Torralba | 502 | 067 | 0 | 0,6920 | TORRECILLA GRASA, JOSE LUIS |
| 1 | 10 | 3 | Huesca | Torralba | 502 | 069 | 0 | 0,1840 | NOVALES CASTERAD, MIGUEL |
| 1 | 10 | 4 | Huesca | Torralba | 502 | 070 | 0 | 0,1481 | PASCUAL BOLEA, MARIA JOSE |
| 1 | 10 | 5 | Huesca | Torralba | 502 | 071 | 0 | 0,0644 | ALLUE VALLE, MARIA BEGOÑA Y MARIA ELENA |
| 1 | 10 | 6 | Huesca | Torralba | 502 | 072 | 0 | 0,0979 | ALLUE PAÑO, MAXIMO |
| | **Total 10** | | | | | | | 2,0379 | |
| 1 | 11 | 1 | Huesca | Torralba | 502 | 076 | 0 | 3,0918 | AYUNTAMIENTO DE TORRALBA DE ARAGON |
| 1 | 11 | 2 | Huesca | Torralba | 502 | 077 | 0 | 1,1822 | ALLUE PAÑO, MAXIMO |
| 1 | 11 | 2 | Huesca | Torralba | 502 | 078 | 0 | 0,8121 | ALLUE PAÑO, FERMIN |
| | **Total 11** | | | | | | | 5,0861 | |
| 1 | 12 | | Huesca | Torralba | 502 | 083 | 0 | 20,5275 | BARRIO FAULO, URBANO |
| | **Total 12** | | | | | | | 20,5275 | |
| 1 | 13 | | Huesca | Torralba | 502 | 079 | 0 | 2,2248 | ALONSO ORUS, MARIA ISABEL |
| 1 | 13 | | Huesca | Torralba | 502 | 080 | 0 | 0,4619 | GRACIA TRULLENQUE, FELIX |
| 1 | 13 | | Huesca | Torralba | 502 | 081 | 0 | 3,2347 | GRACIA TRULLENQUE, FELIX |
| | **Total 13** | | | | | | | 5,9214 | |
| 1 | 14 | | Huesca | Torralba | 502 | 159 | 0 | 16,3174 | GARCIA LABAT, NICOLAS JOSE Y HNO |
| 1 | 14 | | Huesca | Torralba | 502 | 160 | 0 | 6,5666 | GARCIA GARCIA, JESUS |
| 1 | 14 | | Huesca | Torralba | 502 | 202 | 0 | 2,2630 | GARCIA LABAT, NICOLAS JOSE Y HNO |
| 1 | 14 | | Huesca | Torralba | 502 | 203 | 0 | 13,9969 | GARCIA LABAT, NICOLAS JOSE Y FCO JAVIER |
| | **Total 14** | | | | | | | 39,1439 | |
| 1 | 15 | | Huesca | Torralba | 502 | 158 | 0 | 11,7745 | PUYOL JUSTES, MARIA PILAR |
| | **Total 15** | | | | | | | 11,7745 | |
| 1 | 16 | | Huesca | Torralba | 502 | 086 | 0 | 8,7073 | ALCUBIERRE GARCIA, PASCUAL |
| 1 | 16 | | Huesca | Torralba | 502 | 087 | 0 | 0,6538 | ALCUBIERRE OTAL, PASCUAL |
| | **Total 16** | | | | | | | 9,3611 | |
| 1 | 17 | | Huesca | Senés | 503 | 016 | 0 | 9,6817 | PUERTOLAS VAL, MARIA PILAR |
| 1 | 17 | | Huesca | Senés | 503 | 017 | 0 | 0,4043 | ALCUBIERRE GARCIA, JOAQUIN |
| 1 | 17 | | Huesca | Senés | 503 | 018 | 0 | 0,1098 | ARNAL CABREJAS, LUIS |
| 1 | 17 | | Huesca | Torralba | 502 | 206 | 0 | 4,1622 | ALCUBIERRE PUERTOLAS, JOSE MARIA |
| 1 | 17 | | Huesca | Torralba | 502 | 207 | 0 | 14,8073 | ALCUBIERRE GARCIA, JOAQUIN |
| | **Total 17** | | | | | | | 29,1653 | |
| 1 | 18 | 1 | Huesca | Torralba | 502 | 161 | 0 | 1,6508 | CABREJAS LAORDEN, LUIS |
| 1 | 18 | 1 | Huesca | Torralba | 502 | 199 | 0 | 7,4183 | ARNAL CABREJAS, LUIS |
| 1 | 18 | 2 | Huesca | Torralba | 502 | 200 | 0 | 9,5562 | CABREJAS LAORDEN, LUIS |
| | **Total 18** | | | | | | | 18,6253 | |
| 1 | 19 | | Huesca | Torralba | 502 | 163 | 0 | 3,4902 | NOVALES CASTERAD, MARIA TERESA |
| 1 | 19 | | Huesca | Torralba | 502 | 164 | 0 | 2,6785 | BERCERO ALCUBIERRE, PASCUAL |
| 1 | 19 | | Huesca | Torralba | 502 | 165 | 0 | 1,9062 | BERCERO ALCUBIERRE, PASCUAL |
| 1 | 19 | | Huesca | Torralba | 502 | 168 | 0 | 5,7703 | BERCERO NOVALES, ANTONIO |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 19 | | Huesca | Torralba | 502 | 170 | 0 | 4,0869 | BERCERO ALCUBIERRE, PASCUAL |
| | **Total 19** | | | | | | | 17,9321 | |
| 1 | 20 | 1 | Huesca | Torralba | 502 | 166 | 0 | 4,3623 | ALCUBIERRE SERAL, ROBERTO |
| 1 | 20 | 2 | Huesca | Torralba | 502 | 182 | 0 | 2,7184 | ALCUBIERRE PUYOL, MARIA DEL CARMEN |
| | **Total 20** | | | | | | | 7,0807 | |
| 1 | 21 | 1 | Huesca | Torralba | 502 | 183 | 0 | 3,5180 | GRACIA VIÑUALES, CLEMENTE |
| 1 | 21 | 2 | Huesca | Torralba | 502 | 186 | 0 | 3,6778 | MASA COMUN |
| 1 | 21 | 3 | Huesca | Torralba | 502 | 187 | 0 | 0,3759 | LERI BOLEA, JOAQUIN |
| | **Total 21** | | | | | | | 7,5717 | |
| 1 | 22 | | Huesca | Torralba | 502 | 171 | 0 | 7,2457 | OLIVA AVELLANAS, PEDRO PASCUAL |
| 1 | 22 | | Huesca | Torralba | 502 | 172 | 0 | 4,0092 | OLIVA AVELLANAS, PEDRO PASCUAL |
| 1 | 22 | | Huesca | Torralba | 502 | 180 | 0 | 2,0043 | OLIVA AVELLANAS, PEDRO PASCUAL |
| 1 | 22 | | Huesca | Torralba | 502 | 089 | 0 | 8,0158 | OLIVA AVELLANAS, PEDRO PASCUAL |
| | **Total 22** | | | | | | | 21,2750 | |
| 1 | 23 | | Huesca | Torralba | 502 | 189 | 0 | 4,2194 | ABRIL BERCERO, EVARISTO |
| 1 | 23 | | Huesca | Torralba | 502 | 190 | 0 | 0,2359 | ABRIL ABRIL, TOMAS EVARISTO |
| | **Total 23** | | | | | | | 4,4553 | |
| 1 | 24 | | Huesca | Torralba | 502 | 179 | 0 | 13,6271 | ALCUBIERRE GARCIA, PASCUAL |
| | **Total 24** | | | | | | | 13,6271 | |
| 1 | 25 | | Huesca | Almuniente | 505 | 011 | 0 | 0,2141 | GANADOS JIMENEZ CAMBRA, S.L. |
| 1 | 25 | | Huesca | Senés | 503 | 019 | 0 | 0,3939 | GANADOS JIMENEZ CAMBRA, S.L. |
| 1 | 25 | | Huesca | Torralba | 502 | 198 | 0 | 47,7455 | GANADOS JIMENEZ CAMBRA, S.L. |
| | **Total 25** | | | | | | | 48,3535 | |
| 1 | 26 | | Huesca | Almuniente | 505 | 010 | 0 | 0,8106 | TORRECILLA ALCUBIERRE, ROSA MARIA |
| 1 | 26 | | Huesca | Torralba | 502 | 195 | 0 | 3,5230 | TORRECILLA GRASA, JOSE LUIS |
| 1 | 26 | | Huesca | Torralba | 502 | 196 | 0 | 2,6223 | TORRECILLA ALCUBIERRE, ROSA MARIA |
| | **Total 26** | | | | | | | 6,9559 | |
| 1 | 27 | | Huesca | Torralba | 502 | 194 | 0 | 11,2809 | ABADIA BUIL, MARIA TERESA Y OTRA |
| | **Total 27** | | | | | | | 11,2809 | |
| 1 | 28 | | Huesca | Torralba | 502 | 193 | 0 | 9,4021 | ESTEBAN GALVEZ, PASCUAL E HIJOS |
| | **Total 28** | | | | | | | 9,4021 | |
| 1 | 29 | 1 | Huesca | Torralba | 502 | 192 | 0 | 1,9216 | MASA COMUN |
| 1 | 29 | 2 | Huesca | Torralba | 502 | 174 | 0 | 3,2431 | MASA COMUN |
| | **Total 29** | | | | | | | 5,1647 | |
| 1 | 30 | | Huesca | Almuniente | 505 | 001 | 0 | 3,7237 | TORRECILLA BURON, JOSE |
| 1 | 30 | | Huesca | Torralba | 502 | 175 | 0 | 11,9517 | TORRECILLA BURON, JOSE |
| | **Total 30** | | | | | | | 15,6754 | |
| 1 | 31 | 1 | Huesca | Almuniente | 505 | 062 | 0 | 1,1501 | OTAL BETRAN, VALENTIN |
| 1 | 31 | 2 | Huesca | Almuniente | 505 | 063 | 0 | 1,6974 | MASA COMUN |
| | **Total 31** | | | | | | | 2,8475 | |
| 1 | 32 | | Huesca | Almuniente | 505 | 012 | 0 | 1,4744 | GIRON PABAN, SARA |
| 1 | 32 | | Huesca | Almuniente | 505 | 060 | 0 | 7,9201 | GIRON PABAN, SARA |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 32 | | Huesca | Almuniente | 505 | 061 | 0 | 0,4013 | PABAN GIRON, JOSE LUIS Y JOAQUIN |
| | **Total 32** | | | | | | | 9,7958 | |
| 1 | 33 | 1 | Huesca | Almuniente | 505 | 009 | 0 | 0,9194 | MORA DURAN, JOSE Y HNAS |
| 1 | 33 | 2 | Huesca | Almuniente | 505 | 014 | 0 | 2,0720 | NOVALES BOLEA, FRANCISCO |
| 1 | 33 | 2 | Huesca | Almuniente | 505 | 015 | 0 | 1,4579 | NOVALES BOLEA, FRANCISCO |
| 1 | 33 | 2 | Huesca | Torralba | 502 | 197 | 0 | 0,2799 | NOVALES BOLEA, FRANCISCO |
| | **Total 33** | | | | | | | 4,7292 | |
| 1 | 34 | | Huesca | Almuniente | 505 | 016 | 0 | 9,6253 | CLAVERIA REVUELTA, FRANCISCO |
| | **Total 34** | | | | | | | 9,6253 | |
| 1 | 35 | | Huesca | Almuniente | 505 | 008 | 0 | 7,2139 | OLIVA AVELLANAS, PEDRO PASCUAL |
| | **Total 35** | | | | | | | 7,2139 | |
| 1 | 36 | 1 | Huesca | Almuniente | 505 | 004 | 0 | 4,1201 | PERTUSA DOTO, GERMAN |
| 1 | 36 | 2 | Huesca | Almuniente | 505 | 007 | 0 | 1,9793 | MASA COMUN |
| | **Total 36** | | | | | | | 6,0994 | |
| 1 | 37 | | Huesca | Almuniente | 505 | 005 | 0 | 10,1114 | GUALLAR GUTIERREZ, ANA BELEN |
| 1 | 37 | | Huesca | Almuniente | 505 | 006 | 0 | 0,4000 | SANJUAN GOMEZ, ELIAS Y JESUS |
| | **Total 37** | | | | | | | 10,5114 | |
| 1 | 38 | | Huesca | Almuniente | 505 | 059 | 0 | 9,9390 | GOMEZ LANUZA, FRANCISCO |
| | **Total 38** | | | | | | | 9,9390 | |
| 1 | 39 | | Huesca | Almuniente | 505 | 056 | 0 | 9,9835 | GAYAN LORENTE, VICENTE |
| | **Total 39** | | | | | | | 9,9835 | |
| 1 | 40 | 1 | Huesca | Almuniente | 505 | 055 | 0 | 5,4903 | LABORDA SANCHEZ, ANGEL |
| 1 | 40 | 2 | Huesca | Almuniente | 505 | 058 | 0 | 1,8248 | ASESIO ORUS, FE CORAZON |
| | **Total 40** | | | | | | | 7,3151 | |
| 1 | 41 | | Huesca | Almuniente | 505 | 017 | 0 | 0,4802 | APARICIO CONTE, SERGIO |
| 1 | 41 | | Huesca | Almuniente | 505 | 018 | 0 | 3,8679 | APARICIO FUSTERO, JESUS |
| 1 | 41 | | Huesca | Almuniente | 505 | 019 | 0 | 0,2225 | AYUNTAMIENTO DE SENES DE ALCUBIERRE |
| 1 | 41 | | Huesca | Almuniente | 505 | 021 | 0 | 0,7831 | APARICIO FUSTERO, JESUS |
| 1 | 41 | | Huesca | Almuniente | 505 | 022 | 0 | 0,1127 | APARICIO FUSTERO, JESUS |
| 1 | 41 | | Huesca | Almuniente | 505 | 057 | 0 | 4,5733 | APARICIO CONTE, SERGIO |
| | **Total 41** | | | | | | | 10,0397 | |
| 1 | 42 | | Huesca | Almuniente | 505 | 023 | 0 | 8,4362 | BARRIO FAULO, URBANO |
| | **Total 42** | | | | | | | 8,4362 | |
| 1 | 43 | | Huesca | Almuniente | 505 | 026 | 0 | 3,7616 | BIARGE ASIN, JOSE ANTONIO |
| 1 | 43 | | Huesca | Almuniente | 505 | 027 | 0 | 1,4140 | PARDO BIARGE, BASILIO JAVIER |
| | **Total 43** | | | | | | | 5,1756 | |
| 1 | 44 | 1 | Huesca | Almuniente | 505 | 020 | 0 | 1,1916 | MASA COMUN |
| 1 | 44 | 2 | Huesca | Almuniente | 505 | 025 | 0 | 0,8737 | DESCONOCIDO |
| | **Total 44** | | | | | | | 2,0653 | |
| 1 | 45 | | Huesca | Almuniente | 505 | 054 | 0 | 10,0200 | ALLUE ALCUBIERRE, MARIO ANTONIO Y MARIA JESUS |
| | **Total 45** | | | | | | | 10,0200 | |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 46 | 1 | Huesca | Almuniente | 505 | 049 | 0 | 1,4720 | MALLADA GRACIA, PEDRO Y HNAS |
| 1 | 46 | 2 | Huesca | Almuniente | 505 | 050 | 0 | 0,5919 | LOPEZ BARLUENGA, RAMON |
| 1 | 46 | 2 | Huesca | Almuniente | 505 | 051 | 0 | 2,3268 | DOTO LOPEZ, GUSTAVO JAIME |
| 1 | 46 | 2 | Huesca | Almuniente | 505 | 052 | 0 | 2,4504 | LOPEZ LAGUNA, CONCEPCION |
| 1 | 46 | 2 | Huesca | Almuniente | 505 | 053 | 0 | 0,8010 | LOPEZ LAGUNA, CONCEPCION E HIJO |
| | **Total 46** | | | | | | | 7,6421 | |
| 1 | 47 | | Huesca | Almuniente | 505 | 028 | 0 | 4,8297 | ASIN DURANGO, PABLO |
| 1 | 47 | | Huesca | Almuniente | 505 | 029 | 0 | 12,3240 | ASIN MENDOZA, FRANCISCO |
| | **Total 47** | | | | | | | 17,1537 | |
| 1 | 48 | | Huesca | Almuniente | 505 | 031 | 0 | 10,3861 | BARRIO LORENQUE, MIGUEL ANGEL |
| | **Total 48** | | | | | | | 10,3861 | |
| 1 | 49 | | Huesca | Almuniente | 505 | 033 | 0 | 4,0215 | ABADIA PUYAL, MANUEL RAMON |
| 1 | 49 | | Huesca | Almuniente | 505 | 034 | 0 | 2,7793 | ABADIA PUYAL, MANUEL RAMON |
| 1 | 49 | | Huesca | Almuniente | 505 | 041 | 0 | 1,2815 | ABADIA PUYAL, MANUEL RAMON |
| 1 | 49 | | Huesca | Almuniente | 505 | 042 | 0 | 0,5800 | ABADIA PUYAL, MANUEL RAMON |
| 1 | 49 | | Huesca | Almuniente | 505 | 043 | 0 | 1,2758 | ABADIA PUYAL, MANUEL RAMON Y ESPOSA |
| | **Total 49** | | | | | | | 9,9381 | |
| 1 | 50 | | Huesca | Almuniente | 505 | 035 | 0 | 0,3327 | CERVERA ANZANO S.L. |
| 1 | 50 | | Huesca | Almuniente | 505 | 036 | 0 | 5,3134 | CERVERA ANZANO S.L. |
| | **Total 50** | | | | | | | 5,6461 | |
| 1 | 51 | | Huesca | Almuniente | 505 | 037 | 0 | 1,9916 | ITURRE HUARTE, JAVIER ANGEL |
| 1 | 51 | | Huesca | Almuniente | 505 | 038 | 0 | 3,0277 | ITURRE HUARTE, JAVIER ANGEL |
| | **Total 51** | | | | | | | 5,0193 | |
| 1 | 52 | | Huesca | Almuniente | 505 | 047 | 0 | 10,9901 | ASIN DURANGO, PABLO |
| | **Total 52** | | | | | | | 10,9901 | |
| 1 | 53 | | Huesca | Almuniente | 505 | 046 | 0 | 2,5302 | MORENO RECIO, IRENE |
| | **Total 53** | | | | | | | 2,5302 | |
| 1 | 54 | | Huesca | Almuniente | 505 | 044 | 0 | 4,4828 | ASIN MENDOZA, JESUS MARIANO |
| 1 | 54 | | Huesca | Almuniente | 505 | 045 | 0 | 3,1472 | ASIN MENDOZA, JESUS MARIANO |
| | **Total 54** | | | | | | | 7,6300 | |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | a | 52,1180 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | d | 0,8174 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | f | 10,0814 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | g | 14,4901 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | h | 2,5840 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | i | 8,0982 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | k | 10,7595 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | l | 3,2462 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | n | 3,7021 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00295 | p | 10,3417 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00296 | a | 4,8883 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00297 | a | 11,4602 | MONTEFRULA |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 | | Huesca | Almuniente | 005 | 00297 | b | 13,7968 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00298 | a | 28,7764 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00298 | b | 8,3537 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00298 | c | 13,0034 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00298 | d | 1,6875 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00298 | e | 2,6328 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00299 | a | 3,9310 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00299 | b | 5,6501 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00299 | c | 7,5966 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00299 | d | 5,1984 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | a | 7,2468 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | b | 19,9266 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | c | 0,5325 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | d | 4,3862 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | f | 9,8388 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | g | 10,9069 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | h | 36,6144 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | i | 0,0078 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00301 | j | 5,9677 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00638 | a | 12,3212 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00638 | b | 4,6436 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00638 | c | 6,8041 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00639 | a | 16,3641 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00640 | 0 | 9,5287 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00642 | a | 16,3966 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00642 | b | 5,3578 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00643 | a | 3,7615 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00643 | b | 0,5975 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00643 | c | 0,8140 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00644 | a | 5,3776 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00644 | b | 14,8747 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00646 | a | 13,7496 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00646 | b | 4,1257 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00646 | e | 0,1711 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00649 | 0 | 0,2245 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00650 | 0 | 4,4363 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00651 | 0 | 1,2237 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00652 | a | 0,3383 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00653 | a | 7,1159 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00653 | b | 2,1540 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00658 | 0 | 2,2874 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00659 | 0 | 14,2592 | MONTEFRULA |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 | | Huesca | Almuniente | 005 | 00675 | a | 23,8245 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00675 | b | 17,1530 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00675 | c | 1,5988 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00675 | d | 2,9331 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00676 | a | 5,4816 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00676 | c | 3,1971 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00679 | a | 13,9464 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00680 | a | 16,3390 | MONTEFRULA |
| 1 | 60 | | Huesca | Almuniente | 005 | 00683 | a | 7,3465 | MONTEFRULA |
| | **Total 60** | | | | | | | 557,3886 | |
| 1 | 61 | | Huesca | Almuniente | 005 | 00178 | a | 7,9803 | COTELA SANTOS, FELIX |
| 1 | 61 | | Huesca | Almuniente | 005 | 00178 | b | 0,5843 | COTELA SANTOS, FELIX |
| 1 | 61 | | Huesca | Almuniente | 005 | 00179 | 0 | 1,8050 | COTELA SANTOS, FELIX |
| 1 | 61 | | Huesca | Almuniente | 005 | 00607 | 0 | 1,2858 | COTELA SANTOS, FELIX |
| | **Total 61** | | | | | | | 11,6554 | |
| 1 | 62 | | Huesca | Almuniente | 005 | 00176 | a | 7,4844 | MAIRAL LAIGLESIA, MARIANO |
| 1 | 62 | | Huesca | Almuniente | 005 | 00176 | b | 1,9028 | MAIRAL LAIGLESIA, MARIANO |
| 1 | 62 | | Huesca | Almuniente | 005 | 00176 | c | 1,2532 | MAIRAL LAIGLESIA, MARIANO |
| 1 | 62 | | Huesca | Almuniente | 005 | 00606 | 0 | 3,1499 | MAIRAL LAIGLESIA, MARIANO |
| | **Total 62** | | | | | | | 13,7903 | |
| 1 | 63 | | Huesca | Almuniente | 005 | 00177 | 0 | 10,4736 | CACHO BAILO, ANGEL |
| | **Total 63** | | | | | | | 10,4736 | |
| 1 | 64 | | Huesca | Almuniente | 005 | 00173 | 0 | 9,6409 | MONTESINOS PLO, ALVARO |
| | **Total 64** | | | | | | | 9,6409 | |
| 1 | 65 | | Huesca | Almuniente | 005 | 00171 | 0 | 6,9274 | ESTEBAN MARISCAL, FRANCISCO |
| 1 | 65 | | Huesca | Almuniente | 005 | 00172 | 0 | 3,3088 | ESTEBAN MARISCAL, FRANCISCO |
| 1 | 65 | | Huesca | Almuniente | 005 | 00605 | 0 | 0,4722 | ESTEBAN MARISCAL, FRANCISCO |
| | **Total 65** | | | | | | | 10,7084 | |
| 1 | 66 | | Huesca | Almuniente | 005 | 00170 | 0 | 11,7005 | GARCIA CRUZ, VICENTE |
| | **Total 66** | | | | | | | 11,7005 | |
| 1 | 67 | | Huesca | Almuniente | 005 | 00167 | a | 3,9375 | HNOS ARRUEGO VICENTE S.C. |
| 1 | 67 | | Huesca | Almuniente | 005 | 00167 | b | 7,9769 | HNOS ARRUEGO VICENTE S.C. |
| 1 | 67 | | Huesca | Almuniente | 005 | 00168 | 0 | 3,8426 | HNOS ARRUEGO VICENTE S.C. |
| 1 | 67 | | Huesca | Almuniente | 005 | 00169 | 0 | 8,6479 | HNOS ARRUEGO VICENTE S.C. |
| 1 | 67 | | Huesca | Almuniente | 005 | 00603 | 0 | 1,8950 | HNOS ARRUEGO VICENTE S.C. |
| | **Total 67** | | | | | | | 26,2999 | |
| 1 | 68 | | Huesca | Almuniente | 005 | 00151 | 0 | 2,0439 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00152 | 0 | 6,6163 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00154 | 0 | 9,8594 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00155 | 0 | 3,9368 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00156 | 0 | 5,3297 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00160 | 0 | 2,6542 | S.A.T. ASGI |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 68 | | Huesca | Almuniente | 005 | 00161 | 0 | 1,7590 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00162 | 0 | 1,4143 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00596 | 0 | 0,4922 | S.A.T. ASGI |
| 1 | 68 | | Huesca | Almuniente | 005 | 00597 | 0 | 0,1299 | S.A.T. ASGI |
| | **Total 68** | | | | | | | 34,2357 | |
| 1 | 69 | | Huesca | Almuniente | 005 | 00150 | 0 | 6,0644 | HIDALGO BERGUA, ANTONIO |
| | **Total 69** | | | | | | | 6,0644 | |
| 1 | 70 | | Huesca | Almuniente | 005 | 00157 | 0 | 3,1893 | ESCARTIN SERAL, CARMEN |
| 1 | 70 | | Huesca | Almuniente | 005 | 00158 | 0 | 0,3275 | ESCARTIN SERAL, CARMEN |
| 1 | 70 | | Huesca | Almuniente | 005 | 00159 | 0 | 5,4432 | ESCARTIN SERAL, CARMEN |
| 1 | 70 | | Huesca | Almuniente | 005 | 00163 | 0 | 6,1951 | ESCARTIN SERAL, CARMEN |
| 1 | 70 | | Huesca | Almuniente | 005 | 00600 | 0 | 4,7311 | ESCARTIN SERAL, CARMEN |
| 1 | 70 | | Huesca | Almuniente | 005 | 00601 | 0 | 0,5500 | ESCARTIN SERAL, CARMEN |
| | **Total 70** | | | | | | | 20,4362 | |
| 1 | 71 | | Huesca | Almuniente | 005 | 00164 | 0 | 2,8315 | CACHO BAILO, ANGEL |
| 1 | 71 | | Huesca | Almuniente | 005 | 00165 | 0 | 10,1801 | CACHO BAILO, ANGEL |
| 1 | 71 | | Huesca | Almuniente | 005 | 00602 | 0 | 0,3340 | CACHO BAILO, ANGEL |
| | **Total 71** | | | | | | | 13,3456 | |
| 1 | 80 | | Huesca | Torralba | 501 | 089 | 0 | 3,7599 | NOVALES CASTERAD, MIGUEL |
| 1 | 80 | | Huesca | Torralba | 501 | 093 | 0 | 34,2184 | NOVALES ASCASO, FRANCISCO JAVIER |
| | **Total 80** | | | | | | | 37,9783 | |
| 1 | 81 | | Huesca | Torralba | 501 | 065 | 0 | 2,0671 | PUEYO CORVINOS, JESUS ANGEL |
| 1 | 81 | | Huesca | Torralba | 501 | 066 | 0 | 27,6965 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD |
| | **Total 81** | | | | | | | 29,7636 | |
| 1 | 82 | | Huesca | Torralba | 501 | 044 | 0 | 0,7860 | TORRECILLA GRASA, JOSE LUIS |
| 1 | 82 | | Huesca | Torralba | 501 | 046 | 0 | 17,3334 | TORRECILLA GRASA, JOSE LUIS |
| 1 | 82 | | Huesca | Torralba | 501 | 064 | 0 | 7,6959 | TORRECILLA GRASA, JOSE LUIS |
| | **Total 82** | | | | | | | 25,8153 | |
| 1 | 83 | | Huesca | Torralba | 501 | 042 | 0 | 13,4148 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 83** | | | | | | | 13,4148 | |
| 1 | 84 | | Huesca | Torralba | 501 | 039 | 0 | 24,8692 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 84** | | | | | | | 24,8692 | |
| 1 | 85 | | Huesca | Torralba | 501 | 019 | 0 | 37,2570 | GANADOS JIMENEZ CAMBRA, S.L. |
| | **Total 85** | | | | | | | 37,2570 | |
| 1 | 86 | | Huesca | Torralba | 501 | 069 | 0 | 25,0526 | GANADOS JIMENEZ CAMBRA, S.L. |
| | **Total 86** | | | | | | | 25,0526 | |
| 1 | 87 | | Huesca | Torralba | 501 | 071 | 0 | 9,5741 | ROBA HUGUET, PILAR E HIJA |
| | **Total 87** | | | | | | | 9,5741 | |
| 1 | 88 | | Huesca | Barbués | 502 | 098 | 0 | 2,4937 | PASCUAL BOLEA, MARIA JOSE |
| 1 | 88 | | Huesca | Torralba | 501 | 022 | 0 | 1,7839 | PASCUAL BOLEA, MARIA JOSE |
| 1 | 88 | | Huesca | Torralba | 501 | 023 | 0 | 1,1929 | PASCUAL BOLEA, MARIA JOSE |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 88 | | Huesca | Torralba | 501 | 024 | 0 | 5,8349 | PASCUAL BOLEA, MARIA JOSE |
| | **Total 88** | | | | | | | 11,3054 | |
| 1 | 89 | | Huesca | Torralba | 501 | 025 | 0 | 2,6724 | ALCUBIERRE RODELLAR, LUIS MANUEL |
| 1 | 89 | | Huesca | Torralba | 501 | 026 | 0 | 1,9673 | ALCUBIERRE GARCIA, LUIS MANUEL |
| 1 | 89 | | Huesca | Torralba | 501 | 027 | 0 | 8,6980 | ALCUBIERRE RODELLAR, CARLOS |
| | **Total 89** | | | | | | | 13,3377 | |
| 1 | 90 | | Huesca | Torralba | 501 | 017 | 0 | 20,0005 | BAYOD CALVO, JOSE ALFREDO |
| 1 | 90 | | Huesca | Torralba | 501 | 028 | 0 | 2,1139 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 90** | | | | | | | 22,1144 | |
| 1 | 91 | | Huesca | Torralba | 501 | 029 | 0 | 7,7662 | MARTINEZ PEREZ, NEMESIO AGUSTIN JESUS |
| 1 | 91 | | Huesca | Torralba | 501 | 030 | 0 | 1,3090 | CABRERO MARTINEZ, RUBEN |
| | **Total 91** | | | | | | | 9,0752 | |
| 1 | 92 | 1 | Huesca | Torralba | 501 | 032 | 0 | 0,6046 | MUR CATON, LORENZO |
| 1 | 92 | 2 | Huesca | Torralba | 501 | 033 | 0 | 1,8972 | MASA COMUN |
| 1 | 92 | 3 | Huesca | Torralba | 501 | 034 | 0 | 0,9284 | PELEATO PELEATO, FRANCISCO |
| | **Total 92** | | | | | | | 3,4302 | |
| 1 | 93 | 1 | Huesca | Torralba | 501 | 013 | 0 | 2,2203 | GAVIN MARTINEZ, MARIANO Y OTROS |
| 1 | 93 | 2 | Huesca | Torralba | 501 | 014 | 0 | 2,9122 | CORZ PLO, MARIA TERESA |
| | **Total 93** | | | | | | | 5,1325 | |
| 1 | 94 | 1 | Huesca | Tardienta | 504 | 006 | 0 | 1,7034 | MASA COMUN |
| 1 | 94 | 2 | Huesca | Tardienta | 504 | 007 | 0 | 0,7573 | BARLUENGA ORTIZ, ANTONIO Y HNAS |
| 1 | 94 | 3 | Huesca | Tardienta | 504 | 008 | 0 | 0,4325 | ALADREN OLIVA, FRANCISCO |
| 1 | 94 | 4 | Huesca | Tardienta | 504 | 009 | 0 | 0,5395 | AYUNTAMIENTO DE TARDIENTA |
| 1 | 94 | 5 | Huesca | Tardienta | 504 | 010 | 0 | 1,2250 | BARLUENGA ALCUBIERRE, PEDRO Y ESPOSA |
| | **Total 94** | | | | | | | 4,6577 | |
| 1 | 95 | 1 | Huesca | Tardienta | 504 | 004 | 0 | 0,6117 | TORNE BOLEA, ANTONIO |
| 1 | 95 | 2 | Huesca | Tardienta | 504 | 005 | 0 | 0,9004 | ALCUBIERRE SAURAS, JOSE |
| 1 | 95 | 3 | Huesca | Tardienta | 504 | 011 | 0 | 1,4561 | EL HASNAOUI ALLAL, HAMID Y MENANA |
| 1 | 95 | 4 | Huesca | Tardienta | 504 | 012 | 0 | 0,7524 | MAZA ALCUBIERRE, JESUS ANTONIO |
| | **Total 95** | | | | | | | 3,7206 | |
| 1 | 100 | | Huesca | Torralba | 501 | 098 | 0 | 18,5167 | ALCUBIERRE PUERTOLAS, JOSE MARIA |
| | **Total 100** | | | | | | | 18,5167 | |
| 1 | 101 | | Huesca | Torralba | 501 | 085 | 0 | 7,2427 | MARTINEZ ARAGONCILLO, BASILIO E HIJO |
| 1 | 101 | | Huesca | Torralba | 501 | 086 | 0 | 1,4263 | MARTINEZ MATEO, LUIS MIGUEL |
| 1 | 101 | | Huesca | Torralba | 501 | 087 | 0 | 2,7645 | MARTINEZ CABEZUDO, MIGUEL ANGEL |
| | **Total 101** | | | | | | | 11,4335 | |
| 1 | 102 | | Huesca | Barbués | 502 | 131 | 0 | 4,2513 | PUEYO CALVO, JUSTO Y HNAS |
| 1 | 102 | | Huesca | Torralba | 501 | 104 | 0 | 4,5176 | PUEYO CALVO, JUSTO |
| 1 | 102 | | Huesca | Torralba | 501 | 105 | 0 | 0,7859 | PUEYO CALVO, JUSTO |
| 1 | 102 | | Huesca | Torralba | 501 | 106 | 0 | 9,6901 | PUEYO CALVO, JUSTO Y HNAS |
| 1 | 102 | | Huesca | Torralba | 501 | 083 | 0 | 2,2291 | PUEYO CALVO, JUSTO Y HNAS |
| | **Total 102** | | | | | | | 21,4740 | |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 103 | | Huesca | Torralba | 501 | 102 | 0 | 4,3204 | BOROBIA MICHELENA, ENRIQUE |
| 1 | 103 | | Huesca | Torralba | 501 | 082 | 0 | 7,9314 | BOROBIA MICHELENA, ENRIQUE |
| | **Total 103** | | | | | | | 12,2518 | |
| 1 | 104 | | Huesca | Torralba | 501 | 113 | 0 | 5,3168 | GARCÍA LABAT, NICOLAS Y FRANCISCO |
| 1 | 104 | | Huesca | Torralba | 501 | 115 | 0 | 7,6710 | GARCIA LABAT, NICOLAS JOSE |
| | **Total 104** | | | | | | | 12,9878 | |
| 1 | 105 | | Huesca | Torralba | 501 | 074 | 0 | 0,6702 | ABADIA BUIL, MARIA TERESA Y OTRA |
| 1 | 105 | | Huesca | Torralba | 501 | 077 | 0 | 3,6066 | ABADIA BUIL, MARIA TERESA Y OTRA |
| | **Total 105** | | | | | | | 4,2768 | |
| 1 | 106 | | Huesca | Barbués | 502 | 130 | 0 | 9,7779 | BOROBIA MICHELENA, YOLANDA |
| 1 | 106 | | Huesca | Torralba | 501 | 075 | 0 | 1,0542 | BOROBIA MICHELENA, YOLANDA |
| | **Total 106** | | | | | | | 10,8321 | |
| 1 | 107 | 1 | Huesca | Barbués | 502 | 105 | 0 | 8,8634 | BARRIO FAULO, URBANO |
| 1 | 107 | 2 | Huesca | Barbués | 502 | 128 | 0 | 0,4347 | REVUELTA ABADIA, JOSE MIGUEL |
| | **Total 107** | | | | | | | 9,2981 | |
| 1 | 108 | | Huesca | Barbués | 502 | 101 | 0 | 8,9983 | SAUCO DOTO, MARIA ANGELES |
| | **Total 108** | | | | | | | 8,9983 | |
| 1 | 109 | | Huesca | Barbués | 502 | 100 | 0 | 4,8625 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS |
| 1 | 109 | | Huesca | Barbués | 502 | 081 | 0 | 4,2757 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS |
| 1 | 109 | | Huesca | Barbués | 502 | 096 | 0 | 0,5472 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS |
| | **Total 109** | | | | | | | 9,6854 | |
| 1 | 110 | | Huesca | Torralba | 501 | 112 | 0 | 6,7648 | TORRECILLA ALCUBIERRE, ROSA MARIA |
| | **Total 110** | | | | | | | 6,7648 | |
| 1 | 111 | | Huesca | Torralba | 501 | 116 | 0 | 14,9080 | TORRECILLA VIÑAS, YOLANDA Y CESAR |
| | **Total 111** | | | | | | | 14,9080 | |
| 1 | 112 | 1 | Huesca | Torralba | 501 | 109 | 0 | 1,1188 | LISA PLO, MARIA CARMEN |
| 1 | 112 | 1 | Huesca | Torralba | 501 | 110 | 0 | 5,1524 | REVUELTA LOPEZ, JOSE PASCUAL |
| 1 | 112 | 2 | Huesca | Barbués | 502 | 132 | 0 | 1,2859 | MASA COMUN |
| | **Total 112** | | | | | | | 7,5571 | |
| 1 | 113 | Sin Toma | Huesca | Almuniente | 503 | 004 | 0 | 0,1470 | MASA COMUN |
| 1 | 113 | | Huesca | Almuniente | 503 | 001 | 0 | 4,4378 | RODRIGUEZ GUALLARTE, ALBA |
| 1 | 113 | | Huesca | Almuniente | 503 | 003 | 0 | 1,9236 | RODRIGUEZ GUALLARTE, ALBA |
| | **Total 113** | | | | | | | 6,5084 | |
| 1 | 114 | | Huesca | Barbués | 502 | 133 | 0 | 9,8699 | REVUELTA ABADIA, JOSE MIGUEL |
| | **Total 114** | | | | | | | 9,8699 | |
| 1 | 115 | | Huesca | Barbués | 502 | 135 | 0 | 9,0456 | DOTO OTO, FRANCISCA MARIA CARMEN |
| | **Total 115** | | | | | | | 9,0456 | |
| 1 | 116 | | Huesca | Barbués | 502 | 114 | 0 | 0,1838 | PAULES SESE, ANDRES |
| 1 | 116 | | Huesca | Barbués | 502 | 115 | 0 | 0,4191 | IBAÑEZ IBAÑEZ, JOSE |
| 1 | 116 | | Huesca | Barbués | 502 | 117 | 0 | 0,4006 | GALINO ALTAFAJ, ALVARO |
| 1 | 116 | | Huesca | Barbués | 502 | 120 | 0 | 0,5460 | SARVISE MORCATE, DANIEL |
| 1 | 116 | | Huesca | Barbués | 502 | 121 | 0 | 0,7653 | RAMON CUBERO, ANTONIO |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 116 | | Huesca | Barbués | 502 | 122 | 0 | 0,4005 | MASA COMUN |
| 1 | 116 | | Huesca | Barbués | 502 | 123 | 0 | 0,2433 | ACIN BERCERO, VICENTE |
| 1 | 116 | | Huesca | Barbués | 502 | 124 | 0 | 0,2339 | SEBASTIAN DELGADO, ISMAEL Y RAQUEL |
| | **Total 116** | | | | | | | 3,1925 | |
| 1 | 117 | | Huesca | Barbués | 502 | 126 | 0 | 8,5843 | ROMEO OLIVAN, CARLOS |
| | **Total 117** | | | | | | | 8,5843 | |
| 1 | 118 | 1 | Huesca | Barbués | 502 | 106 | 0 | 0,2160 | GRACIA MARTIN, MIGUELA E HIJOS |
| 1 | 118 | 2 | Huesca | Barbués | 502 | 107 | 0 | 0,2265 | CREMALLET LABORDA, JOSE |
| 1 | 118 | 3 | Huesca | Barbués | 502 | 108 | 0 | 1,0195 | OLIVA AVELLANAS, PEDRO PASCUAL |
| 1 | 118 | 3 | Huesca | Barbués | 502 | 109 | 0 | 0,5565 | OLIVA GUALLAR, PEDRO |
| 1 | 118 | 4 | Huesca | Barbués | 502 | 110 | 0 | 0,2145 | SALAMANCA LEON, JOSE |
| 1 | 118 | 5 | Huesca | Barbués | 502 | 083 | 0 | 0,2745 | AYUNTAMIENTO DE TORRES DE BARBUES |
| 1 | 118 | 6 | Huesca | Barbués | 502 | 084 | 0 | 0,2143 | ASENSIO PEREZ, TIRSO |
| 1 | 118 | 7 | Huesca | Barbués | 502 | 085 | 0 | 0,1670 | OBISPADO DE HUESCA |
| 1 | 118 | 8 | Huesca | Barbués | 502 | 086 | 0 | 0,1935 | LISA BERNAD, RODOLFO FAUSTINO |
| | **Total 118** | | | | | | | 3,0823 | |
| 1 | 119 | 1 | Huesca | Barbués | 502 | 087 | 0 | 0,2877 | DOTO OTO, FRANCISCA MARIA CARMEN |
| 1 | 119 | 1 | Huesca | Barbués | 502 | 088 | 0 | 0,1371 | PIRACES LAIRLA, EMILIO |
| 1 | 119 | 2 | Huesca | Barbués | 502 | 089 | 0 | 0,2307 | DURANGO GAYAN, FRANCISCO |
| 1 | 119 | 3 | Huesca | Barbués | 502 | 090 | 0 | 0,2158 | SESE SANTOLARIA, VICTORIA E HIJO |
| 1 | 119 | 4 | Huesca | Barbués | 502 | 091 | 0 | 0,4064 | ROMERO CALVO, FRANCISCO |
| 1 | 119 | 5 | Huesca | Barbués | 502 | 092 | 0 | 0,4084 | GRASA ARA, ROMAN |
| 1 | 119 | 6 | Huesca | Barbués | 502 | 093 | 0 | 0,3110 | BARRIO LORAQUE, MIGUEL ANGEL |
| 1 | 119 | 6 | Huesca | Barbués | 502 | 094 | 0 | 0,2491 | BARRIO FAULO, URBANO |
| 1 | 119 | 7 | Huesca | Barbués | 502 | 095 | 0 | 0,2514 | HIGUERA FERNANDEZ, FELIX |
| | **Total 119** | | | | | | | 2,4976 | |
| 1 | 120 | | Huesca | Almuniente | 503 | 005 | 0 | 3,8028 | BARRIO FAULO, URBANO |
| 1 | 120 | | Huesca | Barbués | 502 | 160 | 0 | 7,6150 | BARRIO FAULO, URBANO |
| | **Total 120** | | | | | | | 11,4178 | |
| 1 | 121 | | Huesca | Barbués | 502 | 158 | 0 | 9,5440 | REVUELTA LOPEZ, JOSE PASCUAL |
| 1 | 121 | | Huesca | Barbués | 502 | 159 | 0 | 7,8536 | REVUELTA LISA, ANTONIO JOSE |
| | **Total 121** | | | | | | | 17,3976 | |
| 1 | 122 | | Huesca | Barbués | 502 | 137 | 0 | 8,2880 | LISA GOMEZ, ABEL JOSE |
| 1 | 122 | | Huesca | Barbués | 502 | 138 | 0 | 0,4677 | LISA BERNAD, RODOLFO FAUSTINO |
| | **Total 122** | | | | | | | 8,7557 | |
| 1 | 123 | 1 | Huesca | Barbués | 502 | 070 | 0 | 0,3376 | LOPEZ BARREDO, MANUEL |
| 1 | 123 | 2 | Huesca | Barbués | 502 | 145 | 0 | 0,5475 | RODRIGUEZ GUALLARTE, ALBA |
| 1 | 123 | 2 | Huesca | Barbués | 502 | 146 | 0 | 0,1466 | RODRIGUEZ GARCIA, JOSE |
| 1 | 123 | 3 | Huesca | Barbués | 502 | 148 | 0 | 0,3260 | PUERTOLAS BERDUN, EUGENIO |
| 1 | 123 | 3 | Huesca | Barbués | 502 | 149 | 0 | 0,2084 | DELGADO OSUNA, FRANCISCO |
| 1 | 123 | 4 | Huesca | Barbués | 502 | 140 | 0 | 0,2044 | REVUELTA LOPEZ, PEDRO CARLOS |
| 1 | 123 | 5 | Huesca | Barbués | 502 | 141 | 0 | 0,2091 | GRACIA ROBERT, JOSE |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 123 | 6 | Huesca | Barbués | 502 | 142 | 0 | 0,1952 | CALLE GARCIA, VALENTIN |
| 1 | 123 | 7 | Huesca | Barbués | 502 | 143 | 0 | 0,2324 | PABAN GIRON, JOSE LUIS |
| 1 | 123 | 8 | Huesca | Barbués | 502 | 144 | 0 | 0,2764 | SAUCO DOTO, ANA ISABEL |
| | **Total 123** | | | | | | | 2,6836 | |
| 1 | 124 | | Huesca | Barbués | 502 | 071 | 0 | 7,7947 | MIRANDA CAPISTROS, JORGE MANUEL |
| | **Total 124** | | | | | | | 7,7947 | |
| 1 | 125 | 1 | Huesca | Barbués | 502 | 077 | 0 | 2,4896 | PAULES SESE, ANDRES |
| 1 | 125 | 2 | Huesca | Barbués | 502 | 079 | 0 | 4,9993 | PAULES SESE, ANDRES |
| | **Total 125** | | | | | | | 7,4889 | |
| 1 | 126 | 1 | Huesca | Barbués | 502 | 072 | 0 | 0,7603 | OLIVAN ESCAR, DIONISIO |
| 1 | 126 | 1 | Huesca | Barbués | 502 | 073 | 0 | 2,4015 | OLIVA BIARGE, BASILIO ANTONIO |
| 1 | 126 | 2 | Huesca | Barbués | 502 | 074 | 0 | 2,3012 | PALACIO BRUN, GLORIA CARMEN |
| 1 | 126 | 3 | Huesca | Barbués | 502 | 075 | 0 | 0,6399 | MASA COMUN |
| | **Total 126** | | | | | | | 6,1029 | |
| 1 | 127 | 1 | Huesca | Barbués | 502 | 062 | 0 | 0,1341 | GAYAN GALVEZ, ALVARO |
| 1 | 127 | 2 | Huesca | Barbués | 502 | 063 | 0 | 0,2356 | FORTES BARRANQUERO, ANTONIO |
| 1 | 127 | 3 | Huesca | Barbués | 502 | 064 | 0 | 0,1889 | LAFUENTE DOTO, BENITO |
| 1 | 127 | 4 | Huesca | Barbués | 502 | 065 | 0 | 0,1509 | MOLINA ZAFRA, JOSE MARIA |
| 1 | 127 | 5 | Huesca | Barbués | 502 | 066 | 0 | 0,1965 | MAZA ACEBILLO, JOSEFA Y OTROS |
| 1 | 127 | 6 | Huesca | Barbués | 502 | 067 | 0 | 0,2018 | GOMEZ LANUZA, FRANCISCO |
| 1 | 127 | 7 | Huesca | Barbués | 502 | 068 | 0 | 0,1862 | LAGUNA MORCATE, FRANCISCO JAVIER Y HNOS |
| 1 | 127 | 8 | Huesca | Barbués | 502 | 069 | 0 | 0,1680 | LATORRE MAGALLON, ALEJANDRO |
| | **Total 127** | | | | | | | 1,4620 | |
| 1 | 128 | 1 | Huesca | Barbués | 502 | 055 | 0 | 0,2400 | GARCES TORRABIAS, PEDRO Y JORGE |
| 1 | 128 | 2 | Huesca | Barbués | 502 | 056 | 0 | 0,2556 | LUCAS AROCA, DESIDERIO |
| 1 | 128 | 3 | Huesca | Barbués | 502 | 057 | 0 | 0,2240 | CADENAS CAMON, SANTIAGO |
| 1 | 128 | 3 | Huesca | Barbués | 502 | 058 | 0 | 0,1962 | ROPERO ORTIZ, PRIMITIVO |
| 1 | 128 | 4 | Huesca | Barbués | 502 | 059 | 0 | 0,1500 | BOROBIA MICHELENA, EDURNE |
| 1 | 128 | 5 | Huesca | Barbués | 502 | 060 | 0 | 0,2600 | CORREAS OTIN, EMERITA |
| 1 | 128 | 6 | Huesca | Barbués | 502 | 061 | 0 | 0,1330 | OCA BAGUENA, PEDRO JAVIER Y EVA MARIA |
| 1 | 128 | 7 | Huesca | Barbués | 502 | 153 | 0 | 0,2225 | NOGUES SEN, JUAN CARLOS Y MARIA LOURDES |
| 1 | 128 | 8 | Huesca | Barbués | 502 | 154 | 0 | 0,2153 | ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS |
| 1 | 128 | 9 | Huesca | Barbués | 502 | 152 | 0 | 0,4801 | MASA COMUN |
| | **Total 128** | | | | | | | 2,3767 | |
| 1 | 129 | | Huesca | Barbués | 502 | 139 | 0 | 8,2583 | SANJUAN MILLAN, JESUS |
| 1 | 129 | | Huesca | Barbués | 502 | 150 | 0 | 0,2414 | SANJUAN GOMEZ, ELIAS Y ANA MARIA |
| 1 | 129 | | Huesca | Barbués | 502 | 151 | 0 | 8,1096 | SANJUAN GOMEZ, ELIAS Y JESUS |
| 1 | 129 | | Huesca | Barbués | 502 | 155 | 0 | 2,2954 | SANJUAN GOMEZ, ELIAS Y JESUS |
| | **Total 129** | | | | | | | 18,9047 | |
| 1 | 130 | | Huesca | Barbués | 502 | 054 | 0 | 6,6925 | CASTAN LUNA, FELIX ANTONIO |
| | **Total 130** | | | | | | | 6,6925 | |
| 1 | 131 | | Huesca | Barbués | 502 | 053 | 0 | 11,0194 | CASTEL CANALIS, ANTONIO |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| | **Total 131** | | | | | | | 11,0194 | |
| 1 | 132 | | Huesca | Barbués | 502 | 046 | 0 | 25,5104 | MAZANA PIENSOS COMPUESTOS S.L. |
| | **Total 132** | | | | | | | 25,5104 | |
| 1 | 133 | | Huesca | Barbués | 502 | 052 | 0 | 7,0911 | SANJUAN GOMEZ, ELIAS Y NATIVIDAD |
| | **Total 133** | | | | | | | 7,0911 | |
| 1 | 134 | | Huesca | Barbués | 502 | 047 | 0 | 3,9430 | LIESA PISA, JOAQUIN |
| 1 | 134 | | Huesca | Barbués | 502 | 050 | 0 | 4,6729 | LIESA PISA, JOAQUIN |
| | **Total 134** | | | | | | | 8,6159 | |
| 1 | 135 | | Huesca | Almuniente | 503 | 022 | 0 | 2,4285 | LATORRE ESCARTIN, LUIS ANTONIO |
| | **Total 135** | | | | | | | 2,4285 | |
| 1 | 136 | | Huesca | Almuniente | 503 | 020 | 0 | 1,2492 | ASESIO ORUS, FE CORAZON |
| 1 | 136 | | Huesca | Almuniente | 503 | 021 | 0 | 10,5224 | ASESIO ORUS, FE CORAZON |
| | **Total 136** | | | | | | | 11,7716 | |
| 1 | 137 | | Huesca | Almuniente | 503 | 023 | 0 | 10,0773 | AGRICOLA MAZANA S.L.U. |
| | **Total 137** | | | | | | | 10,0773 | |
| 1 | 138 | | Huesca | Almuniente | 503 | 025 | 0 | 8,9801 | DELGADO OSUNA, FRANCISCO |
| 1 | 138 | | Huesca | Almuniente | 503 | 027 | 0 | 1,9717 | DELGADO OSUNA, FRANCISCO |
| | **Total 138** | | | | | | | 10,9518 | |
| 1 | 139 | | Huesca | Almuniente | 503 | 031 | 0 | 3,9150 | BOLEA ALCUBIERRE, CARMELO |
| 1 | 139 | | Huesca | Almuniente | 503 | 032 | 0 | 2,0209 | BOLEA ALCUBIERRE, CARMELO |
| | **Total 139** | | | | | | | 5,9359 | |
| 1 | 140 | | Huesca | Almuniente | 503 | 028 | 0 | 1,8078 | MOLINA ZAFRA, JOSE MARIA |
| 1 | 140 | | Huesca | Almuniente | 503 | 029 | 0 | 7,0507 | MOLINA ZAFRA, JOSE MARIA |
| 1 | 140 | | Huesca | Almuniente | 503 | 030 | 0 | 2,0393 | MOLINA ZAFRA, JOSE MARIA |
| | **Total 140** | | | | | | | 10,8978 | |
| 1 | 141 | | Huesca | Almuniente | 503 | 008 | 0 | 9,6035 | RODRIGUEZ GUALLARTE, ALBA |
| 1 | 141 | | Huesca | Almuniente | 503 | 012 | 0 | 2,3411 | RODRIGUEZ RODRIGUEZ, BENJAMIN |
| | **Total 141** | | | | | | | 11,9446 | |
| 1 | 142 | | Huesca | Almuniente | 503 | 009 | 0 | 8,7143 | SARVISE MORCATE, DANIEL |
| | **Total 142** | | | | | | | 8,7143 | |
| 1 | 143 | | Huesca | Almuniente | 503 | 013 | 0 | 8,5350 | REVUELTA ABADIA, JOSE MIGUEL Y HNOS |
| 1 | 143 | | Huesca | Almuniente | 503 | 015 | 0 | 5,5065 | REVUELTA ABADIA, JOSE MIGUEL Y HNOS |
| | **Total 143** | | | | | | | 14,0415 | |
| 1 | 144 | | Huesca | Almuniente | 503 | 010 | 0 | 14,0949 | SARVISE ABADIA, ANTONIO FRANCISCO |
| | **Total 144** | | | | | | | 14,0949 | |
| 1 | 145 | | Huesca | Almuniente | 503 | 017 | 0 | 1,0883 | ABADIA LIENAS, JULIAN |
| 1 | 145 | | Huesca | Almuniente | 503 | 018 | 0 | 9,9880 | NOGUES SEN, JUAN CARLOS Y MARIA LOURDES |
| | **Total 145** | | | | | | | 11,0763 | |
| 1 | 146 | 1 | Huesca | Almuniente | 503 | 034 | 0 | 3,6979 | LOPEZ LAFUENTE, ANTONIO JOSE Y HNAS |
| | **Total 146** | | | | | | | 3,6979 | |
| 1 | 147 | | Huesca | Almuniente | 503 | 019 | 0 | 10,7404 | LAGUNA MORCATE, FRANCISCO JAVIER |
| 1 | 147 | | Huesca | Almuniente | 503 | 033 | 0 | 4,5205 | LAGUNA MORCATE, FRANCISCO JAVIER |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| | **Total 147** | | | | | | | 15,2609 | |
| 1 | 150 | | Huesca | Barbués | 502 | 005 | 0 | 4,1153 | BARRIO FAULO, URBANO |
| 1 | 150 | | Huesca | Barbués | 502 | 007 | 0 | 0,2522 | BARRIO FAULO, URBANO |
| 1 | 150 | | Huesca | Barbués | 502 | 008 | 0 | 0,2199 | BARRIO LORAQUE, MIGUEL ANGEL |
| 1 | 150 | | Huesca | Barbués | 502 | 024 | 0 | 5,5812 | BARRIO FAULO, URBANO |
| 1 | 150 | | Huesca | Barbués | 502 | 026 | 0 | 7,7561 | BARRIO FAULO, URBANO |
| | **Total 150** | | | | | | | 17,9247 | |
| 1 | 151 | | Huesca | Barbués | 502 | 025 | 0 | 8,5012 | GALINO ALTAFAJ, ALVARO |
| 1 | 151 | | Huesca | Torralba | 501 | 011 | 0 | 1,2679 | GALINO ALTAFAJ, ALVARO |
| | **Total 151** | | | | | | | 9,7691 | |
| 1 | 152 | | Huesca | Torralba | 501 | 003 | 0 | 8,5233 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD |
| 1 | 152 | | Huesca | Torralba | 501 | 004 | 0 | 12,3773 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD |
| 1 | 152 | | Huesca | Torralba | 501 | 010 | 0 | 5,3497 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD |
| | **Total 152** | | | | | | | 26,2503 | |
| 1 | 153 | | Huesca | Torralba | 501 | 002 | 0 | 10,0509 | ACIN BERCERO, VICENTE |
| | **Total 153** | | | | | | | 10,0509 | |
| 1 | 154 | | Huesca | Torralba | 501 | 009 | 0 | 4,7786 | ORUS ABADIA EUGENIA Y OTROS |
| | **Total 154** | | | | | | | 4,7786 | |
| 1 | 155 | | Huesca | Tardienta | 504 | 002 | 0 | 0,8164 | PELEATO ESTAUN, FRANCISCO JOSE |
| 1 | 155 | | Huesca | Tardienta | 504 | 003 | 0 | 4,2907 | PELEATO ESTAUN, FRANCISCO JOSE |
| 1 | 155 | | Huesca | Torralba | 501 | 006 | 0 | 5,8267 | PELEATO ESTAUN, FRANCISCO JOSE |
| 1 | 155 | | Huesca | Torralba | 501 | 007 | 0 | 0,3147 | PELEATO ESTAUN, FRANCISCO JOSE |
| 1 | 155 | | Huesca | Torralba | 501 | 008 | 0 | 0,6612 | PELEATO PELEATO, FRANCISCO |
| | **Total 155** | | | | | | | 11,9097 | |
| 1 | 156 | | Huesca | Barbués | 502 | 004 | 0 | 3,3904 | LORAQUE RODRIGO, BERNABE |
| | **Total 156** | | | | | | | 3,3904 | |
| 1 | 157 | | Huesca | Barbués | 502 | 003 | 0 | 6,1967 | CABREJAS LAORDEN, LUIS |
| | **Total 157** | | | | | | | 6,1967 | |
| 1 | 158 | | Huesca | Barbués | 502 | 002 | 0 | 13,7013 | SANTOS SESE, JESUS |
| | **Total 158** | | | | | | | 13,7013 | |
| 1 | 159 | 1 | Huesca | Barbués | 502 | 001 | 0 | 2,1303 | MASA COMUN |
| 1 | 159 | 2 | Huesca | Barbués | 502 | 016 | 0 | 1,4228 | CLAVER BALDOVINOS, MARIA CRUZ |
| 1 | 159 | 3 | Huesca | Barbués | 502 | 019 | 0 | 2,5281 | ARBUENS FERRANDO, MARIA JESUS |
| | **Total 159** | | | | | | | 6,0812 | |
| 1 | 160 | | Huesca | Barbués | 502 | 015 | 0 | 12,4067 | SARVISE ANDREU, ANGEL FELIX |
| | **Total 160** | | | | | | | 12,4067 | |
| 1 | 161 | | Huesca | Barbués | 502 | 009 | 0 | 9,4315 | REVUELTA LOPEZ, PEDRO CARLOS |
| | **Total 161** | | | | | | | 9,4315 | |
| 1 | 162 | | Huesca | Barbués | 502 | 010 | 0 | 11,5912 | CASTAN LUNA, FELIX ANTONIO |
| | **Total 162** | | | | | | | 11,5912 | |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 163 | | Huesca | Barbués | 502 | 011 | 0 | 9,5215 | BENEDI MURO, MANUEL |
| | **Total 163** | | | | | | | 9,5215 | |
| 1 | 164 | | Huesca | Barbués | 502 | 012 | 0 | 7,5594 | MONESMA MAZA, BONIFACIO LUIS |
| 1 | 164 | | Huesca | Barbués | 502 | 013 | 0 | 3,2900 | MONESMA MAZA, BONIFACIO LUIS |
| 1 | 164 | | Huesca | Barbués | 502 | 014 | 0 | 8,8464 | MONESMA MAZA, BONIFACIO LUIS |
| | **Total 164** | | | | | | | 19,6958 | |
| 1 | 165 | | Huesca | Barbués | 502 | 023 | 0 | 9,4579 | LISA GOMEZ, ABEL JOSE |
| | **Total 165** | | | | | | | 9,4579 | |
| 1 | 166 | | Huesca | Barbués | 502 | 022 | 0 | 9,4861 | GRIMAL CUBERO, JESUS |
| | **Total 166** | | | | | | | 9,4861 | |
| 1 | 167 | | Huesca | Barbués | 502 | 017 | 0 | 2,9308 | GUALLAR MAVILLA, DOMINGO |
| 1 | 167 | | Huesca | Barbués | 502 | 018 | 0 | 3,0469 | GUALLAR MAVILLA, DOMINGO |
| | **Total 167** | | | | | | | 5,9777 | |
| 1 | 169 | | Huesca | Barbués | 502 | 021 | 0 | 9,7698 | SESE SANTOLARIA, VICTORIA E HIJO |
| | **Total 169** | | | | | | | 9,7698 | |
| 1 | 170 | | Huesca | Barbués | 502 | 020 | 0 | 6,5279 | REVUELTA LISA, ALBERTO |
| | **Total 170** | | | | | | | 6,5279 | |
| 1 | 171 | | Huesca | Barbués | 502 | 027 | 0 | 7,9637 | SANCHEZ LACASA, GUADALUPE |
| | **Total 171** | | | | | | | 7,9637 | |
| 1 | 172 | | Huesca | Barbués | 502 | 028 | 0 | 11,2569 | MUÑOZ LACAMPA, MARIA TERESA Y ANTONIO |
| | **Total 172** | | | | | | | 11,2569 | |
| 1 | 173 | | Huesca | Barbués | 502 | 029 | 0 | 7,6499 | MUÑOZ LACAMPA, ANTONIO MANUEL Y OTROS |
| | **Total 173** | | | | | | | 7,6499 | |
| 1 | 174 | | Huesca | Barbués | 502 | 031 | 0 | 5,2981 | ORUS MIRANDA, PATROCINIO Mª MAGDALENA |
| | **Total 174** | | | | | | | 5,2981 | |
| 1 | 175 | | Huesca | Barbués | 502 | 032 | 0 | 3,8930 | GARCES POBO, MARIA PILAR E HIJO |
| | **Total 175** | | | | | | | 3,8930 | |
| 1 | 176 | | Huesca | Barbués | 502 | 033 | 0 | 6,1156 | LACAMPA ABAD, MARIA CARMEN |
| | **Total 176** | | | | | | | 6,1156 | |
| 1 | 177 | | Huesca | Barbués | 502 | 035 | 0 | 11,4225 | EXPLOTACIONES GANADERAS VALDEMORO S.L.U. |
| | **Total 177** | | | | | | | 11,4225 | |
| 1 | 178 | | Huesca | Barbués | 502 | 043 | 0 | 7,5678 | REVUELTA MONESMA, PEDRO CARLOS |
| | **Total 178** | | | | | | | 7,5678 | |
| 1 | 179 | 1 | Huesca | Barbués | 502 | 036 | 0 | 0,6808 | OTISAR SOCIEDAD LIMITADA |
| 1 | 179 | 1 | Huesca | Barbués | 502 | 037 | 0 | 2,6005 | OTIN ORUS, MARIA DOLORES |
| 1 | 179 | 2 | Huesca | Barbués | 502 | 038 | 0 | 1,7501 | BARRIO FAULO, URBANO |
| | **Total 179** | | | | | | | 5,0314 | |
| 1 | 180 | | Huesca | Barbués | 502 | 039 | 0 | 10,2861 | NAVARRO RUBIO, ANTONIA |
| | **Total 180** | | | | | | | 10,2861 | |
| 1 | 181 | | Huesca | Barbués | 502 | 041 | 0 | 5,6940 | SANCHEZ COSANO, MARIA CONCEPCION |
| | **Total 181** | | | | | | | 5,6940 | |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 182 | | Huesca | Barbués | 502 | 045 | 0 | 1,1433 | LIESA USON, AGUSTIN |
| 1 | 182 | | Huesca | Valfonda | 502 | 164 | 0 | 0,8415 | LIESA USON, AGUSTIN |
| | **Total 182** | | | | | | | 1,9848 | |
| 2 | 201 | 1 | Huesca | Torralba | 502 | 111 | 0 | 4,5644 | AYUNTAMIENTO DE TORRALBA DE ARAGON |
| 2 | 201 | 2 | Huesca | Torralba | 502 | 112 | 0 | 1,7716 | ALCUBIERRE GARCIA, ANTONIO SILVESTRE |
| | **Total 201** | | | | | | | 6,3360 | |
| 2 | 202 | | Huesca | Torralba | 502 | 064 | 0 | 5,5832 | PUERTOLAS VAL, MARIA PILAR |
| | **Total 202** | | | | | | | 5,5832 | |
| 2 | 203 | 1 | Huesca | Torralba | 002 | 403 | 0 | 0,1258 | GARCIA BALLARIN, JUAN CARLOS |
| 2 | 203 | 2 | Huesca | Torralba | 502 | 047 | 0 | 1,1042 | MORLANS LASTANAO, CONCEPCION |
| 2 | 203 | 2 | Huesca | Torralba | 002 | 404 | 0 | 0,0658 | BERCERO NOVALES, ANTONIO |
| 2 | 203 | 3 | Huesca | Torralba | 502 | 065 | 0 | 1,4669 | GANADOS JIMENEZ CAMBRA, S.L. |
| 2 | 203 | 4 | Huesca | Torralba | 502 | 057 | 0 | 0,1517 | LACAMBRA PAÑO, PEDRO FERNANDO |
| | **Total 203** | | | | | | | 2,9144 | |
| 2 | 204 | | Huesca | Torralba | 502 | 051 | 0 | 8,5651 | PUEYO CORVINOS, JESUS ANGEL |
| 2 | 204 | | Huesca | Torralba | 502 | 053 | 0 | 0,1254 | PUEYO CORVINOS,JESUS ANGEL Y ESPOSA |
| | **Total 204** | | | | | | | 8,6905 | |
| 2 | 205 | 1 | Huesca | Torralba | 502 | 042 | 0 | 2,1306 | AYUNTAMIENTO DE TORRALBA DE ARAGON |
| 2 | 205 | 2 | Huesca | Torralba | 502 | 041 | 0 | 0,1464 | MARTINEZ BANDRES, ANTONIO |
| 2 | 205 | 3 | Huesca | Torralba | 003 | 409 | 0 | 0,1693 | FEDIUC, MARIANA |
| | **Total 205** | | | | | | | 2,4463 | |
| 2 | 206 | 1 | Huesca | Torralba | 502 | 044 | 0 | 0,8978 | AZNAREZ GASTON, JAIME Y HNOS |
| 2 | 206 | 2 | Huesca | Torralba | 502 | 030 | 0 | 0,1300 | LOPEZ ABAD, MARIA BEGOÑA |
| 2 | 206 | 3 | Huesca | Torralba | 502 | 031 | 0 | 0,0500 | TORRECILLA GRASA, JOSE LUIS |
| 2 | 206 | 3 | Huesca | Torralba | 502 | 032 | 0 | 0,0500 | TORRECILLA ALCUBIERRE, ROSA MARIA |
| 2 | 206 | 4 | Huesca | Torralba | 502 | 033 | 0 | 0,0758 | BAYOD CALVO, JOSE ALFREDO |
| 2 | 206 | 5 | Huesca | Torralba | 502 | 034 | 0 | 0,0250 | PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD |
| 2 | 206 | 5 | Huesca | Torralba | 502 | 035 | 0 | 0,0250 | PUEYO CORVINOS, JESUS ANGEL |
| 2 | 206 | 6 | Huesca | Torralba | 502 | 036 | 0 | 0,0700 | GRACIA LAFUENTE, RAUL Y OTRA |
| 2 | 206 | 7 | Huesca | Torralba | 502 | 037 | 0 | 0,1220 | NOVALES ALLUE, ENRIQUE |
| 2 | 206 | 8 | Huesca | Torralba | 502 | 038 | 0 | 0,0450 | ALCUBIERRE GARCIA, JOAQUIN |
| 2 | 206 | 8 | Huesca | Torralba | 502 | 039 | 0 | 0,0450 | ALCUBIERRE PUERTOLAS, JOSE MARIA |
| 2 | 206 | 8 | Huesca | Torralba | 502 | 040 | 0 | 0,0450 | PUERTOLAS VAL, MARIA PILAR |
| | **Total 206** | | | | | | | 1,5806 | |
| 2 | 207 | 1 | Huesca | Torralba | 502 | 028 | 0 | 0,3819 | AYUNTAMIENTO DE TORRALBA DE ARAGON |
| 2 | 207 | 2 | Huesca | Torralba | 502 | 024 | 0 | 1,4744 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 207** | | | | | | | 1,8563 | |
| 2 | 208 | | Huesca | Torralba | 502 | 018 | 0 | 2,2452 | GANADOS JIMENEZ CAMBRA, S.L. |
| 2 | 208 | | Huesca | Torralba | 502 | 021 | 0 | 21,4396 | GANADOS JIMENEZ CAMBRA, S.L. |
| | **Total 208** | | | | | | | 23,6848 | |
| 2 | 209 | | Huesca | Torralba | 502 | 015 | 0 | 11,7365 | GARCIA ARTERO, ROSA MARIA Y M PILAR |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| | **Total 209** | | | | | | | 11,7365 | |
| 2 | 210 | | Huesca | Torralba | 502 | 003 | 0 | 7,2307 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 210** | | | | | | | 7,2307 | |
| 2 | 211 | | Huesca | Tardienta | 504 | 015 | 0 | 0,3315 | TORRECILLA VIÑAS, YOLANDA Y CESAR |
| 2 | 211 | | Huesca | Torralba | 502 | 004 | 0 | 7,0797 | TORRECILLA VIÑAS, YOLANDA Y CESAR |
| | **Total 211** | | | | | | | 7,4112 | |
| 2 | 212 | | Huesca | Tardienta | 504 | 016 | 0 | 0,3361 | ABADIA BUIL, PEDRO LUIS |
| 2 | 212 | | Huesca | Tardienta | 504 | 018 | 0 | 1,1522 | SANZ BIELSA, ANTONIO |
| 2 | 212 | | Huesca | Torralba | 502 | 005 | 0 | 1,0132 | ABADIA BUIL, PEDRO LUIS |
| 2 | 212 | | Huesca | Torralba | 502 | 006 | 0 | 0,3794 | SIRON IRIONDO, FILOMENO |
| 2 | 212 | | Huesca | Torralba | 502 | 007 | 0 | 3,5258 | SANZ BIELSA, ANTONIO |
| 2 | 212 | | Huesca | Torralba | 502 | 008 | 0 | 9,4393 | ABADIA ORUS, PEDRO |
| 2 | 212 | | Huesca | Torralba | 502 | 009 | 0 | 0,9146 | ABADIA BUIL, PEDRO LUIS |
| | **Total 212** | | | | | | | 16,7606 | |
| 2 | 213 | | Huesca | Torralba | 502 | 010 | 0 | 7,2009 | OLONA MALLADA, JOAQUIN |
| 2 | 213 | | Huesca | Torralba | 502 | 012 | 0 | 0,6893 | OLONA ALAGON, ERNESTO |
| | **Total 213** | | | | | | | 7,8902 | |
| 2 | 214 | | Huesca | Torralba | 502 | 014 | 0 | 32,4010 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 214** | | | | | | | 32,4010 | |
| 2 | 215 | | Huesca | Torralba | 501 | 040 | 0 | 33,8796 | GANADOS JIMENEZ CAMBRA, S.L. |
| | **Total 215** | | | | | | | 33,8796 | |
| 2 | 216 | | Huesca | Tardienta | 504 | 013 | 0 | 1,0983 | BAILO BOLEA, DIEGO |
| 2 | 216 | | Huesca | Tardienta | 504 | 014 | 0 | 2,5285 | BAILO BOLEA, DIEGO |
| 2 | 216 | | Huesca | Torralba | 501 | 037 | 0 | 34,5687 | BAILO BOLEA, DIEGO |
| | **Total 216** | | | | | | | 38,1955 | |
| 2 | 217 | | Huesca | Torralba | 501 | 043 | 0 | 5,2239 | IZUEL GASTON, JOSE ANTONIO |
| | **Total 217** | | | | | | | 5,2239 | |
| 2 | 218 | | Huesca | Torralba | 501 | 057 | 0 | 4,9932 | ABADIA ORUS, PEDRO |
| 2 | 218 | | Huesca | Torralba | 501 | 059 | 0 | 6,6195 | ABADIA ORUS, PEDRO |
| | **Total 218** | | | | | | | 11,6127 | |
| 2 | 219 | 1 | Huesca | Torralba | 501 | 048 | 0 | 1,4302 | MASA COMUN |
| 2 | 219 | 2 | Huesca | Torralba | 501 | 056 | 0 | 3,0445 | BAYOD CALVO, JOSE ALFREDO |
| | **Total 219** | | | | | | | 4,4747 | |
| 2 | 220 | | Huesca | Torralba | 501 | 052 | 0 | 4,2588 | LISA BERNAD, ANTONIO JAVIER |
| 2 | 220 | | Huesca | Torralba | 501 | 060 | 0 | 1,9602 | LISA BERNAD, ANTONIO JAVIER Y MARIA EUGENIA |
| 2 | 220 | | Huesca | Torralba | 501 | 061 | 0 | 3,1367 | LISA BERNAD, ANTONIO JAVIER |
| 2 | 220 | | Huesca | Torralba | 501 | 062 | 0 | 0,5263 | PUEYO CORVINOS, JESUS ANGEL |
| 2 | 220 | | Huesca | Torralba | 501 | 095 | 0 | 1,5944 | LISA BERNAD, ANTONIO JAVIER |
| 2 | 220 | | Huesca | Torralba | 502 | 022 | 0 | 1,8878 | LISA BERNAD, ANTONIO JAVIER |
| | **Total 220** | | | | | | | 13,3642 | |
| 2 | 221 | | Huesca | Torralba | 502 | 120 | 0 | 0,5383 | MORLANS BOLEA, GONZALO |

| PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) | PROPIETARIO |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 221 | | Huesca | Torralba | 502 | 122 | 0 | 3,4448 | MORLANS BOLEA, GONZALO |
| | **Total 221** | | | | | | | 3,9831 | |
| 2 | 222 | | Huesca | Torralba | 502 | 124 | 0 | 17,2741 | LOPEZ ABAD, MARIA BEGOÑA |
| 2 | 222 | | Huesca | Torralba | 502 | 138 | 0 | 6,8631 | LOPEZ ABAD, MARIA BEGOÑA |
| | **Total 222** | | | | | | | 24,1372 | |
| 2 | 223 | | Huesca | Torralba | 502 | 137 | 0 | 5,7233 | GARCIA PAÑO, JOSE ANTONIO |
| | **Total 223** | | | | | | | 5,7233 | |
| 2 | 224 | | Huesca | Torralba | 502 | 204 | 0 | 14,2432 | PUEYO CORVINOS, JESUS ANGEL |
| | **Total 224** | | | | | | | 14,2432 | |
| 2 | 225 | | Huesca | Torralba | 502 | 205 | 0 | 6,9973 | TORRECILLA GRASA, JOSE LUIS |
| | **Total 225** | | | | | | | 6,9973 | |
| 2 | 226 | | Huesca | Torralba | 502 | 136 | 0 | 6,9760 | ARNAL CABREJAS, ROBERTO JESUS |
| | **Total 226** | | | | | | | 6,9760 | |
| 2 | 227 | 1 | Huesca | Senés | 503 | 001 | 0 | 0,1095 | BERCERO ABRIL, MARIANO |
| 2 | 227 | 1 | Huesca | Torralba | 502 | 128 | 0 | 3,5991 | LOPEZ ABAD, MARIA BEGOÑA |
| 2 | 227 | 1 | Huesca | Torralba | 502 | 133 | 0 | 2,6867 | LOPEZ ABAD, MARIA BEGOÑA |
| 2 | 227 | 1 | Huesca | Torralba | 502 | 134 | 0 | 2,6803 | LOPEZ ABAD, MARIA BEGOÑA |
| 2 | 227 | 2 | Huesca | Torralba | 502 | 131 | 0 | 1,8603 | BERCERO ABRIL, MARIANO |
| 2 | 227 | 2 | Huesca | Torralba | 502 | 132 | 0 | 0,1559 | BERCERO ABRIL, MARIANO |
| 2 | 227 | Sin Toma | Huesca | Senés | 503 | 011 | 0 | 0,3650 | CASTILLO PICAPEO, FRANCISCO |
| 2 | 227 | Sin Toma | Huesca | Senés | 503 | 013 | 0 | 0,3108 | PUYOL MASIAS, JOSE CARMELO |
| | **Total 227** | | | | | | | 11,7676 | |
| 2 | 228 | | Huesca | Senés | 503 | 009 | 0 | 9,8415 | ABADIA PAÑO, MARIA JESUS |
| | **Total 228** | | | | | | | 9,8415 | |
| 2 | 229 | | Huesca | Senés | 503 | 005 | 0 | 2,7961 | SUBIAS SUBIAS, JOAQUINA |
| 2 | 229 | | Huesca | Senés | 503 | 007 | 0 | 0,6981 | SUBIAS SUBIAS, JOAQUINA |
| 2 | 229 | | Huesca | Senés | 503 | 008 | 0 | 12,9519 | ABARDIA CONTE, JOSE MANUEL Y CARLOTA |
| | **Total 229** | | | | | | | 16,4461 | |
| 2 | 230 | | Huesca | Senés | 503 | 016 | 0 | 9,6817 | PUERTOLAS VAL, MARIA PILAR |
| 2 | 230 | | Huesca | Torralba | 502 | 207 | 0 | 14,8073 | ALCUBIERRE GARCIA, JOAQUIN |
| | **Total 230** | | | | | | | 24,4890 | |
| 2 | 231 | | Huesca | Senés | 503 | 014 | 0 | 0,6015 | ALLUE OTAL, JOSE MANUEL |
| 2 | 231 | | Huesca | Senés | 503 | 015 | 0 | 6,0907 | MUR POMAR, LUIS FERNANDO |
| | **Total 231** | | | | | | | 6,6922 | |
| | **Total general** | | | | | | | 2.714,5256 | |

### 3.3 LISTADO DE PROPIETARIOS

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| ABADIA BUIL, MARIA TERESA Y OTRA | 1 | 27 | | Huesca | Torralba | 502 | 194 | 0 | 11,2809 |
| ABADIA BUIL, MARIA TERESA Y OTRA | 1 | 105 | | Huesca | Torralba | 501 | 074 | 0 | 0,6702 |
| ABADIA BUIL, MARIA TERESA Y OTRA | 1 | 105 | | Huesca | Torralba | 501 | 077 | 0 | 3,6066 |
| **Total ABADIA BUIL, MARIA TERESA Y OTRA** | | | | | | | | | 15,5577 |
| ABADIA BUIL, PEDRO LUIS | 2 | 212 | | Huesca | Tardienta | 504 | 016 | 0 | 0,3361 |
| ABADIA BUIL, PEDRO LUIS | 2 | 212 | | Huesca | Torralba | 502 | 005 | 0 | 1,0132 |
| ABADIA BUIL, PEDRO LUIS | 2 | 212 | | Huesca | Torralba | 502 | 009 | 0 | 0,9146 |
| **Total ABADIA BUIL, PEDRO LUIS** | | | | | | | | | 2,2639 |
| ABADIA LIENAS, JULIAN | 1 | 145 | | Huesca | Almuniente | 503 | 017 | 0 | 1,0883 |
| **Total ABADIA LIENAS, JULIAN** | | | | | | | | | 1,0883 |
| ABADIA ORUS, PEDRO | 1 | 6 | 4 | Huesca | Torralba | 502 | 102 | 0 | 2,3704 |
| ABADIA ORUS, PEDRO | 2 | 212 | | Huesca | Torralba | 502 | 008 | 0 | 9,4393 |
| ABADIA ORUS, PEDRO | 2 | 218 | | Huesca | Torralba | 501 | 057 | 0 | 4,9932 |
| ABADIA ORUS, PEDRO | 2 | 218 | | Huesca | Torralba | 501 | 059 | 0 | 6,6195 |
| **Total ABADIA ORUS, PEDRO** | | | | | | | | | 23,4224 |
| ABADIA PAÑO, MARIA JESUS | 2 | 228 | | Huesca | Senés | 503 | 009 | 0 | 9,8415 |
| **Total ABADIA PAÑO, MARIA JESUS** | | | | | | | | | 9,8415 |
| ABADIA PUYAL, MANUEL RAMON | 1 | 49 | | Huesca | Almuniente | 505 | 033 | 0 | 4,0215 |
| ABADIA PUYAL, MANUEL RAMON | 1 | 49 | | Huesca | Almuniente | 505 | 034 | 0 | 2,7793 |
| ABADIA PUYAL, MANUEL RAMON | 1 | 49 | | Huesca | Almuniente | 505 | 041 | 0 | 1,2815 |
| ABADIA PUYAL, MANUEL RAMON | 1 | 49 | | Huesca | Almuniente | 505 | 042 | 0 | 0,5800 |
| **Total ABADIA PUYAL, MANUEL RAMON** | | | | | | | | | 8,6623 |
| ABADIA PUYAL, MANUEL RAMON Y ESPOSA | 1 | 49 | | Huesca | Almuniente | 505 | 043 | 0 | 1,2758 |
| **Total ABADIA PUYAL, MANUEL RAMON Y ESPOSA** | | | | | | | | | 1,2758 |
| ABARDIA CONTE, JOSE MANUEL Y CARLOTA | 2 | 229 | | Huesca | Senés | 503 | 008 | 0 | 12,9519 |
| **Total ABARDIA CONTE, JOSE MANUEL Y CARLOTA** | | | | | | | | | 12,9519 |
| ABRIL ABRIL, TOMAS EVARISTO | 1 | 23 | | Huesca | Torralba | 502 | 190 | 0 | 0,2359 |
| **Total ABRIL ABRIL, TOMAS EVARISTO** | | | | | | | | | 0,2359 |
| ABRIL BERCERO, EVARISTO | 1 | 23 | | Huesca | Torralba | 502 | 189 | 0 | 4,2194 |
| **Total ABRIL BERCERO, EVARISTO** | | | | | | | | | 4,2194 |
| ACIN BERCERO, VICENTE | 1 | 153 | | Huesca | Torralba | 501 | 002 | 0 | 10,0509 |
| **Total ACIN BERCERO, VICENTE** | | | | | | | | | 10,0509 |
| ACIN BERCERO, VICENTE | 1 | 116 | | Huesca | Barbués | 502 | 123 | 0 | 0,2433 |
| **Total ACIN BERCERO, VICENTE** | | | | | | | | | 0,2433 |
| AGRICOLA MAZANA S.L.U. | 1 | 137 | | Huesca | Almuniente | 503 | 023 | 0 | 10,0773 |
| **Total AGRICOLA MAZANA S.L.U.** | | | | | | | | | 10,0773 |
| ALADREN OLIVA, FRANCISCO | 1 | 94 | 3 | Huesca | Tardienta | 504 | 008 | 0 | 0,4325 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| **Total ALADREN OLIVA, FRANCISCO** | | | | | | | | | 0,4325 |
| ALCUBIERRE GARCIA, ANTONIO SILVESTRE | 2 | 201 | 2 | Huesca | Torralba | 502 | 112 | 0 | 1,7716 |
| **Total ALCUBIERRE GARCIA, ANTONIO SILVESTRE** | | | | | | | | | 1,7716 |
| ALCUBIERRE GARCIA, JOAQUIN | 1 | 17 | | Huesca | Senés | 503 | 017 | 0 | 0,4043 |
| ALCUBIERRE GARCIA, JOAQUIN | 1 | 17 | | Huesca | Torralba | 502 | 207 | 0 | 14,8073 |
| ALCUBIERRE GARCIA, JOAQUIN | 2 | 206 | 8 | Huesca | Torralba | 502 | 038 | 0 | 0,0450 |
| ALCUBIERRE GARCIA, JOAQUIN | 2 | 230 | | Huesca | Torralba | 502 | 207 | 0 | 14,8073 |
| **Total ALCUBIERRE GARCIA, JOAQUIN** | | | | | | | | | 30,0639 |
| ALCUBIERRE GARCIA, LUIS MANUEL | 1 | 89 | | Huesca | Torralba | 501 | 026 | 0 | 1,9673 |
| **Total ALCUBIERRE GARCIA, LUIS MANUEL** | | | | | | | | | 1,9673 |
| ALCUBIERRE GARCIA, PASCUAL | 1 | 16 | | Huesca | Torralba | 502 | 086 | 0 | 8,7073 |
| ALCUBIERRE GARCIA, PASCUAL | 1 | 24 | | Huesca | Torralba | 502 | 179 | 0 | 13,6271 |
| **Total ALCUBIERRE GARCIA, PASCUAL** | | | | | | | | | 22,3344 |
| ALCUBIERRE OTAL, PASCUAL | 1 | 16 | | Huesca | Torralba | 502 | 087 | 0 | 0,6538 |
| **Total ALCUBIERRE OTAL, PASCUAL** | | | | | | | | | 0,6538 |
| ALCUBIERRE PUERTOLAS, JOSE MARIA | 1 | 17 | | Huesca | Torralba | 502 | 206 | 0 | 4,1622 |
| ALCUBIERRE PUERTOLAS, JOSE MARIA | 1 | 100 | | Huesca | Torralba | 501 | 098 | 0 | 18,5167 |
| ALCUBIERRE PUERTOLAS, JOSE MARIA | 2 | 206 | 8 | Huesca | Torralba | 502 | 039 | 0 | 0,0450 |
| **Total ALCUBIERRE PUERTOLAS, JOSE MARIA** | | | | | | | | | 22,7239 |
| ALCUBIERRE PUYOL, MARIA DEL CARMEN | 1 | 5 | 1 | Huesca | Torralba | 502 | 155 | 0 | 0,7204 |
| ALCUBIERRE PUYOL, MARIA DEL CARMEN | 1 | 20 | 2 | Huesca | Torralba | 502 | 182 | 0 | 2,7184 |
| **Total ALCUBIERRE PUYOL, MARIA DEL CARMEN** | | | | | | | | | 3,4388 |
| ALCUBIERRE RODELLAR, CARLOS | 1 | 89 | | Huesca | Torralba | 501 | 027 | 0 | 8,6980 |
| **Total ALCUBIERRE RODELLAR, CARLOS** | | | | | | | | | 8,6980 |
| ALCUBIERRE RODELLAR, LUIS MANUEL | 1 | 89 | | Huesca | Torralba | 501 | 025 | 0 | 2,6724 |
| **Total ALCUBIERRE RODELLAR, LUIS MANUEL** | | | | | | | | | 2,6724 |
| ALCUBIERRE SAURAS, JOSE | 1 | 95 | 2 | Huesca | Tardienta | 504 | 005 | 0 | 0,9004 |
| **Total ALCUBIERRE SAURAS, JOSE** | | | | | | | | | 0,9004 |
| ALCUBIERRE SERAL, ROBERTO | 1 | 5 | 1 | Huesca | Torralba | 502 | 154 | 0 | 1,9403 |
| ALCUBIERRE SERAL, ROBERTO | 1 | 20 | 1 | Huesca | Torralba | 502 | 166 | 0 | 4,3623 |
| **Total ALCUBIERRE SERAL, ROBERTO** | | | | | | | | | 6,3026 |
| ALLUE ALCUBIERRE, MARIO ANTONIO Y MARIA JESUS | 1 | 45 | | Huesca | Almuniente | 505 | 054 | 0 | 10,0200 |
| **Total ALLUE ALCUBIERRE, MARIO ANTONIO Y MARIA JESUS** | | | | | | | | | 10,0200 |
| ALLUE OTAL, JOSE MANUEL | 2 | 231 | | Huesca | Senés | 503 | 014 | 0 | 0,6015 |
| **Total ALLUE OTAL, JOSE MANUEL** | | | | | | | | | 0,6015 |
| ALLUE PAÑO, FERMIN | 1 | 11 | 2 | Huesca | Torralba | 502 | 078 | 0 | 0,8121 |
| **Total ALLUE PAÑO, FERMIN** | | | | | | | | | 0,8121 |
| ALLUE PAÑO, MAXIMO | 1 | 10 | 6 | Huesca | Torralba | 502 | 072 | 0 | 0,0979 |
| ALLUE PAÑO, MAXIMO | 1 | 11 | 2 | Huesca | Torralba | 502 | 077 | 0 | 1,1822 |
| **Total ALLUE PAÑO, MAXIMO** | | | | | | | | | 1,2801 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| ALLUE VALLE, MARIA BEGOÑA Y MARIA ELENA | 1 | 10 | 5 | Huesca | Torralba | 502 | 071 | 0 | 0,0644 |
| **Total ALLUE VALLE, MARIA BEGOÑA Y MARIA ELENA** | | | | | | | | | 0,0644 |
| ALONSO ORUS, JOSE IGNACIO | 1 | 4 | | Huesca | Torralba | 502 | 139 | 0 | 1,3307 |
| **Total ALONSO ORUS, JOSE IGNACIO** | | | | | | | | | 1,3307 |
| ALONSO ORUS, MARIA ISABEL | 1 | 6 | 1 | Huesca | Torralba | 502 | 098 | 0 | 0,2108 |
| ALONSO ORUS, MARIA ISABEL | 1 | 13 | | Huesca | Torralba | 502 | 079 | 0 | 2,2248 |
| **Total ALONSO ORUS, MARIA ISABEL** | | | | | | | | | 2,4356 |
| APARICIO CONTE, SERGIO | 1 | 41 | | Huesca | Almuniente | 505 | 017 | 0 | 0,4802 |
| APARICIO CONTE, SERGIO | 1 | 41 | | Huesca | Almuniente | 505 | 057 | 0 | 4,5733 |
| **Total APARICIO CONTE, SERGIO** | | | | | | | | | 5,0535 |
| APARICIO FUSTERO, JESUS | 1 | 41 | | Huesca | Almuniente | 505 | 018 | 0 | 3,8679 |
| APARICIO FUSTERO, JESUS | 1 | 41 | | Huesca | Almuniente | 505 | 021 | 0 | 0,7831 |
| APARICIO FUSTERO, JESUS | 1 | 41 | | Huesca | Almuniente | 505 | 022 | 0 | 0,1127 |
| **Total APARICIO FUSTERO, JESUS** | | | | | | | | | 4,7637 |
| ARBUENS FERRANDO, MARIA JESUS | 1 | 159 | 3 | Huesca | Barbués | 502 | 019 | 0 | 2,5281 |
| **Total ARBUENS FERRANDO, MARIA JESUS** | | | | | | | | | 2,5281 |
| ARNAL CABREJAS, LUIS | 1 | 17 | | Huesca | Senés | 503 | 018 | 0 | 0,1098 |
| ARNAL CABREJAS, LUIS | 1 | 18 | 1 | Huesca | Torralba | 502 | 199 | 0 | 7,4183 |
| **Total ARNAL CABREJAS, LUIS** | | | | | | | | | 7,5281 |
| ARNAL CABREJAS, ROBERTO JESUS | 2 | 226 | | Huesca | Torralba | 502 | 136 | 0 | 6,9760 |
| **Total ARNAL CABREJAS, ROBERTO JESUS** | | | | | | | | | 6,9760 |
| ASENSIO PEREZ, TIRSO | 1 | 118 | 6 | Huesca | Barbués | 502 | 084 | 0 | 0,2143 |
| **Total ASENSIO PEREZ, TIRSO** | | | | | | | | | 0,2143 |
| ASESIO ORUS, FE CORAZON | 1 | 40 | 2 | Huesca | Almuniente | 505 | 058 | 0 | 1,8248 |
| ASESIO ORUS, FE CORAZON | 1 | 136 | | Huesca | Almuniente | 503 | 020 | 0 | 1,2492 |
| ASESIO ORUS, FE CORAZON | 1 | 136 | | Huesca | Almuniente | 503 | 021 | 0 | 10,5224 |
| **Total ASESIO ORUS, FE CORAZON** | | | | | | | | | 13,5964 |
| ASIN DURANGO, PABLO | 1 | 47 | | Huesca | Almuniente | 505 | 028 | 0 | 4,8297 |
| ASIN DURANGO, PABLO | 1 | 52 | | Huesca | Almuniente | 505 | 047 | 0 | 10,9901 |
| **Total ASIN DURANGO, PABLO** | | | | | | | | | 15,8198 |
| ASIN MENDOZA, FRANCISCO | 1 | 47 | | Huesca | Almuniente | 505 | 029 | 0 | 12,3240 |
| **Total ASIN MENDOZA, FRANCISCO** | | | | | | | | | 12,3240 |
| ASIN MENDOZA, JESUS MARIANO | 1 | 54 | | Huesca | Almuniente | 505 | 044 | 0 | 4,4828 |
| ASIN MENDOZA, JESUS MARIANO | 1 | 54 | | Huesca | Almuniente | 505 | 045 | 0 | 3,1472 |
| **Total ASIN MENDOZA, JESUS MARIANO** | | | | | | | | | 7,6300 |
| AYUNTAMIENTO DE SENES DE ALCUBIERRE | 1 | 41 | | Huesca | Almuniente | 505 | 019 | 0 | 0,2225 |
| **Total AYUNTAMIENTO DE SENES DE ALCUBIERRE** | | | | | | | | | 0,2225 |
| AYUNTAMIENTO DE TARDIENTA | 1 | 94 | 4 | Huesca | Tardienta | 504 | 009 | 0 | 0,5395 |
| **Total AYUNTAMIENTO DE TARDIENTA** | | | | | | | | | 0,5395 |
| AYUNTAMIENTO DE TORRALBA DE ARAGON | 1 | 1 | 2 | Huesca | Torralba | 502 | 107 | 0 | 0,4003 |
| AYUNTAMIENTO DE TORRALBA DE ARAGON | 1 | 11 | 1 | Huesca | Torralba | 502 | 076 | 0 | 3,0918 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| AYUNTAMIENTO DE TORRALBA DE ARAGON | 2 | 201 | 1 | Huesca | Torralba | 502 | 111 | 0 | 4,5644 |
| AYUNTAMIENTO DE TORRALBA DE ARAGON | 2 | 205 | 1 | Huesca | Torralba | 502 | 042 | 0 | 2,1306 |
| AYUNTAMIENTO DE TORRALBA DE ARAGON | 2 | 207 | 1 | Huesca | Torralba | 502 | 028 | 0 | 0,3819 |
| **Total AYUNTAMIENTO DE TORRALBA DE ARAGON** | | | | | | | | | 10,5690 |
| AYUNTAMIENTO DE TORRES DE BARBUES | 1 | 118 | 5 | Huesca | Barbués | 502 | 083 | 0 | 0,2745 |
| **Total AYUNTAMIENTO DE TORRES DE BARBUES** | | | | | | | | | 0,2745 |
| AZNAREZ GASTON, JAIME Y HNOS | 2 | 206 | 1 | Huesca | Torralba | 502 | 044 | 0 | 0,8978 |
| **Total AZNAREZ GASTON, JAIME Y HNOS** | | | | | | | | | 0,8978 |
| BAILO BOLEA, DIEGO | 2 | 216 | | Huesca | Tardienta | 504 | 013 | 0 | 1,0983 |
| BAILO BOLEA, DIEGO | 2 | 216 | | Huesca | Tardienta | 504 | 014 | 0 | 2,5285 |
| BAILO BOLEA, DIEGO | 2 | 216 | | Huesca | Torralba | 501 | 037 | 0 | 34,5687 |
| **Total BAILO BOLEA, DIEGO** | | | | | | | | | 38,1955 |
| BARLUENGA ALCUBIERRE, PEDRO Y ESPOSA | 1 | 94 | 5 | Huesca | Tardienta | 504 | 010 | 0 | 1,2250 |
| **Total BARLUENGA ALCUBIERRE, PEDRO Y ESPOSA** | | | | | | | | | 1,2250 |
| BARLUENGA ORTIZ, ANTONIO Y HNAS | 1 | 94 | 2 | Huesca | Tardienta | 504 | 007 | 0 | 0,7573 |
| **Total BARLUENGA ORTIZ, ANTONIO Y HNAS** | | | | | | | | | 0,7573 |
| BARRIO FAULO, URBANO | 1 | 12 | | Huesca | Torralba | 502 | 083 | 0 | 20,5275 |
| BARRIO FAULO, URBANO | 1 | 42 | | Huesca | Almuniente | 505 | 023 | 0 | 8,4362 |
| BARRIO FAULO, URBANO | 1 | 107 | 1 | Huesca | Barbués | 502 | 105 | 0 | 8,8634 |
| BARRIO FAULO, URBANO | 1 | 119 | 6 | Huesca | Barbués | 502 | 094 | 0 | 0,2491 |
| BARRIO FAULO, URBANO | 1 | 120 | | Huesca | Almuniente | 503 | 005 | 0 | 3,8028 |
| BARRIO FAULO, URBANO | 1 | 120 | | Huesca | Barbués | 502 | 160 | 0 | 7,6150 |
| BARRIO FAULO, URBANO | 1 | 150 | | Huesca | Barbués | 502 | 005 | 0 | 4,1153 |
| BARRIO FAULO, URBANO | 1 | 150 | | Huesca | Barbués | 502 | 007 | 0 | 0,2522 |
| BARRIO FAULO, URBANO | 1 | 150 | | Huesca | Barbués | 502 | 024 | 0 | 5,5812 |
| BARRIO FAULO, URBANO | 1 | 150 | | Huesca | Barbués | 502 | 026 | 0 | 7,7561 |
| BARRIO FAULO, URBANO | 1 | 179 | 2 | Huesca | Barbués | 502 | 038 | 0 | 1,7501 |
| **Total BARRIO FAULO, URBANO** | | | | | | | | | 68,9489 |
| BARRIO LORAQUE, MIGUEL ANGEL | 1 | 119 | 6 | Huesca | Barbués | 502 | 093 | 0 | 0,3110 |
| BARRIO LORAQUE, MIGUEL ANGEL | 1 | 150 | | Huesca | Barbués | 502 | 008 | 0 | 0,2199 |
| **Total BARRIO LORAQUE, MIGUEL ANGEL** | | | | | | | | | 0,5309 |
| BARRIO LORENQUE, MIGUEL ANGEL | 1 | 48 | | Huesca | Almuniente | 505 | 031 | 0 | 10,3861 |
| **Total BARRIO LORENQUE, MIGUEL ANGEL** | | | | | | | | | 10,3861 |
| BAYOD CALVO, ANTONIO | 1 | 9 | | Huesca | Torralba | 502 | 084 | 0 | 0,9427 |
| **Total BAYOD CALVO, ANTONIO** | | | | | | | | | 0,9427 |
| BAYOD CALVO, JOSE ALFREDO | 1 | 7 | | Huesca | Torralba | 502 | 091 | 0 | 6,7218 |
| BAYOD CALVO, JOSE ALFREDO | 1 | 9 | | Huesca | Torralba | 502 | 085 | 0 | 22,2264 |
| BAYOD CALVO, JOSE ALFREDO | 1 | 83 | | Huesca | Torralba | 501 | 042 | 0 | 13,4148 |
| BAYOD CALVO, JOSE ALFREDO | 1 | 84 | | Huesca | Torralba | 501 | 039 | 0 | 24,8692 |
| BAYOD CALVO, JOSE ALFREDO | 1 | 90 | | Huesca | Torralba | 501 | 017 | 0 | 20,0005 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| BAYOD CALVO, JOSE ALFREDO | 1 | 90 | | Huesca | Torralba | 501 | 028 | 0 | 2,1139 |
| BAYOD CALVO, JOSE ALFREDO | 2 | 206 | 4 | Huesca | Torralba | 502 | 033 | 0 | 0,0758 |
| BAYOD CALVO, JOSE ALFREDO | 2 | 207 | 2 | Huesca | Torralba | 502 | 024 | 0 | 1,4744 |
| BAYOD CALVO, JOSE ALFREDO | 2 | 210 | | Huesca | Torralba | 502 | 003 | 0 | 7,2307 |
| BAYOD CALVO, JOSE ALFREDO | 2 | 214 | | Huesca | Torralba | 502 | 014 | 0 | 32,4010 |
| BAYOD CALVO, JOSE ALFREDO | 2 | 219 | 2 | Huesca | Torralba | 501 | 056 | 0 | 3,0445 |
| **Total BAYOD CALVO, JOSE ALFREDO** | | | | | | | | | 133,5730 |
| BAYOD CALVO, JOSE ALFREDO Y ANTONIO | 1 | 7 | | Huesca | Torralba | 502 | 090 | 0 | 0,3382 |
| **Total BAYOD CALVO, JOSE ALFREDO Y ANTONIO** | | | | | | | | | 0,3382 |
| BENEDI MURO, MANUEL | 1 | 163 | | Huesca | Barbués | 502 | 011 | 0 | 9,5215 |
| **Total BENEDI MURO, MANUEL** | | | | | | | | | 9,5215 |
| BERCERO ABRIL, MARIANO | 2 | 227 | 1 | Huesca | Senés | 503 | 001 | 0 | 0,1095 |
| BERCERO ABRIL, MARIANO | 2 | 227 | 2 | Huesca | Torralba | 502 | 131 | 0 | 1,8603 |
| BERCERO ABRIL, MARIANO | 2 | 227 | 2 | Huesca | Torralba | 502 | 132 | 0 | 0,1559 |
| **Total BERCERO ABRIL, MARIANO** | | | | | | | | | 2,1257 |
| BERCERO ALCUBIERRE, PASCUAL | 1 | 19 | | Huesca | Torralba | 502 | 164 | 0 | 2,6785 |
| BERCERO ALCUBIERRE, PASCUAL | 1 | 19 | | Huesca | Torralba | 502 | 165 | 0 | 1,9062 |
| BERCERO ALCUBIERRE, PASCUAL | 1 | 19 | | Huesca | Torralba | 502 | 170 | 0 | 4,0869 |
| **Total BERCERO ALCUBIERRE, PASCUAL** | | | | | | | | | 8,6716 |
| BERCERO NOVALES, ANTONIO | 1 | 19 | | Huesca | Torralba | 502 | 168 | 0 | 5,7703 |
| BERCERO NOVALES, ANTONIO | 2 | 203 | 2 | Huesca | Torralba | 002 | 404 | 0 | 0,0658 |
| **Total BERCERO NOVALES, ANTONIO** | | | | | | | | | 5,8361 |
| BIARGE ASIN, JOSE ANTONIO | 1 | 43 | | Huesca | Almuniente | 505 | 026 | 0 | 3,7616 |
| **Total BIARGE ASIN, JOSE ANTONIO** | | | | | | | | | 3,7616 |
| BOLEA ALCUBIERRE, CARMELO | 1 | 139 | | Huesca | Almuniente | 503 | 031 | 0 | 3,9150 |
| BOLEA ALCUBIERRE, CARMELO | 1 | 139 | | Huesca | Almuniente | 503 | 032 | 0 | 2,0209 |
| **Total BOLEA ALCUBIERRE, CARMELO** | | | | | | | | | 5,9359 |
| BOROBIA MICHELENA, EDURNE | 1 | 128 | 4 | Huesca | Barbués | 502 | 059 | 0 | 0,1500 |
| **Total BOROBIA MICHELENA, EDURNE** | | | | | | | | | 0,1500 |
| BOROBIA MICHELENA, ENRIQUE | 1 | 103 | | Huesca | Torralba | 501 | 102 | 0 | 4,3204 |
| BOROBIA MICHELENA, ENRIQUE | 1 | 103 | | Huesca | Torralba | 501 | 082 | 0 | 7,9314 |
| **Total BOROBIA MICHELENA, ENRIQUE** | | | | | | | | | 12,2518 |
| BOROBIA MICHELENA, YOLANDA | 1 | 106 | | Huesca | Barbués | 502 | 130 | 0 | 9,7779 |
| BOROBIA MICHELENA, YOLANDA | 1 | 106 | | Huesca | Torralba | 501 | 075 | 0 | 1,0542 |
| **Total BOROBIA MICHELENA, YOLANDA** | | | | | | | | | 10,8321 |
| CABREJAS LAORDEN, LUIS | 1 | 18 | 1 | Huesca | Torralba | 502 | 161 | 0 | 1,6508 |
| CABREJAS LAORDEN, LUIS | 1 | 18 | 2 | Huesca | Torralba | 502 | 200 | 0 | 9,5562 |
| CABREJAS LAORDEN, LUIS | 1 | 157 | | Huesca | Barbués | 502 | 003 | 0 | 6,1967 |
| **Total CABREJAS LAORDEN, LUIS** | | | | | | | | | 17,4037 |
| CABRERO MARTINEZ, RUBEN | 1 | 91 | | Huesca | Torralba | 501 | 030 | 0 | 1,3090 |
| **Total CABRERO MARTINEZ, RUBEN** | | | | | | | | | 1,3090 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| CACHO BAILO, ANGEL | 1 | 63 | | Huesca | Almuniente | 005 | 00177 | 0 | 10,4736 |
| CACHO BAILO, ANGEL | 1 | 71 | | Huesca | Almuniente | 005 | 00164 | 0 | 2,8315 |
| CACHO BAILO, ANGEL | 1 | 71 | | Huesca | Almuniente | 005 | 00165 | 0 | 10,1801 |
| CACHO BAILO, ANGEL | 1 | 71 | | Huesca | Almuniente | 005 | 00602 | 0 | 0,3340 |
| **Total CACHO BAILO, ANGEL** | | | | | | | | | 23,8192 |
| CADENAS CAMON, SANTIAGO | 1 | 128 | 3 | Huesca | Barbués | 502 | 057 | 0 | 0,2240 |
| **Total CADENAS CAMON, SANTIAGO** | | | | | | | | | 0,2240 |
| CALLE GARCIA, VALENTIN | 1 | 123 | 6 | Huesca | Barbués | 502 | 142 | 0 | 0,1952 |
| **Total CALLE GARCIA, VALENTIN** | | | | | | | | | 0,1952 |
| CASTAN LUNA, FELIX ANTONIO | 1 | 130 | | Huesca | Barbués | 502 | 054 | 0 | 6,6925 |
| CASTAN LUNA, FELIX ANTONIO | 1 | 162 | | Huesca | Barbués | 502 | 010 | 0 | 11,5912 |
| **Total CASTAN LUNA, FELIX ANTONIO** | | | | | | | | | 18,2837 |
| CASTEL CANALIS, ANTONIO | 1 | 131 | | Huesca | Barbués | 502 | 053 | 0 | 11,0194 |
| **Total CASTEL CANALIS, ANTONIO** | | | | | | | | | 11,0194 |
| CASTILLO PICAPEO, FRANCISCO | 2 | 227 | Sin Toma | Huesca | Senés | 503 | 011 | 0 | 0,3650 |
| **Total CASTILLO PICAPEO, FRANCISCO** | | | | | | | | | 0,3650 |
| CERVERA ANZANO S.L. | 1 | 50 | | Huesca | Almuniente | 505 | 035 | 0 | 0,3327 |
| CERVERA ANZANO S.L. | 1 | 50 | | Huesca | Almuniente | 505 | 036 | 0 | 5,3134 |
| **Total CERVERA ANZANO S.L.** | | | | | | | | | 5,6461 |
| CLAVER BALDOVINOS, MARIA CRUZ | 1 | 159 | 2 | Huesca | Barbués | 502 | 016 | 0 | 1,4228 |
| **Total CLAVER BALDOVINOS, MARIA CRUZ** | | | | | | | | | 1,4228 |
| CLAVERIA REVUELTA, FRANCISCO | 1 | 34 | | Huesca | Almuniente | 505 | 016 | 0 | 9,6253 |
| **Total CLAVERIA REVUELTA, FRANCISCO** | | | | | | | | | 9,6253 |
| CORREAS OTIN, EMERITA | 1 | 128 | 5 | Huesca | Barbués | 502 | 060 | 0 | 0,2600 |
| **Total CORREAS OTIN, EMERITA** | | | | | | | | | 0,2600 |
| CORZ PLO, MARIA TERESA | 1 | 93 | 2 | Huesca | Torralba | 501 | 014 | 0 | 2,9122 |
| **Total CORZ PLO, MARIA TERESA** | | | | | | | | | 2,9122 |
| COTELA SANTOS, FELIX | 1 | 61 | | Huesca | Almuniente | 005 | 00178 | a | 7,9803 |
| COTELA SANTOS, FELIX | 1 | 61 | | Huesca | Almuniente | 005 | 00178 | b | 0,5843 |
| COTELA SANTOS, FELIX | 1 | 61 | | Huesca | Almuniente | 005 | 00179 | 0 | 1,8050 |
| COTELA SANTOS, FELIX | 1 | 61 | | Huesca | Almuniente | 005 | 00607 | 0 | 1,2858 |
| **Total COTELA SANTOS, FELIX** | | | | | | | | | 11,6554 |
| CREMALLET LABORDA, JOSE | 1 | 118 | 2 | Huesca | Barbués | 502 | 107 | 0 | 0,2265 |
| **Total CREMALLET LABORDA, JOSE** | | | | | | | | | 0,2265 |
| DELGADO OSUNA, FRANCISCO | 1 | 123 | 3 | Huesca | Barbués | 502 | 149 | 0 | 0,2084 |
| DELGADO OSUNA, FRANCISCO | 1 | 138 | | Huesca | Almuniente | 503 | 025 | 0 | 8,9801 |
| DELGADO OSUNA, FRANCISCO | 1 | 138 | | Huesca | Almuniente | 503 | 027 | 0 | 1,9717 |
| **Total DELGADO OSUNA, FRANCISCO** | | | | | | | | | 11,1602 |
| DESCONOCIDO | 1 | 44 | 2 | Huesca | Almuniente | 505 | 025 | 0 | 0,8737 |
| **Total DESCONOCIDO** | | | | | | | | | 0,8737 |
| DOTO LOPEZ, GUSTAVO JAIME | 1 | 46 | 2 | Huesca | Almuniente | 505 | 051 | 0 | 2,3268 |
| **Total DOTO LOPEZ, GUSTAVO JAIME** | | | | | | | | | 2,3268 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| DOTO OTO, FRANCISCA MARIA CARMEN | 1 | 115 | | Huesca | Barbués | 502 | 135 | 0 | 9,0456 |
| DOTO OTO, FRANCISCA MARIA CARMEN | 1 | 119 | 1 | Huesca | Barbués | 502 | 087 | 0 | 0,2877 |
| **Total DOTO OTO, FRANCISCA MARIA CARMEN** | | | | | | | | | 9,3333 |
| DURANGO GAYAN, FRANCISCO | 1 | 119 | 2 | Huesca | Barbués | 502 | 089 | 0 | 0,2307 |
| **Total DURANGO GAYAN, FRANCISCO** | | | | | | | | | 0,2307 |
| EL HASNAOUI ALLAL, HAMID Y MENANA | 1 | 95 | 3 | Huesca | Tardienta | 504 | 011 | 0 | 1,4561 |
| **Total EL HASNAOUI ALLAL, HAMID Y MENANA** | | | | | | | | | 1,4561 |
| ESCARTIN SERAL, CARMEN | 1 | 70 | | Huesca | Almuniente | 005 | 00157 | 0 | 3,1893 |
| ESCARTIN SERAL, CARMEN | 1 | 70 | | Huesca | Almuniente | 005 | 00158 | 0 | 0,3275 |
| ESCARTIN SERAL, CARMEN | 1 | 70 | | Huesca | Almuniente | 005 | 00159 | 0 | 5,4432 |
| ESCARTIN SERAL, CARMEN | 1 | 70 | | Huesca | Almuniente | 005 | 00163 | 0 | 6,1951 |
| ESCARTIN SERAL, CARMEN | 1 | 70 | | Huesca | Almuniente | 005 | 00600 | 0 | 4,7311 |
| ESCARTIN SERAL, CARMEN | 1 | 70 | | Huesca | Almuniente | 005 | 00601 | 0 | 0,5500 |
| **Total ESCARTIN SERAL, CARMEN** | | | | | | | | | 20,4362 |
| ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 109 | | Huesca | Barbués | 502 | 100 | 0 | 4,8625 |
| ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 109 | | Huesca | Barbués | 502 | 081 | 0 | 4,2757 |
| ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 109 | | Huesca | Barbués | 502 | 096 | 0 | 0,5472 |
| ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS | 1 | 128 | 8 | Huesca | Barbués | 502 | 154 | 0 | 0,2153 |
| **Total ESPUÑA MONGUILOD, RAMON ANGEL Y HNOS** | | | | | | | | | 9,9007 |
| ESTEBAN GALVEZ, PASCUAL E HIJOS | 1 | 28 | | Huesca | Torralba | 502 | 193 | 0 | 9,4021 |
| **Total ESTEBAN GALVEZ, PASCUAL E HIJOS** | | | | | | | | | 9,4021 |
| ESTEBAN MARISCAL, FRANCISCO | 1 | 65 | | Huesca | Almuniente | 005 | 00171 | 0 | 6,9274 |
| ESTEBAN MARISCAL, FRANCISCO | 1 | 65 | | Huesca | Almuniente | 005 | 00172 | 0 | 3,3088 |
| ESTEBAN MARISCAL, FRANCISCO | 1 | 65 | | Huesca | Almuniente | 005 | 00605 | 0 | 0,4722 |
| **Total ESTEBAN MARISCAL, FRANCISCO** | | | | | | | | | 10,7084 |
| EXPLOTACIONES GANADERAS VALDEMORO S.L.U. | 1 | 177 | | Huesca | Barbués | 502 | 035 | 0 | 11,4225 |
| **Total EXPLOTACIONES GANADERAS VALDEMORO S.L.U.** | | | | | | | | | 11,4225 |
| FEDIUC, MARIANA | 2 | 205 | 3 | Huesca | Torralba | 003 | 409 | 0 | 0,1693 |
| **Total FEDIUC, MARIANA** | | | | | | | | | 0,1693 |
| FERRER BOLEA, JOSEFINA Y PASCUAL | 1 | 2 | 2 | Huesca | Torralba | 502 | 144 | 0 | 1,7485 |
| FERRER BOLEA, JOSEFINA Y PASCUAL | 1 | 7 | | Huesca | Torralba | 502 | 092 | 0 | 2,2435 |
| **Total FERRER BOLEA, JOSEFINA Y PASCUAL** | | | | | | | | | 3,9920 |
| FORTES BARRANQUERO, ANTONIO | 1 | 127 | 2 | Huesca | Barbués | 502 | 063 | 0 | 0,2356 |
| **Total FORTES BARRANQUERO, ANTONIO** | | | | | | | | | 0,2356 |
| GALINO ALTAFAJ, ALVARO | 1 | 116 | | Huesca | Barbués | 502 | 117 | 0 | 0,4006 |
| GALINO ALTAFAJ, ALVARO | 1 | 151 | | Huesca | Barbués | 502 | 025 | 0 | 8,5012 |
| GALINO ALTAFAJ, ALVARO | 1 | 151 | | Huesca | Torralba | 501 | 011 | 0 | 1,2679 |
| **Total GALINO ALTAFAJ, ALVARO** | | | | | | | | | 10,1697 |
| GANADOS JIMENEZ CAMBRA, S.L. | 1 | 25 | | Huesca | Almuniente | 505 | 011 | 0 | 0,2141 |
| GANADOS JIMENEZ CAMBRA, S.L. | 1 | 25 | | Huesca | Senés | 503 | 019 | 0 | 0,3939 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| GANADOS JIMENEZ CAMBRA, S.L. | 1 | 25 | | Huesca | Torralba | 502 | 198 | 0 | 47,7455 |
| GANADOS JIMENEZ CAMBRA, S.L. | 1 | 85 | | Huesca | Torralba | 501 | 019 | 0 | 37,2570 |
| GANADOS JIMENEZ CAMBRA, S.L. | 1 | 86 | | Huesca | Torralba | 501 | 069 | 0 | 25,0526 |
| GANADOS JIMENEZ CAMBRA, S.L. | 2 | 203 | 3 | Huesca | Torralba | 502 | 065 | 0 | 1,4669 |
| GANADOS JIMENEZ CAMBRA, S.L. | 2 | 208 | | Huesca | Torralba | 502 | 018 | 0 | 2,2452 |
| GANADOS JIMENEZ CAMBRA, S.L. | 2 | 208 | | Huesca | Torralba | 502 | 021 | 0 | 21,4396 |
| GANADOS JIMENEZ CAMBRA, S.L. | 2 | 215 | | Huesca | Torralba | 501 | 040 | 0 | 33,8796 |
| **Total GANADOS JIMENEZ CAMBRA, S.L.** | | | | | | | | | 169,6944 |
| GARCES POBO, MARIA PILAR E HIJO | 1 | 175 | | Huesca | Barbués | 502 | 032 | 0 | 3,8930 |
| **Total GARCES POBO, MARIA PILAR E HIJO** | | | | | | | | | 3,8930 |
| GARCES TORRABIAS, PEDRO Y JORGE | 1 | 128 | 1 | Huesca | Barbués | 502 | 055 | 0 | 0,2400 |
| **Total GARCES TORRABIAS, PEDRO Y JORGE** | | | | | | | | | 0,2400 |
| GARCIA ARTERO, ROSA MARIA Y M PILAR | 2 | 209 | | Huesca | Torralba | 502 | 015 | 0 | 11,7365 |
| **Total GARCIA ARTERO, ROSA MARIA Y M PILAR** | | | | | | | | | 11,7365 |
| GARCIA BALLARIN, JUAN CARLOS | 1 | 2 | 1 | Huesca | Torralba | 502 | 143 | 0 | 0,3347 |
| GARCIA BALLARIN, JUAN CARLOS | 2 | 203 | 1 | Huesca | Torralba | 002 | 403 | 0 | 0,1258 |
| **Total GARCIA BALLARIN, JUAN CARLOS** | | | | | | | | | 0,4605 |
| GARCIA BALLARIN, JUAN CARLOS Y HNOS | 1 | 2 | 1 | Huesca | Torralba | 502 | 142 | 0 | 0,5163 |
| **Total GARCIA BALLARIN, JUAN CARLOS Y HNOS** | | | | | | | | | 0,5163 |
| GARCIA CRUZ, VICENTE | 1 | 66 | | Huesca | Almuniente | 005 | 00170 | 0 | 11,7005 |
| **Total GARCIA CRUZ, VICENTE** | | | | | | | | | 11,7005 |
| GARCIA GARCIA, JESUS | 1 | 8 | | Huesca | Torralba | 502 | 095 | 0 | 3,0540 |
| GARCIA GARCIA, JESUS | 1 | 14 | | Huesca | Torralba | 502 | 160 | 0 | 6,5666 |
| **Total GARCIA GARCIA, JESUS** | | | | | | | | | 9,6206 |
| GARCIA LABAT, NICOLAS JOSE | 1 | 104 | | Huesca | Torralba | 501 | 115 | 0 | 7,6710 |
| **Total GARCIA LABAT, NICOLAS JOSE** | | | | | | | | | 7,6710 |
| GARCIA LABAT, NICOLAS JOSE Y FCO JAVIER | 1 | 14 | | Huesca | Torralba | 502 | 203 | 0 | 13,9969 |
| **Total GARCIA LABAT, NICOLAS JOSE Y FCO JAVIER** | | | | | | | | | 13,9969 |
| GARCIA LABAT, NICOLAS JOSE Y HNO | 1 | 8 | Tubería sin toma | Huesca | Torralba | 502 | 074 | 0 | 0,5598 |
| GARCIA LABAT, NICOLAS JOSE Y HNO | 1 | 14 | | Huesca | Torralba | 502 | 159 | 0 | 16,3174 |
| GARCIA LABAT, NICOLAS JOSE Y HNO | 1 | 14 | | Huesca | Torralba | 502 | 202 | 0 | 2,2630 |
| **Total GARCIA LABAT, NICOLAS JOSE Y HNO** | | | | | | | | | 19,1402 |
| GARCÍA LABAT, NICOLAS Y FRANCISCO | 1 | 104 | | Huesca | Torralba | 501 | 113 | 0 | 5,3168 |
| **Total GARCÍA LABAT, NICOLAS Y FRANCISCO** | | | | | | | | | 5,3168 |
| GARCIA PAÑO, JOSE ANTONIO | 2 | 223 | | Huesca | Torralba | 502 | 137 | 0 | 5,7233 |
| **Total GARCIA PAÑO, JOSE ANTONIO** | | | | | | | | | 5,7233 |
| GAVIN MARTINEZ, MARIANO Y OTROS | 1 | 93 | 1 | Huesca | Torralba | 501 | 013 | 0 | 2,2203 |
| **Total GAVIN MARTINEZ, MARIANO Y OTROS** | | | | | | | | | 2,2203 |
| GAYAN GALVEZ, ALVARO | 1 | 127 | 1 | Huesca | Barbués | 502 | 062 | 0 | 0,1341 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| **Total GAYAN GALVEZ, ALVARO** | | | | | | | | | 0,1341 |
| GAYAN LORENTE, VICENTE | 1 | 39 | | Huesca | Almuniente | 505 | 056 | 0 | 9,9835 |
| **Total GAYAN LORENTE, VICENTE** | | | | | | | | | 9,9835 |
| GIRON PABAN, SARA | 1 | 32 | | Huesca | Almuniente | 505 | 012 | 0 | 1,4744 |
| GIRON PABAN, SARA | 1 | 32 | | Huesca | Almuniente | 505 | 060 | 0 | 7,9201 |
| **Total GIRON PABAN, SARA** | | | | | | | | | 9,3945 |
| GOMEZ LANUZA, FRANCISCO | 1 | 38 | | Huesca | Almuniente | 505 | 059 | 0 | 9,9390 |
| GOMEZ LANUZA, FRANCISCO | 1 | 127 | 6 | Huesca | Barbués | 502 | 067 | 0 | 0,2018 |
| **Total GOMEZ LANUZA, FRANCISCO** | | | | | | | | | 10,1408 |
| GRACIA LAFUENTE, RAUL Y OTRA | 2 | 206 | 6 | Huesca | Torralba | 502 | 036 | 0 | 0,0700 |
| **Total GRACIA LAFUENTE, RAUL Y OTRA** | | | | | | | | | 0,0700 |
| GRACIA MARTIN, MIGUELA E HIJOS | 1 | 118 | 1 | Huesca | Barbués | 502 | 106 | 0 | 0,2160 |
| **Total GRACIA MARTIN, MIGUELA E HIJOS** | | | | | | | | | 0,2160 |
| GRACIA ROBERT, JOSE | 1 | 123 | 5 | Huesca | Barbués | 502 | 141 | 0 | 0,2091 |
| **Total GRACIA ROBERT, JOSE** | | | | | | | | | 0,2091 |
| GRACIA TRULLENQUE, FELIX | 1 | 13 | | Huesca | Torralba | 502 | 080 | 0 | 0,4619 |
| GRACIA TRULLENQUE, FELIX | 1 | 13 | | Huesca | Torralba | 502 | 081 | 0 | 3,2347 |
| **Total GRACIA TRULLENQUE, FELIX** | | | | | | | | | 3,6966 |
| GRACIA VIÑUALES, CLEMENTE | 1 | 10 | 1 | Huesca | Torralba | 502 | 059 | 0 | 0,8515 |
| GRACIA VIÑUALES, CLEMENTE | 1 | 21 | 1 | Huesca | Torralba | 502 | 183 | 0 | 3,5180 |
| **Total GRACIA VIÑUALES, CLEMENTE** | | | | | | | | | 4,3695 |
| GRASA ARA, ROMAN | 1 | 119 | 5 | Huesca | Barbués | 502 | 092 | 0 | 0,4084 |
| **Total GRASA ARA, ROMAN** | | | | | | | | | 0,4084 |
| GRIMAL CUBERO, JESUS | 1 | 166 | | Huesca | Barbués | 502 | 022 | 0 | 9,4861 |
| **Total GRIMAL CUBERO, JESUS** | | | | | | | | | 9,4861 |
| GUALLAR GUTIERREZ, ANA BELEN | 1 | 37 | | Huesca | Almuniente | 505 | 005 | 0 | 10,1114 |
| **Total GUALLAR GUTIERREZ, ANA BELEN** | | | | | | | | | 10,1114 |
| GUALLAR MAVILLA, DOMINGO | 1 | 167 | | Huesca | Barbués | 502 | 017 | 0 | 2,9308 |
| GUALLAR MAVILLA, DOMINGO | 1 | 167 | | Huesca | Barbués | 502 | 018 | 0 | 3,0469 |
| **Total GUALLAR MAVILLA, DOMINGO** | | | | | | | | | 5,9777 |
| HIDALGO BERGUA, ANTONIO | 1 | 69 | | Huesca | Almuniente | 005 | 00150 | 0 | 6,0644 |
| **Total HIDALGO BERGUA, ANTONIO** | | | | | | | | | 6,0644 |
| HIGUERA FERNANDEZ, FELIX | 1 | 119 | 7 | Huesca | Barbués | 502 | 095 | 0 | 0,2514 |
| **Total HIGUERA FERNANDEZ, FELIX** | | | | | | | | | 0,2514 |
| HNOS ARRUEGO VICENTE S.C. | 1 | 67 | | Huesca | Almuniente | 005 | 00167 | a | 3,9375 |
| HNOS ARRUEGO VICENTE S.C. | 1 | 67 | | Huesca | Almuniente | 005 | 00167 | b | 7,9769 |
| HNOS ARRUEGO VICENTE S.C. | 1 | 67 | | Huesca | Almuniente | 005 | 00168 | 0 | 3,8426 |
| HNOS ARRUEGO VICENTE S.C. | 1 | 67 | | Huesca | Almuniente | 005 | 00169 | 0 | 8,6479 |
| HNOS ARRUEGO VICENTE S.C. | 1 | 67 | | Huesca | Almuniente | 005 | 00603 | 0 | 1,8950 |
| **Total HNOS ARRUEGO VICENTE S.C.** | | | | | | | | | 26,2999 |
| IBAÑEZ IBAÑEZ, JOSE | 1 | 116 | | Huesca | Barbués | 502 | 115 | 0 | 0,4191 |
| **Total IBAÑEZ IBAÑEZ, JOSE** | | | | | | | | | 0,4191 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| ITURRE HUARTE, JAVIER ANGEL | 1 | 51 | | Huesca | Almuniente | 505 | 037 | 0 | 1,9916 |
| ITURRE HUARTE, JAVIER ANGEL | 1 | 51 | | Huesca | Almuniente | 505 | 038 | 0 | 3,0277 |
| **Total ITURRE HUARTE, JAVIER ANGEL** | | | | | | | | | 5,0193 |
| IZUEL GASTON, JOSE ANTONIO | 2 | 217 | | Huesca | Torralba | 501 | 043 | 0 | 5,2239 |
| **Total IZUEL GASTON, JOSE ANTONIO** | | | | | | | | | 5,2239 |
| LABORDA SANCHEZ, ANGEL | 1 | 40 | 1 | Huesca | Almuniente | 505 | 055 | 0 | 5,4903 |
| **Total LABORDA SANCHEZ, ANGEL** | | | | | | | | | 5,4903 |
| LACAMBRA PAÑO, PEDRO FERNANDO | 1 | 3 | | Huesca | Torralba | 502 | 140 | 0 | 4,9129 |
| LACAMBRA PAÑO, PEDRO FERNANDO | 1 | 3 | | Huesca | Torralba | 502 | 141 | 0 | 0,9707 |
| LACAMBRA PAÑO, PEDRO FERNANDO | 1 | 3 | | Huesca | Torralba | 502 | 151 | 0 | 2,2155 |
| LACAMBRA PAÑO, PEDRO FERNANDO | 2 | 203 | 4 | Huesca | Torralba | 502 | 057 | 0 | 0,1517 |
| **Total LACAMBRA PAÑO, PEDRO FERNANDO** | | | | | | | | | 8,2508 |
| LACAMPA ABAD, MARIA CARMEN | 1 | 176 | | Huesca | Barbués | 502 | 033 | 0 | 6,1156 |
| **Total LACAMPA ABAD, MARIA CARMEN** | | | | | | | | | 6,1156 |
| LAFUENTE DOTO, BENITO | 1 | 127 | 3 | Huesca | Barbués | 502 | 064 | 0 | 0,1889 |
| **Total LAFUENTE DOTO, BENITO** | | | | | | | | | 0,1889 |
| LAGUNA MORCATE, FRANCISCO JAVIER | 1 | 147 | | Huesca | Almuniente | 503 | 019 | 0 | 10,7404 |
| LAGUNA MORCATE, FRANCISCO JAVIER | 1 | 147 | | Huesca | Almuniente | 503 | 033 | 0 | 4,5205 |
| **Total LAGUNA MORCATE, FRANCISCO JAVIER** | | | | | | | | | 15,2609 |
| LAGUNA MORCATE, FRANCISCO JAVIER Y HNOS | 1 | 127 | 7 | Huesca | Barbués | 502 | 068 | 0 | 0,1862 |
| **Total LAGUNA MORCATE, FRANCISCO JAVIER Y HNOS** | | | | | | | | | 0,1862 |
| LATORRE ESCARTIN, LUIS ANTONIO | 1 | 135 | | Huesca | Almuniente | 503 | 022 | 0 | 2,4285 |
| **Total LATORRE ESCARTIN, LUIS ANTONIO** | | | | | | | | | 2,4285 |
| LATORRE MAGALLON, ALEJANDRO | 1 | 127 | 8 | Huesca | Barbués | 502 | 069 | 0 | 0,1680 |
| **Total LATORRE MAGALLON, ALEJANDRO** | | | | | | | | | 0,1680 |
| LERI BOLEA, JOAQUIN | 1 | 21 | 3 | Huesca | Torralba | 502 | 187 | 0 | 0,3759 |
| **Total LERI BOLEA, JOAQUIN** | | | | | | | | | 0,3759 |
| LIESA PISA, JOAQUIN | 1 | 134 | | Huesca | Barbués | 502 | 047 | 0 | 3,9430 |
| LIESA PISA, JOAQUIN | 1 | 134 | | Huesca | Barbués | 502 | 050 | 0 | 4,6729 |
| **Total LIESA PISA, JOAQUIN** | | | | | | | | | 8,6159 |
| LIESA USON, AGUSTIN | 1 | 182 | | Huesca | Barbués | 502 | 045 | 0 | 1,1433 |
| LIESA USON, AGUSTIN | 1 | 182 | | Huesca | Valfonda | 502 | 164 | 0 | 0,8415 |
| **Total LIESA USON, AGUSTIN** | | | | | | | | | 1,9848 |
| LISA BERNAD, ANTONIO JAVIER | 2 | 220 | | Huesca | Torralba | 501 | 052 | 0 | 4,2588 |
| LISA BERNAD, ANTONIO JAVIER | 2 | 220 | | Huesca | Torralba | 501 | 061 | 0 | 3,1367 |
| LISA BERNAD, ANTONIO JAVIER | 2 | 220 | | Huesca | Torralba | 501 | 095 | 0 | 1,5944 |
| LISA BERNAD, ANTONIO JAVIER | 2 | 220 | | Huesca | Torralba | 502 | 022 | 0 | 1,8878 |
| **Total LISA BERNAD, ANTONIO JAVIER** | | | | | | | | | 10,8777 |
| LISA BERNAD, ANTONIO JAVIER Y MARIA EUGENIA | 2 | 220 | | Huesca | Torralba | 501 | 060 | 0 | 1,9602 |
| **Total LISA BERNAD, ANTONIO JAVIER Y MARIA EUGENIA** | | | | | | | | | 1,9602 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| LISA BERNAD, RODOLFO FAUSTINO | 1 | 118 | 8 | Huesca | Barbués | 502 | 086 | 0 | 0,1935 |
| LISA BERNAD, RODOLFO FAUSTINO | 1 | 122 | | Huesca | Barbués | 502 | 138 | 0 | 0,4677 |
| **Total LISA BERNAD, RODOLFO FAUSTINO** | | | | | | | | | 0,6612 |
| LISA GOMEZ, ABEL JOSE | 1 | 122 | | Huesca | Barbués | 502 | 137 | 0 | 8,2880 |
| LISA GOMEZ, ABEL JOSE | 1 | 165 | | Huesca | Barbués | 502 | 023 | 0 | 9,4579 |
| **Total LISA GOMEZ, ABEL JOSE** | | | | | | | | | 17,7459 |
| LISA PLO, MARIA CARMEN | 1 | 112 | 1 | Huesca | Torralba | 501 | 109 | 0 | 1,1188 |
| **Total LISA PLO, MARIA CARMEN** | | | | | | | | | 1,1188 |
| LOPEZ BARLUENGA, RAMON | 1 | 46 | 2 | Huesca | Almuniente | 505 | 050 | 0 | 0,5919 |
| **Total LOPEZ BARLUENGA, RAMON** | | | | | | | | | 0,5919 |
| LOPEZ ABAD, MARIA BEGOÑA | 2 | 206 | 2 | Huesca | Torralba | 502 | 030 | 0 | 0,1300 |
| LOPEZ ABAD, MARIA BEGOÑA | 2 | 222 | | Huesca | Torralba | 502 | 124 | 0 | 17,2741 |
| LOPEZ ABAD, MARIA BEGOÑA | 2 | 222 | | Huesca | Torralba | 502 | 138 | 0 | 6,8631 |
| LOPEZ ABAD, MARIA BEGOÑA | 2 | 227 | 1 | Huesca | Torralba | 502 | 128 | 0 | 3,5991 |
| LOPEZ ABAD, MARIA BEGOÑA | 2 | 227 | 1 | Huesca | Torralba | 502 | 133 | 0 | 2,6867 |
| LOPEZ ABAD, MARIA BEGOÑA | 2 | 227 | 1 | Huesca | Torralba | 502 | 134 | 0 | 2,6803 |
| **Total LOPEZ ABAD, MARIA BEGOÑA** | | | | | | | | | 33,2333 |
| LOPEZ BARREDO, MANUEL | 1 | 123 | 1 | Huesca | Barbués | 502 | 070 | 0 | 0,3376 |
| **Total LOPEZ BARREDO, MANUEL** | | | | | | | | | 0,3376 |
| LOPEZ LAFUENTE, ANTONIO JOSE Y HNAS | 1 | 146 | 1 | Huesca | Almuniente | 503 | 034 | 0 | 3,6979 |
| **Total LOPEZ LAFUENTE, ANTONIO JOSE Y HNAS** | | | | | | | | | 3,6979 |
| LOPEZ LAGUNA, CONCEPCION | 1 | 46 | 2 | Huesca | Almuniente | 505 | 052 | 0 | 2,4504 |
| **Total LOPEZ LAGUNA, CONCEPCION** | | | | | | | | | 2,4504 |
| LOPEZ LAGUNA, CONCEPCION E HIJO | 1 | 46 | 2 | Huesca | Almuniente | 505 | 053 | 0 | 0,8010 |
| **Total LOPEZ LAGUNA, CONCEPCION E HIJO** | | | | | | | | | 0,8010 |
| LORAQUE RODRIGO, BERNABE | 1 | 156 | | Huesca | Barbués | 502 | 004 | 0 | 3,3904 |
| **Total LORAQUE RODRIGO, BERNABE** | | | | | | | | | 3,3904 |
| LUCAS AROCA, DESIDERIO | 1 | 128 | 2 | Huesca | Barbués | 502 | 056 | 0 | 0,2556 |
| **Total LUCAS AROCA, DESIDERIO** | | | | | | | | | 0,2556 |
| MAIRAL LAIGLESIA, MARIANO | 1 | 62 | | Huesca | Almuniente | 005 | 00176 | a | 7,4844 |
| MAIRAL LAIGLESIA, MARIANO | 1 | 62 | | Huesca | Almuniente | 005 | 00176 | b | 1,9028 |
| MAIRAL LAIGLESIA, MARIANO | 1 | 62 | | Huesca | Almuniente | 005 | 00176 | c | 1,2532 |
| MAIRAL LAIGLESIA, MARIANO | 1 | 62 | | Huesca | Almuniente | 005 | 00606 | 0 | 3,1499 |
| **Total MAIRAL LAIGLESIA, MARIANO** | | | | | | | | | 13,7903 |
| MALLADA GRACIA, PEDRO Y HNAS | 1 | 46 | 1 | Huesca | Almuniente | 505 | 049 | 0 | 1,4720 |
| **Total MALLADA GRACIA, PEDRO Y HNAS** | | | | | | | | | 1,4720 |
| MARTINEZ ARAGONCILLO, BASILIO E HIJO | 1 | 101 | | Huesca | Torralba | 501 | 085 | 0 | 7,2427 |
| **Total MARTINEZ ARAGONCILLO, BASILIO E HIJO** | | | | | | | | | 7,2427 |
| MARTINEZ BANDRES, ANTONIO | 2 | 205 | 2 | Huesca | Torralba | 502 | 041 | 0 | 0,1464 |
| **Total MARTINEZ BANDRES, ANTONIO** | | | | | | | | | 0,1464 |
| MARTINEZ CABEZUDO, MIGUEL ANGEL | 1 | 101 | | Huesca | Torralba | 501 | 087 | 0 | 2,7645 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| **Total MARTINEZ CABEZUDO, MIGUEL ANGEL** | | | | | | | | | 2,7645 |
| MARTINEZ MATEO, LUIS MIGUEL | 1 | 101 | | Huesca | Torralba | 501 | 086 | 0 | 1,4263 |
| **Total MARTINEZ MATEO, LUIS MIGUEL** | | | | | | | | | 1,4263 |
| MARTINEZ PEREZ, NEMESIO AGUSTIN JESUS | 1 | 91 | | Huesca | Torralba | 501 | 029 | 0 | 7,7662 |
| **Total MARTINEZ PEREZ, NEMESIO AGUSTIN JESUS** | | | | | | | | | 7,7662 |
| MASA COMUN | 1 | 21 | 2 | Huesca | Torralba | 502 | 186 | 0 | 3,6778 |
| MASA COMUN | 1 | 29 | 1 | Huesca | Torralba | 502 | 192 | 0 | 1,9216 |
| MASA COMUN | 1 | 29 | 2 | Huesca | Torralba | 502 | 174 | 0 | 3,2431 |
| MASA COMUN | 1 | 31 | 2 | Huesca | Almuniente | 505 | 063 | 0 | 1,6974 |
| MASA COMUN | 1 | 36 | 2 | Huesca | Almuniente | 505 | 007 | 0 | 1,9793 |
| MASA COMUN | 1 | 44 | 1 | Huesca | Almuniente | 505 | 020 | 0 | 1,1916 |
| MASA COMUN | 1 | 92 | 2 | Huesca | Torralba | 501 | 033 | 0 | 1,8972 |
| MASA COMUN | 1 | 94 | 1 | Huesca | Tardienta | 504 | 006 | 0 | 1,7034 |
| MASA COMUN | 1 | 112 | 2 | Huesca | Barbués | 502 | 132 | 0 | 1,2859 |
| MASA COMUN | 1 | 113 | Sin Toma | Huesca | Almuniente | 503 | 004 | 0 | 0,1470 |
| MASA COMUN | 1 | 116 | | Huesca | Barbués | 502 | 122 | 0 | 0,4005 |
| MASA COMUN | 1 | 126 | 3 | Huesca | Barbués | 502 | 075 | 0 | 0,6399 |
| MASA COMUN | 1 | 128 | 9 | Huesca | Barbués | 502 | 152 | 0 | 0,4801 |
| MASA COMUN | 1 | 159 | 1 | Huesca | Barbués | 502 | 001 | 0 | 2,1303 |
| MASA COMUN | 2 | 219 | 1 | Huesca | Torralba | 501 | 048 | 0 | 1,4302 |
| **Total MASA COMUN** | | | | | | | | | 23,8253 |
| MAZA ACEBILLO, JOSEFA Y OTROS | 1 | 127 | 5 | Huesca | Barbués | 502 | 066 | 0 | 0,1965 |
| **Total MAZA ACEBILLO, JOSEFA Y OTROS** | | | | | | | | | 0,1965 |
| MAZA ALCUBIERRE, JESUS ANTONIO | 1 | 95 | 4 | Huesca | Tardienta | 504 | 012 | 0 | 0,7524 |
| **Total MAZA ALCUBIERRE, JESUS ANTONIO** | | | | | | | | | 0,7524 |
| MAZANA PIENSOS COMPUESTOS S.L. | 1 | 132 | | Huesca | Barbués | 502 | 046 | 0 | 25,5104 |
| **Total MAZANA PIENSOS COMPUESTOS S.L.** | | | | | | | | | 25,5104 |
| MIRANDA CAPISTROS, JORGE MANUEL | 1 | 124 | | Huesca | Barbués | 502 | 071 | 0 | 7,7947 |
| **Total MIRANDA CAPISTROS, JORGE MANUEL** | | | | | | | | | 7,7947 |
| MOLINA ZAFRA, JOSE MARIA | 1 | 127 | 4 | Huesca | Barbués | 502 | 065 | 0 | 0,1509 |
| MOLINA ZAFRA, JOSE MARIA | 1 | 140 | | Huesca | Almuniente | 503 | 028 | 0 | 1,8078 |
| MOLINA ZAFRA, JOSE MARIA | 1 | 140 | | Huesca | Almuniente | 503 | 029 | 0 | 7,0507 |
| MOLINA ZAFRA, JOSE MARIA | 1 | 140 | | Huesca | Almuniente | 503 | 030 | 0 | 2,0393 |
| **Total MOLINA ZAFRA, JOSE MARIA** | | | | | | | | | 11,0487 |
| MONESMA MAZA, BONIFACIO LUIS | 1 | 164 | | Huesca | Barbués | 502 | 012 | 0 | 7,5594 |
| MONESMA MAZA, BONIFACIO LUIS | 1 | 164 | | Huesca | Barbués | 502 | 013 | 0 | 3,2900 |
| MONESMA MAZA, BONIFACIO LUIS | 1 | 164 | | Huesca | Barbués | 502 | 014 | 0 | 8,8464 |
| **Total MONESMA MAZA, BONIFACIO LUIS** | | | | | | | | | 19,6958 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | a | 52,1180 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | d | 0,8174 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | f | 10,0814 |

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|---|---|---|---|---|---|---|---|---|---|
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | g | 14,4901 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | h | 2,5840 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | i | 8,0982 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | k | 10,7595 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | l | 3,2462 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | n | 3,7021 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00295 | p | 10,3417 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00296 | a | 4,8883 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00297 | a | 11,4602 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00297 | b | 13,7968 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00298 | a | 28,7764 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00298 | b | 8,3537 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00298 | c | 13,0034 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00298 | d | 1,6875 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00298 | e | 2,6328 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00299 | a | 3,9310 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00299 | b | 5,6501 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00299 | c | 7,5966 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00299 | d | 5,1984 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | a | 7,2468 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | b | 19,9266 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | c | 0,5325 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | d | 4,3862 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | f | 9,8388 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | g | 10,9069 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | h | 36,6144 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | i | 0,0078 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00301 | j | 5,9677 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00638 | a | 12,3212 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00638 | b | 4,6436 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00638 | c | 6,8041 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00639 | a | 16,3641 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00640 | 0 | 9,5287 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00642 | a | 16,3966 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00642 | b | 5,3578 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00643 | a | 3,7615 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00643 | b | 0,5975 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00643 | c | 0,8140 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00644 | a | 5,3776 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00644 | b | 14,8747 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00646 | a | 13,7496 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00646 | b | 4,1257 |

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|---|---|---|---|---|---|---|---|---|---|
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00646 | e | 0,1711 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00649 | 0 | 0,2245 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00650 | 0 | 4,4363 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00651 | 0 | 1,2237 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00652 | a | 0,3383 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00653 | a | 7,1159 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00653 | b | 2,1540 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00658 | 0 | 2,2874 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00659 | 0 | 14,2592 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00675 | a | 23,8245 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00675 | b | 17,1530 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00675 | c | 1,5988 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00675 | d | 2,9331 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00676 | a | 5,4816 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00676 | c | 3,1971 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00679 | a | 13,9464 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00680 | a | 16,3390 |
| MONTEFRULA | 1 | 60 | | Huesca | Almuniente | 005 | 00683 | a | 7,3465 |
| **Total MONTEFRULA** | | | | | | | | | 557,3886 |
| MONTESINOS PLO, ALVARO | 1 | 64 | | Huesca | Almuniente | 005 | 00173 | 0 | 9,6409 |
| **Total MONTESINOS PLO, ALVARO** | | | | | | | | | 9,6409 |
| MORA DURAN, JOSE Y HNAS | 1 | 33 | 1 | Huesca | Almuniente | 505 | 009 | 0 | 0,9194 |
| **Total MORA DURAN, JOSE Y HNAS** | | | | | | | | | 0,9194 |
| MORENO RECIO, IRENE | 1 | 53 | | Huesca | Almuniente | 505 | 046 | 0 | 2,5302 |
| **Total MORENO RECIO, IRENE** | | | | | | | | | 2,5302 |
| MORLANS BOLEA, GONZALO | 2 | 221 | | Huesca | Torralba | 502 | 120 | 0 | 0,5383 |
| MORLANS BOLEA, GONZALO | 2 | 221 | | Huesca | Torralba | 502 | 122 | 0 | 3,4448 |
| **Total MORLANS BOLEA, GONZALO** | | | | | | | | | 3,9831 |
| MORLANS LASTANAO, CONCEPCION | 2 | 203 | 2 | Huesca | Torralba | 502 | 047 | 0 | 1,1042 |
| **Total MORLANS LASTANAO, CONCEPCION** | | | | | | | | | 1,1042 |
| MUÑOZ LACAMPA, ANTONIO MANUEL Y OTROS | 1 | 173 | | Huesca | Barbués | 502 | 029 | 0 | 7,6499 |
| **Total MUÑOZ LACAMPA, ANTONIO MANUEL Y OTROS** | | | | | | | | | 7,6499 |
| MUÑOZ LACAMPA, MARIA TERESA Y ANTONIO | 1 | 172 | | Huesca | Barbués | 502 | 028 | 0 | 11,2569 |
| **Total MUÑOZ LACAMPA, MARIA TERESA Y ANTONIO** | | | | | | | | | 11,2569 |
| MUR CATON, LORENZO | 1 | 92 | 1 | Huesca | Torralba | 501 | 032 | 0 | 0,6046 |
| **Total MUR CATON, LORENZO** | | | | | | | | | 0,6046 |
| MUR POMAR, LUIS FERNANDO | 2 | 231 | | Huesca | Senés | 503 | 015 | 0 | 6,0907 |
| **Total MUR POMAR, LUIS FERNANDO** | | | | | | | | | 6,0907 |
| NAVARRO RUBIO, ANTONIA | 1 | 180 | | Huesca | Barbués | 502 | 039 | 0 | 10,2861 |
| **Total NAVARRO RUBIO, ANTONIA** | | | | | | | | | 10,2861 |
| NOGUES SEN, JUAN CARLOS Y MARIA LOURDES | 1 | 128 | 7 | Huesca | Barbués | 502 | 153 | 0 | 0,2225 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| NOGUES SEN, JUAN CARLOS Y MARIA LOURDES | 1 | 145 | | Huesca | Almuniente | 503 | 018 | 0 | 9,9880 |
| **Total NOGUES SEN, JUAN CARLOS Y MARIA LOURDES** | | | | | | | | | 10,2105 |
| NOVALES ALLUE, ENRIQUE | 2 | 206 | 7 | Huesca | Torralba | 502 | 037 | 0 | 0,1220 |
| **Total NOVALES ALLUE, ENRIQUE** | | | | | | | | | 0,1220 |
| NOVALES ASCASO, FRANCISCO JAVIER | 1 | 80 | | Huesca | Torralba | 501 | 093 | 0 | 34,2184 |
| **Total NOVALES ASCASO, FRANCISCO JAVIER** | | | | | | | | | 34,2184 |
| NOVALES BOLEA, FRANCISCO | 1 | 33 | 2 | Huesca | Almuniente | 505 | 014 | 0 | 2,0720 |
| NOVALES BOLEA, FRANCISCO | 1 | 33 | 2 | Huesca | Almuniente | 505 | 015 | 0 | 1,4579 |
| NOVALES BOLEA, FRANCISCO | 1 | 33 | 2 | Huesca | Torralba | 502 | 197 | 0 | 0,2799 |
| **Total NOVALES BOLEA, FRANCISCO** | | | | | | | | | 3,8098 |
| NOVALES CASTERAD, MARIA TERESA | 1 | 19 | | Huesca | Torralba | 502 | 163 | 0 | 3,4902 |
| **Total NOVALES CASTERAD, MARIA TERESA** | | | | | | | | | 3,4902 |
| NOVALES CASTERAD, MIGUEL | 1 | 5 | 2 | Huesca | Torralba | 502 | 156 | 0 | 3,2666 |
| NOVALES CASTERAD, MIGUEL | 1 | 5 | 2 | Huesca | Torralba | 502 | 157 | 0 | 3,0965 |
| NOVALES CASTERAD, MIGUEL | 1 | 5 | 2 | Huesca | Torralba | 502 | 201 | 0 | 4,6687 |
| NOVALES CASTERAD, MIGUEL | 1 | 10 | 3 | Huesca | Torralba | 502 | 069 | 0 | 0,1840 |
| NOVALES CASTERAD, MIGUEL | 1 | 80 | | Huesca | Torralba | 501 | 089 | 0 | 3,7599 |
| **Total NOVALES CASTERAD, MIGUEL** | | | | | | | | | 14,9757 |
| OBISPADO DE HUESCA | 1 | 118 | 7 | Huesca | Barbués | 502 | 085 | 0 | 0,1670 |
| **Total OBISPADO DE HUESCA** | | | | | | | | | 0,1670 |
| OCA BAGUENA, PEDRO JAVIER Y EVA MARIA | 1 | 128 | 6 | Huesca | Barbués | 502 | 061 | 0 | 0,1330 |
| **Total OCA BAGUENA, PEDRO JAVIER Y EVA MARIA** | | | | | | | | | 0,1330 |
| OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | | Huesca | Torralba | 502 | 171 | 0 | 7,2457 |
| OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | | Huesca | Torralba | 502 | 172 | 0 | 4,0092 |
| OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | | Huesca | Torralba | 502 | 180 | 0 | 2,0043 |
| OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 22 | | Huesca | Torralba | 502 | 089 | 0 | 8,0158 |
| OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 35 | | Huesca | Almuniente | 505 | 008 | 0 | 7,2139 |
| OLIVA AVELLANAS, PEDRO PASCUAL | 1 | 118 | 3 | Huesca | Barbués | 502 | 108 | 0 | 1,0195 |
| **Total OLIVA AVELLANAS, PEDRO PASCUAL** | | | | | | | | | 29,5084 |
| OLIVA BIARGE, BASILIO ANTONIO | 1 | 126 | 1 | Huesca | Barbués | 502 | 073 | 0 | 2,4015 |
| **Total OLIVA BIARGE, BASILIO ANTONIO** | | | | | | | | | 2,4015 |
| OLIVA GUALLAR, PEDRO | 1 | 118 | 3 | Huesca | Barbués | 502 | 109 | 0 | 0,5565 |
| **Total OLIVA GUALLAR, PEDRO** | | | | | | | | | 0,5565 |
| OLIVAN ESCAR, DIONISIO | 1 | 126 | 1 | Huesca | Barbués | 502 | 072 | 0 | 0,7603 |
| **Total OLIVAN ESCAR, DIONISIO** | | | | | | | | | 0,7603 |
| OLONA ALAGON, ERNESTO | 2 | 213 | | Huesca | Torralba | 502 | 012 | 0 | 0,6893 |
| **Total OLONA ALAGON, ERNESTO** | | | | | | | | | 0,6893 |
| OLONA MALLADA, JOAQUIN | 2 | 213 | | Huesca | Torralba | 502 | 010 | 0 | 7,2009 |
| **Total OLONA MALLADA, JOAQUIN** | | | | | | | | | 7,2009 |
| ORUS ABADIA EUGENIA Y OTROS | 1 | 6 | 3 | Huesca | Torralba | 502 | 101 | 0 | 0,1344 |
| ORUS ABADIA EUGENIA Y OTROS | 1 | 154 | | Huesca | Torralba | 501 | 009 | 0 | 4,7786 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| **Total ORUS ABADIA EUGENIA Y OTROS** | | | | | | | | | 4,9130 |
| ORUS MIRANDA, PATROCINIO Mª MAGDALENA | 1 | 174 | | Huesca | Barbués | 502 | 031 | 0 | 5,2981 |
| **Total ORUS MIRANDA, PATROCINIO Mª MAGDALENA** | | | | | | | | | 5,2981 |
| OTAL BETRAN, VALENTIN | 1 | 31 | 1 | Huesca | Almuniente | 505 | 062 | 0 | 1,1501 |
| **Total OTAL BETRAN, VALENTIN** | | | | | | | | | 1,1501 |
| OTIN ORUS, MARIA DOLORES | 1 | 179 | 1 | Huesca | Barbués | 502 | 037 | 0 | 2,6005 |
| **Total OTIN ORUS, MARIA DOLORES** | | | | | | | | | 2,6005 |
| OTISAR SOCIEDAD LIMITADA | 1 | 179 | 1 | Huesca | Barbués | 502 | 036 | 0 | 0,6808 |
| **Total OTISAR SOCIEDAD LIMITADA** | | | | | | | | | 0,6808 |
| PABAN GIRON, JOSE LUIS | 1 | 123 | 7 | Huesca | Barbués | 502 | 143 | 0 | 0,2324 |
| **Total PABAN GIRON, JOSE LUIS** | | | | | | | | | 0,2324 |
| PABAN GIRON, JOSE LUIS Y JOAQUIN | 1 | 32 | | Huesca | Almuniente | 505 | 061 | 0 | 0,4013 |
| **Total PABAN GIRON, JOSE LUIS Y JOAQUIN** | | | | | | | | | 0,4013 |
| PALACIO BRUN, GLORIA CARMEN | 1 | 126 | 2 | Huesca | Barbués | 502 | 074 | 0 | 2,3012 |
| **Total PALACIO BRUN, GLORIA CARMEN** | | | | | | | | | 2,3012 |
| PALACIOS LOPEZ, JOSE IGNACIO | 1 | 1 | 4 | Huesca | Torralba | 502 | 109 | 0 | 0,9560 |
| **Total PALACIOS LOPEZ, JOSE IGNACIO** | | | | | | | | | 0,9560 |
| PAÑO ABADIA, JOSE | 1 | 2 | 4 | Huesca | Torralba | 502 | 149 | 0 | 0,1404 |
| **Total PAÑO ABADIA, JOSE** | | | | | | | | | 0,1404 |
| PAÑO LERIN, MIGUEL | 1 | 2 | 3 | Huesca | Torralba | 502 | 148 | 0 | 0,5624 |
| **Total PAÑO LERIN, MIGUEL** | | | | | | | | | 0,5624 |
| PAÑO PUEYO, FRANCISCA | 1 | 1 | 5 | Huesca | Torralba | 502 | 110 | 0 | 0,3008 |
| **Total PAÑO PUEYO, FRANCISCA** | | | | | | | | | 0,3008 |
| PARDO BIARGE, BASILIO JAVIER | 1 | 43 | | Huesca | Almuniente | 505 | 027 | 0 | 1,4140 |
| **Total PARDO BIARGE, BASILIO JAVIER** | | | | | | | | | 1,4140 |
| PASCUAL BOLEA, MARIA JOSE | 1 | 10 | 4 | Huesca | Torralba | 502 | 070 | 0 | 0,1481 |
| PASCUAL BOLEA, MARIA JOSE | 1 | 88 | | Huesca | Barbués | 502 | 098 | 0 | 2,4937 |
| PASCUAL BOLEA, MARIA JOSE | 1 | 88 | | Huesca | Torralba | 501 | 022 | 0 | 1,7839 |
| PASCUAL BOLEA, MARIA JOSE | 1 | 88 | | Huesca | Torralba | 501 | 023 | 0 | 1,1929 |
| PASCUAL BOLEA, MARIA JOSE | 1 | 88 | | Huesca | Torralba | 501 | 024 | 0 | 5,8349 |
| **Total PASCUAL BOLEA, MARIA JOSE** | | | | | | | | | 11,4535 |
| PAULES SESE, ANDRES | 1 | 116 | | Huesca | Barbués | 502 | 114 | 0 | 0,1838 |
| PAULES SESE, ANDRES | 1 | 125 | 1 | Huesca | Barbués | 502 | 077 | 0 | 2,4896 |
| PAULES SESE, ANDRES | 1 | 125 | 2 | Huesca | Barbués | 502 | 079 | 0 | 4,9993 |
| **Total PAULES SESE, ANDRES** | | | | | | | | | 7,6727 |
| PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | | Huesca | Tardienta | 504 | 002 | 0 | 0,8164 |
| PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | | Huesca | Tardienta | 504 | 003 | 0 | 4,2907 |
| PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | | Huesca | Torralba | 501 | 006 | 0 | 5,8267 |
| PELEATO ESTAUN, FRANCISCO JOSE | 1 | 155 | | Huesca | Torralba | 501 | 007 | 0 | 0,3147 |
| **Total PELEATO ESTAUN, FRANCISCO JOSE** | | | | | | | | | 11,2485 |
| PELEATO PELEATO, FRANCISCO | 1 | 92 | 3 | Huesca | Torralba | 501 | 034 | 0 | 0,9284 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| PELEATO PELEATO, FRANCISCO | 1 | 155 | | Huesca | Torralba | 501 | 008 | 0 | 0,6612 |
| **Total PELEATO PELEATO, FRANCISCO** | | | | | | | | | 1,5896 |
| PERTUSA DOTO, GERMAN | 1 | 36 | 1 | Huesca | Almuniente | 505 | 004 | 0 | 4,1201 |
| **Total PERTUSA DOTO, GERMAN** | | | | | | | | | 4,1201 |
| PIRACES LAIRLA, EMILIO | 1 | 119 | 1 | Huesca | Barbués | 502 | 088 | 0 | 0,1371 |
| **Total PIRACES LAIRLA, EMILIO** | | | | | | | | | 0,1371 |
| PUERTOLAS BERDUN, EUGENIO | 1 | 123 | 3 | Huesca | Barbués | 502 | 148 | 0 | 0,3260 |
| **Total PUERTOLAS BERDUN, EUGENIO** | | | | | | | | | 0,3260 |
| PUERTOLAS VAL, MARIA PILAR | 1 | 17 | | Huesca | Senés | 503 | 016 | 0 | 9,6817 |
| PUERTOLAS VAL, MARIA PILAR | 2 | 202 | | Huesca | Torralba | 502 | 064 | 0 | 5,5832 |
| PUERTOLAS VAL, MARIA PILAR | 2 | 206 | 8 | Huesca | Torralba | 502 | 040 | 0 | 0,0450 |
| PUERTOLAS VAL, MARIA PILAR | 2 | 230 | | Huesca | Senés | 503 | 016 | 0 | 9,6817 |
| **Total PUERTOLAS VAL, MARIA PILAR** | | | | | | | | | 24,9915 |
| PUEYO CALVO, JUSTO | 1 | 102 | | Huesca | Torralba | 501 | 104 | 0 | 4,5176 |
| PUEYO CALVO, JUSTO | 1 | 102 | | Huesca | Torralba | 501 | 105 | 0 | 0,7859 |
| **Total PUEYO CALVO, JUSTO** | | | | | | | | | 5,3035 |
| PUEYO CALVO, JUSTO Y HNAS | 1 | 1 | 3 | Huesca | Torralba | 502 | 108 | 0 | 3,3361 |
| PUEYO CALVO, JUSTO Y HNAS | 1 | 6 | 5 | Huesca | Torralba | 502 | 103 | 0 | 0,1075 |
| PUEYO CALVO, JUSTO Y HNAS | 1 | 102 | | Huesca | Barbués | 502 | 131 | 0 | 4,2513 |
| PUEYO CALVO, JUSTO Y HNAS | 1 | 102 | | Huesca | Torralba | 501 | 106 | 0 | 9,6901 |
| PUEYO CALVO, JUSTO Y HNAS | 1 | 102 | | Huesca | Torralba | 501 | 083 | 0 | 2,2291 |
| **Total PUEYO CALVO, JUSTO Y HNAS** | | | | | | | | | 19,6141 |
| PUEYO CORVINOS, JESUS ANGEL | 1 | 81 | | Huesca | Torralba | 501 | 065 | 0 | 2,0671 |
| PUEYO CORVINOS, JESUS ANGEL | 2 | 204 | | Huesca | Torralba | 502 | 051 | 0 | 8,5651 |
| PUEYO CORVINOS, JESUS ANGEL | 2 | 206 | 5 | Huesca | Torralba | 502 | 035 | 0 | 0,0250 |
| PUEYO CORVINOS, JESUS ANGEL | 2 | 220 | | Huesca | Torralba | 501 | 062 | 0 | 0,5263 |
| PUEYO CORVINOS, JESUS ANGEL | 2 | 224 | | Huesca | Torralba | 502 | 204 | 0 | 14,2432 |
| **Total PUEYO CORVINOS, JESUS ANGEL** | | | | | | | | | 25,4267 |
| PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 81 | | Huesca | Torralba | 501 | 066 | 0 | 27,6965 |
| PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 152 | | Huesca | Torralba | 501 | 003 | 0 | 8,5233 |
| PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 152 | | Huesca | Torralba | 501 | 004 | 0 | 12,3773 |
| PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 1 | 152 | | Huesca | Torralba | 501 | 010 | 0 | 5,3497 |
| PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD | 2 | 206 | 5 | Huesca | Torralba | 502 | 034 | 0 | 0,0250 |
| **Total PUEYO CORVINOS, JESUS ANGEL Y MARIA SOLEDAD** | | | | | | | | | 53,9718 |
| PUEYO CORVINOS,JESUS ANGEL Y ESPOSA | 2 | 204 | | Huesca | Torralba | 502 | 053 | 0 | 0,1254 |
| **Total PUEYO CORVINOS,JESUS ANGEL Y ESPOSA** | | | | | | | | | 0,1254 |
| PUYOL JUSTES, MARIA PILAR | 1 | 15 | | Huesca | Torralba | 502 | 158 | 0 | 11,7745 |
| **Total PUYOL JUSTES, MARIA PILAR** | | | | | | | | | 11,7745 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| PUYOL MASIAS , JOSE CARMELO | 2 | 227 | Sin Toma | Huesca | Senés | 503 | 013 | 0 | 0,3108 |
| **Total PUYOL MASIAS , JOSE CARMELO** | | | | | | | | | 0,3108 |
| RAMON CUBERO, ANTONIO | 1 | 116 | | Huesca | Barbués | 502 | 121 | 0 | 0,7653 |
| **Total RAMON CUBERO, ANTONIO** | | | | | | | | | 0,7653 |
| REVUELTA ABADIA, JOSE MIGUEL | 1 | 107 | 2 | Huesca | Barbués | 502 | 128 | 0 | 0,4347 |
| REVUELTA ABADIA, JOSE MIGUEL | 1 | 114 | | Huesca | Barbués | 502 | 133 | 0 | 9,8699 |
| **Total REVUELTA ABADIA, JOSE MIGUEL** | | | | | | | | | 10,3046 |
| REVUELTA ABADIA, JOSE MIGUEL Y HNOS | 1 | 143 | | Huesca | Almuniente | 503 | 013 | 0 | 8,5350 |
| REVUELTA ABADIA, JOSE MIGUEL Y HNOS | 1 | 143 | | Huesca | Almuniente | 503 | 015 | 0 | 5,5065 |
| **Total REVUELTA ABADIA, JOSE MIGUEL Y HNOS** | | | | | | | | | 14,0415 |
| REVUELTA LISA, ALBERTO | 1 | 170 | | Huesca | Barbués | 502 | 020 | 0 | 6,5279 |
| **Total REVUELTA LISA, ALBERTO** | | | | | | | | | 6,5279 |
| REVUELTA LISA, ANTONIO JOSE | 1 | 121 | | Huesca | Barbués | 502 | 159 | 0 | 7,8536 |
| **Total REVUELTA LISA, ANTONIO JOSE** | | | | | | | | | 7,8536 |
| REVUELTA LOPEZ, JOSE PASCUAL | 1 | 112 | 1 | Huesca | Torralba | 501 | 110 | 0 | 5,1524 |
| REVUELTA LOPEZ, JOSE PASCUAL | 1 | 121 | | Huesca | Barbués | 502 | 158 | 0 | 9,5440 |
| **Total REVUELTA LOPEZ, JOSE PASCUAL** | | | | | | | | | 14,6964 |
| REVUELTA LOPEZ, PEDRO CARLOS | 1 | 123 | 4 | Huesca | Barbués | 502 | 140 | 0 | 0,2044 |
| REVUELTA LOPEZ, PEDRO CARLOS | 1 | 161 | | Huesca | Barbués | 502 | 009 | 0 | 9,4315 |
| **Total REVUELTA LOPEZ, PEDRO CARLOS** | | | | | | | | | 9,6359 |
| REVUELTA MONESMA, PEDRO CARLOS | 1 | 178 | | Huesca | Barbués | 502 | 043 | 0 | 7,5678 |
| **Total REVUELTA MONESMA, PEDRO CARLOS** | | | | | | | | | 7,5678 |
| ROBA HUGUET, PILAR E HIJA | 1 | 87 | | Huesca | Torralba | 501 | 071 | 0 | 9,5741 |
| **Total ROBA HUGUET, PILAR E HIJA** | | | | | | | | | 9,5741 |
| RODRIGUEZ GARCIA, JOSE | 1 | 123 | 2 | Huesca | Barbués | 502 | 146 | 0 | 0,1466 |
| **Total RODRIGUEZ GARCIA, JOSE** | | | | | | | | | 0,1466 |
| RODRIGUEZ GUALLARTE, ALBA | 1 | 113 | | Huesca | Almuniente | 503 | 001 | 0 | 4,4378 |
| RODRIGUEZ GUALLARTE, ALBA | 1 | 113 | | Huesca | Almuniente | 503 | 003 | 0 | 1,9236 |
| RODRIGUEZ GUALLARTE, ALBA | 1 | 123 | 2 | Huesca | Barbués | 502 | 145 | 0 | 0,5475 |
| RODRIGUEZ GUALLARTE, ALBA | 1 | 141 | | Huesca | Almuniente | 503 | 008 | 0 | 9,6035 |
| **Total RODRIGUEZ GUALLARTE, ALBA** | | | | | | | | | 16,5124 |
| RODRIGUEZ RODRIGUEZ, BENJAMIN | 1 | 141 | | Huesca | Almuniente | 503 | 012 | 0 | 2,3411 |
| **Total RODRIGUEZ RODRIGUEZ, BENJAMIN** | | | | | | | | | 2,3411 |
| ROMEO OLIVAN, CARLOS | 1 | 117 | | Huesca | Barbués | 502 | 126 | 0 | 8,5843 |
| **Total ROMEO OLIVAN, CARLOS** | | | | | | | | | 8,5843 |
| ROMERO CALVO, FRANCISCO | 1 | 119 | 4 | Huesca | Barbués | 502 | 091 | 0 | 0,4064 |
| **Total ROMERO CALVO, FRANCISCO** | | | | | | | | | 0,4064 |
| ROPERO ORTIZ, PRIMITIVO | 1 | 128 | 3 | Huesca | Barbués | 502 | 058 | 0 | 0,1962 |
| **Total ROPERO ORTIZ, PRIMITIVO** | | | | | | | | | 0,1962 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00151 | 0 | 2,0439 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00152 | 0 | 6,6163 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00154 | 0 | 9,8594 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00155 | 0 | 3,9368 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00156 | 0 | 5,3297 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00160 | 0 | 2,6542 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00161 | 0 | 1,7590 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00162 | 0 | 1,4143 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00596 | 0 | 0,4922 |
| S.A.T. ASGI | 1 | 68 | | Huesca | Almuniente | 005 | 00597 | 0 | 0,1299 |
| **Total S.A.T. ASGI** | | | | | | | | | 34,2357 |
| SALAMANCA LEON, JOSE | 1 | 118 | 4 | Huesca | Barbués | 502 | 110 | 0 | 0,2145 |
| **Total SALAMANCA LEON, JOSE** | | | | | | | | | 0,2145 |
| SANCHEZ COSANO, MARIA CONCEPCION | 1 | 181 | | Huesca | Barbués | 502 | 041 | 0 | 5,6940 |
| **Total SANCHEZ COSANO, MARIA CONCEPCION** | | | | | | | | | 5,6940 |
| SANCHEZ LACASA, GUADALUPE | 1 | 171 | | Huesca | Barbués | 502 | 027 | 0 | 7,9637 |
| **Total SANCHEZ LACASA, GUADALUPE** | | | | | | | | | 7,9637 |
| SANJUAN GOMEZ, ELIAS Y ANA MARIA | 1 | 129 | | Huesca | Barbués | 502 | 150 | 0 | 0,2414 |
| **Total SANJUAN GOMEZ, ELIAS Y ANA MARIA** | | | | | | | | | 0,2414 |
| SANJUAN GOMEZ, ELIAS Y JESUS | 1 | 37 | | Huesca | Almuniente | 505 | 006 | 0 | 0,4000 |
| SANJUAN GOMEZ, ELIAS Y JESUS | 1 | 129 | | Huesca | Barbués | 502 | 151 | 0 | 8,1096 |
| SANJUAN GOMEZ, ELIAS Y JESUS | 1 | 129 | | Huesca | Barbués | 502 | 155 | 0 | 2,2954 |
| **Total SANJUAN GOMEZ, ELIAS Y JESUS** | | | | | | | | | 10,8050 |
| SANJUAN GOMEZ, ELIAS Y NATIVIDAD | 1 | 133 | | Huesca | Barbués | 502 | 052 | 0 | 7,0911 |
| **Total SANJUAN GOMEZ, ELIAS Y NATIVIDAD** | | | | | | | | | 7,0911 |
| SANJUAN MILLAN, JESUS | 1 | 129 | | Huesca | Barbués | 502 | 139 | 0 | 8,2583 |
| **Total SANJUAN MILLAN, JESUS** | | | | | | | | | 8,2583 |
| SANTOS SESE, JESUS | 1 | 158 | | Huesca | Barbués | 502 | 002 | 0 | 13,7013 |
| **Total SANTOS SESE, JESUS** | | | | | | | | | 13,7013 |
| SANZ BIELSA, ANTONIO | 2 | 212 | | Huesca | Tardienta | 504 | 018 | 0 | 1,1522 |
| SANZ BIELSA, ANTONIO | 2 | 212 | | Huesca | Torralba | 502 | 007 | 0 | 3,5258 |
| **Total SANZ BIELSA, ANTONIO** | | | | | | | | | 4,6780 |
| SARVISE ABADIA, ANTONIO FRANCISCO | 1 | 144 | | Huesca | Almuniente | 503 | 010 | 0 | 14,0949 |
| **Total SARVISE ABADIA, ANTONIO FRANCISCO** | | | | | | | | | 14,0949 |
| SARVISE ANDREU, ANGEL FELIX | 1 | 160 | | Huesca | Barbués | 502 | 015 | 0 | 12,4067 |
| **Total SARVISE ANDREU, ANGEL FELIX** | | | | | | | | | 12,4067 |
| SARVISE MORCATE, DANIEL | 1 | 116 | | Huesca | Barbués | 502 | 120 | 0 | 0,5460 |
| SARVISE MORCATE, DANIEL | 1 | 142 | | Huesca | Almuniente | 503 | 009 | 0 | 8,7143 |
| **Total SARVISE MORCATE, DANIEL** | | | | | | | | | 9,2603 |
| SAUCO DOTO, ANA ISABEL | 1 | 123 | 8 | Huesca | Barbués | 502 | 144 | 0 | 0,2764 |
| **Total SAUCO DOTO, ANA ISABEL** | | | | | | | | | 0,2764 |
| SAUCO DOTO, MARIA ANGELES | 1 | 108 | | Huesca | Barbués | 502 | 101 | 0 | 8,9983 |
| **Total SAUCO DOTO, MARIA ANGELES** | | | | | | | | | 8,9983 |

| PROPIETARIO | PISO RIEGO | Nº HIDRANTE | Nº TOMA | PROV. | MUN. | POL. | PAR. | SUBP. | AREA (ha) |
|---|---|---|---|---|---|---|---|---|---|
| SEBASTIAN DELGADO, ISMAEL Y RAQUEL | 1 | 116 | | Huesca | Barbués | 502 | 124 | 0 | 0,2339 |
| **Total SEBASTIAN DELGADO, ISMAEL Y RAQUEL** | | | | | | | | | 0,2339 |
| SESE SANTOLARIA, VICTORIA E HIJO | 1 | 119 | 3 | Huesca | Barbués | 502 | 090 | 0 | 0,2158 |
| SESE SANTOLARIA, VICTORIA E HIJO | 1 | 169 | | Huesca | Barbués | 502 | 021 | 0 | 9,7698 |
| **Total SESE SANTOLARIA, VICTORIA E HIJO** | | | | | | | | | 9,9856 |
| SIRON IRIONDO, FILOMENO | 1 | 6 | 2 | Huesca | Torralba | 502 | 099 | 0 | 0,0852 |
| SIRON IRIONDO, FILOMENO | 2 | 212 | | Huesca | Torralba | 502 | 006 | 0 | 0,3794 |
| **Total SIRON IRIONDO, FILOMENO** | | | | | | | | | 0,4646 |
| SUBIAS SUBIAS, JOAQUINA | 2 | 229 | | Huesca | Senés | 503 | 005 | 0 | 2,7961 |
| SUBIAS SUBIAS, JOAQUINA | 2 | 229 | | Huesca | Senés | 503 | 007 | 0 | 0,6981 |
| **Total SUBIAS SUBIAS, JOAQUINA** | | | | | | | | | 3,4942 |
| TORNE BOLEA, ANTONIO | 1 | 95 | 1 | Huesca | Tardienta | 504 | 004 | 0 | 0,6117 |
| **Total TORNE BOLEA, ANTONIO** | | | | | | | | | 0,6117 |
| TORRECILLA ALCUBIERRE, ROSA MARIA | 1 | 26 | | Huesca | Almuniente | 505 | 010 | 0 | 0,8106 |
| TORRECILLA ALCUBIERRE, ROSA MARIA | 1 | 26 | | Huesca | Torralba | 502 | 196 | 0 | 2,6223 |
| TORRECILLA ALCUBIERRE, ROSA MARIA | 1 | 110 | | Huesca | Torralba | 501 | 112 | 0 | 6,7648 |
| TORRECILLA ALCUBIERRE, ROSA MARIA | 2 | 206 | 3 | Huesca | Torralba | 502 | 032 | 0 | 0,0500 |
| **Total TORRECILLA ALCUBIERRE, ROSA MARIA** | | | | | | | | | 10,2477 |
| TORRECILLA BURON, JOSE | 1 | 1 | 1 | Huesca | Torralba | 502 | 106 | 0 | 0,7535 |
| TORRECILLA BURON, JOSE | 1 | 30 | | Huesca | Almuniente | 505 | 001 | 0 | 3,7237 |
| TORRECILLA BURON, JOSE | 1 | 30 | | Huesca | Torralba | 502 | 175 | 0 | 11,9517 |
| **Total TORRECILLA BURON, JOSE** | | | | | | | | | 16,4289 |
| TORRECILLA GRASA, JOSE LUIS | 1 | 6 | 6 | Huesca | Torralba | 502 | 104 | 0 | 1,3472 |
| TORRECILLA GRASA, JOSE LUIS | 1 | 10 | 2 | Huesca | Torralba | 502 | 067 | 0 | 0,6920 |
| TORRECILLA GRASA, JOSE LUIS | 1 | 26 | | Huesca | Torralba | 502 | 195 | 0 | 3,5230 |
| TORRECILLA GRASA, JOSE LUIS | 1 | 82 | | Huesca | Torralba | 501 | 044 | 0 | 0,7860 |
| TORRECILLA GRASA, JOSE LUIS | 1 | 82 | | Huesca | Torralba | 501 | 046 | 0 | 17,3334 |
| TORRECILLA GRASA, JOSE LUIS | 1 | 82 | | Huesca | Torralba | 501 | 064 | 0 | 7,6959 |
| TORRECILLA GRASA, JOSE LUIS | 2 | 206 | 3 | Huesca | Torralba | 502 | 031 | 0 | 0,0500 |
| TORRECILLA GRASA, JOSE LUIS | 2 | 225 | | Huesca | Torralba | 502 | 205 | 0 | 6,9973 |
| **Total TORRECILLA GRASA, JOSE LUIS** | | | | | | | | | 38,4248 |
| TORRECILLA VIÑAS, YOLANDA Y CESAR | 1 | 111 | | Huesca | Torralba | 501 | 116 | 0 | 14,9080 |
| TORRECILLA VIÑAS, YOLANDA Y CESAR | 2 | 211 | | Huesca | Tardienta | 504 | 015 | 0 | 0,3315 |
| TORRECILLA VIÑAS, YOLANDA Y CESAR | 2 | 211 | | Huesca | Torralba | 502 | 004 | 0 | 7,0797 |
| **Total TORRECILLA VIÑAS, YOLANDA Y CESAR** | | | | | | | | | 22,3192 |
| **Total general** | | | | | | | | | 2.714,5256 |

# ANEJO Nº 3.- ESTUDIO AGRONÓMICO

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# ANEJO 3.- ESTUDIO AGRONÓMICO

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

En el presente anejo se establecen las necesidades hídricas del total de la zona regable, en función de una alternativa de cultivos dada. Se indicarán para ello las necesidades mensuales en $m^3$/ha, volumen anual consumido y caudal ficticio continúo expresado en l/s y ha. La definición de los anteriores parámetros, permitirá un correcto dimensionado de la red de riego.

## 2 ESTUDIO AGRONÓMICO

### 2.1 ALTERNATIVA DE CULTIVOS ESTUDIADA

Se plantea una alternativa de cultivos para conocer las necesidades de riego con las cuales se dimensiona la red de riego. Se han considerado los cultivos predominantes en la actualidad, así como las preferencias de los agricultores. La consideración realizada en cuanto a distribución de cultivos es la que se muestra a continuación:

**Tabla 1.** Alternativa de Cultivos Adoptada

| Cultivo | Superficie (%) |
|---|---|
| Almendro | 35,00% |
| Alfalfa | 15,00% |
| Maíz | 35,00% |
| Cebada | 15,00% |
| **TOTAL** | **100,00%** |

De cualquier forma, debemos considerar la alternativa de cultivos planteada como una aproximación a la realidad futura que nos permita obtener una estimación de las necesidades futuras, teniendo claro que dicha alternativa puede variar en mayor o menor medida en función de los cultivos finalmente desarrollados por los agricultores implicados.

### 2.2 PROCEDIMIENTO DE CÁLCULO

Para la estimación de las necesidades hídricas de los cultivos incluidos en la alternativa de cultivos estudiada se siguió el procedimiento de cálculo recomendado por la Organización de las Naciones Unidas para la Agricultura y la Alimentación (FAO), en su publicación "Las necesidades de agua de los cultivos".

Según este procedimiento, el proceso a seguir para el cálculo de las necesidades de agua de riego de los cultivos será el siguiente:

1.- *Cálculo de la evapotranspiración de referencia (ETo);* considerada como el consumo de agua de una superficie extensa de hierba, uniforme, de 8 a 15 cm de altura, en crecimiento activo, sombreando la totalidad del suelo y bien provista de agua.

2.- *Cálculo de la evapotranspiración de los cultivos (ETc);* considerada como las necesidades hídricas brutas de los cultivos para su desarrollo óptimo, representando la cantidad de agua que debe existir en la zona radical del cultivo para satisfacer su demanda evaporativa.

3.- *Cálculo de las necesidades hídricas netas de los cultivos (NHn);* consideradas como la cantidad de agua a suministrar a la zona radical del cultivo mediante el riego. Para ello, se deduce a la ETc la cantidad de agua aportada por la precipitación efectiva (PE).

4.- *Cálculo de las necesidades brutas de agua de riego de los cultivos (NRb);* consideradas como la cantidad de agua que el sistema de riego ha de proporcionar en parcela para que, una vez deducidas las pérdidas debidas a la propia eficiencia del riego, la cantidad de agua que se almacene en dicha zona radical sea igual a las NHn del cultivo.

### 2.3 CARACTERÍSTICAS CLIMÁTICAS

En la página siguiente se encuentra la ficha climática de la estación meteorológica de Tardienta (Huesca), que es la más cercana a la zona objeto del presente proyecto.

Esta estación se encuentra situada a 362 metros de altitud sobre el nivel del mar, en las siguientes coordenadas UTM (Huso 30):

X: 706522

Y: 4649380

En esta ficha se indican, para cada mes:

- La temperatura media de las máximas.
- La temperatura media.
- La temperatura media de las mínimas.
- La precipitación media mensual.
- Media mensual de la humedad relativa media diaria del aire (%).
- Media mensual de la evapotranspiración diaria de una hierba en mm/día.

En la siguiente tabla se pueden observar los valores mensuales y anuales.

**Tabla 2.** Ficha climática de la estación de Tardienta (Huesca).

| MEDIA MES | PREC mm | Tª Max ºC | Tª Min ºC | Tª Med ºC | HR Med % | ETo mm/d | ETo mm/mes |
|---|---|---|---|---|---|---|---|
| Enero | 28,60 | 17,23 | -5,27 | 5,07 | 81,94 | 1,12 | 34,59 |
| Febrero | 24,96 | 18,68 | -5,72 | 6,08 | 73,88 | 1,83 | 51,28 |
| Marzo | 50,21 | 23,60 | -2,56 | 9,21 | 70,69 | 2,66 | 82,34 |
| Abril | 45,20 | 27,62 | 0,50 | 12,48 | 70,42 | 3,57 | 107,06 |
| Mayo | 36,13 | 30,96 | 2,83 | 16,22 | 64,59 | 4,94 | 153,09 |
| Junio | 31,14 | 36,29 | 8,28 | 20,99 | 58,49 | 5,77 | 172,98 |
| Julio | 24,45 | 37,78 | 11,74 | 23,98 | 54,78 | 6,48 | 200,73 |
| Agosto | 24,66 | 37,64 | 10,46 | 23,36 | 58,77 | 5,52 | 171,26 |
| Septiembre | 25,71 | 32,99 | 5,78 | 19,22 | 66,15 | 4,04 | 121,09 |
| Octubre | 50,64 | 28,79 | 1,08 | 14,34 | 74,59 | 2,40 | 74,53 |
| Noviembre | 45,30 | 21,42 | -3,19 | 8,80 | 83,40 | 1,25 | 37,41 |
| Diciembre | 18,50 | 16,35 | -5,32 | 5,24 | 85,39 | 0,84 | 26,06 |
| **Anual** | **405,50** | **27,45** | **1,55** | **13,75** | **70,26** | **3,45** | **1232,42** |

La temperatura media anual es de 13,75 ºC, siendo enero el mes más frío, con 5,07 ºC de temperatura media, y julio y agosto los más calurosos con 23,98 ºC y 23,36 ºC, respectivamente.

La precipitación media anual es de 405,50 mm, siendo marzo y octubre los meses más lluviosos con 50,21 mm y 50,64 mm de precipitación media respectivamente y julio el más seco con 24,45 mm.

La ETo media anual es de 1.232,42mm, siendo diciembre el mes en que es menor con 26,06 mm. En julio alcanza el mayor valor, con 200,73 mm.

## 2.4 CÁLCULO DE LA EVAPOTRANSPIRACIÓN POTENCIAL

En la siguiente tabla se muestra el valor de la evapotranspiración de referencia (ETo), obtenido de la publicación citada en el apartado anterior.

**Tabla 3.** Evapotranspiración de Referencia (ETo).

| MES | ETo mm/d | ETo mm/mes |
|---|---|---|
| Enero | 1,12 | 34,59 |
| Febrero | 1,83 | 51,28 |
| Marzo | 2,66 | 82,34 |
| Abril | 3,57 | 107,06 |
| Mayo | 4,94 | 153,09 |
| Junio | 5,77 | 172,98 |
| Julio | 6,48 | 200,73 |
| Agosto | 5,52 | 171,26 |
| Septiembre | 4,04 | 121,09 |
| Octubre | 2,40 | 74,53 |
| Noviembre | 1,25 | 37,41 |
| Diciembre | 0,84 | 26,06 |
| **TOTAL** | **3,45** | **1232,42** |

Esta estimación de la evapotranspiración de referencia se ha realizado según el método de FAO-USDA Blaney-Criddle (Doorenbos y Pruitt, 1.977; Allen y Pruitt, 1.986).

## 2.5 CÁLCULO DE LA EVAPOTRANSPIRACIÓN DEL CUTIVO

Para tener en cuenta las características del cultivo sobre sus necesidades de agua, se presenta el coeficiente de cultivo (Kc). Este coeficiente representa la evapotranspiración de un cultivo en condiciones óptimas y que obtenga rendimientos óptimos.

En la elección de los valores de Kc se han considerado los valores recomendados en la publicación realizada por la Excma. Diputación de Zaragoza "Evapotranspiración y necesidades de riego de los principales cultivos en las comarcas de Aragón", adaptados a la realidad de la zona de estudio.

**Tabla 4.** Coeficientes de cultivo Kc.

| MES | Almendro | Alfalfa | Maíz | Cebada |
|---|---|---|---|---|
| Enero | 0,00 | 0,76 | 0,00 | 0,79 |
| Febrero | 0,00 | 0,77 | 0,00 | 0,95 |
| Marzo | 0,34 | 0,82 | 0,00 | 1,05 |
| Abril | 0,58 | 0,82 | 0,00 | 1,05 |
| Mayo | 0,58 | 0,84 | 0,47 | 0,83 |
| Junio | 0,83 | 0,84 | 0,80 | 0,25 |
| Julio | 0,95 | 0,85 | 1,01 | 0,00 |
| Agosto | 0,80 | 0,85 | 1,01 | 0,00 |
| Septiembre | 0,74 | 0,84 | 0,90 | 0,00 |
| Octubre | 0,49 | 0,80 | 0,57 | 0,00 |
| Noviembre | 0,00 | 0,77 | 0,00 | 0,00 |
| Diciembre | 0,00 | 0,76 | 0,00 | 0,73 |

Para obtener la evapotranspiración real del cultivo, siguiendo las directrices establecidas por Doorenbos y Pruitt, 1.977, basta con multiplicar la ETo por el coeficiente Kc, siguiendo la siguiente expresión:

$ET_C = K_C \times ET_O$

Siendo:

- $K_C$: coeficiente del cultivo mensual.
- $ET_O$: evapotranspiración de referencia (mm/día), (mm/mes).
- $ET_C$: evapotranspiración del cultivo (mm/día), (mm/mes).

**Tabla 5.** Evapotranspiración (ETC) de los cultivos (mm/mes).

| MES | Almendro | Alfalfa | Maíz | Cebada |
|---|---|---|---|---|
| Enero | 0,00 | 26,29 | 0,00 | 27,33 |
| Febrero | 0,00 | 39,49 | 0,00 | 48,72 |
| Marzo | 28,00 | 67,52 | 0,00 | 86,46 |
| Abril | 62,09 | 87,79 | 0,00 | 112,41 |
| Mayo | 88,79 | 128,60 | 71,95 | 127,06 |
| Junio | 143,57 | 145,30 | 138,38 | 43,25 |
| Julio | 190,69 | 170,62 | 202,74 | 0,00 |
| Agosto | 137,01 | 145,57 | 172,97 | 0,00 |
| Septiembre | 89,61 | 101,72 | 108,98 | 0,00 |
| Octubre | 36,52 | 59,62 | 42,48 | 0,00 |
| Noviembre | 0,00 | 28,81 | 0,00 | 0,00 |
| Diciembre | 0,00 | 19,81 | 0,00 | 19,02 |
| **TOTAL** | **776,28** | **1021,12** | **737,51** | **464,25** |

## 2.6 CÁLCULO DE LA LLUVIA EFECTIVA

Hasta ahora se ha hablado únicamente de las necesidades de agua, sin embargo, puede haber aportes de agua diferentes de los aportes hídricos del propio riego.

Se consideran nulos los posibles aportes por parte del rocío y de las capas freáticas altas. Sólo se contabilizarán como aportes positivos, las lluvias y, dentro de ellas, se considerará únicamente la porción de lluvia considerada como precipitación efectiva.

Así, desde un punto de vista agronómico, se considera como precipitación efectiva a la porción de lluvia que satisface parte de las necesidades de consumo de agua del cultivo.

Esta precipitación efectiva depende de factores como:

- Intensidad de la precipitación.
- Contenido de humedad del suelo antes de la lluvia.
- Tasa de infiltración del suelo.
- Capacidad de retención de agua en la zona radicular del cultivo.
- Evapotranspiración del cultivo.

Para la estimación de esta precipitación efectiva en la publicación consultada se ha aplicado el método del Soil Conservation Service del Departamento de Agricultura de Estados Unidos (Dastane, 1.974).

Se trata de un método empírico desarrollado a partir de numerosos trabajos experimentales, en el que se calcula la PE mensual a partir de la precipitación total mensual, de la $ET_c$ del cultivo y del déficit de humedad de agua en el suelo.

Este método considera que el límite máximo de la PE mensual es la $ET_c$ mensual del cultivo en el mes considerado.

Se calcula la PE para cada cultivo, por lo que ésta puede variar de un cultivo a otro. La ecuación utilizada es la siguiente:

$$PE = f(D)\left[1{,}25P^{0{,}824} - 2{,}93\right]10^{0{,}000955ETc}$$

Donde: PE = precipitación efectiva mensual (mm/mes)

P = precipitación total mensual (mm/mes)

$ET_c$ = evapotranspiración de cultivo mensual, (mm/mes).

$f(D)$ = función correctora para un déficit de humedad en el suelo distinto de 75 mm. Para D = 75 mm, $f(D)$ = 1

Esta función correctora $f(D)$ se ha calculado según la fórmula (Cuenca, 1.989):

$$f(D) = 0{,}53 + 0{,}0116D - 8{,}94E - 5 \cdot D^2 + 2{,}32E - 7 \cdot D^3$$

Donde D = déficit de humedad del suelo, mm. (Se ha supuesto que D = 75 mm)

Según esto, los valores de lluvia efectiva mensual, en la zona considerada y para los cultivos analizados, son los que se indican en la siguiente tabla.

**Tabla 6.** Precipitación Efectiva (PE) para cada uno de los cultivos (mm/mes).

| MES | Almendro | Alfalfa | Maíz | Cebada |
|---|---|---|---|---|
| Enero | 0,00 | 17,89 | 0,00 | 17,93 |
| Febrero | 14,78 | 16,12 | 0,00 | 16,45 |
| Marzo | 30,39 | 33,15 | 0,00 | 34,56 |
| Abril | 29,76 | 31,49 | 0,00 | 33,24 |
| Mayo | 25,64 | 27,98 | 24,71 | 27,89 |
| Junio | 25,12 | 25,22 | 24,84 | 20,15 |
| Julio | 22,03 | 21,08 | 22,62 | 0,00 |
| Agosto | 19,74 | 20,12 | 21,36 | 0,00 |
| Septiembre | 18,53 | 19,03 | 19,34 | 0,00 |
| Octubre | 31,20 | 32,83 | 31,62 | 0,00 |
| Noviembre | 26,01 | 27,71 | 0,00 | 0,00 |
| Diciembre | 0,00 | 11,39 | 0,00 | 11,37 |
| **TOTAL** | **243,20** | **284,01** | **144,48** | **161,59** |

## 2.7 CÁLCULO DE LAS NECESIDADES HÍDRICAS NETAS

Las necesidades hídricas netas (NHn) se calculan como la diferencia entre evapotranspiración del cultivo y la precipitación efectiva:

$$NH_n = ET_c - PE$$

En el proceso de cálculo seguido se han considerado las condiciones locales de cada cultivo, reflejándose este hecho en la obtención de estas necesidades netas.

**Tabla 7.** Necesidades Hídricas Netas (NHn) para los cultivos (mm/mes).

| MES | Almendro | Alfalfa | Maíz | Cebada |
|---|---|---|---|---|
| Enero | 0,00 | 8,40 | 0,00 | 9,40 |
| Febrero | 0,00 | 23,36 | 0,00 | 32,26 |
| Marzo | 0,00 | 34,37 | 0,00 | 51,90 |
| Abril | 32,34 | 56,30 | 0,00 | 79,17 |
| Mayo | 63,15 | 100,61 | 47,25 | 99,17 |
| Junio | 118,45 | 120,08 | 113,54 | 23,09 |
| Julio | 168,67 | 149,55 | 180,12 | 0,00 |
| Agosto | 117,27 | 125,46 | 151,61 | 0,00 |
| Septiembre | 71,07 | 82,68 | 89,64 | 0,00 |
| Octubre | 5,32 | 26,79 | 10,87 | 0,00 |
| Noviembre | 0,00 | 1,09 | 0,00 | 0,00 |
| Diciembre | 0,00 | 8,41 | 0,00 | 7,65 |
| **TOTAL** | **576,26** | **737,11** | **593,03** | **302,65** |

## 2.8 CÁLCULO DE LAS NECESIDADES BRUTAS DE AGUA DE RIEGO

Para la estimación de las necesidades brutas de agua de riego es necesario conocer la eficiencia actual y futura en la aplicación del riego (relación entre agua aplicada y la realmente útil para las plantas). En la eficiencia de aplicación del riego influyen varios factores como:

- Calidad de los materiales.
- Diseño de la instalación.
- Manejo del riego (frecuencia y tiempo de los riegos).
- Mantenimiento de las instalaciones.

Se considera para este estudio una eficiencia de riego del 75 % para la alfalfa, el maíz y la cebada, mientras que para el almendro se considerará una eficiencia de riego del 85 %, puesto que las características del riego instalado (riego por goteo), junto con el grado de tecnificación y la gestión realizada por los técnicos de la finca permiten considerar una mejor eficiencia.

Las necesidades reales o brutas de riego se obtendrán restando a la evapotranspiración del cultivo las lluvias efectivas y dividiéndolo por el coeficiente de eficiencia del riego.

Las necesidades brutas vienen dadas por la expresión: NRB = NHN / EA

**Tabla 8.** Necesidades Hídricas Brutas (NHB) para cada cultivo (mm y mes).

| MES | Almendro | Alfalfa | Maíz | Cebada |
|---|---|---|---|---|
| Enero | 0,00 | 11,20 | 0,00 | 12,53 |
| Febrero | 0,00 | 31,15 | 0,00 | 43,02 |
| Marzo | 0,00 | 45,83 | 0,00 | 69,20 |
| Abril | 35,93 | 75,07 | 0,00 | 105,56 |
| Mayo | 70,17 | 134,15 | 62,99 | 132,23 |
| Junio | 131,61 | 160,11 | 151,39 | 30,79 |
| Julio | 187,41 | 199,39 | 240,16 | 0,00 |
| Agosto | 130,30 | 167,27 | 202,14 | 0,00 |
| Septiembre | 78,97 | 110,24 | 119,52 | 0,00 |
| Octubre | 5,91 | 35,73 | 14,49 | 0,00 |
| Noviembre | 0,00 | 1,46 | 0,00 | 0,00 |
| Diciembre | 0,00 | 11,22 | 0,00 | 10,20 |
| **TOTAL** | **640,29** | **982,82** | **790,70** | **403,54** |

Las necesidades brutas teóricas de agua de riego expresadas en la tabla 8, serían las necesarias para obtener el máximo rendimiento de la plantación.

## 2.9 NECESIDADES DE RIEGO TOTALES

Las necesidades brutas teóricas de riego para la alternativa estudiada son las siguientes:

**Tabla 9.** Superficie de riego y necesidades teóricas de la alternativa estudiada

| Cultivo | $m^3$/ha y año | Superficie (ha) | $m^3$/año |
|---|---|---|---|
| Almendro | 6.402,94 | 950,08 | 6.083.329,47 |
| Alfalfa | 9.828,20 | 407,18 | 4.001.834,95 |
| Maíz | 7.907,02 | 950,08 | 7.512.332,00 |
| Cebada | 4.035,40 | 407,18 | 1.643.128,40 |
| **TOTAL** | | **2714,53** | **19.240.624,82** |

Las necesidades que se generan para el total de las 2.714,53 ha son de 19.240.624,82 $m^3$/año.

Es interesante conocer las demandas que se generan mensualmente, ya que estas varían mes a mes en función del estado fenológico del cultivo.

Estas necesidades brutas teóricas de agua de riego, recogidas en la Tabla 10, serían las necesarias para obtener el máximo rendimiento de la plantación.

**Tabla 10.** Necesidades teóricas de la Alternativa estudiada

| MES | NRb (m3/Ha) | | | |
|---|---|---|---|---|
| | Almendro | Alfalfa | Maíz | Cebada |
| Enero | 0,00 | 112,01 | 0,00 | 125,30 |
| Febrero | 0,00 | 311,52 | 0,00 | 430,18 |
| Marzo | 0,00 | 458,29 | 0,00 | 692,00 |
| Abril | 359,30 | 750,69 | 0,00 | 1.055,65 |
| Mayo | 701,71 | 1.341,49 | 629,94 | 1.322,33 |
| Junio | 1.316,10 | 1.601,11 | 1.513,93 | 307,93 |
| Julio | 1.874,08 | 1.993,94 | 2.401,60 | 0,00 |
| Agosto | 1.302,98 | 1.672,74 | 2.021,44 | 0,00 |
| Septiembre | 789,71 | 1.102,44 | 1.195,22 | 0,00 |
| Octubre | 59,07 | 357,25 | 144,89 | 0,00 |
| Noviembre | 0,00 | 14,56 | 0,00 | 0,00 |
| Diciembre | 0,00 | 112,17 | 0,00 | 102,00 |
| **TOTAL** | **6.402,94** | **9.828,20** | **7.907,02** | **4.035,40** |

**Tabla 11.** Necesidades de diseño de la Alternativa estudiada

| Alternativa | $m^3$/mes | NRb (m3/Ha) | mm/día | Caudal (l/s y Ha) |
|---|---|---|---|---|
| Enero | 96.624,46 | 35,60 | 0,11 | 0,01 |
| Febrero | 302.006,26 | 111,26 | 0,36 | 0,04 |
| Marzo | 468.374,63 | 172,54 | 0,56 | 0,06 |
| Abril | 1.076.865,71 | 396,70 | 1,28 | 0,15 |
| Mayo | 2.349.828,04 | 865,65 | 2,79 | 0,32 |
| Junio | 3.466.093,32 | 1.276,87 | 4,12 | 0,48 |
| **Julio** | **4.874.137,85** | **1.795,58** | **5,79** | **0,67** |
| Agosto | 3.839.576,11 | 1.414,46 | 4,56 | 0,53 |
| Septiembre | 2.334.742,07 | 860,09 | 2,77 | 0,32 |
| Octubre | 339.240,78 | 124,97 | 0,40 | 0,05 |
| Noviembre | 5.929,98 | 2,18 | 0,01 | 0,00 |
| Diciembre | 87.205,58 | 32,13 | 0,10 | 0,01 |
| **TOTAL** | **19.240.624,82** | **7.088,02** | | |

Como se puede ver en la tabla anterior, el consumo establecido para el total de las 2.714,53 ha es de 19.240.624,82 $m^3$/año, lo que supone unas necesidades medias por hectárea de **7.088,02 $m^3$/año**.

El periodo de máximas necesidades se da en el mes de julio, con una demanda de 0,67 l/s y ha. Al ser la superficie total a cultivar de 2.714,53 ha, el caudal ficticio continuo será de **1.819,79 l/s**

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# ANEJO 4.- ESTUDIO DE ALTERNATIVAS

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

Conocidos los parámetros básicos que definen la presente actuación, como son las parcelas y superficies a transformar, así como la distribución y morfología de la zona regable, se ha llevado a cabo una valoración preliminar de diferentes alternativas para la puesta en riego, con el fin de tener la información necesaria que nos permita adoptar la alternativa más viable.

Para determinar la alternativa más viable se han barajado como aspectos fundamentales los condicionantes de carácter medioambiental, los parámetros técnicos y los parámetros económicos.

Durante la fase de estudio de alternativas se han barajado multitud de opciones combinadas que, tras un análisis de sus ventajas e inconvenientes, han derivado en un estudio más detallado de aquellas alternativas consideradas a priori como más idóneas.

En cualquier caso, este estudio de alternativas debe considerarse como un estudio comparativo entre las diferentes opciones, y no como un estudio definitivo de costes.

## 2 ESQUEMA GENERAL

El esquema general plantea el estudio de varios pisos de riego, con el objetivo, por un lado, de reducir al máximo la necesidad de energía, así como los excesos de presión en las redes, y por otro, del aprovechamiento de los emplazamientos de las balsas. El esquema general contempla:

- Infraestructuras de captación en el Canal de Monegros
- Tubería de llenado de la Balsa de Regulación a pie de Canal
- Una balsa junto al Canal de Monegros (B0)
- Una o dos balsas elevadas, situadas en los secanos de la margen izquierda del Canal, desde las que se daría servicio a la red de riego.
- Una Estación de Bombeo situada junto a la Balsa B0
- Tuberías de impulsión hasta cada una de las balsas elevadas.
- Red de Riego dividida en varios pisos.
- Red de Distribución Interior o Red Terciaria.
- Infraestructuras e instalaciones necesarias para el suministro energético al bombeo.
- Sistema de telecontrol de la red de riego

Tras el estudio de alternativas se concluye que las afecciones por las infraestructuras principales son iguales entre todas las alternativas, siendo, los elementos diferenciadores los siguientes:

- La división de la red de riego en 2 o 3 pisos
- La ejecución de 2 o 3 balsas
- El suministro energético con o sin apoyo fotovoltaico
- La ejecución o no se sistema de Telecontrol

El estudio de alternativas que se presenta es un estudio realizado en fechas preliminares del desarrollo del proyecto. Es por ello que las superficies que se manejan no son las finalmente desarrolladas en el proyecto, aunque sí muy similares.

## 3 ALTERNATIVAS ESTUDIADAS (PRIMERA FASE)

Las alternativas estudiadas parten del planteamiento general con captación en el Canal de Monegros, Balsa a pie de Canal y una red de riego dividida en varios pisos para reducir al máximo las necesidades de energía.

Las alternativas barajan la posibilidad de 3 pisos de riego (alternativas 1, 2, 3, 6 y 7) o 2 pisos (alternativas 4 y 5). En cuanto a las balsas, todas plantean 3 (una a pie de canal y 2 elevadas) excepto la alternativa 7, que plantea una balsa a pie de canal y una elevada.

Hay 2 planteamientos en cuanto al bombeo: 88 h/semana (alternativas 3 y 6) y 123 h/semana (alternativas 1, 2, 4, 5 y 7), pudiendo complementarse con energía fotovoltaica (alternativas 2, 5 y 7).

En el coste de la inversión de las distintas opciones analizadas no se ha tenido en consideración el coste de la acometida eléctrica en MT ni el telecontrol.

A continuación, se enumeran las siete alternativas de ejecución planteadas en una primera fase.

- Alternativa 1: 3 pisos de riego, siendo el riego en uno de ellos (1.142 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos

a balsa en 123 h/semana, en los que todo el suministro energético se realice a través de la red eléctrica convencional.

- Alternativa 2: 3 Pisos de riego siendo el riego en uno de ellos (1.142 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 123 h/semana, con apoyo de energía fotovoltaica.
- Alternativa 3: 3 Pisos de riego siendo el riego en uno de ellos (1.142 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 88 h/semana (sólo periodo tarifario P6), en los que todo el suministro energético se realice a través de la red eléctrica convencional.
- Alternativa 4: 2 Pisos de riego, ambos desde 2 balsas elevadas. 2 bombeos a balsa en 123 h/semana, en los que todo el suministro energético se realice a través de la red eléctrica convencional.
- Alternativa 5: 2 Pisos de riego, ambos desde 2 balsas elevadas. 2 bombeos a balsa en 123 h/semana, con apoyo de energía fotovoltaica.
- Alternativa 6: 3 pisos de riego, siendo el riego en uno de ellos (608 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 88 h/semana (sólo periodo tarifario P6), en los que todo el suministro energético se realice a través de la red eléctrica convencional.
- Alternativa 7: 3 pisos de riego, siendo el riego en uno de ellos (1.142 ha) por presión natural sin bombeo. Piso 2 con riego desde 1 balsa elevada y Piso 3 con riego por bombeo directo. Ambas líneas de bombeo en la misma EB, 2 con apoyo de energía fotovoltaica.

## 3.1 ALTERNATIVA 1

En esta alternativa se plantean 3 pisos de riego, siendo el riego en uno de ellos (1.142 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 123 h/semana (evitando P1), en los que todo el suministro energético se realice a través de la red eléctrica convencional.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Bajo: 1.142 has.
  - Superficie Piso Intermedio: 968 has.
  - Superficie Piso Alto: 503 has.
- Necesidades, 6.926m$^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 m$^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 1.011 l/s
  - 600 kW de potencia instalada.
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 900 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 100.000 m$^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 494 l/s
  - 470 kW de potencia instalada.
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 700 mm.
- Balsa elevada (BE2). Capacidad aproximada de 40.000 m$^3$.
- 3 redes de tuberías, con una presión en hidrante de 35 m.c.a.:
  - Red Peso, de 23,3 km, con funcionamiento por gravedad desde Balsa Inferior
  - Red Bombeo 1, de 24,7 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 11,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.400
- Los costes energéticos, para estos bombeos son 295.717 €/año (IVA e impuestos incluidos), 113 €/ha y año
- Inversión, 13.957.335 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 257 €/ha y año. (inversión y costes energéticos incluidos).

### 3.2 ALTERNATIVA 2

Esta alternativa es una variante de la anterior. Simplemente se añade una instalación fotovoltaica, para evitar el bombeo en periodo P2.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Bajo: 1.142 has.
  - Superficie Piso Intermedio: 968 has.
  - Superficie Piso Alto: 503 has.
- Necesidades, 6.926m$^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 m$^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 1.011 l/s
  - 600 kW de potencia instalada.
  - Instalación fotovoltaica de 550 kwp
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 900 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 100.000 m$^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 494 l/s
  - 470 kW de potencia instalada.
  - Instalación fotovoltaica de 370 kwp
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 700 mm.
- Balsa elevada (BE2). Capacidad aproximada de 40.000 m$^3$.
- 3 redes de tuberías, con una presión en hidrante de 35 m.c.a.:
  - Red Peso, de 23,3 km, con funcionamiento por gravedad desde Balsa Inferior
  - Red Bombeo 1, de 24,7 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 11,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.400
- Los costes energéticos, para estos bombeos son 82.026 €/año (IVA e impuestos incluidos), 31 €/ha y año
- Inversión, 15.149.572 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 188 €/ha y año. (inversión y costes energéticos incluidos).

### 3.3 ALTERNATIVA 3

Como la alternativa 1, pero estableciendo las horas de bombeo en 88 h/semana: 3 pisos de riego, siendo el riego en uno de ellos (1.223 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 88 h/semana (evitando P2), en los que todo el suministro energético se realice a través de la red eléctrica convencional.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Bajo: 1.142 has.
  - Superficie Piso Intermedio: 968 has.
  - Superficie Piso Alto: 503 has.
- Necesidades, 6.926m$^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 m$^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 1.327 l/s
  - 850 kW de potencia instalada.
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 1.200 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 110.000 m$^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 690 l/s
  - 660 kW de potencia instalada.

- Tubería de Impulsión 2, de unos 1.900 m de PRFV 800 mm.
- Balsa elevada (BE2). Capacidad aproximada de 60.000 $m^3$.
- 3 redes de tuberías, con una presión en hidrante de 35 m.c.a.:
  - Red Peso, de 23,3 km, con funcionamiento por gravedad desde Balsa Inferior
  - Red Bombeo 1, de 24,7 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 11,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.400
- Los costes energéticos, para este bombeo son 172.783 €/año (IVA e impuestos incluidos), 66 €/ha y año
- Inversión, 14.645.350 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 217 €/ha y año. (inversión y costes energéticos incluidos).

### 3.4 ALTERNATIVA 4

2 pisos de riego, ambos con riego desde sendas balsas elevadas. Se incrementa la presión en hidrante a 40 m.c.a. 2 bombeos a balsa en 123 h/semana (evitando P1), en los que todo el suministro energético se realice a través de la red eléctrica convencional.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Intermedio: 1.714has.
  - Superficie Piso Alto: 990 has.
- Necesidades, 6.926$m^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 $m^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 1.914 l/s
  - 1.250 kW de potencia instalada.
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 1.200 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 100.000 $m^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 883 l/s
  - 850 kW de potencia instalada.
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 900 mm.
- Balsa elevada (BE2). Capacidad aproximada de 40.000 $m^3$.
- 2 redes de tuberías, con una presión en hidrante de 40 m.c.a.:
  - Red Bombeo 1, de 32,4 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 19,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.200
- Los costes energéticos, para este bombeo son 480.926 €/año (IVA e impuestos incluidos), 184 €/ha y año
- Inversión, 12.313.722 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 311 €/ha y año. (inversión y costes energéticos incluidos).

### 3.5 ALTERNATIVA 5

Esta alternativa es una variante de la anterior alternativa 4. Simplemente se añade una instalación fotovoltaica, para evitar el bombeo en periodo P2.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Intermedio: 1.714has.
  - Superficie Piso Alto: 990 has.
- Necesidades, 6.926$m^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 $m^3$.
- Estación doble línea de Bombeo:

- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 1.914 l/s
  - 1.250 kW de potencia instalada.
  - Instalación fotovoltaica de 1.075 kwp
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 1.200 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 100.000 $m^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 883 l/s
  - 850 kW de potencia instalada.
  - Instalación fotovoltaica de 725 kwp
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 900 mm.
- Balsa elevada (BE2). Capacidad aproximada de 40.000 $m^3$.
- 2 redes de tuberías, con una presión en hidrante de 40 m.c.a.:
  - Red Bombeo 1, de 32,4 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 19,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.200
- Los costes energéticos, para este bombeo son 143.058 €/año (IVA e impuestos incluidos), 55 €/ha y año
- Inversión, 14.646.360 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 206 €/ha y año. (inversión y costes energéticos incluidos).

### 3.6 ALTERNATIVA 6

Como la alternativa 3, pero pasando la finca de almendros a la zona de bombeo bajo: 3 pisos de riego, siendo el riego en uno de ellos (608 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 88 h/semana (evitando P2), en los que todo el suministro energético se realice a través de la red eléctrica convencional.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Bajo: 608 has.
  - Superficie Piso Intermedio: 1.503 has.
  - Superficie Piso Alto: 503 has.
- Necesidades, 6.926$m^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 $m^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 2.060 l/s
  - 1.325 kW de potencia instalada.
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 1.200 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 170.000 $m^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 690 l/s
  - 660 kW de potencia instalada.
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 800 mm.
- Balsa elevada (BE2). Capacidad aproximada de 60.000 $m^3$.
- 3 redes de tuberías, con una presión en hidrante de 35 m.c.a.:
  - Red Peso, de 22,4 km, con funcionamiento por gravedad desde Balsa Inferior
  - Red Bombeo 1, de 25,3 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 11,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.200
- Los costes energéticos, para este bombeo son 226.610 €/año (IVA e impuestos incluidos), 87 €/ha y año
- Inversión, 15.025.922 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 242 €/ha y año. (inversión y costes energéticos incluidos).

### 3.7 ALTERNATIVA 7

Esta alternativa similar a la alternativa 2, pero con rebombeo directo para el piso más alto. Las principales características de esta alternativa son:

- Superficie, 2.614.
  - o Superficie Piso Bajo: 1.142 has.
  - o Superficie Piso Intermedio: 968 has.
  - o Superficie Piso Alto: 503 has.
- Necesidades, 6.926m$^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 200.000 m$^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - o Altura de bombeo, 43 m.c.a.
  - o Caudal, 1.011 l/s
  - o 600 kW de potencia instalada.
  - o Instalación fotovoltaica de 550 kwp
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 1.200 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 100.000 m$^3$.
- Rebombeo 2
  - o Altura de bombeo, 64 m.c.a.
  - o Caudal, 494 l/s
  - o 470 kW de potencia instalada.
  - o Instalación fotovoltaica de 370 kwp
- 3 redes de tuberías, con una presión en hidrante de 35 m.c.a.:
  - o Red Peso, de 23,3 km, con funcionamiento por gravedad desde Balsa Inferior
  - o Red Bombeo 1, de 24,7 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - o Red Bombeo 2, de 11,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - o Materiales:
    - ▪ PVC, DN 110 a DN 500
    - ▪ PRFV, DN 500 a DN 1.400
- Los costes energéticos, para estos bombeos son 82.026 €/año (IVA e impuestos incluidos), 31 €/ha y año
- Inversión, 14.282.198 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 179 €/ha y año. (inversión y costes energéticos incluidos).

## 4 RESUMEN DE LAS ALTERNATIVAS ESTUDIADAS (PRIMERA FASE)

Se resumen a continuación los costes estimados para cada una de las alternativas anteriores, tanto a nivel de inversión como a nivel energético.

**Tabla 1.** Resumen de las alternativas analizadas (primera fase)

| ALT. | COSTES ENERGETICOS | | POTENCIA A INSTALAR | | | COSTE OBRA | | AMORTIZACIÓN | |
|---|---|---|---|---|---|---|---|---|---|
| | TOTAL | POR HA | B1 | B2 | TOTAL | EM | EC | Inversión | Inc. Energía |
| | € | €/ha | kw | kw | kw | € | € | €/ha | €/ha |
| **1** | 295.717 | 113 | 600 | 470 | 1.070 | 9.693.267 | 13.957.335 | 144 | **257** |
| **2** | 82.026 | 31 | 600 | 470 | 1.070 | 10.521.267 | 15.149.572 | 156 | **188** |
| **3** | 172.783 | 66 | 850 | 660 | 1.510 | 10.171.088 | 14.645.350 | 151 | **217** |
| **4** | 480.926 | 184 | 1.250 | 850 | 2.100 | 8.551.790 | 12.313.722 | 127 | **311** |
| **5** | 143.058 | 55 | 1.250 | 850 | 2.100 | 10.171.790 | 14.646.360 | 151 | **206** |
| **6** | 226.610 | 87 | 1.325 | 660 | 1.985 | 10.435.393 | 15.025.922 | 155 | **242** |
| **7** | 82.026 | 31 | 600 | 470 | 1.070 | 9.918.882 | 14.282.198 | 147 | **179** |

Los resultados anteriores indican que la alternativa más atractiva desde el punto de vista económico es la alternativa 7, con 3 pisos de riego (uno de ellos con bombeo directo y otro con riego desde Balsa inferior) y con el uso de energía fotovoltaica.

Esta alternativa incluye la Finca Montefrula en el piso inferior, con riego por gravedad desde la Balsa Inferior. Esta finca, que tiene una superficie aproximada de 559 ha, en la actualidad está plantada con almendros. Es por ello que para el cálculo se ha tenido en cuenta una presión de servicio inferior al resto de hidrantes (22 mca), lo que favorece el dimensionado del resto de la red, pero al mismo tiempo, limita la explotación futura de la finca en caso de cambio de cultivo. Además, se vio que las zonas más elevadas de otros hidrantes tampoco llegarían a la presión de consigna.

De esta forma, a pesar de ser una alternativa atractiva desde el punto de vista económico, se descartó por motivos técnicos, eligiéndose las alternativas 2 y 5 para su estudio en profundidad en una siguiente fase.

# 5 ALTERNATIVAS ESTUDIADAS. FASE 2

Tal y como se ha indicado, tras descartar por temas técnicos la alternativa 7, la Comunidad de Regantes decidió profundizar en el estudio de las 2 alternativas que económicamente eran más atractivas, incluyendo en este caso una variable más, referente a la inclusión o no de un capítulo de telecontrol de la red de riego.

Se aprovechó para definir con mayor detalle los trazados de la red de riego, así como las agrupaciones de riego, de forma que el estudio de alternativas se acercara más así a la realidad del proyecto final.

De esta forma, se analizaron de nuevo las alternativas 2 y 5, y de cada una de ellas, se consideraron las opciones de:

- Alternativa sin parque solar ni telecontrol
- Alternativa sin parque solar y con telecontrol
- Alternativa con parque solar y telecontrol

## 5.1 ALTERNATIVA 1.1. SIN SOLAR NI TELECONTROL

3 pisos de riego, siendo el riego en uno de ellos (1.222 ha) por presión natural sin bombeo. Resto de la superficie con riego desde 2 balsas elevadas. 2 bombeos a balsa en 123 h/semana (evitando P1), en los que todo el suministro energético se realice a través de la red eléctrica convencional.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Bajo: 1.222 has.
  - Superficie Piso Intermedio: 1.040 has.
  - Superficie Piso Alto: 353 has.
- Necesidades, 6.926m$^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 209.000 m$^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 1.011 l/s
  - 645 kW de potencia instalada.
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 900 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 80.000 m$^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 341 l/s
  - 330 kW de potencia instalada.
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 600 mm.
- Balsa elevada (BE2). Capacidad aproximada de 28.000 m$^3$.
- 3 redes de tuberías, con una presión en hidrante de 35 m.c.a.:
  - Red Peso, de 26,6 km, con funcionamiento por gravedad desde Balsa Inferior
  - Red Bombeo 1, de 26,2 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 10,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.400
- Los costes energéticos, para estos bombeos son 238.566 €/año (IVA e impuestos incluidos), 91 €/ha y año
- Inversión, 14.293.887 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 223 €/ha y año. (inversión y costes energéticos incluidos).

## 5.2 ALTERNATIVA 1.2. SIN SOLAR CON TELECONTROL

Esta alternativa, igual a la anterior, sólo incrementa la inversión al incluir un capítulo de telecontrol.

- Los costes energéticos, para estos bombeos son 238.566 €/año (IVA e impuestos incluidos), 91 €/ha y año
- Inversión, 14.688.420 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 226 €/ha y año. (inversión y costes energéticos incluidos).

## 5.3 ALTERNATIVA 1.3. CON SOLAR Y TELECONTROL

Esta alternativa es una variante de la anterior. Simplemente se añade una instalación fotovoltaica, para evitar el bombeo en periodo P2. Se mantiene el telecontrol

  - Instalación fotovoltaica de 500 kwp en Bombeo 1
  - Instalación fotovoltaica de 230 kwp en Bombeo 2
- Los costes energéticos, para estos bombeos son 82.276 €/año (IVA e impuestos incluidos), 31 €/ha y año
- Inversión, 15.634.434 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 175 €/ha y año. (inversión y costes energéticos incluidos).

## 5.4 ALTERNATIVA 2.1. SIN SOLAR NI TELECONTROL

2 pisos de riego, ambos con riego desde sendas balsas elevadas. Se incrementa la presión en hidrante a 40 m.c.a. 2 bombeos a balsa en 123 h/semana (evitando P1), en los que todo el suministro energético se realice a través de la red eléctrica convencional.

Las principales características de esta alternativa son:

- Superficie, 2.614 ha.
  - Superficie Piso Intermedio: 2.261 has.
  - Superficie Piso Alto: 353 has.
- Necesidades, 6.926m$^3$/mes y ha ($qfc_{máx.}$ 0,67 l/s y ha en julio)
- Captación. Canal de Monegros.
- Tubería de llenado hasta Balsa Inferior.
- Balsa de Regulación Inferior (B0). Capacidad aproximada de 209.000 m$^3$.
- Estación doble línea de Bombeo:
- Bombeo 1
  - Altura de bombeo, 43 m.c.a.
  - Caudal, 2.192 l/s
  - 1.447 kW de potencia instalada.
- Tubería de Impulsión 1, de unos 1.000 m de PRFV 1.400 mm.
- Balsa intermedia (BE1). Capacidad aproximada de 80.000 m$^3$.
- Bombeo 2
  - Altura de bombeo, 64 m.c.a.
  - Caudal, 341 l/s
  - 330 kW de potencia instalada.
- Tubería de Impulsión 2, de unos 1.900 m de PRFV 600 mm.
- Balsa elevada (BE2). Capacidad aproximada de 28.000 m$^3$.
- 2 redes de tuberías, con una presión en hidrante de 40 m.c.a.:
  - Red Bombeo 1, de 46,1 km, con funcionamiento por gravedad desde Balsa Elevada 1
  - Red Bombeo 2, de 10,9 km, con funcionamiento por gravedad desde Balsa Elevada 2
  - Materiales:
    - PVC, DN 110 a DN 500
    - PRFV, DN 500 a DN 1.400
- Los costes energéticos, para este bombeo son 424.962 €/año (IVA e impuestos incluidos), 163 €/ha y año
- Inversión, 12.242.030 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 275 €/ha y año. (inversión y costes energéticos incluidos).

## 5.5 ALTERNATIVA 2.2. SIN SOLAR CON TELECONTROL

Esta alternativa, igual a la anterior, sólo incrementa la inversión al incluir un capítulo de telecontrol.

- Los costes energéticos, para estos bombeos son 424.962 €/año (IVA e impuestos incluidos), 163 €/ha y año
- Inversión, 12.636.562 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 279 €/ha y año. (inversión y costes energéticos incluidos).

### 5.6 ALTERNATIVA 2.3. CON SOLAR Y TELECONTROL

Esta alternativa es una variante de la anterior. Simplemente se añade una instalación fotovoltaica, para evitar el bombeo en periodo P2. Se mantiene el telecontrol

- o Instalación fotovoltaica de 1200 kwp en Bombeo 1
- o Instalación fotovoltaica de 230 kwp en Bombeo 2
- Los costes energéticos, para estos bombeos son 145.066 €/año (IVA e impuestos incluidos), 55 €/ha y año
- Inversión, 14.490.000 € IVA incluido.
- Si consideramos un préstamo a 25 años, el coste por hectárea y año sale a 189 €/ha y año. (inversión y costes energéticos incluidos).

## 6 RESUMEN DE LAS ALTERNATIVAS. FASE 2

Se resumen a continuación los costes estimados para cada una de las alternativas anteriores, tanto a nivel de inversión como a nivel energético.

**Tabla 2.** Resumen de las alternativas analizadas (fase 2)

| ALT. | COSTES ENERGETICOS | | | | POTENCIA A INSTALAR | | | COSTE OBRA | | AMORTIZACIÓN | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | BOMBEO1 | BOMBEO2 | TOTAL | POR HA | B1 | B2 | TOTAL | EM | EC | Inversión | Inc. Energía |
| | € | € | € | €/ha | kw | kw | kw | € | € | €/ha | €/ha |
| **1.1** | 159.530 € | 79.037 € | 238.566 € | 91 | 645 | 330 | 975 | 9.927.000 € | 14.293.887 € | 132 € | **223 €** |
| **1.2** | 159.530 € | 79.037 € | 238.566 € | 91 | 645 | 330 | 975 | 10.201.000 € | 14.688.420 € | 135 € | **226 €** |
| **1.3** | 55.071 € | 27.205 € | 82.276 € | 31 | 645 | 330 | 975 | 10.858.000 € | 15.634.434 € | 144 € | **175 €** |
| **2.1** | 345.925 € | 79.037 € | 424.962 € | 163 | 1447 | 330 | 1777 | 8.502.000 € | 12.242.030 € | 113 € | **275 €** |
| **2.2** | 345.925 € | 79.037 € | 424.962 € | 163 | 1447 | 330 | 1777 | 8.776.000 € | 12.636.562 € | 116 € | **279 €** |
| **2.3** | 117.861 € | 27.205 € | 145.066 € | 55 | 1447 | 330 | 1777 | 10.063.199 € | 14.490.000 € | 133 € | **189 €** |

Los resultados anteriores indican que la alternativa más atractiva desde el punto de vista económico es la alternativa 1.3., con 3 pisos de riego, con el uso de energía fotovoltaica y con telecontrol.

Sin embargo, como en la fase anterior, esta alternativa incluye la Finca Montefrula en el piso inferior, con una presión de servicio inferior al resto de hidrantes (22 mca), por lo que se descartó por motivos técnicos.

Tras el análisis del resto de las alternativas por parte de la Comunidad de Regantes, ésta concluye que la alternativa a desarrollar definitivamente en el Proyecto Constructivo será la Alternativa 2.3. "2 pisos de riego ambos con bombeo, con apoyo solar y telecontrol"

## 7 OTRAS ALTERNATIVAS ESTUDIADAS

De forma paralela al estudio de alternativas, se han estudiado otras variables de la red de riego que tienen incidencia sobre el coste de la inversión, como por ejemplo el valor del caudal ficticio continuo o la dotación en hidrante.

Por último, como consecuencia del resultado de los análisis geotécnicos de los emplazamientos de las balsas previstas, se ha realizado un estudio de alternativas de ubicación de balsas.

Estos estudios se adjuntan a modo de apéndice del presente anejo.

# APÉNDICE 1.- ESTUDIO DEL QFC

**1 OTRAS ALTERNATIVAS ESTUDIADAS. QFC..... 1**

**1.1 REDES E IMPULSIONES ..... 1**

**1.2 BALSAS. ..... 1**

**1.3 POTENCIA DE BOMBEO Y PARQUE FOTOVOLTAICO. ..... 2**

**1.4 CONCLUSIONES ..... 2**

# 1 OTRAS ALTERNATIVAS ESTUDIADAS. QFC

De forma paralela al estudio de alternativas, se han estudiado otras variables de la red de riego que tienen incidencia sobre el coste de la inversión. En este caso, el estudio del valor del caudal ficticio continuo Qfc, se realizó sobre una de las alternativas de estudio que planteaba 3 pisos de riego (alternativa que no fue seleccionada posteriormente). Sin embargo, los resultados son extrapolables a la alternativa con 2 pisos de riego elegida finalmente.

Para comprobar la incidencia que sobre el coste total de inversión puede tener la consideración de un valor de Qfc u otro, se tomaron los valores de 0,65, 0,67 y 0,70 l//s de forma consensuada con la CR, valores que se basaban en el consumo real que otras CCRR de la zona tienen en la actualidad.

El caudal ficticio continuo interviene en el dimensionamiento de los caudales de diseño y, por tanto, en las siguientes variables:

- Diámetros de las redes e impulsiones.
- Capacidad de regulación de las balsas.
- Potencia de las estaciones de bombeo y las líneas eléctricas necesarias.
- Dimensionamiento de la planta fotovoltaica.

## 1.1 REDES E IMPULSIONES

Para la obtención de los resultados a comparar se ha modelizado la red de tuberías en el programa GESTAR. Así, sobre esta única red se ha realizado el dimensionado de tuberías para los tres valores de Qfc anteriormente citados, 0,65, 0,67 y 0,70 l//s y ha.

Obviamente, para que el proceso comparativo sea correcto, se han mantenido invariables el resto de parámetros: rendimiento, dotación, cotas etc.

En lo que respecta a los precios considerados para las conducciones, en esta fase del desarrollo de los trabajos todavía no disponemos de ofertas económicas específicas para esta actuación concreta, por lo que se ha optado por considerar precios de referencia considerados en estudios y proyectos recientes para zonas próximas a ésta. (Esta gestión de solicitar precios de mercado a los fabricantes de tuberías se realizará en fases más avanzadas)

Al importe así obtenido se le ha aplicado un incremento de un 30%, con el objeto de contemplar también en el proceso comparativo el coste debido a los movimientos de tierras en las zanjas, a los equipos hidráulicos y mecánicos necesarios, así como a la obra civil esperable (arquetas y obras especiales).

Finalmente, al importe así calculados se le han aplicado los porcentajes correspondientes a los Gastos Generales (13%), al Beneficio Industrial (6%) y, por último, el IVA vigente, en este caso el 21%.

De esta forma se obtiene una comparativa aproximada y actualizada, pudiéndola comparar con el coste total de las redes de tuberías.

Los resultados así obtenidos son los que se muestran en la siguiente tabla:

**Tabla 1.** Resultados de las alternativas estudiadas en el coste de las redes e impulsiones

| | Qfc (l/s y ha) | | |
|---|---|---|---|
| **RED** | **0,65** | **0,67** | **0,70** |
| **NATUAL** | 3.317.590 € | 3.407.614 € | 3.459.451 € |
| **B1** | 1.285.341 € | 1.315.614 € | 1.395.745 € |
| **B2** | 669.735 € | 679.823 € | 699.245 € |
| **Subtotal** | **5.272.666 €** | **5.403.051 €** | **5.554.441 €** |
| | | | |
| **Mov. TT, Equipos y OOEE (30%)** | 6.854.466 € | 7.023.966 € | 7.220.773 € |
| **GG (13%) y BI (6%)** | 8.156.815 € | 8.358.520 € | 8.592.720 € |
| **Ppto Final con IVA (21%)** | **9.869.746 €** | **10.113.809 €** | **10.397.191 €** |
| | | | |
| **Diferencia entre Opciones** | | 244.063 € | 283.382 € |
| **Diferencia entre Extremos** | | | 527.445 € |

## 1.2 BALSAS.

Para realizar la comparativa y de cara a estimar el volumen de regulación necesario en cada balsa, pensamos en las mismas superficies de las zonas de bombeo que en la Alternativa 1 y para 123 h/semana.

Como puede observarse en la tabla siguiente, aproximadamente hay un 5% de variación en cada salto, esperándose una repercusión directamente proporcional en el aumento de coste de inversión.

Teniendo en cuenta los costes estimados en la alternativa e incluyendo igualmente los importes correspondientes a GG (13%), BI (6%) e IVA Vigente (21%), la inversión estimada en esta fase de estudio sería, para las 2 balsas elevadas, la que se recoge en la tabla siguiente.

**Tabla 2.** Resultados de las alternativas estudiadas en el coste de las balsas

| | Qfc (l/s y ha) | | |
|---|---|---|---|
| **PISO** | **0,65** | **0,67** | **0,70** |
| Capacidad Balsa Elevada 1 | 43.000 m³ | 45.000 m³ | 47.000 m³ |
| Capacidad Balsa Elevada 2 | 56.000 m³ | 60.000 m³ | 63.000 m³ |
| **Ppto Final con IVA (21%)** | 860.100 € | 921.536 € | 967.613 € |
| | | | |
| **Diferencia entre Opciones** | | 61.436 € | 46.077 € |
| **Diferencia entre Extremos** | | | 107.513 € |

## 1.3 POTENCIA DE BOMBEO Y PARQUE FOTOVOLTAICO.

Un cambio en el valor del caudal ficticio continuo implica ineludiblemente un cambio en el caudal de impulsión necesario. Obviando las diferencias de pérdidas de carga, esto se traducirá en una diferencia de las potencias necesarias en las bombas.

A su vez, estimamos que el parque fotovoltaico crecerá o disminuirá en la misma proporción.

A nivel presupuestario estimamos la misma relación, partiendo de los costes estimados en la alternativa 1 y la 2 (para la planta fotovoltaica) y añadiendo, como en los casos anteriores, los importes correspondientes a GG (13%), BI (6%) e IVA Vigente (21%) los importes correspondientes a GG (13%), BI (6%) e IVA Vigente (21%).

En cuanto al coste de la acometida eléctrica, consideramos en este caso que no existe variación significativa entre las distintas alternativas analizadas.

Tendremos así los siguientes resultados:

**Tabla 3.** Resultados de las alternativas estudiadas en el coste de bombeos y parque solar

| | Qfc (l/s y ha) | | |
|---|---|---|---|
| **PISO** | **0,65** | **0,67** | **0,70** |
| Potencia Estimada para el Piso 1 | 590 kW | 606 kW | 633 kW |
| Potencia Estimada para el Piso 2 | 454 kW | 470 kW | 490 kW |
| Potencia Estimada Total | 1044 kW | 1076 kW | 1123 kW |
| Pot. Estimada en Planta FV | 893 kW | 920 kW | 960 kW |
| **Ppto Final con IVA (21%)** | 1.778.480 € | 1.832.993 € | 1.913.059 € |
| | | | |
| **Diferencia entre Opciones** | | 54.513 € | 80.066 € |
| **Diferencia entre Extremos** | | | 134.579 € |

## 1.4 CONCLUSIONES

Las diferencias de coste de inversión estimadas entre las opciones analizadas son las siguientes:

**Tabla 4.** Resumen de costes de las alternativas de CFC

| | QFC (l/seg ha) | | |
|---|---|---|---|
| | **0,65** | **0,67** | **0,7** |
| **Redes e Impulsiones** | 9.869.746 € | 10.113.809 € | 10.397.191 € |
| **Balsas** | 860.100 € | 921.536 € | 967.613 € |
| **Potencias de Bombeos y FV** | 1.778.480 € | 1.832.993 € | 1.913.059 € |
| **TOTAL** | 12.508.326 € | 12.868.338 € | 13.277.863 € |
| **Diferencia entre Opciones** | | 360.012 € | 409.525 € |
| **Diferencia entre Extremos** | | | 769.537 € |

En base al anterior análisis, la Comunidad de Regantes, opta por adoptar un Qfc de 0,67 l/s y ha.

# APÉNDICE 2.- ESTUDIO DE DOTACIONES

**1 OTRAS ALTERNATIVAS ESTUDIADAS. DOTACIONES ..... 1**

**1.1 DOTACIONES ESTUDIADAS ..... 1**

**1.2 RESULTADOS..... 1**

**1.3 REVISIÓN DE LA ANTERNATIVA ELEGIDA..... 2**

# 1 OTRAS ALTERNATIVAS ESTUDIADAS. DOTACIONES

Otra de las variables analizadas para el dimensionado de la red de riego es la dotación en hidrante.

Se realiza este estudio comparativo con la alternativa elegida por la Comunidad de Regantes (Alternativa 2.3 de la segunda fase) consistente en la sectorización de la zona regable en dos pisos de riego, cuyo riego se haría desde sendas balsas elevadas.

El objetivo de este análisis no es otro que el de comprobar la incidencia que sobre el coste de inversión puede tener la consideración de unas u otras dotaciones en hidrante. Para cada una de las alternativas se valorará tanto el coste de la red de tuberías como el coste de los hidrantes.

## 1.1 DOTACIONES ESTUDIADAS

Se han analizado 4 alternativas que se describen a continuación:

Opción 1

| Superficie (ha) | Dotación l/s |
|---|---|
| Sup ≤ 10 | 15 |
| Sup > 10 | Sup x 1,5 |
| Finca Almendros | Sup x 1,2 |

Opción 2

| Superficie (ha) | Dotación l/s |
|---|---|
| Sup ≤ 6 | 15 |
| 6 < sup ≤ 10 | 18 |
| 10 < sup ≤ 15 | 23 |
| Sup > 15 | Sup x 1,5 |
| Finca Almendros | Sup x 1,2 |

Opción 3

| Superficie (ha) | Dotación l/s |
|---|---|
| Sup ≤ 10 | 18 |
| 10 < sup ≤ 20 | 36 |
| 20 < sup ≤ 30 | 54 |
| 30 < sup ≤ 40 | 72 |
| 40 < sup ≤ 50 | 90 |
| 50 < sup ≤ 60 | 108 |
| Sup > 60 | Sup x 1,8 |

Opción 4

| Superficie (ha) | Dotación l/s |
|---|---|
| Sup ≤ 10 | 18 |
| 10 < sup ≤ 20 | 36 |
| 20 < sup ≤ 30 | 54 |
| 30 < sup ≤ 40 | 72 |
| 40 < sup ≤ 50 | 90 |
| 50 < sup ≤ 60 | 108 |
| Sup > 60 | Sup x 1,2 |

La Opción nº1 corresponde a una asignación de dotaciones habitual en alternativas de cultivo en la que se asigna, para superficies de hasta 10 ha, una dotación de 15 l/s y para hidrantes de mayor tamaño se aplica una dotación proporcional de 1,5 l/s y ha. Sólo en el caso de la finca de mayor superficie (573 ha), se rebaja ligeramente esta dotación unitaria, al entender que el manejo del riego es mucho más eficiente.

La Opción nº2 es una variación de la anterior, en la que se asignan mayores dotaciones unitarias en hidrantes de hasta 13-14 ha, y a partir de ahí, se aplica una dotación proporcional de 1,5 l/s y ha. Como en la opción anterior, en el caso de la finca de mayor superficie se rebaja ligeramente esta dotación unitaria.

La Opción nº3 supone una asignación de caudales discretos, múltiplos de 18 l/s, de forma que los módulos de riego de las coberturas totales enterradas de las fincas sean más o menos iguales. En esta opción, se asigna un caudal de 1,8 l/s y ha a la finca de mayor tamaño, de forma que la dotación sea proporcional al resto.

La Opción nº4 supone una variación de la anterior, en la que se asigna una dotación de 1,2 l/s y ha a la finca de mayor tamaño.

## 1.2 RESULTADOS

Se presenta a continuación una tabla resumen con los costes de cada una de las alternativas. Se presenta por un lado los costes de las tuberías de ambos pisos de riego, y por otro, el coste de los hidrantes. Finalmente se presenta el coste total incluyendo Gastos Generales, Beneficio Industrial e IVA.

Las diferencias de coste de inversión estimadas entre las opciones analizadas son las siguientes:

**Tabla 1.** Resultados de las alternativas de dotaciones estudiadas

| OPCION | RED 1 | RED 2 | HIDRANTES | TOTAL E.M. | TOTAL E.C |
|---|---|---|---|---|---|
| 1 | 3.367.236 | 570.643 | 380.456 | 4.318.335 | 6.217.970 |
| 2 | 3.550.918 | 590.087 | 405.756 | 4.546.760 | 6.546.880 |
| 3 | 4.582.283 | 710.386 | 486.278 | 5.778.947 | 8.321.106 |
| 4 | 4.502.403 | 710.386 | 470.278 | 5.683.067 | 8.183.049 |

Ante los resultados anteriores, y a petición de la CR, se opta por desarrollar la opción 2 modificada, es decir, considerando para toda la superficie mayor de 15 ha una dotación de sup x 1,5.

## 1.3 REVISIÓN DE LA ANTERNATIVA ELEGIDA

Posteriormente, se ha realizado una revisión de las dotaciones buscando un grado de libertad mínimo de 1,5, partiendo de los siguientes datos:

- duración de la jornada efectiva: 20 horas
- número máximo de sectores de riego o posturas: 10

manteniendo las dotaciones mínimas establecidas en la alternativa elegida (18 l/s en hidrantes con superficie comprendida entre 6 y 10 ha y de 15 l/s en hidrantes con superficie inferior a 6 ha), dado que las parcelas pequeñas necesitan un caudal mínimo para poder establecer un correcto funcionamiento de los sectores de riego.

En el Anejo 6 Parámetros de riego y dotaciones, se incluye una tabla en la que se indican los caudales y superficies de diseño para cada uno de los hidrantes que componen la red de riego.

# APÉNDICE 3.- ESTUDIO DE BALSAS

**1 OTRAS ALTERNATIVAS ESTUDIADAS. BALSAS ..... 1**

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**1.2 ALTERNATIVAS ESTUDIADAS ..... 1**

**1.3 ANÁLISIS DE LAS ALTERNATIVAS ..... 2**

**1.4 RESULTADOS GEOTÉCNICOS DE LAS ALTERNATIVAS 2 Y 3 ..... 2**

**1.5 ALTERNATIVA ELEGIDA ..... 3**

# 1 OTRAS ALTERNATIVAS ESTUDIADAS. BALSAS

Como consecuencia de los resultados geotécnicos obtenidos en el emplazamiento inicial de la Balsa Inferior, en el que se encontró suelos blandos y presencia de agua que hacía inviable la ejecución de una balsa de las características previstas, se estudiaron alternativas de emplazamiento que permitieran mantener un volumen de agua similar en terrenos más favorables.

## 1.1 RESULTADOS EMPLAZAMIENTO INICIAL BALSA INFERIOR

Inicialmente, la Balsa Inferior ocupaba unas parcelas de secano junto al Canal de Monegros, cerca del núcleo de Torralba, de forma que ésta quedaba centrada respecto de la zona regable.

Se realizaron 26 calicatas en total, detectándose en una parte de ellas un nivel de agua muy superficial, asociada principalmente a filtraciones del canal de Monegros. Se puso de manifiesto la existencia de dos zonas geotécnicamente diferentes:

- La zona norte, donde el sustrato Terciario aparece próximo a la superficie y no se reconocen suelos blandos-saturados.
- La zona sur, donde el sustrato Terciario aparece más profundo y en general presenta suelos blandos y saturados, así como la presencia de nivel freático.

De tal forma, la balsa prevista inicialmente se redujo para limitarse a la zona norte, quedando un volumen de agua menor al previsto.

Diseño inicial (volumen 209.000 m$^3$)

Diseño final (volumen 68.000 m$^3$)

## 1.2 ALTERNATIVAS ESTUDIADAS

Las alternativas estudiadas fueron:

1. Una sola balsa inferior, en el emplazamiento previsto inicialmente, de menor capacidad.
2. Dos balsas de menor capacidad, comunicadas entre sí
3. Dos balsas de menor capacidad, comunicadas entre sí (otro emplazamiento)
4. Una balsa más grande en la margen derecha del Canal
5. Una balsa más grande en la margen derecha del Canal (otro emplazamiento)
6. Una balsa más grande al Sur de la zona regable

Alternativas estudiadas

Las características de las opciones estudiadas en cuanto a capacidad son las siguientes:

| Opción | Descripción | Capacidad ($m^3$) | Capacidad total ($m^3$) |
|---|---|---|---|
| 1 | 1 Balsa pequeña en ubicación inicial | 68.500 | 206.000 |
| 2 | 2 Balsas pequeñas comunicadas | 149.000 | 286.500 |
| 3 | 2 Balsas pequeñas comunicadas | 124.000 | 261.500 |
| 4 | 1 Balsa en margen dcha del canal (sur) | 152.100 | 289.600 |
| 5 | 1 Balsa en margen dcha del canal (norte) | 175.300 | 312.800 |
| 6 | 1 Balsa más al Sur | 180.000 | 317.500 |

La columna "capacidad total" hace referencia al volumen total previsto en el sistema considerando los volúmenes de las Balsas Intermedia y Elevada.

## 1.3 ANÁLISIS DE LAS ALTERNATIVAS

Teniendo en cuenta que el volumen diario necesitado en el mes de máximas necesidades para el riego del total de la superficie es de unos 160.000 $m^3$, parece claro que la opción 1 no es viable, ya que apenas supone una reserva de 1,2 días en el mes de máximas necesidades y especialmente, porque el volumen de reserva se encuentra en su mayoría (casi 70%) en las balsas elevadas.

Por otro lado, se estudia también el coste de ejecución de cada una de las alternativas anteriores. En esta estimación se considera, por un lado, el coste del movimiento de tierras, y por otro, el sobrecoste que supone su ejecución (por ejemplo, la opción de balsas comunicadas supone un sobrecoste por la ejecución de la tubería que las comunica; en la opción 6, la ejecución de una balsa "descentrada" de la zona regable, supone un incremento en el coste de las tuberías)

De esta forma, tenemos los siguientes costes estimados:

| Opción | Descripción | Vol. Des. ($m^3$) | Vol. Terr. ($m^3$) | Coste (mvto. Tierras) | Sobrec. redes | Coste Total |
|---|---|---|---|---|---|---|
| 1 | 1 Balsa pequeña en ubicación inicial | 56.600 | 15.800 | 96.750 € | | 96.750 € |
| 2 | 2 Balsas pequeñas comunicadas | 88.900 | 38.400 | 162.150 € | 150.000 € | 312.150 € |
| 3 | 2 Balsas pequeñas comunicadas | 101.600 | 23.300 | 169.875 € | 75.000 € | 244.875 € |
| 4 | 1 Balsa en margen dcha del canal (sur) | 490.000 | | 735.000 € | | 735.000 € |
| 5 | 1 Balsa en margen dcha del canal (norte) | 516.000 | | 774.000 € | | 774.000 € |
| 6 | 1 Balsa más al Sur | 134.000 | 55.000 | 242.250 € | 550.000 € | 792.250 € |

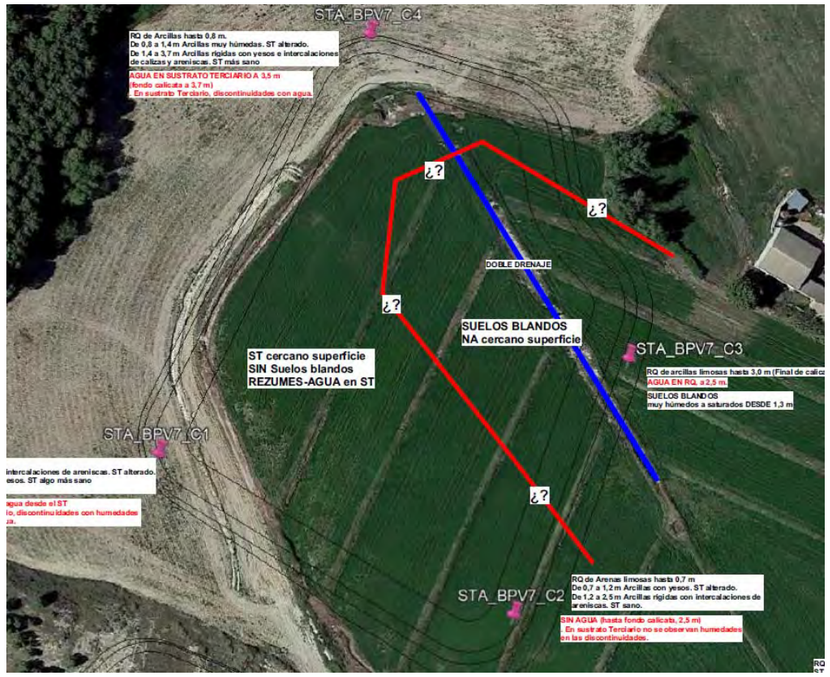
Como se observa en la tabla anterior, las opciones 4 y 5 resultan muy costosas porque son balsas que por su ubicación (al otro lado del canal), son totalmente excavadas. Parece lógico descartar por tanto estas opciones.

En cuanto a la opción 6, resulta también muy costosa por el sobrecoste de la red de tuberías, ya que se incrementa la longitud de las tuberías principales (de mayor diámetro y por tanto, de mayor coste)

Se decide (en conjunto con la CR), seguir adelante con las opciones 2 y 3, para lo cual se llevan a cabo nuevos trabajos geotécnicos que puedan verificar la viabilidad en cuanto a las características del terreno.

## 1.4 RESULTADOS GEOTÉCNICOS DE LAS ALTERNATIVAS 2 Y 3

Se llevaron a cabo nuevas catas y sondeos en las balsas de las opciones 2 y 3. Los resultados obligan a descartar la opción 2, dado que se encontró una zona importante de suelos blandos y presencia de agua.



En cambio, las catas realizadas en la opción 3 no detectaron agua en las profundidades estudiadas, por lo que a priori se presenta como un terreno más favorable.

## 1.5 ALTERNATIVA ELEGIDA

Se decide por tanto seguir adelante con la opción de 2 balsas más pequeñas y comunicadas entre sí, que funcionen conjuntamente como una única balsa. Estas 2 balsas inferiores, junto con la balsa Intermedia y la Balsa Elevada dispondrán finalmente de un volumen total aproximado de 336.000 $m^3$, para adaptarse a los requerimientos de la CR.

Las balsas definitivas se describen y justifican completamente en el Anejo 10 Balsas de Regulación.

# APÉNDICE 4.- CÁLCULOS HIDRÁULICOS Y ENERGÉTICOS DE LAS ALTERNATIVAS ANALIZADAS

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## CÁLCULOS HIDRÁULICOS Y ENERGÉTICOS DE LAS ALTERNATIVAS ANALIZADAS

Se presenta a continuación los resultados hidráulicos de las diferentes alternativas estudiadas, en base a los cuales se han valorado económicamente.

Por otra parte, se incluye el cálculo de los costes energéticos de cada una de ellas.

# 1 RESULTADOS GESTAR 1ª FASE

## 1.1 RED INFERIOR (ALTERNATIVAS 1, 2, 3 Y 7)

Página 1
Gestar2014GESTAR _2014 rev 0 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 389 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-01 | 331 | 40 |
| HA-02 | 336 | 36 |
| HA-04 | 338 | 38 |
| HA-08 | 329 | 35 |
| HA-09 | 339 | 35 |
| HA-11 | 331 | 38 |
| HA-10 | 342 | 35 |
| HA-12 | 331 | 35 |
| HV-35 | 351 | 34 |
| HA-15 | 348 | 35 |
| HA-17 | 334 | 38 |
| HA-14 | 341 | 35 |
| HA-18 | 335 | 35 |
| HA-50 | 340 | 37 |
| HA-45 | 334 | 38 |
| HA-49 | 337 | 38 |
| HA-48 | 337 | 39 |
| HA-41 | 346 | 39 |
| HA-51 | 343 | 38 |
| HA-46 | 348 | 35 |
| HA-47 | 349 | 35 |
| HA-06 | 343 | 35 |
| HA-07 | 345 | 35 |
| HV-11 | 343 | 36 |
| HV-12 | 343 | 36 |
| HV-10 | 343 | 35 |
| HV-09 | 345 | 36 |
| HV-07 | 346 | 35 |
| HV-13 | 345 | 35 |
| HV-14 | 346 | 36 |
| HV-08 | 347 | 35 |
| HV-06 | 350 | 34 |
| HV-02 | 350 | 34 |
| HV-20 | 340 | 35 |
| HV-25 | 340 | 35 |
| HV-22 | 343 | 35 |
| HV-16 | 340 | 36 |
| HV-17 | 342 | 35 |
| HV-26 | 342 | 37 |
| 23 | 351 | 0 |
| HV-24 | 350 | 35 |
| NU6 | 350 | 0 |
| HV-21 | 343 | 37 |
| HV-34 | 343 | 37 |
| HV-33 | 351 | 34 |

Continúa nodos...

Optimización diámetros GESTAR 2010

Página 2
Gestar2014GESTAR _2014 reu 0 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HV-36 | 351 | 35 |
| HV-43 | 345 | 35 |
| HV-42 | 346 | 35 |
| HA-16 | 340 | 35 |
| NU7 | 350 | 0 |
| HA-19 | 342 | 35 |
| HA-20 | 344 | 35 |
| HA-22 | 345 | 37 |
| HA-23 | 346 | 37 |
| HV-04 | 351 | 34 |
| HV-05 | 346 | 35 |
| HV-18 | 342 | 35 |
| HV-19 | 342 | 37 |
| HV-27 | 342 | 35 |
| HV-15 | 342 | 36 |
| NU3 | 335 | 0 |
| HA-03 | 335 | 39 |
| HA-05 | 343 | 36 |
| HA-13 | 342 | 38 |
| HA-38 | 351 | 36 |
| HA-21 | 345 | 40 |
| 44 | 351 | 0 |
| HV-03 | 351 | 34 |
| H-ALM | 365 | 22 |
| NU8 | 350 | 0 |
| 33 | 359 | 0 |
| NU1 | 350 | 0 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| TU26 | NU1 | 33 | 1250 | 25 | 0,007 | 0,015 | 981 | 1000 | |
| TU28 | 0 | NU1 | 3450 | 69 | 0,007 | 0,03 | 1372 | 1400 | |
| TU27 | 33 | NU8 | 812 | 16,24 | 0,007 | 0,18121 | 784 | 800 | |
| | HA-02 | HA-01 | 242,8 | 4,8561 | -- | 0,02 | -- | -- | 0 |
| | HA-23 | HA-21 | 10 | 0,2 | -- | 0,18178 | -- | -- | 0 |
| | HV-24 | HV-22 | 93,163 | 1,8633 | -- | 0,045 | -- | -- | 0 |
| | HV-17 | HV-16 | 100,05 | 2,001 | -- | 0,015 | -- | -- | 0 |
| | HV-19 | HV-17 | 56,789 | 1,1358 | -- | 0,03 | -- | -- | 0 |
| | HV-15 | HV-18 | 22,392 | 0,44784 | -- | 0,06 | -- | -- | 0 |
| | HV-26 | HV-27 | 23,604 | 0,47208 | -- | 0,06958 | -- | -- | 0 |
| | 23 | HV-26 | 281,38 | 5,6277 | -- | 0,07649 | -- | -- | 0 |
| | NU6 | 23 | 120,48 | 2,4096 | -- | 0,07649 | -- | -- | 0 |
| | NU6 | HV-24 | 114,4 | 2,288 | -- | 0,06 | -- | -- | 0 |
| | HV-21 | NU6 | 227,17 | 4,5434 | -- | 0,10206 | -- | -- | 0 |
| | HV-34 | HV-21 | 27,484 | 0,54969 | -- | 0,10904 | -- | -- | 0 |
| | HA-21 | 44 | 450 | 9 | -- | 0,16771 | -- | -- | 0 |
| | HV-33 | HV-34 | 384,41 | 7,6883 | -- | 0,11488 | -- | -- | 0 |
| | HV-36 | HV-33 | 120,72 | 2,4144 | -- | 0,14839 | -- | -- | 0 |
| | NU7 | HV-36 | 323,29 | 6,4658 | -- | 0,17384 | -- | -- | 0 |
| | HV-42 | HV-43 | 209 | 4,1799 | -- | 0,015 | -- | -- | 0 |
| | NU7 | HV-42 | 103,61 | 2,0723 | -- | 0,03 | -- | -- | 0 |
| | NU7 | HA-16 | 88,858 | 1,7772 | -- | 0,018 | -- | -- | 0 |
| | HA-19 | NU7 | 141,87 | 2,8373 | -- | 0,20228 | -- | -- | 0 |
| | HA-20 | HA-19 | 198,05 | 3,961 | -- | 0,21795 | -- | -- | 0 |
| | NU8 | HA-20 | 272,94 | 5,4587 | -- | 0,22798 | -- | -- | 0 |
| | NU8 | HA-22 | 94,004 | 1,8801 | -- | 0,015 | -- | -- | 0 |
| | HA-15 | HV-35 | 177,92 | 3,5584 | -- | 0,015 | -- | -- | 0 |
| | NU8 | HA-23 | 294,77 | 5,8954 | -- | 0,19539 | -- | -- | 0 |
| | HA-14 | HA-15 | 234,63 | 4,6926 | -- | 0,035 | -- | -- | 0 |
| | HA-14 | HA-17 | 307,32 | 6,1465 | -- | 0,017 | -- | -- | 0 |
| | HA-18 | HA-14 | 297,29 | 5,9458 | -- | 0,068 | -- | -- | 0 |
| | HA-50 | HA-18 | 409,85 | 8,197 | -- | 0,07276 | -- | -- | 0 |
| | HA-51 | HA-50 | 171,1 | 3,4221 | -- | 0,08015 | -- | -- | 0 |
| | HA-49 | HA-45 | 149,42 | 2,9883 | -- | 0,19852 | -- | -- | 0 |
| | HA-48 | HA-49 | 30,33 | 0,60659 | -- | 0,20481 | -- | -- | 0 |
| | HA-03 | HA-02 | 147,35 | 2,947 | -- | 0,038 | -- | -- | 0 |
| | HA-51 | HA-48 | 377,99 | 7,5599 | -- | 0,20976 | -- | -- | 0 |

Continúa tuberías...

Página 3
Gestar2014GESTAR _2014 reu 0 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HA-38 | HA-41 | 260,79 | 5,2158 | -- | 0,28303 | -- | -- | 0 |
| | HA-41 | HA-51 | 238,22 | 4,7644 | -- | 0,27489 | -- | -- | 0 |
| | HA-51 | HA-46 | 102,26 | 2,0452 | -- | 0,03 | -- | -- | 0 |
| | HA-46 | HA-47 | 72,821 | 1,4564 | -- | 0,015 | -- | -- | 0 |
| | HV-04 | HV-05 | 481,99 | 9,6398 | -- | 0,015 | -- | -- | 0 |
| | HV-18 | HV-19 | 117,45 | 2,349 | -- | 0,045 | -- | -- | 0 |
| | HV-27 | HV-15 | 337,1 | 6,7419 | -- | 0,06052 | -- | -- | 0 |
| | 44 | HV-03 | 1400 | 28 | -- | 0,16771 | -- | -- | 0 |
| | NU1 | H-ALM | 923 | 18,46 | -- | 0,69 | -- | -- | 0 |
| | HA-45 | HA-13 | 1540 | 30,8 | -- | 0,19232 | -- | -- | 0 |
| | HA-04 | NU3 | 365 | 7,3 | -- | 0,09828 | -- | -- | 0 |
| | NU3 | HA-03 | 245 | 4,9 | -- | 0,053 | -- | -- | 0 |
| | NU3 | HA-05 | 570 | 11,4 | -- | 0,06 | -- | -- | 0 |
| | 33 | HA-38 | 566 | 11,32 | -- | 0,28909 | -- | -- | 0 |
| | HA-08 | HA-04 | 219,15 | 4,3829 | -- | 0,13282 | -- | -- | 0 |
| | HA-05 | HA-06 | 160,93 | 3,2186 | -- | 0,03 | -- | -- | 0 |
| | HA-09 | HA-08 | 287,27 | 5,7453 | -- | 0,14344 | -- | -- | 0 |
| | HA-06 | HA-07 | 270,59 | 5,4118 | -- | 0,015 | -- | -- | 0 |
| | HA-11 | HA-09 | 207,37 | 4,1473 | -- | 0,15556 | -- | -- | 0 |
| | HV-12 | HV-11 | 292,97 | 5,8594 | -- | 0,03 | -- | -- | 0 |
| | HV-10 | HV-12 | 30,93 | 0,61861 | -- | 0,045 | -- | -- | 0 |
| | HV-09 | HV-10 | 282,47 | 5,6493 | -- | 0,066 | -- | -- | 0 |
| | HV-07 | HV-09 | 218,19 | 4,3637 | -- | 0,082 | -- | -- | 0 |
| | HV-08 | HV-07 | 330,84 | 6,6168 | -- | 0,09069 | -- | -- | 0 |
| | HV-14 | HV-13 | 340,36 | 6,8072 | -- | 0,015 | -- | -- | 0 |
| | HV-08 | HV-14 | 262,19 | 5,2439 | -- | 0,03 | -- | -- | 0 |
| | HV-06 | HV-08 | 138,83 | 2,7766 | -- | 0,1202 | -- | -- | 0 |
| | HA-10 | HA-11 | 293,13 | 5,8626 | -- | 0,16499 | -- | -- | 0 |
| | HV-03 | HV-06 | 356,1 | 7,122 | -- | 0,12935 | -- | -- | 0 |
| | HV-03 | HV-02 | 262,45 | 5,249 | -- | 0,015 | -- | -- | 0 |
| | HV-03 | HV-04 | 22,997 | 0,45994 | -- | 0,055 | -- | -- | 0 |
| | HA-12 | HA-10 | 35,136 | 0,70272 | -- | 0,17119 | -- | -- | 0 |
| | HA-13 | HA-12 | 45,068 | 0,90135 | -- | 0,18121 | -- | -- | 0 |
| | HV-25 | HV-20 | 44,709 | 0,89418 | -- | 0,015 | -- | -- | 0 |
| | HV-22 | HV-25 | 151,33 | 3,0265 | -- | 0,03 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |

Continúa materiales...

Página 4
Gestar2014GESTAR _2014 reu 0 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 160 | | | |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |

Continúa materiales...

Página 5
Gestar2014GESTAR _2014 reu 0 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PRFV | TRAGSA | 0,007 | 200 | | | |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

Optimización de Gastos 2020 GESTAR

Página 6
Gestar2014GESTAR _2014 rev D 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 389

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU26 | NU1 | 33 | 1000 | 1250 | 0,84595 | --------- | 30 | 28,222 |
| TU28 | 0 | NU1 | 1400 | 3450 | 0,89893 | --------- | 39 | 37,799 |
| TU27 | 33 | NU8 | 800 | 812 | 0,80524 | --------- | 39 | 36,776 |
| TU1 | HA-02 | HA-01 | 140-(PVC-10) | 242,8 | 1,5255 | 1119,3 | 58 | 40,801 |
| TU10 | HA-23 | HA-21 | 600-(PRFV-6) | 10 | 0,66942 | 829,4 | 44 | 41,683 |
| TU100 | HV-24 | HV-22 | 200-(PVC-10) | 93,163 | 1,6814 | 855,24 | 46 | 41,194 |
| TU101 | HV-17 | HV-16 | 125-(PVC-10) | 100,05 | 1,4341 | 373,2 | 49 | 36,587 |
| TU102 | HV-19 | HV-17 | 160-(PVC-10) | 56,789 | 1,7533 | 343,01 | 47 | 36,148 |
| TU103 | HV-15 | HV-18 | 250-(PVC-10) | 22,392 | 1,4341 | 303,64 | 47 | 37,572 |
| TU104 | HV-26 | HV-27 | 250-(PVC-10) | 23,604 | 1,6631 | 320,07 | 47 | 40,051 |
| TU105 | 23 | HV-26 | 250-(PVC-10) | 281,38 | 1,8283 | 3815,6 | 47 | 40,261 |
| TU106 | NU6 | 23 | 400-(PVC-10) | 120,48 | 0,71344 | 4515,6 | 38 | 34,251 |
| TU107 | NU6 | HV-24 | 400-(PVC-10) | 114,4 | 0,55963 | 4287,8 | 39 | 35,301 |
| TU108 | HV-21 | NU6 | 400-(PVC-10) | 227,17 | 0,95194 | 8514,4 | 39 | 35,381 |
| TU109 | HV-34 | HV-21 | 400-(PVC-10) | 27,484 | 1,017 | 1030,1 | 46 | 42,796 |
| TU11 | HA-21 | 44 | 600-(PRFV-6) | 450 | 0,61761 | 37323 | 38 | 35,469 |
| TU110 | HV-33 | HV-34 | 500-(PRFV-6) | 384,41 | 0,57129 | 25414 | 46 | 42,853 |
| TU111 | HV-36 | HV-33 | 500-(PRFV-6) | 120,72 | 0,73793 | 7980,9 | 38 | 35,043 |
| TU112 | NU7 | HV-36 | 600-(PRFV-6) | 323,29 | 0,64018 | 26814 | 38 | 35,138 |
| TU113 | HV-42 | HV-43 | 125-(PVC-10) | 209 | 1,4341 | 779,56 | 44 | 36,303 |
| TU114 | NU7 | HV-42 | 160-(PVC-10) | 103,61 | 1,7533 | 625,82 | 43 | 38,564 |
| TU115 | NU7 | HA-16 | 125-(PVC-10) | 88,858 | 1,721 | 331,44 | 49 | 44,366 |
| TU116 | HA-19 | NU7 | 600-(PRFV-6) | 141,87 | 0,74492 | 11766 | 39 | 36,302 |
| TU117 | HA-20 | HA-19 | 600-(PRFV-6) | 198,05 | 0,80262 | 16426 | 47 | 44,397 |
| TU118 | NU8 | HA-20 | 600-(PRFV-6) | 272,94 | 0,83956 | 22637 | 45 | 42,549 |
| TU119 | NU8 | HA-22 | 110-(PVC-10) | 94,004 | 1,8502 | 319,61 | 44 | 39,049 |
| TU12 | HA-15 | HV-35 | 250-(PVC-10) | 177,92 | 0,35853 | 2412,6 | 38 | 34,167 |
| TU120 | NU8 | HA-23 | 700-(PRFV-10) | 294,77 | 0,52865 | 39476 | 43 | 40,688 |
| TU13 | HA-14 | HA-15 | 315-(PVC-10) | 234,63 | 0,52697 | 4955,3 | 41 | 37,265 |
| TU14 | HA-14 | HA-17 | 125-(PVC-10) | 307,32 | 1,6254 | 1146,3 | 55 | 45,43 |
| TU15 | HA-18 | HA-14 | 315-(PVC-10) | 297,29 | 1,0238 | 6278,8 | 48 | 44,46 |
| TU16 | HA-50 | HA-18 | 400-(PVC-10) | 409,85 | 0,67865 | 15361 | 54 | 51,286 |
| TU17 | HA-51 | HA-50 | 400-(PVC-10) | 171,1 | 0,74758 | 6413 | 49 | 46,69 |
| TU18 | HA-49 | HA-45 | 500-(PRFV-6) | 149,42 | 0,98722 | 9877,9 | 55 | 52,09 |
| TU19 | HA-48 | HA-49 | 500-(PRFV-6) | 30,33 | 1,0185 | 2005,1 | 52 | 49,289 |
| TU2 | HA-03 | HA-02 | 200-(PVC-10) | 147,35 | 1,4198 | 1352,7 | 53 | 39,503 |
| TU20 | HA-51 | HA-48 | 500-(PRFV-6) | 377,99 | 1,0431 | 24989 | 52 | 49,332 |
| TU21 | HA-38 | HA-41 | 800-(PRFV-6) | 260,79 | 0,58629 | 34495 | 43 | 40,961 |
| TU22 | HA-41 | HA-51 | 800-(PRFV-6) | 238,22 | 0,56943 | 31509 | 46 | 43,892 |
| TU23 | HA-51 | HA-46 | 160-(PVC-10) | 102,26 | 1,7533 | 617,65 | 41 | 37,176 |
| TU24 | HA-46 | HA-47 | 125-(PVC-10) | 72,821 | 1,4341 | 271,62 | 40 | 35,04 |
| TU245 | HV-04 | HV-05 | 160-(PVC-10) | 481,99 | 0,87665 | 2911,2 | 43 | 36,77 |
| TU246 | HV-18 | HV-19 | 250-(PVC-10) | 117,45 | 1,0756 | 1592,6 | 47 | 37,101 |
| TU247 | HV-27 | HV-15 | 250-(PVC-10) | 337,1 | 1,4466 | 4571 | 47 | 37,724 |
| TU25 | 44 | HV-03 | 500-(PRFV-6) | 1400 | 0,834 | 92554 | 38 | 34,093 |
| TU29 | NU1 | H-ALM | 1000-(PRFV-6) | 923 | 0,9129 | 206300 | 24 | 22,309 |
| TU3 | HA-45 | HA-13 | 500-(PRFV-6) | 1540 | 0,95639 | 101809 | 47 | 42,146 |
| TU35 | HA-04 | NU3 | 400-(PVC-10) | 365 | 0,91668 | 13680 | 54 | 45,723 |
| TU36 | NU3 | HA-03 | 200-(PVC-10) | 245 | 1,9803 | 2249,1 | 54 | 41,787 |
| TU37 | NU3 | HA-05 | 400-(PVC-10) | 570 | 0,55963 | 21364 | 46 | 37,327 |
| TU38 | 33 | HA-38 | 800-(PRFV-6) | 566 | 0,59884 | 74865 | 38 | 36,041 |
| TU4 | HA-08 | HA-04 | 400-(PVC-10) | 219,15 | 1,2388 | 8213,6 | 51 | 43,346 |
| TU49 | HA-05 | HA-06 | 315-(PVC-10) | 160,93 | 0,45169 | 3398,8 | 46 | 37,226 |
| TU5 | HA-09 | HA-08 | 400-(PVC-10) | 287,27 | 1,3379 | 10767 | 60 | 52,991 |
| TU50 | HA-06 | HA-07 | 250-(PVC-10) | 270,59 | 0,35853 | 3669,2 | 44 | 35,077 |
| TU6 | HA-11 | HA-09 | 400-(PVC-10) | 207,37 | 1,4509 | 7772 | 50 | 43,964 |
| TU62 | HV-12 | HV-11 | 250-(PVC-10) | 292,97 | 0,71707 | 3972,7 | 46 | 36,902 |
| TU63 | HV-10 | HV-12 | 250-(PVC-10) | 30,93 | 1,0756 | 419,41 | 46 | 37,463 |
| TU64 | HV-09 | HV-10 | 315-(PVC-10) | 282,47 | 0,99372 | 5965,7 | 46 | 37,587 |
| TU65 | HV-07 | HV-09 | 315-(PVC-10) | 218,19 | 1,2346 | 4608,1 | 44 | 36,331 |
| TU66 | HV-08 | HV-07 | 315-(PVC-10) | 330,84 | 1,3655 | 6987,4 | 43 | 36,185 |

Continúa resultados por tramos...

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Gestar2014GESTAR _2014 rev D 18/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU67 | HV-14 | HV-13 | 160-(PVC-10) | 340,36 | 0,87665 | 2055,8 | 44 | 35,653 |
| TU68 | HV-08 | HV-14 | 200-(PVC-10) | 262,19 | 1,1209 | 2406,9 | 43 | 36,263 |
| TU69 | HV-06 | HV-08 | 400-(PVC-10) | 138,83 | 1,1211 | 5203,4 | 42 | 36,745 |
| TU7 | HA-10 | HA-11 | 500-(PRFV-6) | 293,13 | 0,82048 | 19379 | 58 | 52,779 |
| TU70 | HV-03 | HV-06 | 400-(PVC-10) | 356,1 | 1,2065 | 13347 | 39 | 34,087 |
| TU73 | HV-03 | HV-02 | 200-(PVC-10) | 262,45 | 0,56045 | 2409,3 | 39 | 34,672 |
| TU74 | HV-03 | HV-04 | 315-(PVC-10) | 22,997 | 0,8281 | 485,7 | 38 | 34,05 |
| TU8 | HA-12 | HA-10 | 500-(PRFV-6) | 35,136 | 0,85131 | 2322,8 | 47 | 42,059 |
| TU9 | HA-13 | HA-12 | 500-(PRFV-6) | 45,068 | 0,90114 | 2979,4 | 58 | 53,095 |
| TU98 | HV-25 | HV-20 | 110-(PVC-10) | 44,709 | 1,8502 | 152,01 | 49 | 40,358 |
| TU99 | HV-22 | HV-25 | 160-(PVC-10) | 151,33 | 1,7533 | 914,01 | 49 | 41,656 |

** ¡Atención! Elementos TU12 , TU49 , TU50 , Velocidad de Diseño inferior a la Mínima.

** Información El Nodo HA-38 es el más desfavorable.

P Min de la Red (Dinámica) = 22,309 m (Nodo: H-ALM)
P Max de la Red (Estática) = 60 m (Nodo: HA-08)
Caudal de Inyección en Cabecera = 1,329 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 140-(PVC-10) | 4,61 | 243 | 1.119,32 |
| | | 200-(PVC-10) | 9,18 | 1.010 | 9.273,26 |
| | | 400-(PVC-10) | 37,48 | 3.214 | 120.468,30 |
| | | 250-(PVC-10) | 13,56 | 1.554 | 21.076,81 |
| | | 315-(PVC-10) | 21,12 | 1.547 | 32.679,85 |
| | | 125-(PVC-10) | 3,73 | 778 | 2.902,13 |
| | | 160-(PVC-10) | 6,04 | 1.236 | 7.467,49 |
| | | 110-(PVC-10) | 3,40 | 139 | 471,63 |
| | | 700-(PRFV-10) | 133,92 | 295 | 39.475,60 |
| PRFV | 60,0 | 500-(PRFV-6) | 66,11 | 4.376 | 289.311,30 |
| | | 800-(PRFV-6) | 132,27 | 1.065 | 140.868,90 |
| | | 600-(PRFV-6) | 82,94 | 1.396 | 115.796,30 |
| | | 1000-(PRFV-6) | 223,51 | 923 | 206.299,70 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **987.210,55 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **70.045,02 €** |
| **COSTE TOTAL ANUAL** | **70.045,02 €** |

## 1.2 RED BOMBEO 1 (ALTERNATIVAS 1, 2, 3 Y 7)

Página 1
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 425 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-40 | 353 | 37 |
| HA-36 | 359 | 34 |
| NU2 | 370 | 0 |
| HA-34 | 360 | 36 |
| HA-33 | 359 | 37 |
| HA-43 | 353 | 35 |
| HA-37 | 353 | 38 |
| HA-39 | 354 | 36 |
| HA-53 | 354 | 37 |
| HA-42 | 354 | 35 |
| HA-44 | 354 | 37 |
| HA-26 | 354 | 37 |
| HA-28 | 355 | 35 |
| HA-27 | 359 | 35 |
| HA-29 | 359 | 35 |
| HA-31 | 359 | 36 |
| HA-30 | 361 | 36 |
| HT-21 | 363 | 35 |
| HA-32 | 364 | 36 |
| HT-22 | 364 | 41 |
| NU3 | 360 | 0 |
| HV-50 | 355 | 37 |
| HV-51 | 356 | 38 |
| HV-52 | 358 | 37 |
| HV-49 | 362 | 38 |
| HV-46 | 362 | 35 |
| HV-48 | 362 | 35 |
| HV-37 | 353 | 37 |
| HV-30 | 352 | 36 |
| HV-29 | 355 | 36 |
| HV-38 | 354 | 36 |
| HV-39 | 355 | 36 |
| HV-40 | 360 | 35 |
| HV-45 | 354 | 37 |
| NU5 | 360 | 0 |
| NU4 | 360 | 0 |
| HV-47 | 368 | 36 |
| HT-06 | 360 | 36 |
| HT-07 | 357 | 39 |
| HT-62 | 373 | 37 |
| HT-08 | 366 | 35 |
| HT-09 | 364 | 35 |
| HA-21 | 345 | 42 |
| HV-44 | 351 | 36 |
| HA-24 | 351 | 35 |

Continúa nodos...

Página 2
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-25 | 352 | 38 |
| HT-11 | 353 | 37 |
| HT-10 | 355 | 36 |
| HT-12 | 361 | 36 |
| HT-13 | 357 | 37 |
| HT-14 | 357 | 35 |
| HT-17 | 357 | 38 |
| HT-16 | 357 | 35 |
| HT-18 | 358 | 36 |
| HT-15 | 357 | 38 |
| HT-20 | 362 | 44 |
| HT-19 | 367 | 42 |
| HT-28 | 367 | 39 |
| HT-23 | 368 | 37 |
| HT-24 | 370 | 35 |
| HT-27 | 371 | 37 |
| HT-26 | 373 | 38 |
| NU9 | 370 | 0 |
| HT-30 | 368 | 35 |
| NU10 | 370 | 0 |
| HT-31 | 368 | 39 |
| HT-25 | 374 | 36 |
| HT-29 | 368 | 39 |
| HT-98 | 374 | 39 |
| HT-100 | 375 | 38 |
| NU11 | 370 | 0 |
| HT-40 | 360 | 36 |
| HT-41 | 365 | 37 |
| HT-42 | 373 | 38 |
| NU13 | 370 | 0 |
| NU14 | 370 | 0 |
| HT-01 | 356 | 39 |
| HT-02 | 354 | 36 |
| NU15 | 370 | 0 |
| HT-45 | 371 | 38 |
| HT-47 | 369 | 35 |
| HT-46 | 361 | 37 |
| HT-56 | 371 | 35 |
| NU16 | 370 | 0 |
| HT-60 | 375 | 36 |
| 59 | 378 | 0 |
| 61 | 380 | 0 |
| HT-58 | 376 | 36 |
| HT-57 | 376 | 35 |
| HT-04 | 361 | 35 |
| HT-03 | 361 | 35 |
| HT-52 | 365 | 38 |
| HT-53 | 373 | 38 |
| HT-54 | 379 | 35 |
| NU17 | 370 | 0 |
| HT-51 | 372 | 37 |
| HT-50 | 371 | 40 |
| HT-44 | 369 | 40 |
| HT-48 | 363 | 37 |
| NU19 | 370 | 0 |
| HT-49 | 376 | 39 |
| NU18 | 370 | 0 |
| NU20 | 370 | 0 |
| 68 | 388 | 0 |
| 67 | 382 | 0 |
| NU21 | 370 | 0 |
| HT-34 | 372 | 35 |
| HT-33 | 373 | 36 |
| HT-35 | 374 | 37 |
| HT-36 | 375 | 36 |
| HT-37 | 376 | 35 |
| NU22 | 370 | 0 |

Continúa nodos...

Página 3
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| NU12 | 370 | 0 |
| 85 | 381 | 0 |
| 81 | 383 | 0 |
| 82 | 391 | 0 |
| HV-31 | 350 | 35 |
| HV-28 | 351 | 37 |
| HV-41 | 360 | 38 |
| HT-32 | 372 | 35 |
| HA-52 | 356 | 36 |
| HA-35 | 359 | 35 |
| 84 | 379 | 0 |
| HT-86 | 378 | 35 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HA-24 | HA-21 | 178,87 | 3,5773 | -- | 0,021 | -- | -- | 0 |
| | HA-24 | HV-44 | 259,62 | 5,1923 | -- | 0,017 | -- | -- | 0 |
| | HA-25 | HA-24 | 163,67 | 3,2735 | -- | 0,053 | -- | -- | 0 |
| | HT-11 | HA-25 | 241 | 4,82 | -- | 0,082 | -- | -- | 0 |
| | HT-10 | HT-11 | 263,55 | 5,2709 | -- | 0,08274 | -- | -- | 0 |
| | HT-13 | HT-10 | 231,24 | 4,6248 | -- | 0,27199 | -- | -- | 0 |
| | HT-13 | HT-12 | 232,45 | 4,649 | -- | 0,015 | -- | -- | 0 |
| | HT-14 | HT-13 | 156,06 | 3,1212 | -- | 0,28935 | -- | -- | 0 |
| | HT-15 | HT-14 | 230,4 | 4,6079 | -- | 0,29371 | -- | -- | 0 |
| | HT-16 | HT-17 | 34,97 | 0,6994 | -- | 0,017 | -- | -- | 0 |
| | HT-18 | HT-16 | 111,9 | 2,238 | -- | 0,032 | -- | -- | 0 |
| | HT-15 | HT-18 | 42,766 | 0,85532 | -- | 0,047 | -- | -- | 0 |
| | HT-20 | HT-15 | 350,98 | 7,0195 | -- | 0,32618 | -- | -- | 0 |
| | HT-19 | HT-20 | 400,18 | 8,0035 | -- | 0,48702 | -- | -- | 0 |
| | HT-23 | HT-19 | 246,59 | 4,9318 | -- | 0,50916 | -- | -- | 0 |
| | HT-23 | HT-28 | 55,416 | 1,1083 | -- | 0,036 | -- | -- | 0 |
| | NU9 | HT-23 | 124,98 | 2,4996 | -- | 0,53774 | -- | -- | 0 |
| | HT-27 | HT-24 | 280,78 | 5,6156 | -- | 0,015 | -- | -- | 0 |
| | HT-26 | HT-27 | 39,95 | 0,79901 | -- | 0,03 | -- | -- | 0 |
| | NU9 | HT-26 | 171,09 | 3,4219 | -- | 0,047 | -- | -- | 0 |
| | NU10 | NU9 | 222,78 | 4,4557 | -- | 0,56117 | -- | -- | 0 |
| | NU10 | HT-30 | 198,44 | 3,9688 | -- | 0,024 | -- | -- | 0 |
| | HT-25 | NU10 | 461,81 | 9,2363 | -- | 0,57551 | -- | -- | 0 |
| | HT-25 | HT-31 | 63,687 | 1,2737 | -- | 0,017 | -- | -- | 0 |
| | HT-29 | HT-25 | 122,11 | 2,4422 | -- | 0,59484 | -- | -- | 0 |
| | HT-98 | HT-29 | 79,101 | 1,582 | -- | 0,60722 | -- | -- | 0 |
| | NU11 | HT-98 | 110,42 | 2,2085 | -- | 0,61473 | -- | -- | 0 |
| | NU11 | HT-100 | 58,054 | 1,1611 | -- | 0,015 | -- | -- | 0 |
| | NU12 | NU11 | 156,87 | 3,1374 | -- | 0,62083 | -- | -- | 0 |
| | HT-41 | HT-40 | 37,444 | 0,74887 | -- | 0,015 | -- | -- | 0 |
| | NU13 | HT-41 | 330,35 | 6,6069 | -- | 0,03 | -- | -- | 0 |
| | NU13 | HT-42 | 101,24 | 2,0247 | -- | 0,015 | -- | -- | 0 |
| | NU14 | NU13 | 488,64 | 9,7729 | -- | 0,045 | -- | -- | 0 |
| | HT-44 | NU14 | 44,389 | 0,88777 | -- | 0,045 | -- | -- | 0 |
| | NU15 | HT-01 | 379,52 | 7,5904 | -- | 0,016 | -- | -- | 0 |
| | NU15 | HT-02 | 218,8 | 4,3759 | -- | 0,018 | -- | -- | 0 |
| | HT-45 | NU15 | 204,73 | 4,0947 | -- | 0,034 | -- | -- | 0 |
| | HT-47 | HT-45 | 274,37 | 5,4874 | -- | 0,049 | -- | -- | 0 |
| | HT-46 | HT-47 | 132,45 | 2,649 | -- | 0,067 | -- | -- | 0 |
| | HT-48 | HT-46 | 408,75 | 8,175 | -- | 0,07383 | -- | -- | 0 |
| | NU16 | HT-56 | 88,786 | 1,7757 | -- | 0,017 | -- | -- | 0 |
| | HT-57 | NU16 | 368,09 | 7,3619 | -- | 0,017 | -- | -- | 0 |
| | 59 | HT-60 | 222,51 | 4,4501 | -- | 0,02 | -- | -- | 0 |
| | 61 | 59 | 61,905 | 1,2381 | -- | 0,02 | -- | -- | 0 |
| | HT-58 | 61 | 119,8 | 2,3959 | -- | 0,02 | -- | -- | 0 |
| | NU17 | HT-58 | 48,295 | 0,9659 | -- | 0,037 | -- | -- | 0 |
| | NU17 | HT-57 | 74,097 | 1,482 | -- | 0,032 | -- | -- | 0 |
| | HT-03 | HT-04 | 266,55 | 5,3309 | -- | 0,015 | -- | -- | 0 |
| | HT-52 | HT-03 | 308,94 | 6,1788 | -- | 0,03 | -- | -- | 0 |
| | HT-53 | HT-52 | 305,51 | 6,1103 | -- | 0,045 | -- | -- | 0 |
| | HT-54 | HT-53 | 187,82 | 3,7564 | -- | 0,064 | -- | -- | 0 |
| | NU17 | HT-54 | 55,658 | 1,1132 | -- | 0,064 | -- | -- | 0 |

Continúa tuberías...

Página 4
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-51 | NU17 | 756,99 | 15,14 | -- | 0,10693 | -- | -- | 0 |
| | HT-50 | HT-51 | 44,914 | 0,89829 | -- | 0,11384 | -- | -- | 0 |
| | NU18 | HT-50 | 176,33 | 3,5267 | -- | 0,14021 | -- | -- | 0 |
| | NU19 | HT-44 | 104,16 | 2,0832 | -- | 0,12 | -- | -- | 0 |
| | NU19 | HT-48 | 356,08 | 7,1216 | -- | 0,08278 | -- | -- | 0 |
| | HT-49 | NU19 | 488,31 | 9,7663 | -- | 0,17987 | -- | -- | 0 |
| | NU18 | HT-49 | 135,46 | 2,7093 | -- | 0,1807 | -- | -- | 0 |
| | NU20 | NU18 | 202,72 | 4,0543 | -- | 0,28121 | -- | -- | 0 |
| | 68 | NU20 | 413,68 | 8,2736 | -- | 0,28121 | -- | -- | 0 |
| | 67 | 68 | 46,138 | 0,92275 | -- | 0,28121 | -- | -- | 0 |
| | NU21 | 67 | 442,94 | 8,8588 | -- | 0,28121 | -- | -- | 0 |
| | HT-34 | NU21 | 140,03 | 2,8005 | -- | 0,28121 | -- | -- | 0 |
| | HT-33 | HT-34 | 68,864 | 1,3773 | -- | 0,30062 | -- | -- | 0 |
| | HT-35 | HT-33 | 171,14 | 3,4227 | -- | 0,3053 | -- | -- | 0 |
| | HT-36 | HT-35 | 37,71 | 0,7542 | -- | 0,30947 | -- | -- | 0 |
| | 85 | 84 | 104,37 | 2,0874 | -- | 0,92239 | -- | -- | 0 |
| | NU22 | HT-36 | 257,41 | 5,1483 | -- | 0,33839 | -- | -- | 0 |
| | NU22 | HT-37 | 150,91 | 3,0183 | -- | 0,015 | -- | -- | 0 |
| | NU12 | NU22 | 237,25 | 4,745 | -- | 0,34514 | -- | -- | 0 |
| | HT-86 | NU12 | 122,03 | 2,4407 | -- | 0,91595 | -- | -- | 0 |
| | 84 | HT-86 | 267,32 | 5,3464 | -- | 0,92239 | -- | -- | 0 |
| | 81 | 85 | 53,066 | 1,0613 | -- | 0,92239 | -- | -- | 0 |
| | 82 | 81 | 281,87 | 5,6373 | -- | 0,92239 | -- | -- | 0 |
| | 0 | 82 | 1000 | 20 | -- | 0,92239 | -- | -- | 0 |
| | HV-31 | HV-28 | 30,132 | 0,60265 | -- | 0,015 | -- | -- | 0 |
| | HV-40 | HV-41 | 127,03 | 2,5407 | -- | 0,015 | -- | -- | 0 |
| | HT-36 | HT-32 | 127,03 | 2,5407 | -- | 0,031 | -- | -- | 0 |
| | HA-42 | HA-52 | 508,14 | 10,163 | -- | 0,015 | -- | -- | 0 |
| | HA-33 | HA-35 | 1 | 0,02 | -- | 0,015 | -- | -- | 0 |
| | NU2 | HA-40 | 387,35 | 7,7471 | -- | 0,016 | -- | -- | 0 |
| | NU2 | HA-36 | 119 | 2,38 | -- | 0,015 | -- | -- | 0 |
| | HA-33 | NU2 | 258,05 | 5,161 | -- | 0,031 | -- | -- | 0 |
| | HA-33 | HA-34 | 34,371 | 0,68742 | -- | 0,015 | -- | -- | 0 |
| | HA-29 | HA-33 | 271,78 | 5,4355 | -- | 0,06456 | -- | -- | 0 |
| | HA-42 | HA-43 | 286,4 | 5,728 | -- | 0,015 | -- | -- | 0 |
| | HA-39 | HA-37 | 38,28 | 0,76559 | -- | 0,019 | -- | -- | 0 |
| | HA-53 | HA-39 | 184,65 | 3,693 | -- | 0,034 | -- | -- | 0 |
| | HA-42 | HA-53 | 109,04 | 2,1808 | -- | 0,049 | -- | -- | 0 |
| | HA-44 | HA-42 | 241,28 | 4,8255 | -- | 0,06905 | -- | -- | 0 |
| | HA-27 | HA-44 | 274,7 | 5,4941 | -- | 0,0757 | -- | -- | 0 |
| | HA-28 | HA-26 | 196,18 | 3,9237 | -- | 0,015 | -- | -- | 0 |
| | HA-27 | HA-28 | 62,348 | 1,247 | -- | 0,03 | -- | -- | 0 |
| | HA-29 | HA-27 | 411,12 | 8,2224 | -- | 0,09244 | -- | -- | 0 |
| | HA-31 | HA-29 | 256,3 | 5,126 | -- | 0,14138 | -- | -- | 0 |
| | HA-30 | HA-31 | 44,916 | 0,89832 | -- | 0,1456 | -- | -- | 0 |
| | HT-21 | HA-30 | 85,103 | 1,7021 | -- | 0,15156 | -- | -- | 0 |
| | NU3 | HT-21 | 99,794 | 1,9959 | -- | 0,15774 | -- | -- | 0 |
| | HT-22 | HA-32 | 29,753 | 0,59506 | -- | 0,017 | -- | -- | 0 |
| | NU3 | HT-22 | 388,9 | 7,778 | -- | 0,037 | -- | -- | 0 |
| | HT-20 | NU3 | 302,54 | 6,0508 | -- | 0,17692 | -- | -- | 0 |
| | HV-52 | HV-50 | 246,95 | 4,939 | -- | 0,016 | -- | -- | 0 |
| | HV-52 | HV-51 | 174,35 | 3,4871 | -- | 0,015 | -- | -- | 0 |
| | HV-49 | HV-52 | 186,87 | 3,7373 | -- | 0,046 | -- | -- | 0 |
| | HV-48 | HV-49 | 46,959 | 0,93919 | -- | 0,061 | -- | -- | 0 |
| | HV-48 | HV-46 | 63,159 | 1,2632 | -- | 0,015 | -- | -- | 0 |
| | NU4 | HV-48 | 205,8 | 4,116 | -- | 0,06529 | -- | -- | 0 |
| | HV-30 | HV-37 | 174,78 | 3,4957 | -- | 0,015 | -- | -- | 0 |
| | HV-38 | HV-30 | 264,82 | 5,2965 | -- | 0,032 | -- | -- | 0 |
| | HV-29 | HV-31 | 134,59 | 2,6918 | -- | 0,03 | -- | -- | 0 |
| | HV-38 | HV-29 | 91,652 | 1,8331 | -- | 0,045 | -- | -- | 0 |
| | HV-39 | HV-38 | 472,28 | 9,4456 | -- | 0,06739 | -- | -- | 0 |
| | HV-40 | HV-39 | 116,76 | 2,3352 | -- | 0,07716 | -- | -- | 0 |
| | NU5 | HV-40 | 335,58 | 6,7117 | -- | 0,09201 | -- | -- | 0 |
| | NU5 | HV-45 | 107,38 | 2,1475 | -- | 0,015 | -- | -- | 0 |
| | NU4 | NU5 | 101,21 | 2,0241 | -- | 0,10205 | -- | -- | 0 |
| | HT-07 | NU4 | 298,74 | 5,9749 | -- | 0,14166 | -- | -- | 0 |
| | HT-06 | HV-47 | 107,75 | 2,155 | -- | 0,015 | -- | -- | 0 |

Continúa tuberías...

Página 5
Gestar2014GESTAR_2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-07 | HT-06 | 248,28 | 4,9656 | -- | 0,03 | -- | -- | 0 |
| | HT-10 | HT-07 | 742,23 | 14,845 | -- | 0,1821 | -- | -- | 0 |
| | HT-08 | HT-62 | 125,96 | 2,5192 | -- | 0,015 | -- | -- | 0 |
| | HT-09 | HT-08 | 79,014 | 1,5803 | -- | 0,038 | -- | -- | 0 |
| | HT-10 | HT-09 | 476,02 | 9,5204 | -- | 0,056 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |

Continúa materiales...

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Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 200 | | | |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

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Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 425

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU122 | HA-24 | HA-21 | 140-(PVC-10) | 178,87 | 1,6018 | 824,58 | 80 | 55,426 |
| TU123 | HA-24 | HV-44 | 125-(PVC-10) | 259,62 | 1,6254 | 968,37 | 74 | 47,314 |
| TU124 | HA-25 | HA-24 | 200-(PVC-10) | 163,67 | 1,9803 | 1502,5 | 74 | 52,408 |
| TU125 | HT-11 | HA-25 | 250-(PVC-10) | 241 | 1,96 | 3267,9 | 73 | 54,038 |
| TU126 | HT-10 | HT-11 | 250-(PVC-10) | 263,55 | 1,9777 | 3573,7 | 72 | 55,949 |
| TU127 | HT-13 | HT-10 | 500-(PVC-10) | 231,24 | 1,6239 | 16746 | 70 | 57,186 |
| TU128 | HT-13 | HT-12 | 110-(PVC-10) | 232,45 | 1,8502 | 790,33 | 64 | 45,309 |
| TU129 | HT-14 | HT-13 | 500-(PVC-10) | 156,06 | 1,7275 | 11302 | 68 | 56,053 |
| TU130 | HT-15 | HT-14 | 500-(PVC-10) | 230,4 | 1,7536 | 16685 | 68 | 56,709 |
| TU131 | HT-16 | HT-17 | 125-(PVC-10) | 34,97 | 1,6254 | 130,44 | 68 | 54,355 |
| TU132 | HT-18 | HT-16 | 160-(PVC-10) | 111,9 | 1,8702 | 675,87 | 68 | 55,041 |
| TU133 | HT-15 | HT-18 | 200-(PVC-10) | 42,766 | 1,7561 | 392,59 | 67 | 56,155 |
| TU134 | HT-20 | HT-15 | 500-(PRFV-10) | 350,98 | 1,6285 | 28941 | 68 | 57,705 |
| TU135 | HT-19 | HT-20 | 600-(PRFV-10) | 400,18 | 1,7935 | 42739 | 63 | 53,896 |
| TU136 | HT-23 | HT-19 | 600-(PRFV-6) | 246,59 | 1,875 | 20452 | 58 | 50,253 |
| TU137 | HT-23 | HT-28 | 200-(PVC-10) | 55,416 | 1,3451 | 508,72 | 58 | 50,716 |
| TU138 | NU9 | HT-23 | 600-(PRFV-6) | 124,98 | 1,9803 | 10366 | 57 | 50,153 |
| TU139 | HT-27 | HT-24 | 110-(PVC-10) | 280,78 | 1,8502 | 954,65 | 55 | 37,638 |
| TU140 | HT-26 | HT-27 | 160-(PVC-10) | 39,95 | 1,7533 | 241,3 | 54 | 44,784 |
| TU141 | NU9 | HT-26 | 200-(PVC-10) | 171,09 | 1,7561 | 1570,6 | 52 | 43,454 |
| TU142 | NU10 | NU9 | 700-(PRFV-10) | 222,78 | 1,5183 | 29835 | 55 | 48,657 |
| TU143 | NU10 | HT-30 | 140-(PVC-10) | 198,44 | 1,8306 | 914,8 | 57 | 46,888 |
| TU144 | HT-25 | NU10 | 700-(PRFV-10) | 461,81 | 1,5571 | 61846 | 55 | 49,116 |
| TU145 | HT-25 | HT-31 | 125-(PVC-10) | 63,687 | 1,6254 | 237,55 | 57 | 50,872 |
| TU146 | HT-29 | HT-25 | 700-(PRFV-10) | 122,11 | 1,6094 | 16353 | 51 | 46,122 |
| TU147 | HT-98 | HT-29 | 700-(PRFV-10) | 79,101 | 1,6429 | 10593 | 57 | 52,404 |
| TU148 | NU11 | HT-98 | 700-(PRFV-10) | 110,42 | 1,6632 | 14788 | 51 | 46,595 |
| TU157 | NU11 | HT-100 | 110-(PVC-10) | 58,054 | 1,8502 | 197,38 | 50 | 44,182 |
| TU158 | NU12 | NU11 | 700-(PRFV-10) | 156,87 | 1,6797 | 21008 | 55 | 50,866 |
| TU159 | HT-41 | HT-40 | 110-(PVC-10) | 37,444 | 1,8502 | 127,31 | 65 | 45,033 |
| TU160 | NU13 | HT-41 | 160-(PVC-10) | 330,35 | 1,7533 | 1995,3 | 60 | 41,119 |
| TU161 | NU13 | HT-42 | 200-(PVC-10) | 101,24 | 0,56045 | 929,35 | 52 | 38,499 |
| TU162 | NU14 | NU13 | 315-(PVC-10) | 488,64 | 0,67754 | 10320 | 55 | 41,661 |
| TU164 | HT-44 | NU14 | 315-(PVC-10) | 44,389 | 0,67754 | 937,49 | 55 | 42,301 |
| TU165 | NU15 | HT-01 | 125-(PVC-10) | 379,52 | 1,5297 | 1415,6 | 69 | 42,041 |
| TU166 | NU15 | HT-02 | 125-(PVC-10) | 218,8 | 1,721 | 816,11 | 71 | 45,937 |
| TU167 | HT-45 | NU15 | 160-(PVC-10) | 204,73 | 1,9871 | 1236,6 | 55 | 34,704 |
| TU168 | HT-47 | HT-45 | 250-(PVC-10) | 274,37 | 1,1712 | 3720,5 | 54 | 38,029 |
| TU169 | HT-46 | HT-47 | 250-(PVC-10) | 132,45 | 1,6014 | 1796 | 56 | 41,315 |
| TU170 | HT-48 | HT-46 | 315-(PVC-10) | 408,75 | 1,1116 | 8632,8 | 64 | 50,417 |
| TU171 | NU16 | HT-56 | 125-(PVC-10) | 88,786 | 1,6254 | 331,17 | 54 | 35,931 |
| TU173 | HT-57 | NU16 | 140-(PVC-10) | 368,09 | 1,2967 | 1696,9 | 55 | 38,673 |
| TU174 | 59 | HT-60 | 160-(PVC-10) | 222,51 | 1,1689 | 1343,9 | 50 | 36,247 |
| TU175 | 61 | 59 | 160-(PVC-10) | 61,905 | 1,1689 | 373,91 | 47 | 35,023 |
| TU176 | HT-58 | 61 | 200-(PVC-10) | 119,8 | 0,74727 | 1099,7 | 45 | 33,517 |
| TU177 | NU17 | HT-58 | 200-(PVC-10) | 48,295 | 1,3824 | 443,35 | 49 | 37,841 |
| TU178 | NU17 | HT-57 | 160-(PVC-10) | 74,097 | 1,8702 | 447,55 | 49 | 36,842 |
| TU179 | HT-03 | HT-04 | 125-(PVC-10) | 266,55 | 1,4341 | 994,22 | 64 | 38,695 |
| TU180 | HT-52 | HT-03 | 160-(PVC-10) | 308,94 | 1,7533 | 1866 | 64 | 42,853 |
| TU181 | HT-53 | HT-52 | 200-(PVC-10) | 305,51 | 1,6814 | 2804,6 | 60 | 44,036 |
| TU182 | HT-54 | HT-53 | 250-(PVC-10) | 187,82 | 1,5297 | 2546,8 | 52 | 39,667 |
| TU183 | NU17 | HT-54 | 315-(PVC-10) | 55,658 | 0,96361 | 1175,5 | 46 | 35,103 |
| TU184 | HT-51 | NU17 | 400-(PVC-10) | 756,99 | 0,99736 | 28372 | 55 | 44,242 |
| TU185 | HT-50 | HT-51 | 400-(PVC-10) | 44,914 | 1,0618 | 1683,4 | 53 | 43,75 |
| TU186 | NU18 | HT-50 | 400-(PVC-10) | 176,33 | 1,3078 | 6609 | 54 | 44,849 |
| TU187 | NU19 | HT-44 | 315-(PVC-10) | 104,16 | 1,8068 | 2199,9 | 56 | 43,359 |
| TU188 | NU19 | HT-48 | 400-(PVC-10) | 356,08 | 0,77211 | 13346 | 62 | 49,738 |
| TU189 | HT-49 | NU19 | 400-(PVC-10) | 488,31 | 1,6777 | 18302 | 55 | 43,182 |
| TU190 | NU18 | HT-49 | 400-(PVC-10) | 135,46 | 1,6854 | 5077,2 | 49 | 39,714 |
| TU191 | NU20 | NU18 | 500-(PRFV-6) | 202,72 | 1,3984 | 13402 | 55 | 46,422 |
| TU196 | 68 | NU20 | 500-(PRFV-6) | 413,68 | 1,3984 | 27348 | 55 | 46,936 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU197 | 67 | 68 | 500-(PRFV-6) | 46,138 | 1,3984 | 3050,2 | 37 | 29,985 |
| TU199 | NU21 | 67 | 500-(PRFV-6) | 442,94 | 1,3984 | 29283 | 43 | 36,101 |
| TU201 | HT-34 | NU21 | 500-(PRFV-6) | 140,03 | 1,3984 | 9257,2 | 55 | 49,224 |
| TU202 | HT-33 | HT-34 | 500-(PRFV-6) | 68,864 | 1,495 | 4552,6 | 53 | 47,579 |
| TU203 | HT-35 | HT-33 | 500-(PRFV-6) | 171,14 | 1,5182 | 11314 | 52 | 46,776 |
| TU204 | HT-36 | HT-35 | 500-(PRFV-6) | 37,71 | 1,539 | 2493 | 51 | 46,281 |
| TU205 | 85 | 84 | 800-(PRFV-6) | 104,37 | 1,9107 | 13805 | 46 | 43,305 |
| TU206 | NU22 | HT-36 | 600-(PRFV-6) | 257,41 | 1,2462 | 21350 | 50 | 45,395 |
| TU207 | NU22 | HT-37 | 110-(PVC-10) | 150,91 | 1,8502 | 513,11 | 49 | 40,459 |
| TU208 | NU12 | NU22 | 600-(PRFV-6) | 237,25 | 1,271 | 19677 | 55 | 50,837 |
| TU209 | HT-86 | NU12 | 800-(PRFV-6) | 122,03 | 1,8974 | 16141 | 55 | 51,259 |
| TU210 | 84 | HT-86 | 800-(PRFV-6) | 267,32 | 1,9107 | 35358 | 47 | 43,584 |
| TU228 | 81 | 85 | 800-(PRFV-6) | 53,066 | 1,9107 | 7019,1 | 44 | 41,586 |
| TU229 | 82 | 81 | 800-(PRFV-6) | 281,87 | 1,9107 | 37283 | 42 | 39,729 |
| TU242 | 0 | 82 | 900-(PRFV-6) | 1000 | 1,5063 | 160110 | 34 | 32,489 |
| TU248 | HV-31 | HV-28 | 110-(PVC-10) | 30,132 | 1,8502 | 102,45 | 74 | 44,58 |
| TU249 | HV-40 | HV-41 | 110-(PVC-10) | 127,03 | 1,8502 | 431,91 | 65 | 41,348 |
| TU251 | HT-36 | HT-32 | 160-(PVC-10) | 127,03 | 1,8118 | 767,28 | 53 | 46,131 |
| TU253 | HA-42 | HA-52 | 160-(PVC-10) | 508,14 | 0,87665 | 3069,1 | 69 | 47,24 |
| TU254 | HA-33 | HA-35 | 110-(PVC-10) | 1 | 1,8502 | 3,4 | 66 | 51,495 |
| TU30 | NU2 | HA-40 | 125-(PVC-10) | 387,35 | 1,5297 | 1444,8 | 72 | 46,125 |
| TU32 | NU2 | HA-36 | 110-(PVC-10) | 119 | 1,8502 | 404,59 | 66 | 43,474 |
| TU33 | HA-33 | NU2 | 160-(PVC-10) | 258,05 | 1,8118 | 1558,6 | 55 | 35,926 |
| TU34 | HA-33 | HA-34 | 110-(PVC-10) | 34,371 | 1,8502 | 116,86 | 65 | 49,527 |
| TU35 | HA-29 | HA-33 | 250-(PVC-10) | 271,78 | 1,5431 | 3685,3 | 66 | 51,524 |
| TU36 | HA-42 | HA-43 | 110-(PVC-10) | 286,4 | 1,8502 | 973,76 | 72 | 44,335 |
| TU37 | HA-39 | HA-37 | 125-(PVC-10) | 38,28 | 1,8166 | 142,78 | 72 | 46,306 |
| TU38 | HA-53 | HA-39 | 160-(PVC-10) | 184,65 | 1,9871 | 1115,3 | 71 | 46,228 |
| TU39 | HA-42 | HA-53 | 200-(PVC-10) | 109,04 | 1,8308 | 1001 | 71 | 50,128 |
| TU40 | HA-44 | HA-42 | 250-(PVC-10) | 241,28 | 1,6504 | 3271,7 | 71 | 51,644 |
| TU41 | HA-27 | HA-44 | 250-(PVC-10) | 274,7 | 1,8094 | 3725 | 71 | 53,766 |
| TU42 | HA-28 | HA-26 | 110-(PVC-10) | 196,18 | 1,8502 | 667,02 | 71 | 49,892 |
| TU43 | HA-27 | HA-28 | 160-(PVC-10) | 62,348 | 1,7533 | 376,58 | 70 | 54,583 |
| TU44 | HA-29 | HA-27 | 315-(PVC-10) | 411,12 | 1,3918 | 8682,8 | 66 | 51,629 |
| TU45 | HA-31 | HA-29 | 400-(PVC-10) | 256,3 | 1,3187 | 9606,1 | 66 | 53,636 |
| TU46 | HA-30 | HA-31 | 400-(PVC-10) | 44,916 | 1,358 | 1683,4 | 66 | 54,489 |
| TU47 | HT-21 | HA-30 | 400-(PVC-10) | 85,103 | 1,4136 | 3189,7 | 64 | 52,647 |
| TU48 | NU3 | HT-21 | 400-(PVC-10) | 99,794 | 1,4713 | 3740,3 | 62 | 50,968 |
| TU59 | HT-22 | HA-32 | 125-(PVC-10) | 29,753 | 1,6254 | 110,98 | 61 | 46,565 |
| TU60 | NU3 | HT-22 | 200-(PVC-10) | 388,9 | 1,3824 | 3570,1 | 61 | 47,149 |
| TU61 | HT-20 | NU3 | 400-(PVC-10) | 302,54 | 1,6502 | 11339 | 65 | 54,374 |
| TU76 | HV-52 | HV-50 | 110-(PVC-10) | 246,95 | 1,9735 | 839,63 | 70 | 39,91 |
| TU77 | HV-52 | HV-51 | 125-(PVC-10) | 174,35 | 1,4341 | 650,34 | 69 | 44,257 |
| TU78 | HV-49 | HV-52 | 200-(PVC-10) | 186,87 | 1,7187 | 1715,4 | 67 | 44,977 |
| TU79 | HV-48 | HV-49 | 250-(PVC-10) | 46,959 | 1,458 | 636,77 | 63 | 43,289 |
| TU80 | HV-48 | HV-46 | 110-(PVC-10) | 63,159 | 1,8502 | 214,74 | 63 | 41,786 |
| TU81 | NU4 | HV-48 | 250-(PVC-10) | 205,8 | 1,5606 | 2790,6 | 63 | 43,618 |
| TU82 | HV-30 | HV-37 | 160-(PVC-10) | 174,78 | 0,87665 | 1055,7 | 72 | 40,971 |
| TU83 | HV-38 | HV-30 | 160-(PVC-10) | 264,82 | 1,8702 | 1599,5 | 73 | 42,798 |
| TU84 | HV-29 | HV-31 | 160-(PVC-10) | 134,59 | 1,7533 | 812,91 | 75 | 46,454 |
| TU85 | HV-38 | HV-29 | 200-(PVC-10) | 91,652 | 1,6814 | 841,37 | 70 | 43,712 |
| TU86 | HV-39 | HV-38 | 250-(PVC-10) | 472,28 | 1,6108 | 6404,1 | 71 | 45,801 |
| TU87 | HV-40 | HV-39 | 250-(PVC-10) | 116,76 | 1,8443 | 1583,3 | 70 | 48,773 |
| TU88 | NU5 | HV-40 | 315-(PVC-10) | 335,58 | 1,3853 | 7087,5 | 65 | 45,034 |
| TU89 | NU5 | HV-45 | 110-(PVC-10) | 107,38 | 1,8502 | 365,08 | 71 | 49,543 |
| TU90 | NU4 | NU5 | 315-(PVC-10) | 101,21 | 1,5365 | 2137,5 | 65 | 46,658 |
| TU91 | HT-07 | NU4 | 400-(PVC-10) | 298,74 | 1,3213 | 11197 | 65 | 47,251 |
| TU92 | HT-06 | HV-47 | 160-(PVC-10) | 107,75 | 0,87665 | 650,81 | 57 | 38,335 |
| TU93 | HT-07 | HT-06 | 200-(PVC-10) | 248,28 | 1,1209 | 2279,2 | 65 | 46,845 |
| TU94 | HT-10 | HT-07 | 400-(PVC-10) | 742,23 | 1,6985 | 27819 | 68 | 51,248 |
| TU95 | HT-08 | HT-62 | 250-(PVC-10) | 125,96 | 0,35853 | 1708 | 52 | 38,112 |
| TU96 | HT-09 | HT-08 | 315-(PVC-10) | 79,014 | 0,57214 | 1668,8 | 59 | 45,181 |
| TU97 | HT-10 | HT-09 | 315-(PVC-10) | 476,02 | 0,84316 | 10053 | 61 | 47,257 |

** ¡Atención! Elementos TU95 , Velocidad de Diseño inferior a la Mínima.

** Información El Nodo HT-54 es el más desfavorable.

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Entidad: CINGRAL Proyecto: LICENCIA_1

P Min de la Red (Dinámica) = 29,985 m (Nodo: 68)
P Max de la Red (Estática) = 80 m (Nodo: HA-21)
Caudal de Inyección en Cabecera = 0,92239 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 125-(PVC-10) | 3,73 | 1.942 | 7.242,41 |
| | | 110-(PVC-10) | 3,40 | 1.971 | 6.702,23 |
| | | 160-(PVC-10) | 6,04 | 3.177 | 19.186,30 |
| | | 250-(PVC-10) | 13,56 | 2.855 | 38.709,80 |
| | | 200-(PVC-10) | 9,18 | 2.033 | 18.658,61 |
| | | 315-(PVC-10) | 21,12 | 2.505 | 52.895,93 |
| | | 400-(PVC-10) | 37,48 | 3.788 | 141.964,00 |
| | | 140-(PVC-10) | 4,61 | 745 | 3.436,29 |
| | | 500-(PVC-10) | 72,42 | 618 | 44.733,56 |
| | | 500-(PRFV-10) | 82,46 | 351 | 28.941,43 |
| | | 600-(PRFV-10) | 106,80 | 400 | 42.738,81 |
| | | 700-(PRFV-10) | 133,92 | 1.153 | 154.423,60 |
| PRFV | 60,0 | 600-(PRFV-6) | 82,94 | 866 | 71.845,22 |
| | | 500-(PRFV-6) | 66,11 | 1.523 | 100.699,40 |
| | | 800-(PRFV-6) | 132,27 | 829 | 109.606,50 |
| | | 900-(PRFV-6) | 160,11 | 1.000 | 160.110,00 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **1.001.894,17 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **71.086,86 €** |
| **COSTE TOTAL ANUAL** | **71.086,86 €** |

## 1.3 RED BOMBEO 2 (ALTERNATIVAS 1, 2 , 3 Y 6)

Página 1
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 442 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HS-04 | 381 | 36 |
| HS-05 | 378 | 36 |
| HS-06 | 380 | 35 |
| HT-94 | 384 | 35 |
| HT-95 | 376 | 35 |
| HT-93 | 380 | 39 |
| HT-96 | 378 | 36 |
| HT-99 | 379 | 36 |
| HT-100 | 375 | 38 |
| NU11 | 370 | 0 |
| HT-61 | 380 | 36 |
| HT-63 | 377 | 35 |
| HT-64 | 382 | 36 |
| HT-65 | 384 | 35 |
| HT-68 | 388 | 35 |
| HT-69 | 389 | 35 |
| NU12 | 370 | 0 |
| HS-07 | 389 | 36 |
| HS-01 | 387 | 37 |
| HS-02 | 387 | 38 |
| HS-03 | 384 | 36 |
| HT-91 | 390 | 35 |
| HT-92 | 397 | 25 |
| NU23 | 370 | 0 |
| HT-101 | 384 | 35 |
| HT-90 | 390 | 35 |
| HT-89 | 387 | 35 |
| NU24 | 370 | 0 |
| HT-102 | 383 | 35 |
| HT-88 | 379 | 37 |
| HT-87 | 384 | 37 |
| NU25 | 370 | 0 |
| HT-85 | 381 | 35 |
| HT-81 | 383 | 35 |
| HT-70 | 390 | 35 |
| HT-71 | 390 | 35 |
| HT-72 | 392 | 33 |
| HT-73 | 384 | 38 |
| HT-74 | 389 | 35 |
| HT-75 | 390 | 35 |
| NU26 | 370 | 0 |
| HT-77 | 388 | 35 |
| HT-79 | 391 | 34 |
| HT-78 | 388 | 35 |
| NU27 | 370 | 0 |

Continúa nodos...

Página 2
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HT-80 | 384 | 36 |
| HT-82 | 391 | 34 |
| HT-97 | 378 | 39 |
| HT-84 | 379 | 36 |
| 86 | 378 | 0 |
| HT-83 | 379 | 37 |
| HT-76 | 378 | 36 |
| HT-67 | 382 | 39 |
| HT-59 | 378 | 38 |
| HT-66 | 383 | 36 |
| HT-43 | 374 | 50 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-75 | HT-76 | 191 | 3,82 | -- | 0,015 | -- | -- | 0 |
| | HS-05 | HS-04 | 247,34 | 4,9468 | -- | 0,015 | -- | -- | 0 |
| | HS-06 | HS-05 | 43,384 | 0,86768 | -- | 0,03 | -- | -- | 0 |
| | HT-94 | HS-06 | 237,19 | 4,7438 | -- | 0,045 | -- | -- | 0 |
| | HT-93 | HT-94 | 52,6 | 1,052 | -- | 0,06 | -- | -- | 0 |
| | HT-93 | HT-95 | 110,5 | 2,2099 | -- | 0,019 | -- | -- | 0 |
| | HT-96 | HT-93 | 315,65 | 6,313 | -- | 0,07492 | -- | -- | 0 |
| | HT-99 | HT-96 | 62,348 | 1,247 | -- | 0,08627 | -- | -- | 0 |
| | HT-100 | HT-99 | 444,3 | 8,886 | -- | 0,10361 | -- | -- | 0 |
| | NU11 | HT-100 | 58,054 | 1,1611 | -- | 0,11103 | -- | -- | 0 |
| | NU12 | NU11 | 156,87 | 3,1374 | -- | 0,11103 | -- | -- | 0 |
| | HT-59 | HT-61 | 61,905 | 1,2381 | -- | 0,015 | -- | -- | 0 |
| | HT-64 | HT-63 | 179,72 | 3,5944 | -- | 0,058 | -- | -- | 0 |
| | HT-65 | HT-64 | 217,99 | 4,3597 | -- | 0,074 | -- | -- | 0 |
| | HT-66 | HT-65 | 131,63 | 2,6326 | -- | 0,09 | -- | -- | 0 |
| | HT-67 | HT-68 | 46,138 | 0,92275 | -- | 0,03 | -- | -- | 0 |
| | HT-67 | HT-69 | 64,671 | 1,2934 | -- | 0,115 | -- | -- | 0 |
| | HT-75 | HT-67 | 750 | 15 | -- | 0,16 | -- | -- | 0 |
| | HT-85 | HT-84 | 104,37 | 2,0874 | -- | 0,11859 | -- | -- | 0 |
| | 86 | NU12 | 122,03 | 2,4407 | -- | 0,11103 | -- | -- | 0 |
| | HT-84 | 86 | 267,32 | 5,3464 | -- | 0,11103 | -- | -- | 0 |
| | HS-01 | HS-07 | 31,451 | 0,62901 | -- | 0,015 | -- | -- | 0 |
| | HS-02 | HS-01 | 37,456 | 0,74911 | -- | 0,035 | -- | -- | 0 |
| | NU23 | HS-02 | 238,06 | 4,7612 | -- | 0,05 | -- | -- | 0 |
| | HT-91 | HS-03 | 145,83 | 2,9167 | -- | 0,015 | -- | -- | 0 |
| | NU23 | HT-91 | 109,62 | 2,1924 | -- | 0,03 | -- | -- | 0 |
| | NU23 | HT-92 | 165,91 | 3,3182 | -- | 0,015 | -- | -- | 0 |
| | NU24 | NU23 | 197,86 | 3,9573 | -- | 0,06897 | -- | -- | 0 |
| | HT-90 | HT-101 | 173,01 | 3,4602 | -- | 0,015 | -- | -- | 0 |
| | HT-89 | HT-90 | 66,09 | 1,3218 | -- | 0,03 | -- | -- | 0 |
| | NU24 | HT-89 | 167,32 | 3,3464 | -- | 0,045 | -- | -- | 0 |
| | HT-102 | NU24 | 117,03 | 2,3407 | -- | 0,0917 | -- | -- | 0 |
| | NU25 | HT-102 | 413,91 | 8,2783 | -- | 0,09991 | -- | -- | 0 |
| | NU25 | HT-88 | 276,06 | 5,5212 | -- | 0,015 | -- | -- | 0 |
| | NU25 | HT-87 | 136,68 | 2,7336 | -- | 0,015 | -- | -- | 0 |
| | HT-85 | NU25 | 271,86 | 5,4373 | -- | 0,10794 | -- | -- | 0 |
| | HT-84 | HT-83 | 69,83 | 1,3966 | -- | 0,015 | -- | -- | 0 |
| | HT-81 | HT-85 | 53,066 | 1,0613 | -- | 0,20579 | -- | -- | 0 |
| | HT-82 | HT-81 | 281,87 | 5,6373 | -- | 0,21048 | -- | -- | 0 |
| | HT-71 | HT-70 | 245,8 | 4,916 | -- | 0,022 | -- | -- | 0 |
| | HT-72 | HT-71 | 28,566 | 0,57131 | -- | 0,037 | -- | -- | 0 |
| | HT-74 | HT-72 | 836,44 | 16,729 | -- | 0,116 | -- | -- | 0 |
| | HT-74 | HT-73 | 237,42 | 4,7483 | -- | 0,12164 | -- | -- | 0 |
| | NU26 | HT-74 | 338,42 | 6,7684 | -- | 0,22384 | -- | -- | 0 |
| | NU26 | HT-75 | 57,91 | 1,1582 | -- | 0,19435 | -- | -- | 0 |
| | HT-77 | NU26 | 285,39 | 5,7079 | -- | 0,35324 | -- | -- | 0 |
| | NU27 | HT-77 | 384,3 | 7,686 | -- | 0,35703 | -- | -- | 0 |
| | HT-78 | HT-79 | 101,85 | 2,0371 | -- | 0,015 | -- | -- | 0 |
| | NU27 | HT-78 | 178,72 | 3,5745 | -- | 0,03 | -- | -- | 0 |
| | HT-80 | NU27 | 175,58 | 3,5116 | -- | 0,37075 | -- | -- | 0 |
| | HT-82 | HT-80 | 272,7 | 5,4541 | -- | 0,37075 | -- | -- | 0 |
| | 0 | HT-82 | 1900 | 38 | -- | 0,54981 | -- | -- | 0 |
| | HT-99 | HT-97 | 127,03 | 2,5407 | -- | 0,015 | -- | -- | 0 |

Continúa tuberías...

Página 3
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-69 | HT-59 | 1100 | 22 | -- | 0,032 | -- | -- | 0 |
| | HT-73 | HT-66 | 280 | 5,6 | -- | 0,10516 | -- | -- | 0 |
| | HT-63 | HT-43 | 440 | 8,8 | -- | 0,043 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |

Continúa materiales...

Página 4
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 200 | | | |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

Página 5
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 442

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | HT-75 | HT-76 | 110-(PVC-10) | 191 | 1,8502 | 649,4 | 64 | 49,772 |
| TU149 | HS-05 | HS-04 | 160-(PVC-10) | 247,34 | 0,87665 | 1493,9 | 61 | 39,217 |
| TU150 | HS-06 | HS-05 | 200-(PVC-10) | 43,384 | 1,1209 | 398,27 | 64 | 43,387 |
| TU151 | HT-94 | HS-06 | 200-(PVC-10) | 237,19 | 1,6814 | 2177,4 | 62 | 41,633 |
| TU152 | HT-93 | HT-94 | 250-(PVC-10) | 52,6 | 1,4341 | 713,26 | 58 | 40,451 |
| TU153 | HT-93 | HT-95 | 125-(PVC-10) | 110,5 | 1,8166 | 412,15 | 66 | 46,15 |
| TU154 | HT-96 | HT-93 | 250-(PVC-10) | 315,65 | 1,7908 | 4280,2 | 62 | 44,808 |
| TU155 | HT-99 | HT-96 | 315-(PVC-10) | 62,348 | 1,2989 | 1316,8 | 64 | 50,036 |
| TU156 | HT-100 | HT-99 | 315-(PVC-10) | 444,3 | 1,56 | 9383,6 | 63 | 49,304 |
| TU157 | NU11 | HT-100 | 315-(PVC-10) | 58,054 | 1,6717 | 1226,1 | 67 | 55,98 |
| TU158 | NU12 | NU11 | 315-(PVC-10) | 156,87 | 1,6717 | 3313,1 | 72 | 61,377 |
| TU175 | HT-59 | HT-61 | 160-(PVC-10) | 61,905 | 0,87665 | 373,91 | 62 | 42,42 |
| TU192 | HT-64 | HT-63 | 315-(PVC-10) | 179,72 | 0,87327 | 3795,7 | 65 | 50,425 |
| TU193 | HT-65 | HT-64 | 315-(PVC-10) | 217,99 | 1,1142 | 4603,9 | 60 | 45,799 |
| TU194 | HT-66 | HT-65 | 315-(PVC-10) | 131,63 | 1,3551 | 2780 | 58 | 44,506 |
| TU197 | HT-67 | HT-68 | 160-(PVC-10) | 46,138 | 1,7533 | 278,67 | 54 | 41,406 |
| TU198 | HT-67 | HT-69 | 315-(PVC-10) | 64,671 | 1,7315 | 1365,8 | 53 | 40,708 |
| TU2 | HT-75 | HT-67 | 400-(PVC-10) | 750 | 1,4924 | 28110 | 60 | 48,18 |
| TU205 | HT-85 | HT-84 | 315-(PVC-10) | 104,37 | 1,7855 | 2204,3 | 63 | 56,115 |
| TU209 | 86 | NU12 | 315-(PVC-10) | 122,03 | 1,6717 | 2577,4 | 72 | 62,45 |
| TU210 | HT-84 | 86 | 315-(PVC-10) | 267,32 | 1,6717 | 5645,8 | 64 | 55,285 |
| TU211 | HS-01 | HS-07 | 160-(PVC-10) | 31,451 | 0,87665 | 189,96 | 53 | 36,66 |
| TU212 | HS-02 | HS-01 | 200-(PVC-10) | 37,456 | 1,3077 | 343,84 | 55 | 38,809 |
| TU213 | NU23 | HS-02 | 200-(PVC-10) | 238,06 | 1,8682 | 2185,4 | 55 | 39,089 |
| TU214 | HT-91 | HS-03 | 110-(PVC-10) | 145,83 | 1,8502 | 495,84 | 58 | 39,454 |
| TU215 | NU23 | HT-91 | 160-(PVC-10) | 109,62 | 1,7533 | 662,12 | 52 | 37,685 |
| TU216 | NU23 | HT-92 | 110-(PVC-10) | 165,91 | 1,8502 | 564,09 | 45 | 27,711 |
| TU217 | NU24 | NU23 | 250-(PVC-10) | 197,86 | 1,6485 | 2683 | 72 | 59,524 |
| TU218 | HT-90 | HT-101 | 110-(PVC-10) | 173,01 | 1,8502 | 588,23 | 58 | 39,145 |
| TU219 | HT-89 | HT-90 | 160-(PVC-10) | 66,09 | 1,7533 | 399,18 | 52 | 38,164 |
| TU220 | NU24 | HT-89 | 200-(PVC-10) | 167,32 | 1,6814 | 1536 | 55 | 42,272 |
| TU221 | HT-102 | NU24 | 315-(PVC-10) | 117,03 | 1,3807 | 2471,7 | 72 | 61,261 |
| TU222 | NU25 | HT-102 | 315-(PVC-10) | 413,91 | 1,5043 | 8741,8 | 59 | 48,824 |
| TU223 | NU25 | HT-88 | 110-(PVC-10) | 276,06 | 1,8502 | 938,61 | 63 | 47,146 |
| TU224 | NU25 | HT-87 | 110-(PVC-10) | 136,68 | 1,8502 | 464,72 | 58 | 46,19 |
| TU225 | HT-85 | NU25 | 315-(PVC-10) | 271,86 | 1,6252 | 5741,7 | 72 | 64,155 |
| TU226 | HT-84 | HT-83 | 110-(PVC-10) | 69,83 | 1,8502 | 237,42 | 63 | 54,089 |
| TU228 | HT-81 | HT-85 | 400-(PVC-10) | 53,066 | 1,9194 | 1988,9 | 61 | 54,921 |
| TU229 | HT-82 | HT-81 | 400-(PVC-10) | 281,87 | 1,9632 | 10564 | 59 | 53,274 |
| TU230 | HT-71 | HT-70 | 200-(PVC-10) | 245,8 | 0,822 | 2256,5 | 52 | 35,542 |
| TU231 | HT-72 | HT-71 | 200-(PVC-10) | 28,566 | 1,3824 | 262,23 | 52 | 36,332 |
| TU232 | HT-74 | HT-72 | 315-(PVC-10) | 836,44 | 1,7465 | 17666 | 50 | 34,569 |
| TU233 | HT-74 | HT-73 | 315-(PVC-10) | 237,42 | 1,8315 | 5014,2 | 58 | 46,851 |
| TU234 | NU26 | HT-74 | 500-(PVC-10) | 338,42 | 1,3364 | 24508 | 53 | 43,774 |
| TU235 | NU26 | HT-75 | 400-(PVC-10) | 57,91 | 1,8127 | 2170,5 | 52 | 43,313 |
| TU236 | HT-77 | NU26 | 500-(PRFV-10) | 285,39 | 1,7636 | 23534 | 72 | 63,66 |
| TU237 | NU27 | HT-77 | 500-(PRFV-10) | 384,3 | 1,7825 | 31689 | 54 | 46,782 |
| TU238 | HT-78 | HT-79 | 110-(PVC-10) | 101,85 | 1,8502 | 346,3 | 51 | 39,37 |
| TU239 | NU27 | HT-78 | 160-(PVC-10) | 178,72 | 1,7533 | 1079,5 | 54 | 45,325 |
| TU240 | HT-80 | NU27 | 500-(PRFV-10) | 175,58 | 1,851 | 14478 | 72 | 66,323 |
| TU241 | HT-82 | HT-80 | 500-(PRFV-6) | 272,7 | 1,8437 | 18028 | 58 | 53,078 |
| TU242 | 0 | HT-82 | 700-(PRFV-10) | 1900 | 1,4876 | 254448 | 51 | 47,229 |
| TU252 | HT-99 | HT-97 | 110-(PVC-10) | 127,03 | 1,8502 | 431,91 | 64 | 46,618 |
| TU3 | HT-69 | HT-59 | 200-(PVC-10) | 1100 | 1,1956 | 10098 | 64 | 44,713 |
| TU4 | HT-73 | HT-66 | 315-(PVC-10) | 280 | 1,5833 | 5913,6 | 59 | 46,118 |
| TU5 | HT-63 | HT-43 | 250-(PVC-10) | 440 | 1,0278 | 5966,4 | 68 | 51,801 |

** Información El Nodo HT-43 es el más desfavorable.

P Min de la Red (Dinámica) = 27,711 m (Nodo: HT-92)
P Max de la Red (Estática) = 72 m (Nodo: NU11)
Caudal de Inyección en Cabecera = 0,54981 m3/s

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DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 160-(PVC-10) | 6,04 | 741 | 4.477,28 |
| | | 200-(PVC-10) | 9,18 | 2.098 | 19.257,60 |
| | | 250-(PVC-10) | 13,56 | 1.006 | 13.642,90 |
| | | 125-(PVC-10) | 3,73 | 110 | 412,15 |
| | | 315-(PVC-10) | 21,12 | 3.966 | 83.761,28 |
| | | 110-(PVC-10) | 3,40 | 1.387 | 4.716,52 |
| | | 400-(PVC-10) | 37,48 | 1.143 | 42.833,76 |
| | | 500-(PVC-10) | 72,42 | 338 | 24.508,46 |
| | | 500-(PRFV-10) | 82,46 | 845 | 69.701,38 |
| | | 700-(PRFV-10) | 133,92 | 1.900 | 254.448,00 |
| PRFV | 60,0 | 500-(PRFV-6) | 66,11 | 273 | 18.028,38 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **535.787,71 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **38.015,46 €** |
| **COSTE TOTAL ANUAL** | **38.015,46 €** |

## 1.4 RED BOMBEO 1 (ALTERNATIVAS 4 Y 5)

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### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 420 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-01 | 331 | 40 |
| HA-02 | 336 | 36 |
| HA-04 | 338 | 38 |
| HA-08 | 329 | 35 |
| HA-09 | 339 | 35 |
| HA-11 | 331 | 38 |
| HA-10 | 342 | 35 |
| HA-12 | 331 | 35 |
| HV-35 | 351 | 37 |
| HA-15 | 348 | 35 |
| HA-17 | 334 | 38 |
| HA-14 | 341 | 35 |
| HA-18 | 335 | 35 |
| HA-50 | 340 | 37 |
| HA-45 | 334 | 38 |
| HA-49 | 337 | 38 |
| HA-48 | 337 | 39 |
| HA-41 | 346 | 39 |
| HA-51 | 343 | 38 |
| HA-46 | 348 | 35 |
| HA-47 | 349 | 35 |
| HA-40 | 353 | 37 |
| HA-36 | 359 | 34 |
| NU2 | 360 | 0 |
| HA-34 | 360 | 36 |
| HA-33 | 359 | 37 |
| HA-43 | 353 | 35 |
| HA-37 | 353 | 38 |
| HA-39 | 354 | 36 |
| HA-53 | 354 | 37 |
| HA-42 | 354 | 35 |
| HA-44 | 354 | 37 |
| HA-26 | 354 | 37 |
| HA-28 | 355 | 35 |
| HA-27 | 359 | 35 |
| HA-29 | 359 | 35 |
| HA-31 | 359 | 36 |
| HA-30 | 361 | 36 |
| HT-21 | 363 | 35 |
| HA-06 | 343 | 35 |
| HA-07 | 345 | 35 |
| HA-32 | 364 | 36 |
| 22 | 364 | 0 |
| NU3 | 360 | 0 |
| HV-11 | 343 | 36 |

Continúa nodos...

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NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HV-12 | 343 | 36 |
| HV-10 | 343 | 35 |
| HV-09 | 345 | 36 |
| HV-07 | 346 | 35 |
| HV-13 | 345 | 35 |
| HV-14 | 346 | 36 |
| HV-08 | 347 | 35 |
| HV-06 | 350 | 35 |
| HT-05 | 355 | 35 |
| HV-01 | 350 | 38 |
| HV-02 | 350 | 35 |
| HV-03 | 351 | 35 |
| HV-50 | 355 | 37 |
| HV-51 | 356 | 38 |
| HV-52 | 358 | 37 |
| HV-49 | 362 | 38 |
| HV-46 | 362 | 35 |
| HV-48 | 362 | 35 |
| HV-37 | 353 | 37 |
| HV-30 | 352 | 36 |
| HV-29 | 355 | 36 |
| HV-38 | 354 | 36 |
| HV-39 | 355 | 36 |
| HV-40 | 360 | 35 |
| HV-45 | 354 | 37 |
| NU5 | 360 | 0 |
| NU4 | 360 | 0 |
| HV-47 | 368 | 36 |
| HT-06 | 360 | 36 |
| HT-07 | 357 | 39 |
| HT-08 | 366 | 35 |
| HT-09 | 364 | 35 |
| HV-20 | 340 | 35 |
| HV-25 | 340 | 35 |
| HV-22 | 343 | 35 |
| HV-16 | 340 | 36 |
| HV-17 | 342 | 35 |
| HV-26 | 342 | 37 |
| HV-23 | 351 | 35 |
| HV-24 | 350 | 36 |
| NU6 | 360 | 0 |
| HV-21 | 343 | 37 |
| HV-34 | 343 | 37 |
| HV-33 | 351 | 35 |
| HV-36 | 351 | 35 |
| HV-43 | 345 | 35 |
| HV-42 | 346 | 35 |
| HA-16 | 340 | 35 |
| NU7 | 360 | 0 |
| HA-19 | 342 | 35 |
| HA-20 | 344 | 35 |
| HA-22 | 345 | 37 |
| NU8 | 360 | 0 |
| HA-23 | 346 | 37 |
| HA-21 | 345 | 42 |
| HV-44 | 351 | 36 |
| HA-24 | 351 | 35 |
| HA-25 | 352 | 38 |
| HT-11 | 353 | 37 |
| HT-10 | 355 | 36 |
| HT-12 | 361 | 36 |
| HT-13 | 357 | 37 |
| HT-14 | 357 | 35 |
| HT-17 | 357 | 38 |
| HT-16 | 357 | 35 |
| HT-18 | 358 | 36 |
| HT-15 | 357 | 38 |

Continúa nodos...

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NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 20 | 362 | 0 |
| 19 | 367 | 0 |
| 23 | 368 | 0 |
| NU9 | 370 | 0 |
| NU10 | 370 | 0 |
| 25 | 374 | 0 |
| 29 | 368 | 0 |
| 98 | 374 | 0 |
| NU11 | 370 | 0 |
| HT-40 | 360 | 36 |
| HT-01 | 356 | 39 |
| NU15 | 370 | 0 |
| HT-45 | 371 | 38 |
| HT-47 | 369 | 35 |
| HT-46 | 361 | 37 |
| HT-48 | 363 | 37 |
| HT-03 | 361 | 35 |
| HT-52 | 365 | 38 |
| NU12 | 370 | 0 |
| 85 | 381 | 0 |
| 81 | 383 | 0 |
| 82 | 391 | 0 |
| HV-04 | 351 | 35 |
| HV-05 | 346 | 35 |
| HV-18 | 342 | 35 |
| HV-19 | 342 | 37 |
| HV-27 | 342 | 35 |
| HV-15 | 342 | 36 |
| HV-31 | 350 | 35 |
| HV-28 | 351 | 37 |
| HV-41 | 360 | 38 |
| HV-32 | 351 | 36 |
| HA-52 | 356 | 36 |
| HA-35 | 359 | 35 |
| 84 | 379 | 0 |
| 86 | 378 | 0 |
| H-ALM | 365 | 35 |
| NU29 | 330 | 0 |
| HA-05 | 343 | 36 |
| HA-03 | 335 | 39 |
| HA-38 | 351 | 36 |
| HA-13 | 342 | 38 |
| HT-04 | 361 | 35 |
| HT-02 | 354 | 36 |
| HT-41 | 365 | 37 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HA-02 | HA-01 | 242,8 | 4,8561 | -- | 0,02 | -- | -- | 0 |
| | HT-05 | HT-04 | 294 | 5,88 | -- | 0,045 | -- | -- | 0 |
| | HV-24 | HV-22 | 93,163 | 1,8633 | -- | 0,045 | -- | -- | 0 |
| | HV-17 | HV-16 | 100,05 | 2,001 | -- | 0,015 | -- | -- | 0 |
| | HV-19 | HV-17 | 56,789 | 1,1358 | -- | 0,03 | -- | -- | 0 |
| | HV-15 | HV-18 | 22,392 | 0,44784 | -- | 0,06 | -- | -- | 0 |
| | HV-26 | HV-27 | 23,604 | 0,47208 | -- | 0,06829 | -- | -- | 0 |
| | HV-23 | HV-26 | 281,38 | 5,6277 | -- | 0,07502 | -- | -- | 0 |
| | NU6 | HV-23 | 120,48 | 2,4096 | -- | 0,08356 | -- | -- | 0 |
| | NU6 | HV-24 | 114,4 | 2,288 | -- | 0,06 | -- | -- | 0 |
| | HV-21 | NU6 | 227,17 | 4,5434 | -- | 0,10773 | -- | -- | 0 |
| | HV-34 | HV-21 | 27,484 | 0,54969 | -- | 0,11447 | -- | -- | 0 |
| | HV-01 | HT-02 | 608 | 12,16 | -- | 0,09982 | -- | -- | 0 |
| | HV-33 | HV-34 | 384,41 | 7,6883 | -- | 0,1201 | -- | -- | 0 |
| | HV-36 | HV-33 | 120,72 | 2,4144 | -- | 0,16472 | -- | -- | 0 |
| | NU7 | HV-36 | 323,29 | 6,4658 | -- | 0,18931 | -- | -- | 0 |
| | HV-42 | HV-43 | 209 | 4,1799 | -- | 0,015 | -- | -- | 0 |
| | NU7 | HV-42 | 103,61 | 2,0723 | -- | 0,03 | -- | -- | 0 |
| | NU7 | HA-16 | 88,858 | 1,7772 | -- | 0,018 | -- | -- | 0 |

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TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HA-19 | NU7 | 141,87 | 2,8373 | -- | 0,21684 | -- | -- | 0 |
| | HA-20 | HA-19 | 198,05 | 3,961 | -- | 0,22636 | -- | -- | 0 |
| | NU8 | HA-20 | 272,94 | 5,4587 | -- | 0,236 | -- | -- | 0 |
| | NU8 | HA-22 | 94,004 | 1,8801 | -- | 0,015 | -- | -- | 0 |
| | HA-15 | HV-35 | 177,92 | 3,5584 | -- | 0,015 | -- | -- | 0 |
| | HA-23 | NU8 | 294,77 | 5,8954 | -- | 0,24203 | -- | -- | 0 |
| | HA-21 | HA-23 | 226,44 | 4,5289 | -- | 0,25478 | -- | -- | 0 |
| | HA-24 | HA-21 | 178,87 | 3,5773 | -- | 0,26787 | -- | -- | 0 |
| | HA-24 | HV-44 | 259,62 | 5,1923 | -- | 0,017 | -- | -- | 0 |
| | HA-25 | HA-24 | 163,67 | 3,2735 | -- | 0,28596 | -- | -- | 0 |
| | HT-11 | HA-25 | 241 | 4,82 | -- | 0,30433 | -- | -- | 0 |
| | HT-10 | HT-11 | 263,55 | 5,2709 | -- | 0,30785 | -- | -- | 0 |
| | HT-13 | HT-10 | 231,24 | 4,6248 | -- | 0,71492 | -- | -- | 0 |
| | HT-13 | HT-12 | 232,45 | 4,649 | -- | 0,015 | -- | -- | 0 |
| | HT-14 | HT-13 | 156,06 | 3,1212 | -- | 0,73153 | -- | -- | 0 |
| | HA-14 | HA-15 | 234,63 | 4,6926 | -- | 0,035 | -- | -- | 0 |
| | HT-15 | HT-14 | 230,4 | 4,6079 | -- | 0,73565 | -- | -- | 0 |
| | HT-16 | HT-17 | 34,97 | 0,6994 | -- | 0,017 | -- | -- | 0 |
| | HT-18 | HT-16 | 111,9 | 2,238 | -- | 0,032 | -- | -- | 0 |
| | HT-15 | HT-18 | 42,766 | 0,85532 | -- | 0,047 | -- | -- | 0 |
| | 20 | HT-15 | 350,98 | 7,0195 | -- | 0,76661 | -- | -- | 0 |
| | 19 | 20 | 400,18 | 8,0035 | -- | 1,9141 | -- | -- | 0 |
| | 23 | 19 | 246,59 | 4,9318 | -- | 1,9141 | -- | -- | 0 |
| | NU9 | 23 | 124,98 | 2,4996 | -- | 1,9141 | -- | -- | 0 |
| | HA-14 | HA-17 | 307,32 | 6,1465 | -- | 0,017 | -- | -- | 0 |
| | NU10 | NU9 | 222,78 | 4,4556 | -- | 1,9141 | -- | -- | 0 |
| | 25 | NU10 | 461,81 | 9,2363 | -- | 1,9141 | -- | -- | 0 |
| | 29 | 25 | 122,11 | 2,4422 | -- | 1,9141 | -- | -- | 0 |
| | 98 | 29 | 79,101 | 1,582 | -- | 1,9141 | -- | -- | 0 |
| | NU11 | 98 | 110,42 | 2,2085 | -- | 1,9141 | -- | -- | 0 |
| | HA-18 | HA-14 | 297,29 | 5,9458 | -- | 0,068 | -- | -- | 0 |
| | NU12 | NU11 | 156,87 | 3,1374 | -- | 1,9141 | -- | -- | 0 |
| | HT-41 | HT-40 | 37,444 | 0,74887 | -- | 0,015 | -- | -- | 0 |
| | HA-50 | HA-18 | 409,85 | 8,197 | -- | 0,07154 | -- | -- | 0 |
| | NU15 | HT-01 | 379,52 | 7,5904 | -- | 0,046 | -- | -- | 0 |
| | HT-02 | NU15 | 218,8 | 4,376 | -- | 0,08699 | -- | -- | 0 |
| | NU15 | HT-45 | 204,73 | 4,0946 | -- | 0,063 | -- | -- | 0 |
| | HT-45 | HT-47 | 274,37 | 5,4874 | -- | 0,048 | -- | -- | 0 |
| | HT-47 | HT-46 | 132,45 | 2,649 | -- | 0,03 | -- | -- | 0 |
| | HA-51 | HA-50 | 171,1 | 3,4221 | -- | 0,07875 | -- | -- | 0 |
| | HT-46 | HT-48 | 408,75 | 8,175 | -- | 0,015 | -- | -- | 0 |
| | HT-04 | HT-03 | 266,55 | 5,331 | -- | 0,03 | -- | -- | 0 |
| | HA-49 | HA-45 | 149,42 | 2,9883 | -- | 0,19613 | -- | -- | 0 |
| | HT-03 | HT-52 | 308,94 | 6,1788 | -- | 0,015 | -- | -- | 0 |
| | HA-48 | HA-49 | 30,33 | 0,60659 | -- | 0,20222 | -- | -- | 0 |
| | HA-03 | HA-02 | 147,35 | 2,947 | -- | 0,038 | -- | -- | 0 |
| | HA-51 | HA-48 | 377,99 | 7,5599 | -- | 0,20702 | -- | -- | 0 |
| | 85 | 84 | 104,37 | 2,0874 | -- | 1,9141 | -- | -- | 0 |
| | 86 | NU12 | 122,03 | 2,4407 | -- | 1,9141 | -- | -- | 0 |
| | HA-38 | HA-41 | 260,79 | 5,2158 | -- | 0,27778 | -- | -- | 0 |
| | 84 | 86 | 267,32 | 5,3464 | -- | 1,9141 | -- | -- | 0 |
| | HA-41 | HA-51 | 238,22 | 4,7644 | -- | 0,26987 | -- | -- | 0 |
| | 22 | H-ALM | 470 | 9,4 | -- | 0,69 | -- | -- | 0 |
| | 81 | 85 | 53,066 | 1,0613 | -- | 1,9141 | -- | -- | 0 |
| | 82 | 81 | 281,87 | 5,6373 | -- | 1,9141 | -- | -- | 0 |
| | HA-51 | HA-46 | 102,26 | 2,0452 | -- | 0,03 | -- | -- | 0 |
| | HA-46 | HA-47 | 72,821 | 1,4564 | -- | 0,015 | -- | -- | 0 |
| | 0 | 82 | 1000 | 20 | -- | 1,9141 | -- | -- | 0 |
| | HV-04 | HV-05 | 481,99 | 9,6398 | -- | 0,015 | -- | -- | 0 |
| | HV-18 | HV-19 | 117,45 | 2,349 | -- | 0,045 | -- | -- | 0 |
| | HV-27 | HV-15 | 337,1 | 6,7419 | -- | 0,06 | -- | -- | 0 |
| | HV-31 | HV-28 | 30,132 | 0,60265 | -- | 0,015 | -- | -- | 0 |
| | HV-40 | HV-41 | 127,03 | 2,5407 | -- | 0,015 | -- | -- | 0 |
| | HT-01 | HT-41 | 700 | 14 | -- | 0,03 | -- | -- | 0 |
| | HV-33 | HV-32 | 127,03 | 2,5407 | -- | 0,019 | -- | -- | 0 |
| | HA-42 | HA-52 | 508,14 | 10,163 | -- | 0,015 | -- | -- | 0 |
| | HA-33 | HA-35 | 1 | 0,02 | -- | 0,015 | -- | -- | 0 |

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TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | NU29 | HA-03 | 225 | 4,5 | -- | 0,053 | -- | -- | 0 |
| | HA-45 | HA-13 | 1537 | 30,74 | -- | 0,19014 | -- | -- | 0 |
| | HA-40 | HA-38 | 495 | 9,9 | -- | 0,28406 | -- | -- | 0 |
| | NU2 | HA-40 | 387,35 | 7,7471 | -- | 0,29331 | -- | -- | 0 |
| | NU2 | HA-36 | 119 | 2,38 | -- | 0,015 | -- | -- | 0 |
| | HA-33 | NU2 | 258,05 | 5,161 | -- | 0,30216 | -- | -- | 0 |
| | HA-33 | HA-34 | 34,371 | 0,68742 | -- | 0,015 | -- | -- | 0 |
| | HA-29 | HA-33 | 271,78 | 5,4355 | -- | 0,32488 | -- | -- | 0 |
| | HA-42 | HA-43 | 286,4 | 5,728 | -- | 0,015 | -- | -- | 0 |
| | HA-39 | HA-37 | 38,28 | 0,76559 | -- | 0,019 | -- | -- | 0 |
| | HA-53 | HA-39 | 184,65 | 3,693 | -- | 0,034 | -- | -- | 0 |
| | HA-42 | HA-53 | 109,04 | 2,1808 | -- | 0,049 | -- | -- | 0 |
| | HA-08 | HA-04 | 219,15 | 4,3829 | -- | 0,13304 | -- | -- | 0 |
| | HA-44 | HA-42 | 241,28 | 4,8255 | -- | 0,06905 | -- | -- | 0 |
| | HA-27 | HA-44 | 274,7 | 5,4941 | -- | 0,0757 | -- | -- | 0 |
| | HA-28 | HA-26 | 196,18 | 3,9237 | -- | 0,015 | -- | -- | 0 |
| | HA-27 | HA-28 | 62,348 | 1,247 | -- | 0,03 | -- | -- | 0 |
| | HA-29 | HA-27 | 411,12 | 8,2224 | -- | 0,09244 | -- | -- | 0 |
| | HA-31 | HA-29 | 256,3 | 5,126 | -- | 0,3948 | -- | -- | 0 |
| | HA-30 | HA-31 | 44,916 | 0,89832 | -- | 0,39854 | -- | -- | 0 |
| | HT-21 | HA-30 | 85,103 | 1,7021 | -- | 0,40391 | -- | -- | 0 |
| | NU3 | HT-21 | 99,794 | 1,9959 | -- | 0,40952 | -- | -- | 0 |
| | HA-05 | HA-06 | 160,93 | 3,2186 | -- | 0,03 | -- | -- | 0 |
| | HA-09 | HA-08 | 287,27 | 5,7453 | -- | 0,14333 | -- | -- | 0 |
| | HA-06 | HA-07 | 270,59 | 5,4118 | -- | 0,015 | -- | -- | 0 |
| | HA-04 | NU29 | 377 | 7,54 | -- | 0,09914 | -- | -- | 0 |
| | NU29 | HA-05 | 535 | 10,7 | -- | 0,064 | -- | -- | 0 |
| | 22 | HA-32 | 29,753 | 0,59506 | -- | 0,017 | -- | -- | 0 |
| | HA-11 | HA-09 | 207,37 | 4,1473 | -- | 0,15507 | -- | -- | 0 |
| | NU3 | 22 | 388,9 | 7,778 | -- | 0,707 | -- | -- | 0 |
| | 20 | NU3 | 302,54 | 6,0508 | -- | 1,2384 | -- | -- | 0 |
| | HV-12 | HV-11 | 292,97 | 5,8594 | -- | 0,03 | -- | -- | 0 |
| | HV-10 | HV-12 | 30,93 | 0,61861 | -- | 0,045 | -- | -- | 0 |
| | HV-09 | HV-10 | 282,47 | 5,6493 | -- | 0,066 | -- | -- | 0 |
| | HV-07 | HV-09 | 218,19 | 4,3637 | -- | 0,082 | -- | -- | 0 |
| | HV-08 | HV-07 | 330,84 | 6,6168 | -- | 0,0892 | -- | -- | 0 |
| | HV-14 | HV-13 | 340,36 | 6,8072 | -- | 0,015 | -- | -- | 0 |
| | HV-08 | HV-14 | 262,19 | 5,2439 | -- | 0,03 | -- | -- | 0 |
| | HV-06 | HV-08 | 138,83 | 2,7766 | -- | 0,11801 | -- | -- | 0 |
| | HA-10 | HA-11 | 293,13 | 5,8626 | -- | 0,16421 | -- | -- | 0 |
| | HV-03 | HV-06 | 356,1 | 7,122 | -- | 0,12693 | -- | -- | 0 |
| | HV-01 | HT-05 | 46,444 | 0,92888 | -- | 0,061 | -- | -- | 0 |
| | HV-02 | HV-01 | 85,694 | 1,7139 | -- | 0,13338 | -- | -- | 0 |
| | HV-03 | HV-02 | 262,45 | 5,249 | -- | 0,14098 | -- | -- | 0 |
| | HV-03 | HV-04 | 22,997 | 0,45994 | -- | 0,055 | -- | -- | 0 |
| | HV-50 | HV-03 | 160,94 | 3,2188 | -- | 0,26635 | -- | -- | 0 |
| | HV-52 | HV-50 | 246,95 | 4,939 | -- | 0,27569 | -- | -- | 0 |
| | HV-52 | HV-51 | 174,35 | 3,4871 | -- | 0,015 | -- | -- | 0 |
| | HV-49 | HV-52 | 186,87 | 3,7373 | -- | 0,28905 | -- | -- | 0 |
| | HV-48 | HV-49 | 46,959 | 0,93919 | -- | 0,29709 | -- | -- | 0 |
| | HA-12 | HA-10 | 35,136 | 0,70272 | -- | 0,16964 | -- | -- | 0 |
| | HV-48 | HV-46 | 63,159 | 1,2632 | -- | 0,015 | -- | -- | 0 |
| | NU4 | HV-48 | 205,8 | 4,116 | -- | 0,30711 | -- | -- | 0 |
| | HV-30 | HV-37 | 174,78 | 3,4957 | -- | 0,015 | -- | -- | 0 |
| | HV-38 | HV-30 | 264,82 | 5,2965 | -- | 0,032 | -- | -- | 0 |
| | HV-29 | HV-31 | 134,59 | 2,6918 | -- | 0,03 | -- | -- | 0 |
| | HV-38 | HV-29 | 91,652 | 1,8331 | -- | 0,045 | -- | -- | 0 |
| | HV-39 | HV-38 | 472,28 | 9,4456 | -- | 0,06739 | -- | -- | 0 |
| | HV-40 | HV-39 | 116,76 | 2,3352 | -- | 0,07716 | -- | -- | 0 |
| | NU5 | HV-40 | 335,58 | 6,7117 | -- | 0,09201 | -- | -- | 0 |
| | NU5 | HV-45 | 107,38 | 2,1475 | -- | 0,015 | -- | -- | 0 |
| | HA-13 | HA-12 | 45,068 | 0,90135 | -- | 0,17936 | -- | -- | 0 |
| | NU4 | NU5 | 101,21 | 2,0241 | -- | 0,10205 | -- | -- | 0 |
| | HT-07 | NU4 | 298,74 | 5,9749 | -- | 0,37816 | -- | -- | 0 |
| | HT-06 | HV-47 | 107,75 | 2,155 | -- | 0,015 | -- | -- | 0 |
| | HT-07 | HT-06 | 248,28 | 4,9656 | -- | 0,03 | -- | -- | 0 |
| | HT-10 | HT-07 | 742,23 | 14,845 | -- | 0,41451 | -- | -- | 0 |

Continúa tuberías...

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Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-09 | HT-08 | 79,014 | 1,5803 | -- | 0,023 | -- | -- | 0 |
| | HT-10 | HT-09 | 476,02 | 9,5204 | -- | 0,041 | -- | -- | 0 |
| | HV-25 | HV-20 | 44,709 | 0,89418 | -- | 0,015 | -- | -- | 0 |
| | HV-22 | HV-25 | 151,33 | 3,0265 | -- | 0,03 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |

Continúa materiales...

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Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 200 | | | |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

Página 8
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 420

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | HA-02 | HA-01 | 125-(PVC-10) | 242,8 | 1,9122 | 905,65 | 89 | 43 |
| TU10 | HT-05 | HT-04 | 200-(PVC-10) | 294 | 1,6814 | 2698,9 | 59 | 45,485 |
| TU100 | HV-24 | HV-22 | 200-(PVC-10) | 93,163 | 1,6814 | 855,24 | 77 | 53,844 |
| TU101 | HV-17 | HV-16 | 125-(PVC-10) | 100,05 | 1,4341 | 373,2 | 80 | 47,782 |
| TU102 | HV-19 | HV-17 | 160-(PVC-10) | 56,789 | 1,7533 | 343,01 | 78 | 47,343 |
| TU103 | HV-15 | HV-18 | 250-(PVC-10) | 22,392 | 1,4341 | 303,64 | 78 | 49,691 |
| TU104 | HV-26 | HV-27 | 250-(PVC-10) | 23,604 | 1,6323 | 320,07 | 78 | 52,134 |
| TU105 | HV-23 | HV-26 | 250-(PVC-10) | 281,38 | 1,7931 | 3815,6 | 78 | 52,337 |
| TU106 | NU6 | HV-23 | 250-(PVC-10) | 120,48 | 1,9973 | 1633,7 | 69 | 46,221 |
| TU107 | NU6 | HV-24 | 250-(PVC-10) | 114,4 | 1,4341 | 1551,3 | 70 | 47,951 |
| TU108 | HV-21 | NU6 | 315-(PVC-10) | 227,17 | 1,622 | 4797,9 | 60 | 38,728 |
| TU109 | HV-34 | HV-21 | 315-(PVC-10) | 27,484 | 1,7235 | 580,47 | 77 | 57,198 |
| TU11 | HV-01 | HT-02 | 500-(PRFV-10) | 608 | 0,49836 | 50136 | 66 | 56,069 |
| TU110 | HV-33 | HV-34 | 315-(PVC-10) | 384,41 | 1,8083 | 8118,8 | 77 | 57,397 |
| TU111 | HV-36 | HV-33 | 400-(PVC-10) | 120,72 | 1,5364 | 4524,6 | 69 | 52,438 |
| TU112 | NU7 | HV-36 | 400-(PVC-10) | 323,29 | 1,7657 | 12117 | 69 | 52,97 |
| TU113 | HV-42 | HV-43 | 110-(PVC-10) | 209 | 1,8502 | 710,59 | 75 | 53,011 |
| TU114 | NU7 | HV-42 | 160-(PVC-10) | 103,61 | 1,7533 | 625,82 | 74 | 58,074 |
| TU115 | NU7 | HA-16 | 125-(PVC-10) | 88,858 | 1,721 | 331,44 | 80 | 63,877 |
| TU116 | HA-19 | NU7 | 500-(PVC-10) | 141,87 | 1,2946 | 10274 | 60 | 45,813 |
| TU117 | HA-20 | HA-19 | 500-(PVC-10) | 198,05 | 1,3515 | 14343 | 78 | 64,163 |
| TU118 | NU8 | HA-20 | 500-(PVC-10) | 272,94 | 1,409 | 19766 | 76 | 62,692 |
| TU119 | NU8 | HA-22 | 110-(PVC-10) | 94,004 | 1,8502 | 319,61 | 75 | 59,752 |
| TU12 | HA-15 | HV-35 | 140-(PVC-10) | 177,92 | 1,1441 | 820,2 | 69 | 41,349 |
| TU120 | HA-23 | NU8 | 500-(PVC-10) | 294,77 | 1,445 | 21347 | 60 | 47,48 |
| TU121 | HA-21 | HA-23 | 500-(PVC-10) | 226,44 | 1,5211 | 16399 | 74 | 62,371 |
| TU122 | HA-24 | HA-21 | 500-(PVC-10) | 178,87 | 1,5993 | 12954 | 75 | 64,123 |
| TU123 | HA-24 | HV-44 | 125-(PVC-10) | 259,62 | 1,6254 | 968,37 | 69 | 53,682 |
| TU124 | HA-25 | HA-24 | 500-(PVC-10) | 163,67 | 1,7073 | 11853 | 69 | 58,776 |
| TU125 | HT-11 | HA-25 | 500-(PVC-10) | 241 | 1,817 | 17453 | 68 | 58,449 |
| TU126 | HT-10 | HT-11 | 500-(PVC-10) | 263,55 | 1,838 | 19086 | 67 | 58,562 |
| TU127 | HT-13 | HT-10 | 800-(PRFV-10) | 231,24 | 1,4847 | 39348 | 65 | 57,805 |
| TU128 | HT-13 | HT-12 | 110-(PVC-10) | 232,45 | 1,8502 | 790,33 | 59 | 45,456 |
| TU129 | HT-14 | HT-13 | 800-(PRFV-10) | 156,06 | 1,5192 | 26555 | 63 | 56,2 |
| TU13 | HA-14 | HA-15 | 200-(PVC-10) | 234,63 | 1,3077 | 2153,9 | 72 | 45,953 |
| TU130 | HT-15 | HT-14 | 800-(PRFV-10) | 230,4 | 1,5278 | 39204 | 63 | 56,478 |
| TU131 | HT-16 | HT-17 | 125-(PVC-10) | 34,97 | 1,6254 | 130,44 | 63 | 53,542 |
| TU132 | HT-18 | HT-16 | 160-(PVC-10) | 111,9 | 1,8702 | 675,87 | 63 | 54,228 |
| TU133 | HT-15 | HT-18 | 200-(PVC-10) | 42,766 | 1,7561 | 392,59 | 62 | 55,342 |
| TU134 | 20 | HT-15 | 800-(PRFV-10) | 350,98 | 1,5921 | 59722 | 63 | 56,892 |
| TU135 | 19 | 20 | 1200-(PRFV-6) | 400,18 | 1,7622 | 123570 | 58 | 52,574 |
| TU136 | 23 | 19 | 1200-(PRFV-6) | 246,59 | 1,7622 | 76145 | 53 | 48,152 |
| TU138 | NU9 | 23 | 1200-(PRFV-6) | 124,98 | 1,7622 | 38592 | 52 | 47,509 |
| TU14 | HA-14 | HA-17 | 125-(PVC-10) | 307,32 | 1,6254 | 1146,3 | 86 | 55,681 |
| TU142 | NU10 | NU9 | 1200-(PRFV-6) | 222,78 | 1,7622 | 68792 | 50 | 45,69 |
| TU144 | 25 | NU10 | 1200-(PRFV-6) | 461,81 | 1,7622 | 142603 | 50 | 46,012 |
| TU146 | 29 | 25 | 1200-(PRFV-6) | 122,11 | 1,7622 | 37706 | 46 | 42,679 |
| TU147 | 98 | 29 | 1200-(PRFV-6) | 79,101 | 1,7622 | 24426 | 52 | 48,856 |
| TU148 | NU11 | 98 | 1200-(PRFV-6) | 110,42 | 1,7622 | 34098 | 46 | 42,97 |
| TU15 | HA-18 | HA-14 | 250-(PVC-10) | 297,29 | 1,6254 | 4031,3 | 79 | 54,711 |
| TU158 | NU12 | NU11 | 1200-(PRFV-6) | 156,87 | 1,7622 | 48440 | 50 | 47,13 |
| TU159 | HT-41 | HT-40 | 110-(PVC-10) | 37,444 | 1,8502 | 127,31 | 60 | 43,34 |
| TU16 | HA-50 | HA-18 | 250-(PVC-10) | 409,85 | 1,71 | 5557,6 | 85 | 63,253 |
| TU165 | NU15 | HT-01 | 250-(PVC-10) | 379,52 | 1,0995 | 5146,3 | 64 | 52,383 |
| TU166 | HT-02 | NU15 | 500-(PVC-10) | 218,8 | 0,51936 | 15845 | 50 | 39,967 |
| TU167 | NU15 | HT-45 | 400-(PVC-10) | 204,73 | 0,58761 | 7673,3 | 49 | 38,812 |
| TU168 | HT-45 | HT-47 | 200-(PVC-10) | 274,37 | 1,7934 | 2518,7 | 51 | 37,141 |
| TU169 | HT-47 | HT-46 | 160-(PVC-10) | 132,45 | 1,7533 | 800 | 59 | 42,919 |
| TU17 | HA-51 | HA-50 | 250-(PVC-10) | 171,1 | 1,8823 | 2320,2 | 80 | 62,102 |
| TU170 | HT-46 | HT-48 | 140-(PVC-10) | 408,75 | 1,1441 | 1884,3 | 57 | 37,234 |
| TU179 | HT-04 | HT-03 | 200-(PVC-10) | 266,55 | 1,1209 | 2446,9 | 59 | 43,979 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU18 | HA-49 | HA-45 | 400-(PVC-10) | 149,42 | 1,8293 | 5600,1 | 86 | 66,373 |
| TU180 | HT-03 | HT-52 | 160-(PVC-10) | 308,94 | 0,87665 | 1866 | 55 | 38,517 |
| TU19 | HA-48 | HA-49 | 400-(PVC-10) | 30,33 | 1,8861 | 1136,8 | 83 | 64,283 |
| TU2 | HA-03 | HA-02 | 200-(PVC-10) | 147,35 | 1,4198 | 1352,7 | 84 | 44,42 |
| TU20 | HA-51 | HA-48 | 400-(PVC-10) | 377,99 | 1,9309 | 14167 | 83 | 64,478 |
| TU205 | 85 | 84 | 1200-(PRFV-6) | 104,37 | 1,7622 | 32228 | 41 | 38,919 |
| TU209 | 86 | NU12 | 1200-(PRFV-6) | 122,03 | 1,7622 | 37683 | 50 | 47,357 |
| TU21 | HA-38 | HA-41 | 500-(PVC-10) | 260,79 | 1,6585 | 18886 | 74 | 58,901 |
| TU210 | 84 | 86 | 1200-(PRFV-6) | 267,32 | 1,7622 | 82546 | 42 | 39,533 |
| TU22 | HA-41 | HA-51 | 500-(PVC-10) | 238,22 | 1,6112 | 17252 | 77 | 61,02 |
| TU227 | 22 | H-ALM | 700-(PRFV-10) | 470 | 1,8669 | 62942 | 55 | 46,45 |
| TU228 | 81 | 85 | 1200-(PRFV-6) | 53,066 | 1,7622 | 16386 | 39 | 37,07 |
| TU229 | 82 | 81 | 1200-(PRFV-6) | 281,87 | 1,7622 | 87038 | 37 | 35,147 |
| TU23 | HA-51 | HA-46 | 160-(PVC-10) | 102,26 | 1,7533 | 617,65 | 72 | 54,305 |
| TU24 | HA-46 | HA-47 | 110-(PVC-10) | 72,821 | 1,8502 | 247,59 | 71 | 51,192 |
| TU242 | 0 | 82 | 1200-(PRFV-6) | 1000 | 1,7622 | 308790 | 29 | 27,554 |
| TU245 | HV-04 | HV-05 | 110-(PVC-10) | 481,99 | 1,8502 | 1638,8 | 74 | 50,434 |
| TU246 | HV-18 | HV-19 | 200-(PVC-10) | 117,45 | 1,6814 | 1078,2 | 78 | 48,296 |
| TU247 | HV-27 | HV-15 | 250-(PVC-10) | 337,1 | 1,4341 | 4571 | 78 | 49,843 |
| TU248 | HV-31 | HV-28 | 110-(PVC-10) | 30,132 | 1,8502 | 102,45 | 69 | 48,953 |
| TU249 | HV-40 | HV-41 | 110-(PVC-10) | 127,03 | 1,8502 | 431,91 | 60 | 45,721 |
| TU25 | HT-01 | HT-41 | 200-(PVC-10) | 700 | 1,1209 | 6426 | 55 | 39,427 |
| TU250 | HV-33 | HV-32 | 125-(PVC-10) | 127,03 | 1,8166 | 473,84 | 69 | 49,381 |
| TU253 | HA-42 | HA-52 | 140-(PVC-10) | 508,14 | 1,1441 | 2342,5 | 64 | 44,619 |
| TU254 | HA-33 | HA-35 | 110-(PVC-10) | 1 | 1,8502 | 3,4 | 61 | 51,747 |
| TU255 | NU29 | HA-03 | 200-(PVC-10) | 225 | 1,9803 | 2065,5 | 85 | 46,704 |
| TU27 | HA-45 | HA-13 | 400-(PVC-10) | 1537 | 1,7735 | 57607 | 78 | 49,542 |
| TU3 | HA-40 | HA-38 | 500-(PVC-10) | 495 | 1,6959 | 35848 | 69 | 54,918 |
| TU30 | NU2 | HA-40 | 500-(PVC-10) | 387,35 | 1,7512 | 28052 | 67 | 54,93 |
| TU32 | NU2 | HA-36 | 110-(PVC-10) | 119 | 1,8502 | 404,59 | 61 | 47,148 |
| TU33 | HA-33 | NU2 | 500-(PVC-10) | 258,05 | 1,804 | 18688 | 60 | 49,6 |
| TU34 | HA-33 | HA-34 | 110-(PVC-10) | 34,371 | 1,8502 | 116,86 | 60 | 49,779 |
| TU35 | HA-29 | HA-33 | 500-(PVC-10) | 271,78 | 1,9397 | 19682 | 61 | 51,776 |
| TU36 | HA-42 | HA-43 | 110-(PVC-10) | 286,4 | 1,8502 | 973,76 | 67 | 43,891 |
| TU37 | HA-39 | HA-37 | 125-(PVC-10) | 38,28 | 1,8166 | 142,78 | 67 | 45,862 |
| TU38 | HA-53 | HA-39 | 160-(PVC-10) | 184,65 | 1,9871 | 1115,3 | 66 | 45,784 |
| TU39 | HA-42 | HA-53 | 200-(PVC-10) | 109,04 | 1,8308 | 1001 | 66 | 49,684 |
| TU4 | HA-08 | HA-04 | 400-(PVC-10) | 219,15 | 1,2409 | 8213,6 | 82 | 49,412 |
| TU40 | HA-44 | HA-42 | 250-(PVC-10) | 241,28 | 1,6504 | 3271,7 | 66 | 51,2 |
| TU41 | HA-27 | HA-44 | 250-(PVC-10) | 274,7 | 1,8094 | 3725 | 66 | 53,322 |
| TU42 | HA-28 | HA-26 | 110-(PVC-10) | 196,18 | 1,8502 | 667,02 | 66 | 49,448 |
| TU43 | HA-27 | HA-28 | 160-(PVC-10) | 62,348 | 1,7533 | 376,58 | 65 | 54,139 |
| TU44 | HA-29 | HA-27 | 315-(PVC-10) | 411,12 | 1,3918 | 8682,8 | 61 | 51,185 |
| TU45 | HA-31 | HA-29 | 500-(PRFV-10) | 256,3 | 1,9711 | 21134 | 61 | 53,192 |
| TU46 | HA-30 | HA-31 | 500-(PRFV-10) | 44,916 | 1,9898 | 3703,8 | 61 | 54,431 |
| TU47 | HT-21 | HA-30 | 600-(PRFV-6) | 85,103 | 1,4874 | 7058,4 | 59 | 52,652 |
| TU48 | NU3 | HT-21 | 600-(PRFV-6) | 99,794 | 1,5081 | 8276,9 | 57 | 50,854 |
| TU49 | HA-05 | HA-06 | 250-(PVC-10) | 160,93 | 0,71707 | 2182,2 | 77 | 40,679 |
| TU5 | HA-09 | HA-08 | 400-(PVC-10) | 287,27 | 1,3369 | 10767 | 91 | 59,064 |
| TU50 | HA-06 | HA-07 | 200-(PVC-10) | 270,59 | 0,56045 | 2484 | 75 | 38,244 |
| TU51 | HA-04 | NU29 | 315-(PVC-10) | 377 | 1,4927 | 7962,2 | 90 | 55,318 |
| TU58 | NU29 | HA-05 | 315-(PVC-10) | 535 | 0,96361 | 11299 | 77 | 40,987 |
| TU59 | 22 | HA-32 | 125-(PVC-10) | 29,753 | 1,6254 | 110,98 | 56 | 48,286 |
| TU6 | HA-11 | HA-09 | 400-(PVC-10) | 207,37 | 1,4464 | 7772 | 81 | 50,044 |
| TU60 | NU3 | 22 | 700-(PRFV-10) | 388,9 | 1,9129 | 52081 | 56 | 48,869 |
| TU61 | 20 | NU3 | 1000-(PRFV-6) | 302,54 | 1,6385 | 67621 | 60 | 54,098 |
| TU62 | HV-12 | HV-11 | 160-(PVC-10) | 292,97 | 1,7533 | 1769,5 | 77 | 51,65 |
| TU63 | HV-10 | HV-12 | 200-(PVC-10) | 30,93 | 1,6814 | 283,94 | 77 | 56,565 |
| TU64 | HV-09 | HV-10 | 250-(PVC-10) | 282,47 | 1,5775 | 3830,2 | 77 | 56,933 |
| TU65 | HV-07 | HV-09 | 250-(PVC-10) | 218,19 | 1,96 | 2958,6 | 75 | 57,219 |
| TU66 | HV-08 | HV-07 | 315-(PVC-10) | 330,84 | 1,343 | 6987,4 | 74 | 58,855 |
| TU67 | HV-14 | HV-13 | 110-(PVC-10) | 340,36 | 1,8502 | 1157,2 | 75 | 47,095 |
| TU68 | HV-08 | HV-14 | 160-(PVC-10) | 262,19 | 1,7533 | 1583,7 | 74 | 55,969 |
| TU69 | HV-06 | HV-08 | 315-(PVC-10) | 138,83 | 1,7768 | 2932,1 | 73 | 59,368 |
| TU7 | HA-10 | HA-11 | 400-(PVC-10) | 293,13 | 1,5316 | 10987 | 89 | 58,861 |
| TU70 | HV-03 | HV-06 | 315-(PVC-10) | 356,1 | 1,9111 | 7520,9 | 70 | 57,431 |
| TU71 | HV-01 | HT-05 | 250-(PVC-10) | 46,444 | 1,458 | 629,78 | 65 | 54,979 |
| TU72 | HV-02 | HV-01 | 500-(PRFV-10) | 85,694 | 0,66591 | 7066,3 | 70 | 60,304 |
| TU73 | HV-03 | HV-02 | 500-(PRFV-10) | 262,45 | 0,70386 | 21642 | 70 | 60,36 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU74 | HV-03 | HV-04 | 250-(PVC-10) | 22,997 | 1,3146 | 311,84 | 69 | 59,418 |
| TU75 | HV-50 | HV-03 | 600-(PRFV-10) | 160,94 | 0,98086 | 17188 | 69 | 59,551 |
| TU76 | HV-52 | HV-50 | 600-(PRFV-10) | 246,95 | 1,0153 | 26374 | 65 | 55,73 |
| TU77 | HV-52 | HV-51 | 110-(PVC-10) | 174,35 | 1,8502 | 592,81 | 64 | 49,965 |
| TU78 | HV-49 | HV-52 | 600-(PRFV-10) | 186,87 | 1,0645 | 19957 | 62 | 53,023 |
| TU79 | HV-48 | HV-49 | 600-(PRFV-6) | 46,959 | 1,0941 | 3894,8 | 58 | 49,265 |
| TU8 | HA-12 | HA-10 | 400-(PVC-10) | 35,136 | 1,5823 | 1316,9 | 78 | 49,146 |
| TU80 | HV-48 | HV-46 | 110-(PVC-10) | 63,159 | 1,8502 | 214,74 | 58 | 47,496 |
| TU81 | NU4 | HV-48 | 600-(PRFV-6) | 205,8 | 1,131 | 17069 | 58 | 49,328 |
| TU82 | HV-30 | HV-37 | 140-(PVC-10) | 174,78 | 1,1441 | 805,75 | 67 | 44,595 |
| TU83 | HV-38 | HV-30 | 160-(PVC-10) | 264,82 | 1,8702 | 1599,5 | 68 | 47,171 |
| TU84 | HV-29 | HV-31 | 160-(PVC-10) | 134,59 | 1,7533 | 812,91 | 70 | 50,827 |
| TU85 | HV-38 | HV-29 | 200-(PVC-10) | 91,652 | 1,6814 | 841,37 | 65 | 48,085 |
| TU86 | HV-39 | HV-38 | 250-(PVC-10) | 472,28 | 1,6108 | 6404,1 | 66 | 50,174 |
| TU87 | HV-40 | HV-39 | 250-(PVC-10) | 116,76 | 1,8443 | 1583,3 | 65 | 53,146 |
| TU88 | NU5 | HV-40 | 315-(PVC-10) | 335,58 | 1,3853 | 7087,5 | 60 | 49,407 |
| TU89 | NU5 | HV-45 | 110-(PVC-10) | 107,38 | 1,8502 | 365,08 | 66 | 53,916 |
| TU9 | HA-13 | HA-12 | 400-(PVC-10) | 45,068 | 1,6729 | 1689,1 | 89 | 60,31 |
| TU90 | NU4 | NU5 | 315-(PVC-10) | 101,21 | 1,5365 | 2137,5 | 60 | 51,031 |
| TU91 | HT-07 | NU4 | 700-(PRFV-10) | 298,74 | 1,0231 | 40008 | 60 | 51,624 |
| TU92 | HT-06 | HV-47 | 110-(PVC-10) | 107,75 | 1,8502 | 366,35 | 52 | 36,632 |
| TU93 | HT-07 | HT-06 | 160-(PVC-10) | 248,28 | 1,7533 | 1499,6 | 60 | 47,758 |
| TU94 | HT-10 | HT-07 | 700-(PRFV-10) | 742,23 | 1,1215 | 99400 | 63 | 54,924 |
| TU96 | HT-09 | HT-08 | 140-(PVC-10) | 79,014 | 1,7543 | 364,26 | 54 | 40,481 |
| TU97 | HT-10 | HT-09 | 200-(PVC-10) | 476,02 | 1,5319 | 4369,8 | 56 | 44,038 |
| TU98 | HV-25 | HV-20 | 110-(PVC-10) | 44,709 | 1,8502 | 152,01 | 80 | 53,008 |
| TU99 | HV-22 | HV-25 | 160-(PVC-10) | 151,33 | 1,7533 | 914,01 | 80 | 54,305 |

** ¡Atención! Elementos TU11 , Velocidad de Diseño inferior a la Mínima.

** Información El Nodo HT-45 es el más desfavorable.

P Min de la Red (Dinámica) = 27,554 m (Nodo: 82)
P Max de la Red (Estática) = 91 m (Nodo: HA-08)
Caudal de Inyección en Cabecera = 1,9141 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 125-(PVC-10) | 3,73 | 1.229 | 4.583,01 |
| | | 200-(PVC-10) | 9,18 | 3.374 | 30.968,80 |
| | | 400-(PVC-10) | 37,48 | 3.831 | 143.570,70 |
| | | 140-(PVC-10) | 4,61 | 1.349 | 6.217,05 |
| | | 250-(PVC-10) | 13,56 | 3.993 | 54.147,49 |
| | | 500-(PVC-10) | 72,42 | 4.111 | 297.728,90 |
| | | 160-(PVC-10) | 6,04 | 2.417 | 14.599,50 |
| | | 110-(PVC-10) | 3,40 | 2.760 | 9.382,41 |
| | | 315-(PVC-10) | 21,12 | 3.225 | 68.106,82 |
| | | 500-(PRFV-10) | 82,46 | 1.257 | 103.681,80 |
| | | 700-(PRFV-10) | 133,92 | 1.900 | 254.431,00 |
| | | 600-(PRFV-10) | 106,80 | 595 | 63.519,82 |
| | | 800-(PRFV-10) | 170,16 | 969 | 164.829,20 |
| PRFV | 60,0 | 600-(PRFV-6) | 82,94 | 438 | 36.299,19 |
| | | 1000-(PRFV-6) | 223,51 | 303 | 67.621,27 |
| | | 1200-(PRFV-6) | 308,79 | 3.754 | 1.159.044,00 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **2.478.731,21 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **175.872,10 €** |
| **COSTE TOTAL ANUAL** | **175.872,10 €** |

## 1.5 RED BOMBEO 2 (ALTERNATIVAS 4 Y 5)

Página 1
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 438 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HT-22 | 364 | 41 |
| NU3 | 360 | 0 |
| HT-20 | 362 | 44 |
| HT-19 | 367 | 42 |
| HT-28 | 367 | 39 |
| HT-23 | 368 | 37 |
| HT-24 | 370 | 35 |
| HT-27 | 371 | 37 |
| HT-26 | 373 | 38 |
| NU9 | 370 | 0 |
| HT-30 | 368 | 35 |
| NU10 | 370 | 0 |
| HT-31 | 368 | 39 |
| HT-25 | 374 | 36 |
| HT-29 | 368 | 39 |
| HT-98 | 374 | 39 |
| HS-04 | 381 | 36 |
| HS-05 | 378 | 36 |
| HS-06 | 380 | 35 |
| HT-94 | 384 | 35 |
| HT-95 | 376 | 35 |
| HT-93 | 380 | 39 |
| HT-96 | 378 | 36 |
| HT-99 | 379 | 36 |
| HT-100 | 375 | 38 |
| NU11 | 370 | 0 |
| HT-42 | 373 | 38 |
| NU13 | 370 | 0 |
| HT-43 | 374 | 48 |
| NU14 | 370 | 0 |
| HT-56 | 371 | 35 |
| HT-55 | 383 | 37 |
| NU16 | 370 | 0 |
| HT-60 | 375 | 36 |
| HT-59 | 378 | 38 |
| HT-61 | 380 | 36 |
| HT-58 | 376 | 36 |
| HT-57 | 376 | 35 |
| HT-53 | 373 | 38 |
| HT-54 | 379 | 35 |
| NU17 | 370 | 0 |
| HT-51 | 372 | 37 |
| HT-50 | 371 | 40 |
| HT-44 | 369 | 40 |
| NU19 | 370 | 0 |

Continúa nodos...

Página 2
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HT-49 | 376 | 39 |
| NU18 | 370 | 0 |
| HT-63 | 377 | 35 |
| HT-64 | 382 | 36 |
| HT-65 | 384 | 35 |
| HT-66 | 383 | 36 |
| NU20 | 370 | 0 |
| HT-68 | 388 | 35 |
| HT-69 | 389 | 35 |
| HT-67 | 382 | 39 |
| HT-76 | 378 | 36 |
| NU21 | 370 | 0 |
| HT-34 | 372 | 35 |
| HT-33 | 373 | 36 |
| HT-35 | 374 | 37 |
| HT-36 | 375 | 36 |
| HT-37 | 376 | 35 |
| NU22 | 370 | 0 |
| NU12 | 370 | 0 |
| HS-07 | 389 | 36 |
| HS-01 | 387 | 37 |
| HS-02 | 387 | 38 |
| HS-03 | 384 | 36 |
| HT-91 | 390 | 35 |
| HT-92 | 397 | 25 |
| NU23 | 370 | 0 |
| HT-101 | 384 | 35 |
| HT-90 | 390 | 35 |
| HT-89 | 387 | 35 |
| NU24 | 370 | 0 |
| HT-102 | 383 | 35 |
| HT-88 | 379 | 37 |
| HT-87 | 384 | 37 |
| NU25 | 370 | 0 |
| HT-85 | 381 | 35 |
| HT-81 | 383 | 35 |
| HT-70 | 390 | 35 |
| HT-71 | 390 | 35 |
| HT-72 | 392 | 33 |
| HT-73 | 384 | 38 |
| HT-74 | 389 | 35 |
| HT-75 | 390 | 35 |
| NU26 | 370 | 0 |
| HT-77 | 388 | 35 |
| HT-79 | 391 | 34 |
| HT-78 | 388 | 35 |
| NU27 | 370 | 0 |
| HT-80 | 384 | 36 |
| HT-82 | 391 | 34 |
| HT-32 | 372 | 35 |
| HT-97 | 378 | 39 |
| HT-84 | 379 | 36 |
| HT-86 | 378 | 35 |
| HT-83 | 379 | 37 |
| HT-62 | 373 | 35 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-56 | HT-62 | 432 | 8,64 | -- | 0,015 | -- | -- | 0 |
| | HT-19 | HT-20 | 400,18 | 8,0035 | -- | 0,043 | -- | -- | 0 |
| | HT-23 | HT-19 | 246,59 | 4,9318 | -- | 0,078 | -- | -- | 0 |
| | HT-23 | HT-28 | 55,416 | 1,1083 | -- | 0,036 | -- | -- | 0 |
| | NU9 | HT-23 | 124,98 | 2,4996 | -- | 0,11695 | -- | -- | 0 |
| | HT-27 | HT-24 | 280,78 | 5,6156 | -- | 0,015 | -- | -- | 0 |
| | HT-26 | HT-27 | 39,95 | 0,79901 | -- | 0,03 | -- | -- | 0 |
| | NU9 | HT-26 | 171,09 | 3,4219 | -- | 0,047 | -- | -- | 0 |
| | NU10 | NU9 | 222,78 | 4,4556 | -- | 0,1433 | -- | -- | 0 |

Continúa tuberías...

Página 3
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | NU10 | HT-30 | 198,44 | 3,9688 | -- | 0,024 | -- | -- | 0 |
| | HT-25 | NU10 | 461,81 | 9,2363 | -- | 0,15976 | -- | -- | 0 |
| | HT-25 | HT-31 | 63,687 | 1,2737 | -- | 0,017 | -- | -- | 0 |
| | HT-29 | HT-25 | 122,11 | 2,4422 | -- | 0,17232 | -- | -- | 0 |
| | HT-98 | HT-29 | 79,101 | 1,582 | -- | 0,18577 | -- | -- | 0 |
| | NU11 | HT-98 | 110,42 | 2,2085 | -- | 0,1938 | -- | -- | 0 |
| | HS-05 | HS-04 | 247,34 | 4,9468 | -- | 0,015 | -- | -- | 0 |
| | HS-06 | HS-05 | 43,384 | 0,86768 | -- | 0,03 | -- | -- | 0 |
| | HT-94 | HS-06 | 237,19 | 4,7438 | -- | 0,045 | -- | -- | 0 |
| | HT-93 | HT-94 | 52,6 | 1,052 | -- | 0,06 | -- | -- | 0 |
| | HT-93 | HT-95 | 110,5 | 2,2099 | -- | 0,019 | -- | -- | 0 |
| | HT-96 | HT-93 | 315,65 | 6,313 | -- | 0,07492 | -- | -- | 0 |
| | HT-99 | HT-96 | 62,348 | 1,247 | -- | 0,08627 | -- | -- | 0 |
| | HT-100 | HT-99 | 444,3 | 8,886 | -- | 0,10361 | -- | -- | 0 |
| | NU11 | HT-100 | 58,054 | 1,1611 | -- | 0,11103 | -- | -- | 0 |
| | NU12 | NU11 | 156,87 | 3,1374 | -- | 0,26857 | -- | -- | 0 |
| | NU13 | HT-42 | 101,24 | 2,0247 | -- | 0,015 | -- | -- | 0 |
| | NU14 | NU13 | 488,64 | 9,7729 | -- | 0,015 | -- | -- | 0 |
| | NU14 | HT-43 | 269,07 | 5,3814 | -- | 0,043 | -- | -- | 0 |
| | HT-44 | NU14 | 44,389 | 0,88777 | -- | 0,058 | -- | -- | 0 |
| | NU16 | HT-56 | 88,786 | 1,7757 | -- | 0,032 | -- | -- | 0 |
| | NU16 | HT-55 | 112,73 | 2,2545 | -- | 0,015 | -- | -- | 0 |
| | HT-57 | NU16 | 368,09 | 7,3619 | -- | 0,047 | -- | -- | 0 |
| | HT-59 | HT-60 | 222,51 | 4,4501 | -- | 0,02 | -- | -- | 0 |
| | HT-61 | HT-59 | 61,905 | 1,2381 | -- | 0,037 | -- | -- | 0 |
| | HT-58 | HT-61 | 119,8 | 2,3959 | -- | 0,052 | -- | -- | 0 |
| | NU17 | HT-58 | 48,295 | 0,9659 | -- | 0,069 | -- | -- | 0 |
| | NU17 | HT-57 | 74,097 | 1,482 | -- | 0,062 | -- | -- | 0 |
| | HT-54 | HT-53 | 187,82 | 3,7564 | -- | 0,019 | -- | -- | 0 |
| | NU17 | HT-54 | 55,658 | 1,1132 | -- | 0,034 | -- | -- | 0 |
| | HT-51 | NU17 | 756,99 | 15,14 | -- | 0,11806 | -- | -- | 0 |
| | HT-50 | HT-51 | 44,914 | 0,89829 | -- | 0,11878 | -- | -- | 0 |
| | NU18 | HT-50 | 176,33 | 3,5267 | -- | 0,15041 | -- | -- | 0 |
| | NU19 | HT-44 | 104,16 | 2,0832 | -- | 0,133 | -- | -- | 0 |
| | HT-49 | NU19 | 488,31 | 9,7663 | -- | 0,133 | -- | -- | 0 |
| | NU18 | HT-49 | 135,46 | 2,7093 | -- | 0,151 | -- | -- | 0 |
| | NU20 | NU18 | 202,72 | 4,0543 | -- | 0,26343 | -- | -- | 0 |
| | HT-64 | HT-63 | 179,72 | 3,5944 | -- | 0,015 | -- | -- | 0 |
| | HT-65 | HT-64 | 217,99 | 4,3597 | -- | 0,031 | -- | -- | 0 |
| | HT-66 | HT-65 | 131,63 | 2,6326 | -- | 0,047 | -- | -- | 0 |
| | NU20 | HT-66 | 647,84 | 12,957 | -- | 0,067 | -- | -- | 0 |
| | HT-68 | NU20 | 413,68 | 8,2736 | -- | 0,29977 | -- | -- | 0 |
| | HT-67 | HT-68 | 46,138 | 0,92275 | -- | 0,31093 | -- | -- | 0 |
| | HT-67 | HT-69 | 64,671 | 1,2934 | -- | 0,083 | -- | -- | 0 |
| | NU21 | HT-67 | 442,94 | 8,8588 | -- | 0,38025 | -- | -- | 0 |
| | NU21 | HT-76 | 245,15 | 4,903 | -- | 0,015 | -- | -- | 0 |
| | HT-34 | NU21 | 140,03 | 2,8005 | -- | 0,38639 | -- | -- | 0 |
| | HT-33 | HT-34 | 68,864 | 1,3773 | -- | 0,4052 | -- | -- | 0 |
| | HT-35 | HT-33 | 171,14 | 3,4227 | -- | 0,40976 | -- | -- | 0 |
| | HT-36 | HT-35 | 37,71 | 0,7542 | -- | 0,41384 | -- | -- | 0 |
| | HT-85 | HT-84 | 104,37 | 2,0874 | -- | 0,69184 | -- | -- | 0 |
| | NU22 | HT-36 | 257,41 | 5,1483 | -- | 0,44206 | -- | -- | 0 |
| | NU22 | HT-37 | 150,91 | 3,0183 | -- | 0,015 | -- | -- | 0 |
| | NU12 | NU22 | 237,25 | 4,745 | -- | 0,4487 | -- | -- | 0 |
| | HT-86 | NU12 | 122,03 | 2,4407 | -- | 0,67428 | -- | -- | 0 |
| | HT-84 | HT-86 | 267,32 | 5,3464 | -- | 0,68073 | -- | -- | 0 |
| | HS-01 | HS-07 | 31,451 | 0,62901 | -- | 0,015 | -- | -- | 0 |
| | HS-02 | HS-01 | 37,456 | 0,74911 | -- | 0,035 | -- | -- | 0 |
| | NU23 | HS-02 | 238,06 | 4,7612 | -- | 0,05 | -- | -- | 0 |
| | HT-91 | HS-03 | 145,83 | 2,9167 | -- | 0,015 | -- | -- | 0 |
| | NU23 | HT-91 | 109,62 | 2,1924 | -- | 0,03 | -- | -- | 0 |
| | NU23 | HT-92 | 165,91 | 3,3182 | -- | 0,015 | -- | -- | 0 |
| | NU24 | NU23 | 197,86 | 3,9573 | -- | 0,06897 | -- | -- | 0 |
| | HT-90 | HT-101 | 173,01 | 3,4602 | -- | 0,015 | -- | -- | 0 |
| | HT-89 | HT-90 | 66,09 | 1,3218 | -- | 0,03 | -- | -- | 0 |
| | NU24 | HT-89 | 167,32 | 3,3464 | -- | 0,045 | -- | -- | 0 |
| | HT-102 | NU24 | 117,03 | 2,3407 | -- | 0,0917 | -- | -- | 0 |

Continúa tuberías...

Página 4
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | NU25 | HT-102 | 413,91 | 8,2783 | -- | 0,09991 | -- | -- | 0 |
| | NU25 | HT-88 | 276,06 | 5,5212 | -- | 0,015 | -- | -- | 0 |
| | NU25 | HT-87 | 136,68 | 2,7336 | -- | 0,015 | -- | -- | 0 |
| | HT-85 | NU25 | 271,86 | 5,4373 | -- | 0,10794 | -- | -- | 0 |
| | HT-84 | HT-83 | 69,83 | 1,3966 | -- | 0,015 | -- | -- | 0 |
| | HT-81 | HT-85 | 53,066 | 1,0613 | -- | 0,77328 | -- | -- | 0 |
| | HT-82 | HT-81 | 281,87 | 5,6373 | -- | 0,77751 | -- | -- | 0 |
| | HT-71 | HT-70 | 245,8 | 4,916 | -- | 0,022 | -- | -- | 0 |
| | HT-72 | HT-71 | 28,566 | 0,57131 | -- | 0,037 | -- | -- | 0 |
| | HT-74 | HT-72 | 836,44 | 16,729 | -- | 0,116 | -- | -- | 0 |
| | HT-74 | HT-73 | 237,42 | 4,7483 | -- | 0,023 | -- | -- | 0 |
| | NU26 | HT-74 | 338,42 | 6,7684 | -- | 0,1495 | -- | -- | 0 |
| | NU26 | HT-75 | 57,91 | 1,1582 | -- | 0,038 | -- | -- | 0 |
| | HT-77 | NU26 | 285,39 | 5,7079 | -- | 0,17656 | -- | -- | 0 |
| | NU27 | HT-77 | 384,3 | 7,686 | -- | 0,18065 | -- | -- | 0 |
| | HT-78 | HT-79 | 101,85 | 2,0371 | -- | 0,015 | -- | -- | 0 |
| | NU27 | HT-78 | 178,72 | 3,5745 | -- | 0,03 | -- | -- | 0 |
| | HT-80 | NU27 | 175,58 | 3,5116 | -- | 0,19514 | -- | -- | 0 |
| | HT-82 | HT-80 | 272,7 | 5,4541 | -- | 0,20172 | -- | -- | 0 |
| | 0 | HT-82 | 1900 | 38 | -- | 0,92175 | -- | -- | 0 |
| | HT-36 | HT-32 | 127,03 | 2,5407 | -- | 0,031 | -- | -- | 0 |
| | HT-99 | HT-97 | 127,03 | 2,5407 | -- | 0,015 | -- | -- | 0 |
| | NU3 | HT-22 | 388,9 | 7,778 | -- | 0,02 | -- | -- | 0 |
| | HT-20 | NU3 | 302,54 | 6,0508 | -- | 0,02 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |

Continúa materiales...

Página 5
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 160 | | | |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |

Continúa materiales...

Optimización GESTAR 2010

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Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PRFV | TRAGSA | 0,007 | | | | |
| | | | 250 | | | |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

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Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 438

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | HT-56 | HT-62 | 110-(PVC-10) | 432 | 1,8502 | 1468,8 | 65 | 35,981 |
| TU135 | HT-19 | HT-20 | 200-(PVC-10) | 400,18 | 1,6066 | 3673,6 | 76 | 58,049 |
| TU136 | HT-23 | HT-19 | 250-(PVC-10) | 246,59 | 1,8644 | 3343,8 | 71 | 57,422 |
| TU137 | HT-23 | HT-28 | 200-(PVC-10) | 55,416 | 1,3451 | 508,72 | 71 | 59,701 |
| TU138 | NU9 | HT-23 | 315-(PVC-10) | 124,98 | 1,7608 | 2639,6 | 70 | 59,138 |
| TU139 | HT-27 | HT-24 | 110-(PVC-10) | 280,78 | 1,8502 | 954,65 | 68 | 47,061 |
| TU140 | HT-26 | HT-27 | 160-(PVC-10) | 39,95 | 1,7533 | 241,3 | 67 | 54,207 |
| TU141 | NU9 | HT-26 | 200-(PVC-10) | 171,09 | 1,7561 | 1570,6 | 65 | 52,877 |
| TU142 | NU10 | NU9 | 400-(PVC-10) | 222,78 | 1,3366 | 8349,8 | 68 | 58,08 |
| TU143 | NU10 | HT-30 | 140-(PVC-10) | 198,44 | 1,8306 | 914,8 | 70 | 56,611 |
| TU144 | HT-25 | NU10 | 400-(PVC-10) | 461,81 | 1,4901 | 17309 | 68 | 58,839 |
| TU145 | HT-25 | HT-31 | 125-(PVC-10) | 63,687 | 1,6254 | 237,55 | 70 | 61,514 |
| TU146 | HT-29 | HT-25 | 400-(PVC-10) | 122,11 | 1,6073 | 4576,7 | 64 | 56,763 |
| TU147 | HT-98 | HT-29 | 400-(PVC-10) | 79,101 | 1,7327 | 2964,7 | 70 | 63,348 |
| TU148 | NU11 | HT-98 | 400-(PVC-10) | 110,42 | 1,8076 | 4138,7 | 64 | 57,783 |
| TU149 | HS-05 | HS-04 | 160-(PVC-10) | 247,34 | 0,87665 | 1493,9 | 57 | 39,798 |
| TU150 | HS-06 | HS-05 | 160-(PVC-10) | 43,384 | 1,7533 | 262,04 | 60 | 43,968 |
| TU151 | HT-94 | HS-06 | 200-(PVC-10) | 237,19 | 1,6814 | 2177,4 | 58 | 42,696 |
| TU152 | HT-93 | HT-94 | 250-(PVC-10) | 52,6 | 1,4341 | 713,26 | 54 | 41,515 |
| TU153 | HT-93 | HT-95 | 125-(PVC-10) | 110,5 | 1,8166 | 412,15 | 62 | 47,213 |
| TU154 | HT-96 | HT-93 | 250-(PVC-10) | 315,65 | 1,7908 | 4280,2 | 58 | 45,872 |
| TU155 | HT-99 | HT-96 | 315-(PVC-10) | 62,348 | 1,2989 | 1316,8 | 60 | 51,099 |
| TU156 | HT-100 | HT-99 | 315-(PVC-10) | 444,3 | 1,56 | 9383,6 | 59 | 50,368 |
| TU157 | NU11 | HT-100 | 315-(PVC-10) | 58,054 | 1,6717 | 1226,1 | 63 | 57,044 |
| TU158 | NU12 | NU11 | 500-(PVC-10) | 156,87 | 1,6035 | 11361 | 68 | 62,441 |
| TU161 | NU13 | HT-42 | 110-(PVC-10) | 101,24 | 1,8502 | 344,21 | 65 | 40,538 |
| TU162 | NU14 | NU13 | 125-(PVC-10) | 488,64 | 1,4341 | 1822,6 | 68 | 46,475 |
| TU163 | NU14 | HT-43 | 315-(PVC-10) | 269,07 | 0,64743 | 5682,7 | 64 | 49,774 |
| TU164 | HT-44 | NU14 | 315-(PVC-10) | 44,389 | 0,87327 | 937,49 | 68 | 54,099 |
| TU171 | NU16 | HT-56 | 160-(PVC-10) | 88,786 | 1,8702 | 536,27 | 67 | 50,514 |
| TU172 | NU16 | HT-55 | 200-(PVC-10) | 112,73 | 0,56045 | 1034,8 | 55 | 40,01 |
| TU173 | HT-57 | NU16 | 315-(PVC-10) | 368,09 | 0,70765 | 7774,1 | 68 | 53,191 |
| TU174 | HT-59 | HT-60 | 125-(PVC-10) | 222,51 | 1,9122 | 829,94 | 63 | 40,208 |
| TU175 | HT-61 | HT-59 | 200-(PVC-10) | 61,905 | 1,3824 | 568,29 | 60 | 43,091 |
| TU176 | HT-58 | HT-61 | 200-(PVC-10) | 119,8 | 1,9429 | 1099,7 | 58 | 41,604 |
| TU177 | NU17 | HT-58 | 250-(PVC-10) | 48,295 | 1,6493 | 654,88 | 62 | 47,463 |
| TU178 | NU17 | HT-57 | 315-(PVC-10) | 74,097 | 0,9335 | 1564,9 | 62 | 47,713 |
| TU182 | HT-54 | HT-53 | 125-(PVC-10) | 187,82 | 1,8166 | 700,56 | 65 | 45,192 |
| TU183 | NU17 | HT-54 | 160-(PVC-10) | 55,658 | 1,9871 | 336,17 | 59 | 43,711 |
| TU184 | HT-51 | NU17 | 400-(PVC-10) | 756,99 | 1,1012 | 28372 | 68 | 53,887 |
| TU185 | HT-50 | HT-51 | 400-(PVC-10) | 44,914 | 1,1079 | 1683,4 | 66 | 53,695 |
| TU186 | NU18 | HT-50 | 400-(PVC-10) | 176,33 | 1,4029 | 6609 | 67 | 54,803 |
| TU187 | NU19 | HT-44 | 400-(PVC-10) | 104,16 | 1,2405 | 3903,9 | 69 | 55,191 |
| TU189 | HT-49 | NU19 | 400-(PVC-10) | 488,31 | 1,2405 | 18302 | 68 | 54,5 |
| TU190 | NU18 | HT-49 | 400-(PVC-10) | 135,46 | 1,4084 | 5077,2 | 62 | 49,952 |
| TU191 | NU20 | NU18 | 500-(PRFV-10) | 202,72 | 1,3152 | 16716 | 68 | 56,461 |
| TU192 | HT-64 | HT-63 | 110-(PVC-10) | 179,72 | 1,8502 | 611,06 | 61 | 36,316 |
| TU193 | HT-65 | HT-64 | 200-(PVC-10) | 217,99 | 1,1583 | 2001,1 | 56 | 36,53 |
| TU194 | HT-66 | HT-65 | 200-(PVC-10) | 131,63 | 1,7561 | 1208,4 | 54 | 35,838 |
| TU195 | NU20 | HT-66 | 250-(PVC-10) | 647,84 | 1,6014 | 8784,7 | 55 | 38,533 |
| TU196 | HT-68 | NU20 | 500-(PRFV-10) | 413,68 | 1,4966 | 34112 | 68 | 56,924 |
| TU197 | HT-67 | HT-68 | 500-(PRFV-6) | 46,138 | 1,5462 | 3050,2 | 50 | 40,125 |
| TU198 | HT-67 | HT-69 | 250-(PVC-10) | 64,671 | 1,9839 | 876,93 | 49 | 38,467 |
| TU199 | NU21 | HT-67 | 500-(PRFV-10) | 442,94 | 1,8984 | 36525 | 56 | 46,266 |
| TU200 | NU21 | HT-76 | 110-(PVC-10) | 245,15 | 1,8502 | 833,52 | 60 | 45,15 |
| TU201 | HT-34 | NU21 | 500-(PRFV-10) | 140,03 | 1,9291 | 11547 | 68 | 60,262 |
| TU202 | HT-33 | HT-34 | 600-(PRFV-10) | 68,864 | 1,4922 | 7354,7 | 66 | 58,912 |
| TU203 | HT-35 | HT-33 | 600-(PRFV-10) | 171,14 | 1,509 | 18277 | 65 | 58,079 |
| TU204 | HT-36 | HT-35 | 600-(PRFV-10) | 37,71 | 1,524 | 4027,4 | 64 | 57,5 |
| TU205 | HT-85 | HT-84 | 700-(PRFV-10) | 104,37 | 1,8718 | 13977 | 59 | 55,159 |
| TU206 | NU22 | HT-36 | 600-(PRFV-10) | 257,41 | 1,6279 | 27492 | 63 | 56,595 |

Continúa resultados por tramos...

Optimización diámetros GESTAR 2010

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU207 | NU22 | HT-37 | 110-(PVC-10) | 150,91 | 1,8502 | 513,11 | 62 | 51,946 |
| TU208 | NU12 | NU22 | 600-(PRFV-10) | 237,25 | 1,6524 | 25338 | 68 | 62,324 |
| TU209 | HT-86 | NU12 | 700-(PRFV-10) | 122,03 | 1,8243 | 16343 | 68 | 63,015 |
| TU210 | HT-84 | HT-86 | 700-(PRFV-10) | 267,32 | 1,8418 | 35799 | 60 | 55,372 |
| TU211 | HS-01 | HS-07 | 160-(PVC-10) | 31,451 | 0,87665 | 189,96 | 49 | 37,492 |
| TU212 | HS-02 | HS-01 | 200-(PVC-10) | 37,456 | 1,3077 | 343,84 | 51 | 39,641 |
| TU213 | NU23 | HS-02 | 250-(PVC-10) | 238,06 | 1,1951 | 3228,1 | 51 | 39,921 |
| TU214 | HT-91 | HS-03 | 110-(PVC-10) | 145,83 | 1,8502 | 495,84 | 54 | 38,009 |
| TU215 | NU23 | HT-91 | 160-(PVC-10) | 109,62 | 1,7533 | 662,12 | 48 | 36,24 |
| TU216 | NU23 | HT-92 | 110-(PVC-10) | 165,91 | 1,8502 | 564,09 | 41 | 26,266 |
| TU217 | NU24 | NU23 | 250-(PVC-10) | 197,86 | 1,6485 | 2683 | 68 | 58,079 |
| TU218 | HT-90 | HT-101 | 110-(PVC-10) | 173,01 | 1,8502 | 588,23 | 54 | 37,7 |
| TU219 | HT-89 | HT-90 | 160-(PVC-10) | 66,09 | 1,7533 | 399,18 | 48 | 36,719 |
| TU220 | NU24 | HT-89 | 200-(PVC-10) | 167,32 | 1,6814 | 1536 | 51 | 40,827 |
| TU221 | HT-102 | NU24 | 315-(PVC-10) | 117,03 | 1,3807 | 2471,7 | 68 | 59,816 |
| TU222 | NU25 | HT-102 | 315-(PVC-10) | 413,91 | 1,5043 | 8741,8 | 55 | 47,379 |
| TU223 | NU25 | HT-88 | 110-(PVC-10) | 276,06 | 1,8502 | 938,61 | 59 | 45,701 |
| TU224 | NU25 | HT-87 | 110-(PVC-10) | 136,68 | 1,8502 | 464,72 | 54 | 44,745 |
| TU225 | HT-85 | NU25 | 315-(PVC-10) | 271,86 | 1,6252 | 5741,7 | 68 | 62,71 |
| TU226 | HT-84 | HT-83 | 110-(PVC-10) | 69,83 | 1,8502 | 237,42 | 59 | 53,133 |
| TU228 | HT-81 | HT-85 | 800-(PRFV-6) | 53,066 | 1,6018 | 7019,1 | 57 | 53,476 |
| TU229 | HT-82 | HT-81 | 800-(PRFV-6) | 281,87 | 1,6106 | 37283 | 55 | 51,579 |
| TU230 | HT-71 | HT-70 | 250-(PVC-10) | 245,8 | 0,52585 | 3333,1 | 48 | 35,376 |
| TU231 | HT-72 | HT-71 | 250-(PVC-10) | 28,566 | 0,88438 | 387,35 | 48 | 35,644 |
| TU232 | HT-74 | HT-72 | 400-(PVC-10) | 836,44 | 1,082 | 31350 | 46 | 33,724 |
| TU233 | HT-74 | HT-73 | 140-(PVC-10) | 237,42 | 1,7543 | 1094,5 | 54 | 38,981 |
| TU234 | NU26 | HT-74 | 400-(PVC-10) | 338,42 | 1,3944 | 12684 | 49 | 38,659 |
| TU235 | NU26 | HT-75 | 200-(PVC-10) | 57,91 | 1,4198 | 531,61 | 48 | 38,402 |
| TU236 | HT-77 | NU26 | 400-(PVC-10) | 285,39 | 1,6468 | 10697 | 68 | 58,906 |
| TU237 | NU27 | HT-77 | 400-(PVC-10) | 384,3 | 1,685 | 14404 | 50 | 42,336 |
| TU238 | HT-78 | HT-79 | 110-(PVC-10) | 101,85 | 1,8502 | 346,3 | 47 | 35,392 |
| TU239 | NU27 | HT-78 | 160-(PVC-10) | 178,72 | 1,7533 | 1079,5 | 50 | 41,346 |
| TU240 | HT-80 | NU27 | 400-(PVC-10) | 175,58 | 1,8201 | 6580,8 | 68 | 62,345 |
| TU241 | HT-82 | HT-80 | 400-(PVC-10) | 272,7 | 1,8815 | 10221 | 54 | 49,403 |
| TU242 | 0 | HT-82 | 900-(PRFV-6) | 1900 | 1,5052 | 304209 | 47 | 44,133 |
| TU251 | HT-36 | HT-32 | 160-(PVC-10) | 127,03 | 1,8118 | 767,28 | 66 | 57,331 |
| TU252 | HT-99 | HT-97 | 110-(PVC-10) | 127,03 | 1,8502 | 431,91 | 60 | 47,682 |
| TU60 | NU3 | HT-22 | 160-(PVC-10) | 388,9 | 1,1689 | 2348,9 | 74 | 50,529 |
| TU61 | HT-20 | NU3 | 160-(PVC-10) | 302,54 | 1,1689 | 1827,4 | 78 | 57,633 |

** Información El Nodo HT-43 es el más desfavorable.

P Min de la Red (Dinámica) = 26,266 m (Nodo: HT-92)
P Max de la Red (Estática) = 78 m (Nodo: NU3)
Caudal de Inyección en Cabecera = 0,92175 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 160-(PVC-10) | 6,04 | 1.679 | 10.144,07 |
| | | 200-(PVC-10) | 9,18 | 1.771 | 16.254,16 |
| | | 250-(PVC-10) | 13,56 | 2.086 | 28.285,32 |
| | | 315-(PVC-10) | 21,12 | 2.248 | 47.480,65 |
| | | 110-(PVC-10) | 3,40 | 2.586 | 8.792,46 |
| | | 400-(PVC-10) | 37,48 | 4.995 | 187.221,70 |
| | | 140-(PVC-10) | 4,61 | 436 | 2.009,29 |
| | | 125-(PVC-10) | 3,73 | 1.073 | 4.002,85 |
| | | 500-(PVC-10) | 72,42 | 157 | 11.360,63 |
| | | 500-(PRFV-10) | 82,46 | 1.199 | 98.899,47 |
| | | 600-(PRFV-10) | 106,80 | 772 | 82.489,22 |
| | | 700-(PRFV-10) | 133,92 | 494 | 66.119,55 |
| PRFV | 60,0 | 500-(PRFV-6) | 66,11 | 46 | 3.050,17 |
| | | 800-(PRFV-6) | 132,27 | 335 | 44.301,61 |
| | | 900-(PRFV-6) | 160,11 | 1.900 | 304.209,00 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **914.620,20 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **64.894,55 €** |
| **COSTE TOTAL ANUAL** | **64.894,55 €** |

## 1.6 RED INFERIOR (ALTERNATIVA 6)

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Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 389 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-01 | 331 | 40 |
| HA-02 | 336 | 36 |
| HA-04 | 338 | 38 |
| HA-08 | 329 | 35 |
| HA-09 | 339 | 35 |
| HA-11 | 331 | 38 |
| HA-10 | 342 | 35 |
| HA-12 | 331 | 35 |
| HV-35 | 351 | 34 |
| HA-15 | 348 | 35 |
| HA-17 | 334 | 38 |
| HA-14 | 341 | 35 |
| HA-18 | 335 | 35 |
| HA-50 | 340 | 37 |
| HA-45 | 334 | 38 |
| HA-49 | 337 | 38 |
| HA-48 | 337 | 39 |
| HA-41 | 346 | 39 |
| HA-51 | 343 | 38 |
| HA-46 | 348 | 35 |
| HA-47 | 349 | 35 |
| HA-06 | 343 | 35 |
| HA-07 | 345 | 35 |
| HV-11 | 343 | 36 |
| HV-12 | 343 | 36 |
| HV-10 | 343 | 35 |
| HV-09 | 345 | 36 |
| HV-07 | 346 | 35 |
| HV-13 | 345 | 35 |
| HV-14 | 346 | 36 |
| HV-08 | 347 | 35 |
| HV-06 | 350 | 34 |
| HV-02 | 350 | 34 |
| HV-20 | 340 | 35 |
| HV-25 | 340 | 35 |
| HV-22 | 343 | 35 |
| HV-16 | 340 | 36 |
| HV-17 | 342 | 35 |
| HV-26 | 342 | 37 |
| 23 | 351 | 0 |
| HV-24 | 350 | 35 |
| NU6 | 350 | 0 |
| HV-21 | 343 | 37 |
| HV-34 | 343 | 37 |
| HV-33 | 351 | 34 |

Continúa nodos...

Página 2
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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HV-36 | 351 | 34 |
| HV-43 | 345 | 35 |
| HV-42 | 346 | 35 |
| HA-16 | 340 | 35 |
| NU7 | 350 | 0 |
| HA-19 | 342 | 35 |
| HA-20 | 344 | 35 |
| HA-22 | 345 | 37 |
| HA-23 | 346 | 37 |
| HV-04 | 351 | 33 |
| HV-05 | 346 | 35 |
| HV-18 | 342 | 35 |
| HV-19 | 342 | 37 |
| HV-27 | 342 | 35 |
| HV-15 | 342 | 36 |
| NU3 | 335 | 0 |
| HA-03 | 335 | 39 |
| HA-05 | 343 | 36 |
| HA-13 | 342 | 38 |
| HA-38 | 351 | 35 |
| HA-21 | 345 | 40 |
| 44 | 351 | 0 |
| HV-03 | 351 | 33 |
| NU8 | 350 | 0 |
| 33 | 359 | 0 |
| NU1 | 350 | 0 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| TU26 | NU1 | 33 | 1250 | 25 | 0,007 | 0,015 | 981 | 1000 | |
| TU28 | 0 | NU1 | 3450 | 69 | 0,007 | 0,03 | 981 | 1000 | |
| TU27 | 33 | NU8 | 812 | 16,24 | 0,007 | 0,18121 | 981 | 1000 | |
| | HA-02 | HA-01 | 242,8 | 4,8561 | -- | 0,02 | -- | -- | 0 |
| | HA-23 | HA-21 | 10 | 0,2 | -- | 0,18178 | -- | -- | 0 |
| | HV-24 | HV-22 | 93,163 | 1,8633 | -- | 0,045 | -- | -- | 0 |
| | HV-17 | HV-16 | 100,05 | 2,001 | -- | 0,015 | -- | -- | 0 |
| | HV-19 | HV-17 | 56,789 | 1,1358 | -- | 0,03 | -- | -- | 0 |
| | HV-15 | HV-18 | 22,392 | 0,44784 | -- | 0,06 | -- | -- | 0 |
| | HV-26 | HV-27 | 23,604 | 0,47208 | -- | 0,06958 | -- | -- | 0 |
| | 23 | HV-26 | 281,38 | 5,6277 | -- | 0,07649 | -- | -- | 0 |
| | NU6 | 23 | 120,48 | 2,4096 | -- | 0,07649 | -- | -- | 0 |
| | NU6 | HV-24 | 114,4 | 2,288 | -- | 0,06 | -- | -- | 0 |
| | HV-21 | NU6 | 227,17 | 4,5434 | -- | 0,10206 | -- | -- | 0 |
| | HV-34 | HV-21 | 27,484 | 0,54969 | -- | 0,10904 | -- | -- | 0 |
| | HA-21 | 44 | 450 | 9 | -- | 0,16771 | -- | -- | 0 |
| | HV-33 | HV-34 | 384,41 | 7,6883 | -- | 0,11488 | -- | -- | 0 |
| | HV-36 | HV-33 | 120,72 | 2,4144 | -- | 0,14839 | -- | -- | 0 |
| | NU7 | HV-36 | 323,29 | 6,4658 | -- | 0,17384 | -- | -- | 0 |
| | HV-42 | HV-43 | 209 | 4,1799 | -- | 0,015 | -- | -- | 0 |
| | NU7 | HV-42 | 103,61 | 2,0723 | -- | 0,03 | -- | -- | 0 |
| | NU7 | HA-16 | 88,858 | 1,7772 | -- | 0,018 | -- | -- | 0 |
| | HA-19 | NU7 | 141,87 | 2,8373 | -- | 0,20228 | -- | -- | 0 |
| | HA-20 | HA-19 | 198,05 | 3,961 | -- | 0,21795 | -- | -- | 0 |
| | NU8 | HA-20 | 272,94 | 5,4587 | -- | 0,22798 | -- | -- | 0 |
| | NU8 | HA-22 | 94,004 | 1,8801 | -- | 0,015 | -- | -- | 0 |
| | HA-15 | HV-35 | 177,92 | 3,5584 | -- | 0,015 | -- | -- | 0 |
| | NU8 | HA-23 | 294,77 | 5,8954 | -- | 0,19539 | -- | -- | 0 |
| | HA-14 | HA-15 | 234,63 | 4,6926 | -- | 0,035 | -- | -- | 0 |
| | HA-14 | HA-17 | 307,32 | 6,1465 | -- | 0,017 | -- | -- | 0 |
| | HA-18 | HA-14 | 297,29 | 5,9458 | -- | 0,068 | -- | -- | 0 |
| | HA-50 | HA-18 | 409,85 | 8,197 | -- | 0,07276 | -- | -- | 0 |
| | HA-51 | HA-50 | 171,1 | 3,4221 | -- | 0,08015 | -- | -- | 0 |
| | HA-49 | HA-45 | 149,42 | 2,9883 | -- | 0,19852 | -- | -- | 0 |
| | HA-48 | HA-49 | 30,33 | 0,60659 | -- | 0,20481 | -- | -- | 0 |
| | HA-03 | HA-02 | 147,35 | 2,947 | -- | 0,038 | -- | -- | 0 |
| | HA-51 | HA-48 | 377,99 | 7,5599 | -- | 0,20976 | -- | -- | 0 |
| | HA-38 | HA-41 | 260,79 | 5,2158 | -- | 0,28303 | -- | -- | 0 |

Continúa tuberías...

Página 3
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HA-41 | HA-51 | 238,22 | 4,7644 | -- | 0,27489 | -- | -- | 0 |
| | HA-51 | HA-46 | 102,26 | 2,0452 | -- | 0,03 | -- | -- | 0 |
| | HA-46 | HA-47 | 72,821 | 1,4564 | -- | 0,015 | -- | -- | 0 |
| | HV-04 | HV-05 | 481,99 | 9,6398 | -- | 0,015 | -- | -- | 0 |
| | HV-18 | HV-19 | 117,45 | 2,349 | -- | 0,045 | -- | -- | 0 |
| | HV-27 | HV-15 | 337,1 | 6,7419 | -- | 0,06052 | -- | -- | 0 |
| | 44 | HV-03 | 1400 | 28 | -- | 0,16771 | -- | -- | 0 |
| | HA-45 | HA-13 | 1540 | 30,8 | -- | 0,19232 | -- | -- | 0 |
| | HA-04 | NU3 | 365 | 7,3 | -- | 0,09828 | -- | -- | 0 |
| | NU3 | HA-03 | 245 | 4,9 | -- | 0,053 | -- | -- | 0 |
| | NU3 | HA-05 | 570 | 11,4 | -- | 0,06 | -- | -- | 0 |
| | 33 | HA-38 | 566 | 11,32 | -- | 0,28909 | -- | -- | 0 |
| | HA-08 | HA-04 | 219,15 | 4,3829 | -- | 0,13282 | -- | -- | 0 |
| | HA-05 | HA-06 | 160,93 | 3,2186 | -- | 0,03 | -- | -- | 0 |
| | HA-09 | HA-08 | 287,27 | 5,7453 | -- | 0,14344 | -- | -- | 0 |
| | HA-06 | HA-07 | 270,59 | 5,4118 | -- | 0,015 | -- | -- | 0 |
| | HA-11 | HA-09 | 207,37 | 4,1473 | -- | 0,15556 | -- | -- | 0 |
| | HV-12 | HV-11 | 292,97 | 5,8594 | -- | 0,03 | -- | -- | 0 |
| | HV-10 | HV-12 | 30,93 | 0,61861 | -- | 0,045 | -- | -- | 0 |
| | HV-09 | HV-10 | 282,47 | 5,6493 | -- | 0,066 | -- | -- | 0 |
| | HV-07 | HV-09 | 218,19 | 4,3637 | -- | 0,082 | -- | -- | 0 |
| | HV-08 | HV-07 | 330,84 | 6,6168 | -- | 0,09069 | -- | -- | 0 |
| | HV-14 | HV-13 | 340,36 | 6,8072 | -- | 0,015 | -- | -- | 0 |
| | HV-08 | HV-14 | 262,19 | 5,2439 | -- | 0,03 | -- | -- | 0 |
| | HV-06 | HV-08 | 138,83 | 2,7766 | -- | 0,1202 | -- | -- | 0 |
| | HA-10 | HA-11 | 293,13 | 5,8626 | -- | 0,16499 | -- | -- | 0 |
| | HV-03 | HV-06 | 356,1 | 7,122 | -- | 0,12935 | -- | -- | 0 |
| | HV-03 | HV-02 | 262,45 | 5,249 | -- | 0,015 | -- | -- | 0 |
| | HV-03 | HV-04 | 22,997 | 0,45994 | -- | 0,055 | -- | -- | 0 |
| | HA-12 | HA-10 | 35,136 | 0,70272 | -- | 0,17119 | -- | -- | 0 |
| | HA-13 | HA-12 | 45,068 | 0,90135 | -- | 0,18121 | -- | -- | 0 |
| | HV-25 | HV-20 | 44,709 | 0,89418 | -- | 0,015 | -- | -- | 0 |
| | HV-22 | HV-25 | 151,33 | 3,0265 | -- | 0,03 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |

Continúa materiales...

Página 4
Gestar2014GESTAR _2014 rev 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 160 | | | |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |

Continúa materiales...

Página 5
Gestar2014GESTAR _2014 rev 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PRFV | TRAGSA | 0,007 | | | | |
| | | | 200 | | | |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

Página 6
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 389

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU26 | NU1 | 33 | 1000 | 1250 | 0,84595 | --------- | 30 | 27,831 |
| TU28 | 0 | NU1 | 1000 | 3450 | 0,84595 | --------- | 39 | 37,408 |
| TU27 | 33 | NU8 | 1000 | 812 | 0,5143 | --------- | 39 | 36,68 |
| TU1 | HA-02 | HA-01 | 140-(PVC-10) | 242,8 | 1,5255 | 1119,3 | 58 | 40,917 |
| TU10 | HA-23 | HA-21 | 500-(PRFV-6) | 10 | 0,90397 | 661,1 | 44 | 41,286 |
| TU100 | HV-24 | HV-22 | 200-(PVC-10) | 93,163 | 1,6814 | 855,24 | 46 | 41,029 |
| TU101 | HV-17 | HV-16 | 110-(PVC-10) | 100,05 | 1,8502 | 340,18 | 49 | 36,814 |
| TU102 | HV-19 | HV-17 | 160-(PVC-10) | 56,789 | 1,7533 | 343,01 | 47 | 37,717 |
| TU103 | HV-15 | HV-18 | 250-(PVC-10) | 22,392 | 1,4341 | 303,64 | 47 | 39,141 |
| TU104 | HV-26 | HV-27 | 250-(PVC-10) | 23,604 | 1,6631 | 320,07 | 47 | 41,62 |
| TU105 | 23 | HV-26 | 315-(PVC-10) | 281,38 | 1,1517 | 5942,8 | 47 | 41,83 |
| TU106 | NU6 | 23 | 315-(PVC-10) | 120,48 | 1,1517 | 2544,5 | 38 | 33,8 |
| TU107 | NU6 | HV-24 | 400-(PVC-10) | 114,4 | 0,55963 | 4287,8 | 39 | 35,136 |
| TU108 | HV-21 | NU6 | 500-(PRFV-6) | 227,17 | 0,50753 | 15018 | 39 | 35,216 |
| TU109 | HV-34 | HV-21 | 500-(PRFV-6) | 27,484 | 0,54224 | 1817 | 46 | 42,306 |
| TU11 | HA-21 | 44 | 500-(PRFV-6) | 450 | 0,834 | 29750 | 38 | 34,844 |
| TU110 | HV-33 | HV-34 | 500-(PRFV-6) | 384,41 | 0,57129 | 25414 | 46 | 42,319 |
| TU111 | HV-36 | HV-33 | 500-(PRFV-6) | 120,72 | 0,73793 | 7980,9 | 38 | 34,508 |
| TU112 | NU7 | HV-36 | 500-(PRFV-6) | 323,29 | 0,86449 | 21373 | 38 | 34,603 |
| TU113 | HV-42 | HV-43 | 125-(PVC-10) | 209 | 1,4341 | 779,56 | 44 | 35,943 |
| TU114 | NU7 | HV-42 | 160-(PVC-10) | 103,61 | 1,7533 | 625,82 | 43 | 38,204 |
| TU115 | NU7 | HA-16 | 125-(PVC-10) | 88,858 | 1,721 | 331,44 | 49 | 44,006 |
| TU116 | HA-19 | NU7 | 500-(PRFV-6) | 141,87 | 1,0059 | 9378,8 | 39 | 35,942 |
| TU117 | HA-20 | HA-19 | 500-(PRFV-6) | 198,05 | 1,0838 | 13093 | 47 | 44,139 |
| TU118 | NU8 | HA-20 | 600-(PRFV-6) | 272,94 | 0,83956 | 22637 | 45 | 42,453 |
| TU119 | NU8 | HA-22 | 110-(PVC-10) | 94,004 | 1,8502 | 319,61 | 44 | 38,953 |
| TU12 | HA-15 | HV-35 | 250-(PVC-10) | 177,92 | 0,35853 | 2412,6 | 38 | 34,563 |
| TU120 | NU8 | HA-23 | 500-(PRFV-6) | 294,77 | 0,97165 | 19487 | 43 | 40,297 |
| TU13 | HA-14 | HA-15 | 315-(PVC-10) | 234,63 | 0,52697 | 4955,3 | 41 | 37,661 |
| TU14 | HA-14 | HA-17 | 125-(PVC-10) | 307,32 | 1,6254 | 1146,3 | 55 | 45,826 |
| TU15 | HA-18 | HA-14 | 400-(PVC-10) | 297,29 | 0,63425 | 11143 | 48 | 44,855 |
| TU16 | HA-50 | HA-18 | 400-(PVC-10) | 409,85 | 0,67865 | 15361 | 54 | 51,115 |
| TU17 | HA-51 | HA-50 | 400-(PVC-10) | 171,1 | 0,74758 | 6413 | 49 | 46,519 |
| TU18 | HA-49 | HA-45 | 500-(PRFV-6) | 149,42 | 0,98722 | 9877,9 | 55 | 52,206 |
| TU19 | HA-48 | HA-49 | 500-(PRFV-6) | 30,33 | 1,0185 | 2005,1 | 52 | 49,406 |
| TU2 | HA-03 | HA-02 | 200-(PVC-10) | 147,35 | 1,4198 | 1352,7 | 53 | 39,619 |
| TU20 | HA-51 | HA-48 | 600-(PRFV-6) | 377,99 | 0,77246 | 31351 | 52 | 49,449 |
| TU21 | HA-38 | HA-41 | 1000-(PRFV-6) | 260,79 | 0,37446 | 58289 | 43 | 40,742 |
| TU22 | HA-41 | HA-51 | 1000-(PRFV-6) | 238,22 | 0,36369 | 53245 | 46 | 43,719 |
| TU23 | HA-51 | HA-46 | 160-(PVC-10) | 102,26 | 1,7533 | 617,65 | 41 | 37,003 |
| TU24 | HA-46 | HA-47 | 140-(PVC-10) | 72,821 | 1,1441 | 335,7 | 40 | 35,347 |
| TU245 | HV-04 | HV-05 | 160-(PVC-10) | 481,99 | 0,87665 | 2911,2 | 43 | 36,055 |
| TU246 | HV-18 | HV-19 | 250-(PVC-10) | 117,45 | 1,0756 | 1592,6 | 47 | 38,67 |
| TU247 | HV-27 | HV-15 | 250-(PVC-10) | 337,1 | 1,4466 | 4571 | 47 | 39,293 |
| TU25 | 44 | HV-03 | 500-(PRFV-6) | 1400 | 0,834 | 92554 | 38 | 33,468 |
| TU3 | HA-45 | HA-13 | 500-(PRFV-6) | 1540 | 0,95639 | 101809 | 47 | 42,262 |
| TU35 | HA-04 | NU3 | 400-(PVC-10) | 365 | 0,91668 | 13680 | 54 | 45,839 |
| TU36 | NU3 | HA-03 | 200-(PVC-10) | 245 | 1,9803 | 2249,1 | 54 | 41,903 |
| TU37 | NU3 | HA-05 | 400-(PVC-10) | 570 | 0,55963 | 21364 | 46 | 37,443 |
| TU38 | 33 | HA-38 | 1000-(PRFV-6) | 566 | 0,38248 | 126507 | 38 | 35,77 |
| TU4 | HA-08 | HA-04 | 400-(PVC-10) | 219,15 | 1,2388 | 8213,6 | 51 | 43,462 |
| TU49 | HA-05 | HA-06 | 315-(PVC-10) | 160,93 | 0,45169 | 3398,8 | 46 | 37,342 |
| TU5 | HA-09 | HA-08 | 400-(PVC-10) | 287,27 | 1,3379 | 10767 | 60 | 53,107 |
| TU50 | HA-06 | HA-07 | 250-(PVC-10) | 270,59 | 0,35853 | 3669,2 | 44 | 35,194 |
| TU6 | HA-11 | HA-09 | 400-(PVC-10) | 207,37 | 1,4509 | 7772 | 50 | 44,08 |
| TU62 | HV-12 | HV-11 | 250-(PVC-10) | 292,97 | 0,71707 | 3972,7 | 46 | 37,064 |
| TU63 | HV-10 | HV-12 | 250-(PVC-10) | 30,93 | 1,0756 | 419,41 | 46 | 37,626 |
| TU64 | HV-09 | HV-10 | 315-(PVC-10) | 282,47 | 0,99372 | 5965,7 | 46 | 37,75 |
| TU65 | HV-07 | HV-09 | 315-(PVC-10) | 218,19 | 1,2346 | 4608,1 | 44 | 36,493 |
| TU66 | HV-08 | HV-07 | 315-(PVC-10) | 330,84 | 1,3655 | 6987,4 | 43 | 36,348 |
| TU67 | HV-14 | HV-13 | 160-(PVC-10) | 340,36 | 0,87665 | 2055,8 | 44 | 35,816 |

Continúa resultados por tramos...

Página 7
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU68 | HV-08 | HV-14 | 200-(PVC-10) | 262,19 | 1,1209 | 2406,9 | 43 | 36,426 |
| TU69 | HV-06 | HV-08 | 400-(PVC-10) | 138,83 | 1,1211 | 5203,4 | 42 | 36,907 |
| TU7 | HA-10 | HA-11 | 500-(PRFV-6) | 293,13 | 0,82048 | 19379 | 58 | 52,896 |
| TU70 | HV-03 | HV-06 | 500-(PRFV-6) | 356,1 | 0,64324 | 23542 | 39 | 34,25 |
| TU73 | HV-03 | HV-02 | 200-(PVC-10) | 262,45 | 0,56045 | 2409,3 | 39 | 34,046 |
| TU74 | HV-03 | HV-04 | 250-(PVC-10) | 22,997 | 1,3146 | 311,84 | 38 | 33,335 |
| TU8 | HA-12 | HA-10 | 500-(PRFV-6) | 35,136 | 0,85131 | 2322,8 | 47 | 42,175 |
| TU9 | HA-13 | HA-12 | 500-(PRFV-6) | 45,068 | 0,90114 | 2979,4 | 58 | 53,211 |
| TU98 | HV-25 | HV-20 | 110-(PVC-10) | 44,709 | 1,8502 | 152,01 | 49 | 40,194 |
| TU99 | HV-22 | HV-25 | 160-(PVC-10) | 151,33 | 1,7533 | 914,01 | 49 | 41,491 |

** ¡Atención! Elementos TU12 , TU21 , TU22 , TU49 , TU50 , TU38 , Velocidad de Diseño inferior a la Mínima.

** Información El Nodo HV-35 es el más desfavorable.

P Min de la Red (Dinámica) = 27,831 m (Nodo: 33)
P Max de la Red (Estática) = 60 m (Nodo: HA-08)
Caudal de Inyección en Cabecera = 0,6394 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 140-(PVC-10) | 4,61 | 316 | 1.455,02 |
| | | 200-(PVC-10) | 9,18 | 1.010 | 9.273,26 |
| | | 400-(PVC-10) | 37,48 | 2.780 | 104.204,10 |
| | | 250-(PVC-10) | 13,56 | 1.296 | 17.573,07 |
| | | 315-(PVC-10) | 21,12 | 1.629 | 34.402,73 |
| | | 125-(PVC-10) | 3,73 | 605 | 2.257,31 |
| | | 160-(PVC-10) | 6,04 | 1.236 | 7.467,49 |
| | | 110-(PVC-10) | 3,40 | 239 | 811,80 |
| PRFV | 60,0 | 500-(PRFV-6) | 66,11 | 6.027 | 398.441,90 |
| | | 600-(PRFV-6) | 82,94 | 651 | 53.988,05 |
| | | 1000-(PRFV-6) | 223,51 | 1.065 | 238.040,40 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **867.915,06 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **61.580,71 €** |
| **COSTE TOTAL ANUAL** | **61.580,71 €** |

## 1.7 RED BOMBEO 1 (ALTERNATIVA 6)

Página 1
Gestar2014GESTAR _2014 rev.0 30/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 425 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-40 | 353 | 37 |
| HA-36 | 359 | 34 |
| NU2 | 370 | 0 |
| HA-34 | 360 | 36 |
| HA-33 | 359 | 37 |
| HA-43 | 353 | 35 |
| HA-37 | 353 | 38 |
| HA-39 | 354 | 36 |
| HA-53 | 354 | 37 |
| HA-42 | 354 | 35 |
| HA-44 | 354 | 37 |
| HA-26 | 354 | 37 |
| HA-28 | 355 | 35 |
| HA-27 | 359 | 35 |
| HA-29 | 359 | 35 |
| HA-31 | 359 | 36 |
| HA-30 | 361 | 36 |
| HT-21 | 363 | 35 |
| HA-32 | 364 | 36 |
| HT-22 | 364 | 41 |
| NU3 | 360 | 0 |
| HV-50 | 355 | 37 |
| HV-51 | 356 | 38 |
| HV-52 | 358 | 37 |
| HV-49 | 362 | 38 |
| HV-46 | 362 | 35 |
| HV-48 | 362 | 35 |
| HV-37 | 353 | 37 |
| HV-30 | 352 | 36 |
| HV-29 | 355 | 36 |
| HV-38 | 354 | 36 |
| HV-39 | 355 | 36 |
| HV-40 | 360 | 35 |
| HV-45 | 354 | 37 |
| NU5 | 360 | 0 |
| NU4 | 360 | 0 |
| HV-47 | 368 | 36 |
| HT-06 | 360 | 36 |
| HT-07 | 357 | 39 |
| HT-62 | 373 | 37 |
| HT-08 | 366 | 35 |
| HT-09 | 364 | 35 |
| HA-21 | 345 | 42 |
| HV-44 | 351 | 36 |
| HA-24 | 351 | 35 |

Continúa nodos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HA-25 | 352 | 38 |
| HT-11 | 353 | 37 |
| HT-10 | 355 | 36 |
| HT-12 | 361 | 36 |
| HT-13 | 357 | 37 |
| HT-14 | 357 | 35 |
| HT-17 | 357 | 38 |
| HT-16 | 357 | 35 |
| HT-18 | 358 | 36 |
| HT-15 | 357 | 38 |
| HT-20 | 362 | 44 |
| HT-19 | 367 | 42 |
| HT-28 | 367 | 39 |
| HT-23 | 368 | 37 |
| HT-24 | 370 | 35 |
| HT-27 | 371 | 37 |
| HT-26 | 373 | 38 |
| NU9 | 370 | 0 |
| HT-30 | 368 | 35 |
| NU10 | 370 | 0 |
| HT-31 | 368 | 39 |
| HT-25 | 374 | 36 |
| HT-29 | 368 | 39 |
| HT-98 | 374 | 39 |
| HT-100 | 375 | 38 |
| NU11 | 370 | 0 |
| HT-40 | 360 | 36 |
| HT-41 | 365 | 37 |
| HT-42 | 373 | 38 |
| NU13 | 370 | 0 |
| NU14 | 370 | 0 |
| HT-01 | 356 | 39 |
| HT-02 | 354 | 36 |
| NU15 | 370 | 0 |
| HT-45 | 371 | 38 |
| HT-47 | 369 | 35 |
| HT-46 | 361 | 37 |
| HT-56 | 371 | 35 |
| NU16 | 370 | 0 |
| HT-60 | 375 | 36 |
| 59 | 378 | 0 |
| 61 | 380 | 0 |
| HT-58 | 376 | 36 |
| HT-57 | 376 | 35 |
| HT-04 | 361 | 35 |
| HT-03 | 361 | 35 |
| HT-52 | 365 | 38 |
| HT-53 | 373 | 38 |
| HT-54 | 379 | 35 |
| NU17 | 370 | 0 |
| HT-51 | 372 | 37 |
| HT-50 | 371 | 40 |
| HT-44 | 369 | 40 |
| HT-48 | 363 | 37 |
| NU19 | 370 | 0 |
| HT-49 | 376 | 39 |
| NU18 | 370 | 0 |
| NU20 | 370 | 0 |
| 68 | 388 | 0 |
| 67 | 382 | 0 |
| NU21 | 370 | 0 |
| HT-34 | 372 | 35 |
| HT-33 | 373 | 36 |
| HT-35 | 374 | 37 |
| HT-36 | 375 | 36 |
| HT-37 | 376 | 35 |
| NU22 | 370 | 0 |

Continúa nodos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| NU12 | 370 | 0 |
| 85 | 381 | 0 |
| 81 | 383 | 0 |
| 82 | 391 | 0 |
| HV-31 | 350 | 35 |
| HV-28 | 351 | 37 |
| HV-41 | 360 | 38 |
| HT-32 | 372 | 35 |
| HA-52 | 356 | 36 |
| HA-35 | 359 | 35 |
| 84 | 379 | 0 |
| HT-86 | 378 | 35 |
| H-ALM | 365 | 35 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-22 | H-ALM | 510 | 10,2 | -- | 0,69 | -- | -- | 0 |
| | HA-24 | HA-21 | 178,87 | 3,5773 | -- | 0,021 | -- | -- | 0 |
| | HA-24 | HV-44 | 259,62 | 5,1923 | -- | 0,017 | -- | -- | 0 |
| | HA-25 | HA-24 | 163,67 | 3,2735 | -- | 0,053 | -- | -- | 0 |
| | HT-11 | HA-25 | 241 | 4,82 | -- | 0,082 | -- | -- | 0 |
| | HT-10 | HT-11 | 263,55 | 5,2709 | -- | 0,08274 | -- | -- | 0 |
| | HT-13 | HT-10 | 231,24 | 4,6248 | -- | 0,27199 | -- | -- | 0 |
| | HT-13 | HT-12 | 232,45 | 4,649 | -- | 0,015 | -- | -- | 0 |
| | HT-14 | HT-13 | 156,06 | 3,1212 | -- | 0,28935 | -- | -- | 0 |
| | HT-15 | HT-14 | 230,4 | 4,6079 | -- | 0,29371 | -- | -- | 0 |
| | HT-16 | HT-17 | 34,97 | 0,6994 | -- | 0,017 | -- | -- | 0 |
| | HT-18 | HT-16 | 111,9 | 2,238 | -- | 0,032 | -- | -- | 0 |
| | HT-15 | HT-18 | 42,766 | 0,85532 | -- | 0,047 | -- | -- | 0 |
| | HT-20 | HT-15 | 350,98 | 7,0195 | -- | 0,32618 | -- | -- | 0 |
| | HT-19 | HT-20 | 400,18 | 8,0035 | -- | 1,3023 | -- | -- | 0 |
| | HT-23 | HT-19 | 246,59 | 4,9318 | -- | 1,3219 | -- | -- | 0 |
| | HT-23 | HT-28 | 55,416 | 1,1083 | -- | 0,036 | -- | -- | 0 |
| | NU9 | HT-23 | 124,98 | 2,4996 | -- | 1,3476 | -- | -- | 0 |
| | HT-27 | HT-24 | 280,78 | 5,6156 | -- | 0,015 | -- | -- | 0 |
| | HT-26 | HT-27 | 39,95 | 0,79901 | -- | 0,03 | -- | -- | 0 |
| | NU9 | HT-26 | 171,09 | 3,4219 | -- | 0,047 | -- | -- | 0 |
| | NU10 | NU9 | 222,78 | 4,4557 | -- | 1,3697 | -- | -- | 0 |
| | NU10 | HT-30 | 198,44 | 3,9688 | -- | 0,024 | -- | -- | 0 |
| | HT-25 | NU10 | 461,81 | 9,2363 | -- | 1,3829 | -- | -- | 0 |
| | HT-25 | HT-31 | 63,687 | 1,2737 | -- | 0,017 | -- | -- | 0 |
| | HT-29 | HT-25 | 122,11 | 2,4422 | -- | 1,4014 | -- | -- | 0 |
| | HT-98 | HT-29 | 79,101 | 1,582 | -- | 1,413 | -- | -- | 0 |
| | NU11 | HT-98 | 110,42 | 2,2085 | -- | 1,4201 | -- | -- | 0 |
| | NU11 | HT-100 | 58,054 | 1,1611 | -- | 0,015 | -- | -- | 0 |
| | NU12 | NU11 | 156,87 | 3,1374 | -- | 1,4258 | -- | -- | 0 |
| | HT-41 | HT-40 | 37,444 | 0,74887 | -- | 0,015 | -- | -- | 0 |
| | NU13 | HT-41 | 330,35 | 6,6069 | -- | 0,03 | -- | -- | 0 |
| | NU13 | HT-42 | 101,24 | 2,0247 | -- | 0,015 | -- | -- | 0 |
| | NU14 | NU13 | 488,64 | 9,7729 | -- | 0,045 | -- | -- | 0 |
| | HT-44 | NU14 | 44,389 | 0,88777 | -- | 0,045 | -- | -- | 0 |
| | NU15 | HT-01 | 379,52 | 7,5904 | -- | 0,016 | -- | -- | 0 |
| | NU15 | HT-02 | 218,8 | 4,3759 | -- | 0,018 | -- | -- | 0 |
| | HT-45 | NU15 | 204,73 | 4,0947 | -- | 0,034 | -- | -- | 0 |
| | HT-47 | HT-45 | 274,37 | 5,4874 | -- | 0,049 | -- | -- | 0 |
| | HT-46 | HT-47 | 132,45 | 2,649 | -- | 0,067 | -- | -- | 0 |
| | HT-48 | HT-46 | 408,75 | 8,175 | -- | 0,07383 | -- | -- | 0 |
| | NU16 | HT-56 | 88,786 | 1,7757 | -- | 0,017 | -- | -- | 0 |
| | HT-57 | NU16 | 368,09 | 7,3619 | -- | 0,017 | -- | -- | 0 |
| | 59 | HT-60 | 222,51 | 4,4501 | -- | 0,02 | -- | -- | 0 |
| | 61 | 59 | 61,905 | 1,2381 | -- | 0,02 | -- | -- | 0 |
| | HT-58 | 61 | 119,8 | 2,3959 | -- | 0,02 | -- | -- | 0 |
| | NU17 | HT-58 | 48,295 | 0,9659 | -- | 0,037 | -- | -- | 0 |
| | NU17 | HT-57 | 74,097 | 1,482 | -- | 0,032 | -- | -- | 0 |
| | HT-03 | HT-04 | 266,55 | 5,3309 | -- | 0,015 | -- | -- | 0 |
| | HT-52 | HT-03 | 308,94 | 6,1788 | -- | 0,03 | -- | -- | 0 |
| | HT-53 | HT-52 | 305,51 | 6,1103 | -- | 0,045 | -- | -- | 0 |

Continúa tuberías...

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Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-54 | HT-53 | 187,82 | 3,7564 | -- | 0,064 | -- | -- | 0 |
| | NU17 | HT-54 | 55,658 | 1,1132 | -- | 0,064 | -- | -- | 0 |
| | HT-51 | NU17 | 756,99 | 15,14 | -- | 0,10693 | -- | -- | 0 |
| | HT-50 | HT-51 | 44,914 | 0,89829 | -- | 0,11384 | -- | -- | 0 |
| | NU18 | HT-50 | 176,33 | 3,5267 | -- | 0,14021 | -- | -- | 0 |
| | NU19 | HT-44 | 104,16 | 2,0832 | -- | 0,12 | -- | -- | 0 |
| | NU19 | HT-48 | 356,08 | 7,1216 | -- | 0,08278 | -- | -- | 0 |
| | HT-49 | NU19 | 488,31 | 9,7663 | -- | 0,17987 | -- | -- | 0 |
| | NU18 | HT-49 | 135,46 | 2,7093 | -- | 0,1807 | -- | -- | 0 |
| | NU20 | NU18 | 202,72 | 4,0543 | -- | 0,28121 | -- | -- | 0 |
| | 68 | NU20 | 413,68 | 8,2736 | -- | 0,28121 | -- | -- | 0 |
| | 67 | 68 | 46,138 | 0,92275 | -- | 0,28121 | -- | -- | 0 |
| | NU21 | 67 | 442,94 | 8,8588 | -- | 0,28121 | -- | -- | 0 |
| | HT-34 | NU21 | 140,03 | 2,8005 | -- | 0,28121 | -- | -- | 0 |
| | HT-33 | HT-34 | 68,864 | 1,3773 | -- | 0,30062 | -- | -- | 0 |
| | HT-35 | HT-33 | 171,14 | 3,4227 | -- | 0,3053 | -- | -- | 0 |
| | HT-36 | HT-35 | 37,71 | 0,7542 | -- | 0,30947 | -- | -- | 0 |
| | 85 | 84 | 104,37 | 2,0874 | -- | 1,7046 | -- | -- | 0 |
| | NU22 | HT-36 | 257,41 | 5,1483 | -- | 0,33839 | -- | -- | 0 |
| | NU22 | HT-37 | 150,91 | 3,0183 | -- | 0,015 | -- | -- | 0 |
| | NU12 | NU22 | 237,25 | 4,745 | -- | 0,34514 | -- | -- | 0 |
| | HT-86 | NU12 | 122,03 | 2,4407 | -- | 1,6984 | -- | -- | 0 |
| | 84 | HT-86 | 267,32 | 5,3464 | -- | 1,7046 | -- | -- | 0 |
| | 81 | 85 | 53,066 | 1,0613 | -- | 1,7046 | -- | -- | 0 |
| | 82 | 81 | 281,87 | 5,6373 | -- | 1,7046 | -- | -- | 0 |
| | 0 | 82 | 1000 | 20 | -- | 1,7046 | -- | -- | 0 |
| | HV-31 | HV-28 | 30,132 | 0,60265 | -- | 0,015 | -- | -- | 0 |
| | HV-40 | HV-41 | 127,03 | 2,5407 | -- | 0,015 | -- | -- | 0 |
| | HT-36 | HT-32 | 127,03 | 2,5407 | -- | 0,031 | -- | -- | 0 |
| | HA-42 | HA-52 | 508,14 | 10,163 | -- | 0,015 | -- | -- | 0 |
| | HA-33 | HA-35 | 1 | 0,02 | -- | 0,015 | -- | -- | 0 |
| | NU2 | HA-40 | 387,35 | 7,7471 | -- | 0,016 | -- | -- | 0 |
| | NU2 | HA-36 | 119 | 2,38 | -- | 0,015 | -- | -- | 0 |
| | HA-33 | NU2 | 258,05 | 5,161 | -- | 0,031 | -- | -- | 0 |
| | HA-33 | HA-34 | 34,371 | 0,68742 | -- | 0,015 | -- | -- | 0 |
| | HA-29 | HA-33 | 271,78 | 5,4355 | -- | 0,06456 | -- | -- | 0 |
| | HA-42 | HA-43 | 286,4 | 5,728 | -- | 0,015 | -- | -- | 0 |
| | HA-39 | HA-37 | 38,28 | 0,76559 | -- | 0,019 | -- | -- | 0 |
| | HA-53 | HA-39 | 184,65 | 3,693 | -- | 0,034 | -- | -- | 0 |
| | HA-42 | HA-53 | 109,04 | 2,1808 | -- | 0,049 | -- | -- | 0 |
| | HA-44 | HA-42 | 241,28 | 4,8255 | -- | 0,06905 | -- | -- | 0 |
| | HA-27 | HA-44 | 274,7 | 5,4941 | -- | 0,0757 | -- | -- | 0 |
| | HA-28 | HA-26 | 196,18 | 3,9237 | -- | 0,015 | -- | -- | 0 |
| | HA-27 | HA-28 | 62,348 | 1,247 | -- | 0,03 | -- | -- | 0 |
| | HA-29 | HA-27 | 411,12 | 8,2224 | -- | 0,09244 | -- | -- | 0 |
| | HA-31 | HA-29 | 256,3 | 5,126 | -- | 0,14138 | -- | -- | 0 |
| | HA-30 | HA-31 | 44,916 | 0,89832 | -- | 0,1456 | -- | -- | 0 |
| | HT-21 | HA-30 | 85,103 | 1,7021 | -- | 0,15156 | -- | -- | 0 |
| | NU3 | HT-21 | 99,794 | 1,9959 | -- | 0,15774 | -- | -- | 0 |
| | HT-22 | HA-32 | 29,753 | 0,59506 | -- | 0,017 | -- | -- | 0 |
| | NU3 | HT-22 | 388,9 | 7,778 | -- | 0,727 | -- | -- | 0 |
| | HT-20 | NU3 | 302,54 | 6,0508 | -- | 1,018 | -- | -- | 0 |
| | HV-52 | HV-50 | 246,95 | 4,939 | -- | 0,016 | -- | -- | 0 |
| | HV-52 | HV-51 | 174,35 | 3,4871 | -- | 0,015 | -- | -- | 0 |
| | HV-49 | HV-52 | 186,87 | 3,7373 | -- | 0,046 | -- | -- | 0 |
| | HV-48 | HV-49 | 46,959 | 0,93919 | -- | 0,061 | -- | -- | 0 |
| | HV-48 | HV-46 | 63,159 | 1,2632 | -- | 0,015 | -- | -- | 0 |
| | NU4 | HV-48 | 205,8 | 4,116 | -- | 0,06529 | -- | -- | 0 |
| | HV-30 | HV-37 | 174,78 | 3,4957 | -- | 0,015 | -- | -- | 0 |
| | HV-38 | HV-30 | 264,82 | 5,2965 | -- | 0,032 | -- | -- | 0 |
| | HV-29 | HV-31 | 134,59 | 2,6918 | -- | 0,03 | -- | -- | 0 |
| | HV-38 | HV-29 | 91,652 | 1,8331 | -- | 0,045 | -- | -- | 0 |
| | HV-39 | HV-38 | 472,28 | 9,4456 | -- | 0,06739 | -- | -- | 0 |
| | HV-40 | HV-39 | 116,76 | 2,3352 | -- | 0,07716 | -- | -- | 0 |
| | NU5 | HV-40 | 335,58 | 6,7117 | -- | 0,09201 | -- | -- | 0 |
| | NU5 | HV-45 | 107,38 | 2,1475 | -- | 0,015 | -- | -- | 0 |
| | NU4 | NU5 | 101,21 | 2,0241 | -- | 0,10205 | -- | -- | 0 |

Continúa tuberías...

Página 5
Gestar2014GESTAR _2014 reu 0 30/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-07 | NU4 | 298,74 | 5,9749 | -- | 0,14166 | -- | -- | 0 |
| | HT-06 | HV-47 | 107,75 | 2,155 | -- | 0,015 | -- | -- | 0 |
| | HT-07 | HT-06 | 248,28 | 4,9656 | -- | 0,03 | -- | -- | 0 |
| | HT-10 | HT-07 | 742,23 | 14,845 | -- | 0,1821 | -- | -- | 0 |
| | HT-08 | HT-62 | 125,96 | 2,5192 | -- | 0,015 | -- | -- | 0 |
| | HT-09 | HT-08 | 79,014 | 1,5803 | -- | 0,038 | -- | -- | 0 |
| | HT-10 | HT-09 | 476,02 | 9,5204 | -- | 0,056 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |

Continúa materiales...

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Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 200 | | | |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

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Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 425

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | HT-22 | H-ALM | 700-(PRFV-10) | 510 | 1,8669 | 68299 | 60 | 50,86 |
| TU122 | HA-24 | HA-21 | 140-(PVC-10) | 178,87 | 1,6018 | 824,58 | 80 | 58,152 |
| TU123 | HA-24 | HV-44 | 125-(PVC-10) | 259,62 | 1,6254 | 968,37 | 74 | 50,041 |
| TU124 | HA-25 | HA-24 | 200-(PVC-10) | 163,67 | 1,9803 | 1502,5 | 74 | 55,134 |
| TU125 | HT-11 | HA-25 | 250-(PVC-10) | 241 | 1,96 | 3267,9 | 73 | 56,764 |
| TU126 | HT-10 | HT-11 | 250-(PVC-10) | 263,55 | 1,9777 | 3573,7 | 72 | 58,675 |
| TU127 | HT-13 | HT-10 | 500-(PVC-10) | 231,24 | 1,6239 | 16746 | 70 | 59,912 |
| TU128 | HT-13 | HT-12 | 110-(PVC-10) | 232,45 | 1,8502 | 790,33 | 64 | 48,036 |
| TU129 | HT-14 | HT-13 | 500-(PVC-10) | 156,06 | 1,7275 | 11302 | 68 | 58,779 |
| TU130 | HT-15 | HT-14 | 500-(PVC-10) | 230,4 | 1,7536 | 16685 | 68 | 59,435 |
| TU131 | HT-16 | HT-17 | 125-(PVC-10) | 34,97 | 1,6254 | 130,44 | 68 | 57,081 |
| TU132 | HT-18 | HT-16 | 160-(PVC-10) | 111,9 | 1,8702 | 675,87 | 68 | 57,767 |
| TU133 | HT-15 | HT-18 | 200-(PVC-10) | 42,766 | 1,7561 | 392,59 | 67 | 58,881 |
| TU134 | HT-20 | HT-15 | 500-(PVC-10) | 350,98 | 1,9474 | 25418 | 68 | 60,432 |
| TU135 | HT-19 | HT-20 | 1000-(PRFV-10) | 400,18 | 1,723 | 94418 | 63 | 57,275 |
| TU136 | HT-23 | HT-19 | 1000-(PRFV-6) | 246,59 | 1,7489 | 55115 | 58 | 52,966 |
| TU137 | HT-23 | HT-28 | 200-(PVC-10) | 55,416 | 1,3451 | 508,72 | 58 | 52,963 |
| TU138 | NU9 | HT-23 | 1000-(PRFV-6) | 124,98 | 1,7829 | 27934 | 57 | 52,4 |
| TU139 | HT-27 | HT-24 | 110-(PVC-10) | 280,78 | 1,8502 | 954,65 | 55 | 39,61 |
| TU140 | HT-26 | HT-27 | 160-(PVC-10) | 39,95 | 1,7533 | 241,3 | 54 | 46,755 |
| TU141 | NU9 | HT-26 | 200-(PVC-10) | 171,09 | 1,7561 | 1570,6 | 52 | 45,426 |
| TU142 | NU10 | NU9 | 1000-(PRFV-6) | 222,78 | 1,8121 | 49795 | 55 | 50,628 |
| TU143 | NU10 | HT-30 | 140-(PVC-10) | 198,44 | 1,8306 | 914,8 | 57 | 48,819 |
| TU144 | HT-25 | NU10 | 1000-(PRFV-6) | 461,81 | 1,8297 | 103220 | 55 | 51,047 |
| TU145 | HT-25 | HT-31 | 125-(PVC-10) | 63,687 | 1,6254 | 237,55 | 57 | 52,682 |
| TU146 | HT-29 | HT-25 | 1000-(PRFV-6) | 122,11 | 1,8541 | 27293 | 51 | 47,931 |
| TU147 | HT-98 | HT-29 | 1000-(PRFV-6) | 79,101 | 1,8694 | 17680 | 57 | 54,171 |
| TU148 | NU11 | HT-98 | 1000-(PRFV-6) | 110,42 | 1,8788 | 24681 | 51 | 48,329 |
| TU157 | NU11 | HT-100 | 110-(PVC-10) | 58,054 | 1,8502 | 197,38 | 50 | 45,866 |
| TU158 | NU12 | NU11 | 1000-(PRFV-6) | 156,87 | 1,8864 | 35062 | 55 | 52,551 |
| TU159 | HT-41 | HT-40 | 110-(PVC-10) | 37,444 | 1,8502 | 127,31 | 65 | 44,728 |
| TU160 | NU13 | HT-41 | 160-(PVC-10) | 330,35 | 1,7533 | 1995,3 | 60 | 40,814 |
| TU161 | NU13 | HT-42 | 200-(PVC-10) | 101,24 | 0,56045 | 929,35 | 52 | 38,193 |
| TU162 | NU14 | NU13 | 250-(PVC-10) | 488,64 | 1,0756 | 6626 | 55 | 41,356 |
| TU164 | HT-44 | NU14 | 250-(PVC-10) | 44,389 | 1,0756 | 601,91 | 55 | 43,315 |
| TU165 | NU15 | HT-01 | 125-(PVC-10) | 379,52 | 1,5297 | 1415,6 | 69 | 42,199 |
| TU166 | NU15 | HT-02 | 125-(PVC-10) | 218,8 | 1,721 | 816,11 | 71 | 46,096 |
| TU167 | HT-45 | NU15 | 160-(PVC-10) | 204,73 | 1,9871 | 1236,6 | 55 | 34,863 |
| TU168 | HT-47 | HT-45 | 250-(PVC-10) | 274,37 | 1,1712 | 3720,5 | 54 | 38,188 |
| TU169 | HT-46 | HT-47 | 250-(PVC-10) | 132,45 | 1,6014 | 1796 | 56 | 41,473 |
| TU170 | HT-48 | HT-46 | 315-(PVC-10) | 408,75 | 1,1116 | 8632,8 | 64 | 50,576 |
| TU171 | NU16 | HT-56 | 125-(PVC-10) | 88,786 | 1,6254 | 331,17 | 54 | 37,075 |
| TU173 | HT-57 | NU16 | 140-(PVC-10) | 368,09 | 1,2967 | 1696,9 | 55 | 39,816 |
| TU174 | 59 | HT-60 | 160-(PVC-10) | 222,51 | 1,1689 | 1343,9 | 50 | 36,758 |
| TU175 | 61 | 59 | 160-(PVC-10) | 61,905 | 1,1689 | 373,91 | 47 | 35,534 |
| TU176 | HT-58 | 61 | 160-(PVC-10) | 119,8 | 1,1689 | 723,57 | 45 | 34,029 |
| TU177 | NU17 | HT-58 | 200-(PVC-10) | 48,295 | 1,3824 | 443,35 | 49 | 38,985 |
| TU178 | NU17 | HT-57 | 160-(PVC-10) | 74,097 | 1,8702 | 447,55 | 49 | 37,986 |
| TU179 | HT-03 | HT-04 | 125-(PVC-10) | 266,55 | 1,4341 | 994,22 | 64 | 39,838 |
| TU180 | HT-52 | HT-03 | 160-(PVC-10) | 308,94 | 1,7533 | 1866 | 64 | 43,997 |
| TU181 | HT-53 | HT-52 | 200-(PVC-10) | 305,51 | 1,6814 | 2804,6 | 60 | 45,18 |
| TU182 | HT-54 | HT-53 | 250-(PVC-10) | 187,82 | 1,5297 | 2546,8 | 52 | 40,81 |
| TU183 | NU17 | HT-54 | 315-(PVC-10) | 55,658 | 0,96361 | 1175,5 | 46 | 36,247 |
| TU184 | HT-51 | NU17 | 400-(PVC-10) | 756,99 | 0,99736 | 28372 | 55 | 45,385 |
| TU185 | HT-50 | HT-51 | 400-(PVC-10) | 44,914 | 1,0618 | 1683,4 | 53 | 44,884 |
| TU186 | NU18 | HT-50 | 400-(PVC-10) | 176,33 | 1,3078 | 6609 | 54 | 45,983 |
| TU187 | NU19 | HT-44 | 315-(PVC-10) | 104,16 | 1,8068 | 2199,9 | 56 | 44,493 |
| TU188 | NU19 | HT-48 | 315-(PVC-10) | 356,08 | 1,2464 | 7520,4 | 62 | 49,897 |
| TU189 | HT-49 | NU19 | 400-(PVC-10) | 488,31 | 1,6777 | 18302 | 55 | 44,316 |
| TU190 | NU18 | HT-49 | 400-(PVC-10) | 135,46 | 1,6854 | 5077,2 | 49 | 40,848 |
| TU191 | NU20 | NU18 | 500-(PRFV-6) | 202,72 | 1,3984 | 13402 | 55 | 47,556 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU196 | 68 | NU20 | 500-(PRFV-6) | 413,68 | 1,3984 | 27348 | 55 | 48,07 |
| TU197 | 67 | 68 | 500-(PRFV-6) | 46,138 | 1,3984 | 3050,2 | 37 | 31,118 |
| TU199 | NU21 | 67 | 500-(PRFV-6) | 442,94 | 1,3984 | 29283 | 43 | 37,235 |
| TU201 | HT-34 | NU21 | 500-(PRFV-6) | 140,03 | 1,3984 | 9257,2 | 55 | 50,358 |
| TU202 | HT-33 | HT-34 | 500-(PRFV-6) | 68,864 | 1,495 | 4552,6 | 53 | 48,713 |
| TU203 | HT-35 | HT-33 | 500-(PRFV-6) | 171,14 | 1,5182 | 11314 | 52 | 47,91 |
| TU204 | HT-36 | HT-35 | 500-(PRFV-6) | 37,71 | 1,539 | 2493 | 51 | 47,415 |
| TU205 | 85 | 84 | 1200-(PRFV-6) | 104,37 | 1,5694 | 32228 | 46 | 44,322 |
| TU206 | NU22 | HT-36 | 500-(PRFV-6) | 257,41 | 1,6828 | 17018 | 50 | 46,529 |
| TU207 | NU22 | HT-37 | 110-(PVC-10) | 150,91 | 1,8502 | 513,11 | 49 | 42,068 |
| TU208 | NU12 | NU22 | 600-(PRFV-6) | 237,25 | 1,271 | 19677 | 55 | 52,446 |
| TU209 | HT-86 | NU12 | 1200-(PRFV-6) | 122,03 | 1,5637 | 37683 | 55 | 52,869 |
| TU210 | 84 | HT-86 | 1200-(PRFV-6) | 267,32 | 1,5694 | 82546 | 47 | 45,01 |
| TU228 | 81 | 85 | 1200-(PRFV-6) | 53,066 | 1,5694 | 16386 | 44 | 42,443 |
| TU229 | 82 | 81 | 1200-(PRFV-6) | 281,87 | 1,5694 | 87038 | 42 | 40,505 |
| TU242 | 0 | 82 | 1200-(PRFV-6) | 1000 | 1,5694 | 308790 | 34 | 32,834 |
| TU248 | HV-31 | HV-28 | 110-(PVC-10) | 30,132 | 1,8502 | 102,45 | 74 | 47,306 |
| TU249 | HV-40 | HV-41 | 110-(PVC-10) | 127,03 | 1,8502 | 431,91 | 65 | 44,075 |
| TU251 | HT-36 | HT-32 | 160-(PVC-10) | 127,03 | 1,8118 | 767,28 | 53 | 47,265 |
| TU253 | HA-42 | HA-52 | 160-(PVC-10) | 508,14 | 0,87665 | 3069,1 | 69 | 51,587 |
| TU254 | HA-33 | HA-35 | 110-(PVC-10) | 1 | 1,8502 | 3,4 | 66 | 55,842 |
| TU30 | NU2 | HA-40 | 110-(PVC-10) | 387,35 | 1,9735 | 1317 | 72 | 44,62 |
| TU32 | NU2 | HA-36 | 110-(PVC-10) | 119 | 1,8502 | 404,59 | 66 | 47,82 |
| TU33 | HA-33 | NU2 | 160-(PVC-10) | 258,05 | 1,8118 | 1558,6 | 55 | 40,273 |
| TU34 | HA-33 | HA-34 | 110-(PVC-10) | 34,371 | 1,8502 | 116,86 | 65 | 53,874 |
| TU35 | HA-29 | HA-33 | 250-(PVC-10) | 271,78 | 1,5431 | 3685,3 | 66 | 55,871 |
| TU36 | HA-42 | HA-43 | 110-(PVC-10) | 286,4 | 1,8502 | 973,76 | 72 | 48,682 |
| TU37 | HA-39 | HA-37 | 125-(PVC-10) | 38,28 | 1,8166 | 142,78 | 72 | 50,653 |
| TU38 | HA-53 | HA-39 | 160-(PVC-10) | 184,65 | 1,9871 | 1115,3 | 71 | 50,574 |
| TU39 | HA-42 | HA-53 | 200-(PVC-10) | 109,04 | 1,8308 | 1001 | 71 | 54,475 |
| TU40 | HA-44 | HA-42 | 250-(PVC-10) | 241,28 | 1,6504 | 3271,7 | 71 | 55,991 |
| TU41 | HA-27 | HA-44 | 250-(PVC-10) | 274,7 | 1,8094 | 3725 | 71 | 58,113 |
| TU42 | HA-28 | HA-26 | 110-(PVC-10) | 196,18 | 1,8502 | 667,02 | 71 | 54,239 |
| TU43 | HA-27 | HA-28 | 160-(PVC-10) | 62,348 | 1,7533 | 376,58 | 70 | 58,93 |
| TU44 | HA-29 | HA-27 | 315-(PVC-10) | 411,12 | 1,3918 | 8682,8 | 66 | 55,976 |
| TU45 | HA-31 | HA-29 | 400-(PVC-10) | 256,3 | 1,3187 | 9606,1 | 66 | 57,983 |
| TU46 | HA-30 | HA-31 | 400-(PVC-10) | 44,916 | 1,358 | 1683,4 | 66 | 58,836 |
| TU47 | HT-21 | HA-30 | 400-(PVC-10) | 85,103 | 1,4136 | 3189,7 | 64 | 56,994 |
| TU48 | NU3 | HT-21 | 400-(PVC-10) | 99,794 | 1,4713 | 3740,3 | 62 | 55,315 |
| TU59 | HT-22 | HA-32 | 125-(PVC-10) | 29,753 | 1,6254 | 110,98 | 61 | 52,831 |
| TU60 | NU3 | HT-22 | 700-(PRFV-10) | 388,9 | 1,967 | 52081 | 61 | 53,415 |
| TU61 | HT-20 | NU3 | 900-(PRFV-10) | 302,54 | 1,6624 | 61909 | 65 | 58,721 |
| TU76 | HV-52 | HV-50 | 110-(PVC-10) | 246,95 | 1,9735 | 839,63 | 70 | 42,637 |
| TU77 | HV-52 | HV-51 | 125-(PVC-10) | 174,35 | 1,4341 | 650,34 | 69 | 46,983 |
| TU78 | HV-49 | HV-52 | 200-(PVC-10) | 186,87 | 1,7187 | 1715,4 | 67 | 47,703 |
| TU79 | HV-48 | HV-49 | 250-(PVC-10) | 46,959 | 1,458 | 636,77 | 63 | 46,015 |
| TU80 | HV-48 | HV-46 | 110-(PVC-10) | 63,159 | 1,8502 | 214,74 | 63 | 44,512 |
| TU81 | NU4 | HV-48 | 250-(PVC-10) | 205,8 | 1,5606 | 2790,6 | 63 | 46,344 |
| TU82 | HV-30 | HV-37 | 140-(PVC-10) | 174,78 | 1,1441 | 805,75 | 72 | 42,949 |
| TU83 | HV-38 | HV-30 | 160-(PVC-10) | 264,82 | 1,8702 | 1599,5 | 73 | 45,524 |
| TU84 | HV-29 | HV-31 | 160-(PVC-10) | 134,59 | 1,7533 | 812,91 | 75 | 49,18 |
| TU85 | HV-38 | HV-29 | 200-(PVC-10) | 91,652 | 1,6814 | 841,37 | 70 | 46,438 |
| TU86 | HV-39 | HV-38 | 250-(PVC-10) | 472,28 | 1,6108 | 6404,1 | 71 | 48,527 |
| TU87 | HV-40 | HV-39 | 250-(PVC-10) | 116,76 | 1,8443 | 1583,3 | 70 | 51,5 |
| TU88 | NU5 | HV-40 | 315-(PVC-10) | 335,58 | 1,3853 | 7087,5 | 65 | 47,76 |
| TU89 | NU5 | HV-45 | 110-(PVC-10) | 107,38 | 1,8502 | 365,08 | 71 | 52,269 |
| TU90 | NU4 | NU5 | 315-(PVC-10) | 101,21 | 1,5365 | 2137,5 | 65 | 49,385 |
| TU91 | HT-07 | NU4 | 400-(PVC-10) | 298,74 | 1,3213 | 11197 | 65 | 49,977 |
| TU92 | HT-06 | HV-47 | 160-(PVC-10) | 107,75 | 0,87665 | 650,81 | 57 | 41,062 |
| TU93 | HT-07 | HT-06 | 200-(PVC-10) | 248,28 | 1,1209 | 2279,2 | 65 | 49,571 |
| TU94 | HT-10 | HT-07 | 400-(PVC-10) | 742,23 | 1,6985 | 27819 | 68 | 53,975 |
| TU95 | HT-08 | HT-62 | 200-(PVC-10) | 125,96 | 0,56045 | 1156,3 | 52 | 40,549 |
| TU96 | HT-09 | HT-08 | 250-(PVC-10) | 79,014 | 0,90828 | 1071,4 | 59 | 47,751 |
| TU97 | HT-10 | HT-09 | 315-(PVC-10) | 476,02 | 0,84316 | 10053 | 61 | 49,984 |

** Información El Nodo HT-54 es el más desfavorable.

P Min de la Red (Dinámica) = 31,118 m (Nodo: 68)
P Max de la Red (Estática) = 80 m (Nodo: HA-21)
Caudal de Inyección en Cabecera = 1,7046 m3/s

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Entidad: CINGRAL Proyecto: LICENCIA_1

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 110-(PVC-10) | 3,40 | 2.359 | 8.019,23 |
| | | 160-(PVC-10) | 6,04 | 3.122 | 18.854,18 |
| | | 250-(PVC-10) | 13,56 | 3.341 | 45.301,09 |
| | | 125-(PVC-10) | 3,73 | 1.554 | 5.797,58 |
| | | 200-(PVC-10) | 9,18 | 1.650 | 15.145,12 |
| | | 315-(PVC-10) | 21,12 | 2.249 | 47.489,97 |
| | | 400-(PVC-10) | 37,48 | 3.129 | 117.278,80 |
| | | 700-(PRFV-10) | 133,92 | 899 | 120.380,50 |
| | | 900-(PRFV-10) | 204,63 | 303 | 61.909,28 |
| | | 140-(PVC-10) | 4,61 | 920 | 4.242,04 |
| | | 500-(PVC-10) | 72,42 | 969 | 70.151,20 |
| | | 1000-(PRFV-10) | 235,94 | 400 | 94.417,55 |
| PRFV | 60,0 | 1000-(PRFV-6) | 223,51 | 1.525 | 340.779,70 |
| | | 500-(PRFV-6) | 66,11 | 1.781 | 117.717,00 |
| | | 600-(PRFV-6) | 82,94 | 237 | 19.677,38 |
| | | 1200-(PRFV-6) | 308,79 | 1.829 | 564.671,10 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **1.651.831,79 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **117.201,50 €** |
| **COSTE TOTAL ANUAL** | **117.201,50 €** |

## 1.8 RED BOMBEO 2 (ALTERNATIVA 7)

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Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 442 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HS-04 | 381 | 36 |
| HS-05 | 378 | 36 |
| HS-06 | 380 | 35 |
| HT-94 | 384 | 35 |
| HT-95 | 376 | 35 |
| HT-93 | 380 | 39 |
| HT-96 | 378 | 36 |
| HT-99 | 379 | 36 |
| HT-100 | 375 | 38 |
| NU11 | 370 | 0 |
| HT-61 | 380 | 36 |
| HT-63 | 377 | 35 |
| HT-64 | 382 | 36 |
| HT-65 | 384 | 35 |
| HT-68 | 388 | 35 |
| HT-69 | 389 | 35 |
| NU12 | 370 | 0 |
| HS-07 | 389 | 36 |
| HS-01 | 387 | 37 |
| HS-02 | 387 | 38 |
| HS-03 | 384 | 36 |
| HT-91 | 390 | 35 |
| HT-92 | 397 | 25 |
| NU23 | 370 | 0 |
| HT-101 | 384 | 35 |
| HT-90 | 390 | 35 |
| HT-89 | 387 | 35 |
| NU24 | 370 | 0 |
| HT-102 | 383 | 35 |
| HT-88 | 379 | 37 |
| HT-87 | 384 | 37 |
| NU25 | 370 | 0 |
| HT-85 | 381 | 35 |
| HT-81 | 383 | 35 |
| HT-70 | 390 | 35 |
| HT-71 | 390 | 35 |
| HT-72 | 392 | 33 |
| HT-73 | 384 | 38 |
| HT-74 | 389 | 35 |
| HT-75 | 390 | 35 |
| NU26 | 370 | 0 |
| HT-77 | 388 | 35 |
| HT-79 | 391 | 34 |
| HT-78 | 388 | 35 |
| NU27 | 370 | 0 |

Continúa nodos...

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Gestar2014GESTAR _2014 rev 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| HT-80 | 384 | 36 |
| HT-82 | 391 | 34 |
| HT-97 | 378 | 39 |
| HT-84 | 379 | 36 |
| 86 | 378 | 0 |
| HT-83 | 379 | 37 |
| HT-76 | 378 | 36 |
| HT-67 | 382 | 39 |
| HT-59 | 378 | 38 |
| HT-66 | 383 | 36 |
| HT-43 | 374 | 50 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-75 | HT-76 | 191 | 3,82 | -- | 0,015 | -- | -- | 0 |
| | HS-05 | HS-04 | 247,34 | 4,9468 | -- | 0,015 | -- | -- | 0 |
| | HS-06 | HS-05 | 43,384 | 0,86768 | -- | 0,03 | -- | -- | 0 |
| | HT-94 | HS-06 | 237,19 | 4,7438 | -- | 0,045 | -- | -- | 0 |
| | HT-93 | HT-94 | 52,6 | 1,052 | -- | 0,06 | -- | -- | 0 |
| | HT-93 | HT-95 | 110,5 | 2,2099 | -- | 0,019 | -- | -- | 0 |
| | HT-96 | HT-93 | 315,65 | 6,313 | -- | 0,08818 | -- | -- | 0 |
| | HT-99 | HT-96 | 62,348 | 1,247 | -- | 0,10201 | -- | -- | 0 |
| | HT-100 | HT-99 | 444,3 | 8,886 | -- | 0,12385 | -- | -- | 0 |
| | NU11 | HT-100 | 58,054 | 1,1611 | -- | 0,13334 | -- | -- | 0 |
| | NU12 | NU11 | 156,87 | 3,1374 | -- | 0,13334 | -- | -- | 0 |
| | HT-59 | HT-61 | 61,905 | 1,2381 | -- | 0,015 | -- | -- | 0 |
| | HT-64 | HT-63 | 179,72 | 3,5944 | -- | 0,058 | -- | -- | 0 |
| | HT-65 | HT-64 | 217,99 | 4,3597 | -- | 0,074 | -- | -- | 0 |
| | HT-66 | HT-65 | 131,63 | 2,6326 | -- | 0,09 | -- | -- | 0 |
| | HT-67 | HT-68 | 46,138 | 0,92275 | -- | 0,03 | -- | -- | 0 |
| | HT-67 | HT-69 | 64,671 | 1,2934 | -- | 0,115 | -- | -- | 0 |
| | HT-75 | HT-67 | 750 | 15 | -- | 0,16 | -- | -- | 0 |
| | HT-85 | HT-84 | 104,37 | 2,0874 | -- | 0,1449 | -- | -- | 0 |
| | 86 | NU12 | 122,03 | 2,4407 | -- | 0,13334 | -- | -- | 0 |
| | HT-84 | 86 | 267,32 | 5,3464 | -- | 0,13334 | -- | -- | 0 |
| | HS-01 | HS-07 | 31,451 | 0,62901 | -- | 0,015 | -- | -- | 0 |
| | HS-02 | HS-01 | 37,456 | 0,74911 | -- | 0,035 | -- | -- | 0 |
| | NU23 | HS-02 | 238,06 | 4,7612 | -- | 0,05 | -- | -- | 0 |
| | HT-91 | HS-03 | 145,83 | 2,9167 | -- | 0,015 | -- | -- | 0 |
| | NU23 | HT-91 | 109,62 | 2,1924 | -- | 0,03 | -- | -- | 0 |
| | NU23 | HT-92 | 165,91 | 3,3182 | -- | 0,015 | -- | -- | 0 |
| | NU24 | NU23 | 197,86 | 3,9573 | -- | 0,08111 | -- | -- | 0 |
| | HT-90 | HT-101 | 173,01 | 3,4602 | -- | 0,015 | -- | -- | 0 |
| | HT-89 | HT-90 | 66,09 | 1,3218 | -- | 0,03 | -- | -- | 0 |
| | NU24 | HT-89 | 167,32 | 3,3464 | -- | 0,045 | -- | -- | 0 |
| | HT-102 | NU24 | 117,03 | 2,3407 | -- | 0,10984 | -- | -- | 0 |
| | NU25 | HT-102 | 413,91 | 8,2783 | -- | 0,12018 | -- | -- | 0 |
| | NU25 | HT-88 | 276,06 | 5,5212 | -- | 0,015 | -- | -- | 0 |
| | NU25 | HT-87 | 136,68 | 2,7336 | -- | 0,015 | -- | -- | 0 |
| | HT-85 | NU25 | 271,86 | 5,4373 | -- | 0,132 | -- | -- | 0 |
| | HT-84 | HT-83 | 69,83 | 1,3966 | -- | 0,015 | -- | -- | 0 |
| | HT-81 | HT-85 | 53,066 | 1,0613 | -- | 0,2581 | -- | -- | 0 |
| | HT-82 | HT-81 | 281,87 | 5,6373 | -- | 0,26424 | -- | -- | 0 |
| | HT-71 | HT-70 | 245,8 | 4,916 | -- | 0,022 | -- | -- | 0 |
| | HT-72 | HT-71 | 28,566 | 0,57131 | -- | 0,037 | -- | -- | 0 |
| | HT-74 | HT-72 | 836,44 | 16,729 | -- | 0,116 | -- | -- | 0 |
| | HT-74 | HT-73 | 237,42 | 4,7483 | -- | 0,133 | -- | -- | 0 |
| | NU26 | HT-74 | 338,42 | 6,7684 | -- | 0,25972 | -- | -- | 0 |
| | NU26 | HT-75 | 57,91 | 1,1582 | -- | 0,213 | -- | -- | 0 |
| | HT-77 | NU26 | 285,39 | 5,7079 | -- | 0,4258 | -- | -- | 0 |
| | NU27 | HT-77 | 384,3 | 7,686 | -- | 0,43085 | -- | -- | 0 |
| | HT-78 | HT-79 | 101,85 | 2,0371 | -- | 0,015 | -- | -- | 0 |
| | NU27 | HT-78 | 178,72 | 3,5745 | -- | 0,03 | -- | -- | 0 |
| | HT-80 | NU27 | 175,58 | 3,5116 | -- | 0,44892 | -- | -- | 0 |
| | HT-82 | HT-80 | 272,7 | 5,4541 | -- | 0,44892 | -- | -- | 0 |
| | 0 | HT-82 | 20 | 0,4 | -- | 0,68883 | -- | -- | 0 |
| | HT-99 | HT-97 | 127,03 | 2,5407 | -- | 0,015 | -- | -- | 0 |

Continúa tuberías...

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Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | HT-69 | HT-59 | 1100 | 22 | -- | 0,032 | -- | -- | 0 |
| | HT-73 | HT-66 | 280 | 5,6 | -- | 0,11 | -- | -- | 0 |
| | HT-63 | HT-43 | 440 | 8,8 | -- | 0,043 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |

Continúa materiales...

Página 4
Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 200 | | | |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |
| PRFV | TRAGSA | 0,007 | 60 | 300-(PRFV-6) | 308 | 42,8 |
| | | | | 400-(PRFV-6) | 407 | 45,39 |
| | | | | 500-(PRFV-6) | 506 | 66,11 |
| | | | | 600-(PRFV-6) | 588 | 82,94 |
| | | | | 700-(PRFV-6) | 686 | 135,29 |
| | | | | 800-(PRFV-6) | 784 | 132,27 |
| | | | | 900-(PRFV-6) | 883 | 160,11 |
| | | | | 1000-(PRFV-6) | 981 | 223,51 |
| | | | | 1200-(PRFV-6) | 1176 | 308,79 |
| | | | | 1400-(PRFV-6) | 1372 | 391,91 |
| | | | | 1600-(PRFV-6) | 1567 | 503,77 |
| | | | | 1800-(PRFV-6) | 1763 | 614,31 |
| | | | | 2000-(PRFV-6) | 1959 | 756,73 |
| | | | 100 | | | |
| | | | 160 | | | |
| | | | 200 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |
| | | | 250 | 600 | 600 | 1000 |
| | | | | 700 | 700 | 1000 |
| | | | | 800 | 800 | 1000 |
| | | | | 900 | 900 | 1000 |
| | | | | 1000 | 1000 | 1000 |
| | | | | 1200 | 1200 | 1000 |
| | | | | 1400 | 1400 | 1000 |
| | | | | 1600 | 1600 | 1000 |
| | | | | 1800 | 1800 | 1000 |
| | | | | 2000 | 2000 | 1000 |
| | | | | 2200 | 2200 | 1000 |
| | | | | 2400 | 2400 | 1000 |
| | | | | 2600 | 2600 | 1000 |
| | | | | 3200 | 3200 | 1000 |

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Gestar2014GESTAR _2014 reu 0 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 442

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | HT-75 | HT-76 | 110-(PVC-10) | 191 | 1,8502 | 649,4 | 64 | 54,895 |
| TU149 | HS-05 | HS-04 | 160-(PVC-10) | 247,34 | 0,87665 | 1493,9 | 61 | 47,86 |
| TU150 | HS-06 | HS-05 | 200-(PVC-10) | 43,384 | 1,1209 | 398,27 | 64 | 52,03 |
| TU151 | HT-94 | HS-06 | 200-(PVC-10) | 237,19 | 1,6814 | 2177,4 | 62 | 50,276 |
| TU152 | HT-93 | HT-94 | 250-(PVC-10) | 52,6 | 1,4341 | 713,26 | 58 | 49,094 |
| TU153 | HT-93 | HT-95 | 125-(PVC-10) | 110,5 | 1,8166 | 412,15 | 66 | 54,793 |
| TU154 | HT-96 | HT-93 | 315-(PVC-10) | 315,65 | 1,3277 | 6666,5 | 62 | 53,451 |
| TU155 | HT-99 | HT-96 | 315-(PVC-10) | 62,348 | 1,5359 | 1316,8 | 64 | 56,864 |
| TU156 | HT-100 | HT-99 | 315-(PVC-10) | 444,3 | 1,8647 | 9383,6 | 63 | 56,229 |
| TU157 | NU11 | HT-100 | 400-(PVC-10) | 58,054 | 1,2437 | 2175,8 | 67 | 63,949 |
| TU158 | NU12 | NU11 | 400-(PVC-10) | 156,87 | 1,2437 | 5879,5 | 72 | 69,123 |
| TU175 | HT-59 | HT-61 | 160-(PVC-10) | 61,905 | 0,87665 | 373,91 | 62 | 47,543 |
| TU192 | HT-64 | HT-63 | 250-(PVC-10) | 179,72 | 1,3863 | 2437 | 65 | 54,154 |
| TU193 | HT-65 | HT-64 | 250-(PVC-10) | 217,99 | 1,7688 | 2955,9 | 60 | 50,301 |
| TU194 | HT-66 | HT-65 | 315-(PVC-10) | 131,63 | 1,3551 | 2780 | 58 | 50,48 |
| TU197 | HT-67 | HT-68 | 160-(PVC-10) | 46,138 | 1,7533 | 278,67 | 54 | 46,528 |
| TU198 | HT-67 | HT-69 | 315-(PVC-10) | 64,671 | 1,7315 | 1365,8 | 53 | 45,83 |
| TU2 | HT-75 | HT-67 | 400-(PVC-10) | 750 | 1,4924 | 28110 | 60 | 53,302 |
| TU205 | HT-85 | HT-84 | 400-(PVC-10) | 104,37 | 1,3515 | 3911,8 | 63 | 61,754 |
| TU209 | 86 | NU12 | 400-(PVC-10) | 122,03 | 1,2437 | 4573,8 | 72 | 69,591 |
| TU210 | HT-84 | 86 | 400-(PVC-10) | 267,32 | 1,2437 | 10019 | 64 | 61,956 |
| TU211 | HS-01 | HS-07 | 160-(PVC-10) | 31,451 | 0,87665 | 189,96 | 53 | 39,287 |
| TU212 | HS-02 | HS-01 | 200-(PVC-10) | 37,456 | 1,3077 | 343,84 | 55 | 41,436 |
| TU213 | NU23 | HS-02 | 200-(PVC-10) | 238,06 | 1,8682 | 2185,4 | 55 | 41,716 |
| TU214 | HT-91 | HS-03 | 110-(PVC-10) | 145,83 | 1,8502 | 495,84 | 58 | 42,081 |
| TU215 | NU23 | HT-91 | 160-(PVC-10) | 109,62 | 1,7533 | 662,12 | 52 | 40,312 |
| TU216 | NU23 | HT-92 | 110-(PVC-10) | 165,91 | 1,8502 | 564,09 | 45 | 30,338 |
| TU217 | NU24 | NU23 | 250-(PVC-10) | 197,86 | 1,9387 | 2683 | 72 | 62,151 |
| TU218 | HT-90 | HT-101 | 110-(PVC-10) | 173,01 | 1,8502 | 588,23 | 58 | 42,377 |
| TU219 | HT-89 | HT-90 | 160-(PVC-10) | 66,09 | 1,7533 | 399,18 | 52 | 41,396 |
| TU220 | NU24 | HT-89 | 200-(PVC-10) | 167,32 | 1,6814 | 1536 | 55 | 45,505 |
| TU221 | HT-102 | NU24 | 315-(PVC-10) | 117,03 | 1,6538 | 2471,7 | 72 | 64,493 |
| TU222 | NU25 | HT-102 | 315-(PVC-10) | 413,91 | 1,8095 | 8741,8 | 59 | 52,278 |
| TU223 | NU25 | HT-88 | 110-(PVC-10) | 276,06 | 1,8502 | 938,61 | 63 | 51,547 |
| TU224 | NU25 | HT-87 | 110-(PVC-10) | 136,68 | 1,8502 | 464,72 | 58 | 50,591 |
| TU225 | HT-85 | NU25 | 315-(PVC-10) | 271,86 | 1,9874 | 5741,7 | 72 | 68,556 |
| TU226 | HT-84 | HT-83 | 110-(PVC-10) | 69,83 | 1,8502 | 237,42 | 63 | 59,728 |
| TU228 | HT-81 | HT-85 | 500-(PVC-10) | 53,066 | 1,541 | 3843,1 | 61 | 60,117 |
| TU229 | HT-82 | HT-81 | 500-(PRFV-6) | 281,87 | 1,314 | 18634 | 59 | 58,298 |
| TU230 | HT-71 | HT-70 | 160-(PVC-10) | 245,8 | 1,2858 | 1484,6 | 52 | 38,904 |
| TU231 | HT-72 | HT-71 | 200-(PVC-10) | 28,566 | 1,3824 | 262,23 | 52 | 41,239 |
| TU232 | HT-74 | HT-72 | 315-(PVC-10) | 836,44 | 1,7465 | 17666 | 50 | 39,476 |
| TU233 | HT-74 | HT-73 | 400-(PVC-10) | 237,42 | 1,2405 | 8898,3 | 58 | 52,975 |
| TU234 | NU26 | HT-74 | 500-(PVC-10) | 338,42 | 1,5506 | 24508 | 53 | 48,681 |
| TU235 | NU26 | HT-75 | 400-(PVC-10) | 57,91 | 1,9867 | 2170,5 | 52 | 48,436 |
| TU236 | HT-77 | NU26 | 600-(PRFV-10) | 285,39 | 1,5681 | 30480 | 72 | 68,846 |
| TU237 | NU27 | HT-77 | 600-(PRFV-10) | 384,3 | 1,5867 | 41043 | 54 | 51,601 |
| TU238 | HT-78 | HT-79 | 110-(PVC-10) | 101,85 | 1,8502 | 346,3 | 51 | 43,686 |
| TU239 | NU27 | HT-78 | 160-(PVC-10) | 178,72 | 1,7533 | 1079,5 | 54 | 49,641 |
| TU240 | HT-80 | NU27 | 600-(PRFV-10) | 175,58 | 1,6532 | 18752 | 72 | 70,639 |
| TU241 | HT-82 | HT-80 | 600-(PRFV-6) | 272,7 | 1,6532 | 22618 | 58 | 57,152 |
| TU242 | 0 | HT-82 | 700-(PRFV-10) | 20 | 1,8637 | 2678,4 | 51 | 50,94 |
| TU252 | HT-99 | HT-97 | 110-(PVC-10) | 127,03 | 1,8502 | 431,91 | 64 | 53,544 |
| TU3 | HT-69 | HT-59 | 200-(PVC-10) | 1100 | 1,1956 | 10098 | 64 | 49,836 |
| TU4 | HT-73 | HT-66 | 315-(PVC-10) | 280 | 1,6562 | 5913,6 | 59 | 52,092 |
| TU5 | HT-63 | HT-43 | 250-(PVC-10) | 440 | 1,0278 | 5966,4 | 68 | 55,53 |

** Información El Nodo HT-43 es el más desfavorable.

P Min de la Red (Dinámica) = 30,338 m (Nodo: HT-92)
P Max de la Red (Estática) = 72 m (Nodo: NU11)
Caudal de Inyección en Cabecera = 0,68883 m3/s

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Gestar2014GESTAR _2014 reu D 29/09/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 160-(PVC-10) | 6,04 | 987 | 5.961,91 |
| | | 200-(PVC-10) | 9,18 | 1.852 | 17.001,15 |
| | | 250-(PVC-10) | 13,56 | 1.088 | 14.755,62 |
| | | 125-(PVC-10) | 3,73 | 110 | 412,15 |
| | | 315-(PVC-10) | 21,12 | 2.938 | 62.047,29 |
| | | 400-(PVC-10) | 37,48 | 1.754 | 65.738,98 |
| | | 110-(PVC-10) | 3,40 | 1.387 | 4.716,52 |
| | | 500-(PVC-10) | 72,42 | 391 | 28.351,51 |
| | | 600-(PRFV-10) | 106,80 | 845 | 90.275,38 |
| | | 700-(PRFV-10) | 133,92 | 20 | 2.678,40 |
| PRFV | 60,0 | 500-(PRFV-6) | 66,11 | 282 | 18.634,23 |
| | | 600-(PRFV-6) | 82,94 | 273 | 22.617,97 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERIAS** | **333.191,12 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **23.640,73 €** |
| **COSTE TOTAL ANUAL** | **23.640,73 €** |

# 2 CALCULOS COSTES ENERGÉTICOS. 1ª FASE

## 2.1 ALTERNATIVA 1. BOMBEO 1. 123 H

**BOMBEO A BALSA- - P6**

**NECESIDAES HIDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,76 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,76 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 87,12 | 0,00 | 0,00 | 0,00 | 0,00 | 87,12 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 26,21 | 101,19 | 121,09 | 208,45 | 324,56 | 389,71 | 0,00 | 244,18 | 52,17 | 1,82 | 0,00 | 1469,39 |

**DATOS**

| | |
|---|---|
| Superficies [ha] | 1104 |
| Caudal [l/s] | 1011 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 535 |
| Contratada | 642 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 534,60 | 534,60 | 534,60 | 534,60 | 534,60 | 534,60 | 534,60 | 534,60 | 534,60 | 641,52 | 534,60 | 534,60 |

**TÉRMINO DE ENERGÍA**

**CONSUMO [kWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 82736,9 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 82736,9 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 46574,9 | 0,0 | 0,0 | 0,0 | 0,0 | 46574,9 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 14010,7 | ######## | 64734,8 | ######## | 173512,6 | 208342,6 | 208342,6 | 130539,8 | 27891,7 | 973,0 | 0,0 | 993882,2 |

**COSTE**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 82736,9 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 82736,9 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 46574,9 | 0,0 | 0,0 | 0,0 | 0,0 | 46574,9 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 14010,7 | ######## | 64734,8 | ######## | 173512,6 | 208342,6 | 208342,6 | 130539,8 | 27891,7 | 973,0 | 0,0 | 993882,2 |

**TÉRMINO DE POTENCIA**

| | POTEN Contrat | Tarifa €/kW | Coste | COSTES Tarifa €/kW | Coste | COSTES TOTALES |
|---|---|---|---|---|---|---|
| | 0 | 39,139427 | 0,00 € | 0 | 39,139427 | 0,00 € |
| | 642 | 19,586654 | ######## | 642 | 19,586654 | ######## |
| | 642 | 14,334178 | ######## | 642 | 14,334178 | ######## |
| | 642 | 14,334178 | ######## | 642 | 14,334178 | ######## |
| | 642 | 14,334178 | ######## | 642 | 14,334178 | ######## |
| | 642 | 6,540177 | ######## | 642 | 6,540177 | ######## |

| | |
|---|---|
| **Coste Anual Antes de Impuestos eléctricos sin IVA** | **122.182,86 €** |
| **Impuesto Eléctrico** | 5.309,81 € |
| | **127.492,68 €** |
| **IVA 21 %** | 26.773,46 € |
| **COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ €]** | **154.266,14 €** |
| **COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]** | **0,02017** |

Optimización de Aforos GESTAR

## 2.2 ALTERNATIVA 1. BOMBEO 2. 123 H

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6826,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,32 | 0,00 | 0,00 | 0,00 | 0,00 | 154,32 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 86,73 | 0,00 | 0,00 | 0,00 | 86,73 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 26,19 | 101,11 | 120,99 | 208,28 | 324,30 | 389,71 | 0,00 | 243,98 | 52,13 | 1,82 | 0,00 | 1468,50 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 469,47 | 408,23 | 408,23 |

TÉRMINO DE ENERGÍA

CONSUMO [kW/h]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | COSTE Tarifa €/kW | COSTE Coste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 62997,3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 62997,3 | 0,114125 | ######## |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 35406,0 | 0,0 | 0,0 | 0,0 | 0,0 | 35406,0 | 0,088886 | ######## |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € |
| P6 | 0,0 | 10690,1 | ###### | 49392,2 | 85025,8 | 132388,9 | 159094,3 | 159094,3 | 99601,0 | 21281,2 | 742,4 | 0,0 | 758585,9 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIA Contrat | COSTES Tarifa €/kW | COSTES Coste |
|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € |
| P2 | 469 | 19,586654 | ######## |
| P3 | 469 | 14,334178 | ######## |
| P4 | 469 | 14,334178 | ######## |
| P5 | 469 | 14,334178 | ######## |
| P6 | 469 | 6,540177 | ######## |

COSTES TOTALES

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 16.384,88 € |
| P3 | 6.729,44 € |
| P4 | 9.876,54 € |
| P5 | 6.729,44 € |
| P6 | 52.111,46 € |
| | ######## |
| | 91.831,76 € |
| | 3.990,82 € |
| | 95.822,58 € |
| | 20.122,74 € |
| | 115.945,32 € |
| | 0,03106 |

DATOS

| | |
|---|---|
| Superficies [ha] | 539 |
| Caudal [l/s] | 494 |
| Altura bombeo m | 64 |
| Potencias [kW] | |
| Consumida | 408 |
| Contratada | 469 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.3 ALTERNATIVAS 2 Y 7. BOMBEO 1. 88 + SOLAR

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 130,00 | 479,00 | 1169,00 | 972,00 | 311,00 | 0,00 | 0,00 | 0,00 | 3061,00 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 39,46 | 145,39 | 354,83 | 0,00 | 94,40 | 0,00 | 0,00 | 0,00 | 634,09 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 526,91 | 526,91 | 526,91 | 526,91 | 526,91 | 526,91 | 526,91 | 526,91 | 526,91 | 605,95 | 526,91 | 526,91 |

TÉRMINO DE ENERGÍA

CONSUMO [kW/h]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | COSTE Tarifa €/kW | COSTE Coste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,114125 | 0,00 € |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,088886 | 0,00 € |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 20791,7 | 76609,3 | 186965,2 | 155457,8 | 49740,1 | 0,0 | 0,0 | 0,0 | 489564,1 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIA Contrat | COSTES Tarifa €/kW | COSTES Coste |
|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € |
| P5 | 0 | 14,334178 | 0,00 € |
| P6 | 606 | 6,540177 | ######## |

COSTES TOTALES

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 0,00 € |
| P3 | 0,00 € |
| P4 | 0,00 € |
| P5 | 0,00 € |
| P6 | 35.612,33 € |
| | ######## |
| | 35.612,33 € |
| | 1.547,64 € |
| | 37.159,97 € |
| | 7.803,59 € |
| | 44.963,56 € |
| | 0,01417 |

DATOS

| | |
|---|---|
| Superficies [ha] | 1037 |
| Caudal [l/s] | 949 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 527 |
| Contratada | 606 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.4 ALTERNATIVAS 2 Y 7. BOMBEO 2. 88 + SOLAR

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 18,76 | 72,42 | 86,66 | 149,17 | 232,27 | 389,65 | 0,00 | 174,74 | 37,34 | 1,30 | 0,00 | 1162,29 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 847,30 | 736,79 | 736,79 | 0,00 |

TÉRMINO DE ENERGÍA

CONSUMO [kW/h]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 13818,5 | ###### | 63846,4 | ###### | 171131,5 | 287085,1 | 251419,4 | 128748,5 | 27509,0 | 959,6 | 0,0 | 1107780,6 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIAS | |
|---|---|---|
| | Contrat | Tarifa €/kW |
| P1 | 0 | 39,139427 |
| P2 | 0 | 19,586654 |
| P3 | 0 | 14,334178 |
| P4 | 0 | 14,334178 |
| P5 | 0 | 14,334178 |
| P6 | 847 | 6,540177 |

COSTES TOTALES

| | COSTES | |
|---|---|---|
| | Coste | |
| P1 | 0,00 € | |
| P2 | 0,00 € | |
| P3 | 0,00 € | |
| P4 | 0,00 € | |
| P5 | 0,00 € | |
| P6 | ######## | |

DATOS

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 527,00 | 1222,00 | 1033,00 | 327,00 | 0,00 | 0,00 | 0,00 | 3286,00 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 53,65 | 159,72 | 370,37 | 0,00 | 99,11 | 0,00 | 0,00 | 0,00 | 682,84 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 408,23 | 469,47 | 408,23 | 408,23 | 0,00 |

TÉRMINO DE ENERGÍA

CONSUMO [kW/h]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 21899,8 | 65204,6 | 151195,5 | 127810,9 | 40459,0 | 0,0 | 0,0 | 0,0 | 406570,0 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIAS | |
|---|---|---|
| | Contrat | Tarifa €/kW |
| P1 | 0 | 39,139427 |
| P2 | 0 | 19,586654 |
| P3 | 0 | 14,334178 |
| P4 | 0 | 14,334178 |
| P5 | 0 | 14,334178 |
| P6 | 469 | 6,540177 |

COSTES TOTALES

| | COSTES | |
|---|---|---|
| | Coste | |
| P1 | 0,00 € | |
| P2 | 0,00 € | |
| P3 | 0,00 € | |
| P4 | 0,00 € | |
| P5 | 0,00 € | |
| P6 | ######## | |

DATOS

| | |
|---|---|
| Superficies [ha] | 539 |
| Caudal [l/s] | 494 |
| Altura bombeo m | 64 |
| Potencias [kW] | |
| Consumida | 408 |
| Contratada | 469 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.5 ALTERNATIVA 3. BOMBEO 1. 88 H

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 18,76 | 72,42 | 86,66 | 149,17 | 232,27 | 389,65 | 0,00 | 174,74 | 37,34 | 1,30 | 0,00 | 1162,29 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 736,79 | 847,30 | 736,79 | 736,79 | 0,00 |

TÉRMINO DE ENERGÍA

CONSUMO [kW/h]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIAS | |
|---|---|---|
| | Contrat | Tarifa €/kW |
| P1 | 0 | 39,139427 |
| P2 | 0 | 19,586654 |
| P3 | 0 | 14,334178 |
| P4 | 0 | 14,334178 |
| P5 | 0 | 14,334178 |
| P6 | 847 | 6,540177 |

COSTES TOTALES

| | COSTES | |
|---|---|---|
| | Coste | |
| P1 | 0,00 € | |
| P2 | 0,00 € | |
| P3 | 0,00 € | |
| P4 | 0,00 € | |
| P5 | 0,00 € | |
| P6 | ######## | |

DATOS

| | |
|---|---|
| Superficies [ha] | 1037 |
| Caudal [l/s] | 1327 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 737 |
| Contratada | 847 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

| | |
|---|---|
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 77.157,31 € |
| | 3.353,10 € |
| | 80.510,41 € |
| | 16.907,19 € |
| | 97.417,59 € |
| | 0,01356 |

## 2.6 ALTERNATIVA 3. BOMBEO 2. 88 H

**BOMBEO A BALSA- - P6**

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 18,75 | 72,39 | 86,62 | 149,11 | 232,18 | 389,49 | 0,00 | 174,68 | 37,32 | 1,30 | 0,00 | 1161,84 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 655,74 | 570,20 | 570,20 |

CONSUMO [KWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 10690,1 | ###### | 49392,2 | 85025,8 | 132388,9 | 220091,6 | 194500,3 | 99601,0 | 21281,2 | 742,4 | 0,0 | 856989,1 |

TÉRMINO DE ENERGÍA

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | 0,0 |

DATOS

| | |
|---|---|
| Superficies [ha] | 539 |
| Caudal [l/s] | 690 |
| Altura bombeo m | 64 |
| Potencias [kW] | |
| Consumida | 570 |
| Contratada | 656 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| | 0,137322 | 0,00 € |
| | 0,114125 | 0,00 € |
| | 0,101906 | 0,00 € |
| | 0,088886 | 0,00 € |
| | 0,081456 | 0,00 € |
| | 0,064648 | ###### |

TÉRMINO DE POTENCIA

| POTENCIAS | | COSTES | |
|---|---|---|---|
| Contrat | Tarifa €/kW | Coste | |
| 0 | 39,139427 | 0,00 € | |
| 0 | 19,586654 | 0,00 € | |
| 0 | 14,334178 | 0,00 € | |
| 0 | 14,334178 | 0,00 € | |
| 0 | 14,334178 | 0,00 € | |
| 656 | 6,540177 | ###### | |

COSTES TOTALES

| | |
|---|---|
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| ###### | 59.691,25 € |

Coste Anual Antes de Impuestos eléctricos sin IVA 2.594,06 €

Impuesto Eléctrico 62.285,31 €

IVA 21 % 13.079,92 €

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ] 75.365,23 €

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ] 0,02019

## 2.7 ALTERNATIVA 4. BOMBEO 1. 123 H

**BOMBEO A BALSA- - P6**

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 29,16 | 0,00 | 0,00 | 0,00 | 0,00 | 29,16 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 23,02 | 88,89 | 106,37 | 183,11 | 285,11 | 389,71 | 0,00 | 214,50 | 45,83 | 1,60 | 0,00 | 1338,14 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1222,11 | 1062,70 | 1062,70 |

CONSUMO [KWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 941313 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 941313 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 30985,4 | 0,0 | 0,0 | 0,0 | 0,0 | 30985,4 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 24465,5 | ###### | ###### | ###### | 302986,9 | 414150,5 | 414150,5 | 227948,1 | 48704,4 | 1699,0 | 0,0 | 1836199,8 |

TÉRMINO DE ENERGÍA

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | 0,0 |

DATOS

| | |
|---|---|
| Superficies [ha] | 1836 |
| Caudal [l/s] | 1914 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 1063 |
| Contratada | 1222 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| | 0,137322 | 0,00 € |
| | 0,114125 | ###### |
| | 0,101906 | 0,00 € |
| | 0,088886 | ###### |
| | 0,081456 | 0,00 € |
| | 0,064648 | ###### |

TÉRMINO DE POTENCIA

| POTENCIAS | | COSTES | |
|---|---|---|---|
| Contrat | Tarifa €/kW | Coste | |
| 0 | 39,139427 | 0,00 € | |
| 1222 | 19,586654 | ###### | |
| 1222 | 14,334178 | ###### | |
| 1222 | 14,334178 | ###### | |
| 1222 | 14,334178 | ###### | |
| 1222 | 6,540177 | ###### | |

COSTES TOTALES

| | |
|---|---|
| | 0,00 € |
| | 34.679,75 € |
| | 17.517,92 € |
| | 20.272,09 € |
| | 17.517,92 € |
| | 126.699,45 € |
| ###### | 216.687,12 € |

Coste Anual Antes de Impuestos eléctricos sin IVA 9.416,77 €

Impuesto Eléctrico 226.103,89 €

IVA 21 % 47.481,82 €

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ] 273.585,71 €

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ] 0,02151

## 2.8 ALTERNATIVA 4. BOMBEO 2. 123 H

### BOMBEO A BALSA- - P6

**NECESIDADES HIDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 130,00 | 479,00 | 1169,00 | 972,00 | 311,00 | 0,00 | 0,00 | 0,00 | 3061,00 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 34,64 | 127,63 | 311,49 | 0,00 | 82,87 | 0,00 | 0,00 | 0,00 | 556,63 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1062,70 | 1062,70 | ###### | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1222,11 | 1062,70 | 1062,70 |

**TÉRMINO DE ENERGÍA**

**CONSUMO [kWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 36811,5 | 135636,2 | 331020,3 | 275236,7 | 88064,4 | 0,0 | 0,0 | 0,0 | 866769,1 |

**TÉRMINO DE POTENCIA**

| | POTEN Contrat | COSTES Tarifa €/kW | COSTES Coste | COSTES TOTALES |
|---|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P5 | 1222 | 6,540177 | ######## | 64.027,70 € |
| P6 | | | | 2.792,51 € |
| | | | | 66.810,21 € |
| | | | | 14.030,14 € |
| | | | | 80.840,35 € |
| | | | | 0,01438 |

**DATOS**

| Superficies [ha] | 964 |
|---|---|
| Caudal [l/s] | 883 |
| Altura bombeo m | 64 |
| Potencias [kW] | |
| Consumida | 730 |
| Contratada | 839 |

**COSTE**

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | ######## |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | ######## |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

**TÉRMINO DE POTENCIA**

| | POTEN Contrat | COSTES Tarifa €/kw | COSTES Coste |
|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € |
| P2 | 839 | 19,586654 | ######## |
| P3 | 839 | 14,334178 | ######## |
| P4 | 839 | 14,334178 | ######## |
| P5 | 839 | 14,334178 | ######## |
| P6 | 839 | 6,540177 | ######## |

**COSTES TOTALES**

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 29.313,70 € |
| P3 | 12.028,54 € |
| P4 | 17.671,92 € |
| P5 | 12.028,54 € |
| P6 | 93.176,44 € |
| | ######## |
| | 164.219,13 € |
| | 7.136,62 € |
| | 171.355,75 € |
| | 35.984,71 € |
| | 207.340,46 € |
| | 0,03105 |

**Coste Anual Antes de Impuestos eléctricos sin IVA**

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.9 ALTERNATIVA 5. BOMBEO 1. 88 H + SOLAR

### BOMBEO A BALSA- - P6

**NECESIDADES HIDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 130,00 | 479,00 | 1169,00 | 972,00 | 311,00 | 0,00 | 0,00 | 0,00 | 3061,00 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 34,64 | 127,63 | 311,49 | 0,00 | 82,87 | 0,00 | 0,00 | 0,00 | 556,63 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1062,70 | 1062,70 | ###### | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1062,70 | 1222,11 | 1062,70 | 1062,70 |

**TÉRMINO DE ENERGÍA**

**CONSUMO [kWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 36811,5 | 135636,2 | 331020,3 | 275236,7 | 88064,4 | 0,0 | 0,0 | 0,0 | 866769,1 |

**TÉRMINO DE POTENCIA**

| | POTEN Contrat | COSTES Tarifa €/kW | COSTES Coste | COSTES TOTALES |
|---|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P5 | 1222 | 6,540177 | ######## | 64.027,70 € |
| P6 | | | | 2.792,51 € |
| | | | | 66.810,21 € |
| | | | | 14.030,14 € |
| | | | | 80.840,35 € |
| | | | | 0,01438 |

**DATOS**

| Superficies [ha] | 1836 |
|---|---|
| Caudal [l/s] | 1914 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 1063 |
| Contratada | 1222 |

**COSTE**

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

**TÉRMINO DE POTENCIA**

| | POTEN Contrat | COSTES Tarifa €/kw | COSTES Coste |
|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € |
| P5 | 0 | 14,334178 | 0,00 € |
| P6 | 1222 | 6,540177 | ######## |

**COSTES TOTALES**

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 0,00 € |
| P3 | 0,00 € |
| P4 | 0,00 € |
| P5 | 0,00 € |
| P6 | 64.027,70 € |
| | 2.792,51 € |
| | 66.810,21 € |
| | 14.030,14 € |
| | 80.840,35 € |
| | 0,01438 |

**Coste Anual Antes de Impuestos eléctricos sin IVA**

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.10 ALTERNATIVA 5. BOMBEO 2. 88 H + SOLAR

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 18,76 | 72,42 | 86,67 | 149,19 | 232,30 | 389,69 | 0,00 | 174,76 | 37,34 | 1,30 | 0,00 | 1162,43 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1143,77 | 1143,77 | ###### | 1143,77 | 1143,77 | 1143,77 | 1143,77 | 1143,77 | 1143,77 | 1315,33 | 1143,77 | 1143,77 |

TÉRMINO DE ENERGÍA

CONSUMO [KWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P6 | 0,0 | 21453,9 | ###### | 99125,1 | ###### | 265691,2 | 445715,5 | 390342,5 | 199889,1 | 42709,2 | 1489,9 | 0,0 | 1719890,8 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIAS | | COSTES | |
|---|---|---|---|---|
| | Contrat | Tarifa €/kW | Coste | |
| P1 | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P5 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P6 | 839 | 6,540177 | ######## | 49.278,14 € |

COSTES TOTALES

| | |
|---|---|
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 49.278,14 € |
| | 2.141,53 € |
| | 51.419,67 € |
| | 10.798,13 € |
| | 62.217,80 € |
| | 0,02109 |

DATOS

| | |
|---|---|
| Superficies [ha] | 964 |
| Caudal [l/s] | 883 |
| Altura bombeo m | 64 |
| Potencias [kW] | |
| Consumida | 730 |
| Contratada | 839 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.11 ALTERNATIVA 6. BOMBEO 1. 88 H

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 18,76 | 72,42 | 86,67 | 149,19 | 232,30 | 389,69 | 0,00 | 174,76 | 37,34 | 1,30 | 0,00 | 1162,43 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1143,77 | 1143,77 | ###### | 1143,77 | 1143,77 | 1143,77 | 1143,77 | 1143,77 | 1143,77 | 1315,33 | 1143,77 | 1143,77 |

TÉRMINO DE ENERGÍA

CONSUMO [KWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | |
| P6 | 0,0 | 21453,9 | ###### | 99125,1 | ###### | 265691,2 | 445715,5 | 390342,5 | 199889,1 | 42709,2 | 1489,9 | 0,0 | 1719890,8 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTENCIAS | | COSTES | |
|---|---|---|---|---|
| | Contrat | Tarifa €/kW | Coste | |
| P1 | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P5 | 0 | 14,334178 | 0,00 € | 0,00 € |
| P6 | 1315 | 6,540177 | ######## | 119.790,00 € |

COSTES TOTALES

| | |
|---|---|
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 119.790,00 € |
| | 5.205,82 € |
| | 124.995,82 € |
| | 26.249,12 € |
| | 151.244,95 € |
| | 0,01356 |

DATOS

| | |
|---|---|
| Superficies [ha] | 1610 |
| Caudal [l/s] | 2060 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 1144 |
| Contratada | 1315 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 2.12 ALTERNATIVA 6. BOMBEO 2. 88 H

**BOMBEO A BALSA- - P6**

**NECESIDADES HIDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 18,75 | 72,39 | 86,62 | 149,11 | 232,18 | 389,49 | 0,00 | 174,68 | 37,32 | 1,30 | 0,00 | 1161,84 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 570,20 | 655,74 | 570,20 | 570,20 |

**CONSUMO [KWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 10690,1 | ###### | 49392,2 | 85025,8 | 132388,9 | 222091,6 | 194500,3 | 99601,0 | 21281,2 | 742,4 | 0,0 | 856989,1 |

**COSTE**

| | Tarifa €/Kw | Coste | Contrat | Tarifa €/kw | Coste |
|---|---|---|---|---|---|
| P1 | 0,137322 | 0,00 € | 0 | 39,139427 | 0,00 € |
| P2 | 0,114125 | 0,00 € | 0 | 19,586654 | 0,00 € |
| P3 | 0,101906 | 0,00 € | 0 | 14,334178 | 0,00 € |
| P4 | 0,088886 | 0,00 € | 0 | 14,334178 | 0,00 € |
| P5 | 0,081456 | 0,00 € | 0 | 14,334178 | 0,00 € |
| P6 | 0,064648 | ######## | 656 | 6,540177 | ######## |
| | | ######## | | | ######## |

**TÉRMINO DE POTENCIA**

**TÉRMINO DE ENERGÍA**

**COSTES TOTALES**

| | |
|---|---|
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 0,00 € |
| | 59.691,25 € |
| | 2.594,06 € |
| | 62.285,31 € |
| | 13.079,92 € |
| | 75.365,23 € |
| | 0,02019 |

**DATOS**

| | |
|---|---|
| Superficies [ha] | 539 |
| Caudal [l/s] | 690 |
| Altura bombeo m | 64 |
| Potencias [kW] | |
| Consumida | 570 |
| Contratada | 656 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

# 3 CALCULOS GESTAR. 2ª FASE

## 3.1 RED INFERIOR. ALTERNATIVAS 1.1., 1.2. Y 1.3.

Página 1
Gestar2014GESTAR _2014 reu 0 11/12/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 0 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 388,5 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 253 | 346,83 | 35 |
| 254 | 347,21 | 35,79 |
| 267 | 347,05 | 35,95 |
| 255 | 346,92 | 35,08 |
| 256 | 345,18 | 35,82 |
| 266 | 344,68 | 37,32 |
| 257 | 344,21 | 35 |
| 252 | 343,91 | 36,09 |
| 250 | 342,23 | 35 |
| 259 | 342,62 | 35,38 |
| 251 | 342,86 | 35,14 |
| NU1 | 340 | 0 |
| 263 | 343,3 | 35,7 |
| 262 | 343,71 | 35 |
| 264 | 343,49 | 35 |
| 261 | 343,67 | 35,33 |
| 258 | 343,99 | 35,01 |
| 265 | 343,89 | 35,11 |
| 269 | 351,28 | 33 |
| 270 | 347,14 | 37 |
| 271 | 345,18 | 35,82 |
| 272 | 345,02 | 35 |
| 273 | 343,37 | 35,63 |
| 282 | 339,02 | 37,98 |
| 275 | 341,92 | 35,08 |
| 274 | 342,29 | 42,71 |
| NU2 | 340 | 0 |
| 277 | 343,16 | 42 |
| 283 | 341,74 | 35 |
| 281 | 343,62 | 41,38 |
| 278 | 345,55 | 35,45 |
| 280 | 344,95 | 40,05 |
| 307 | 346,01 | 37,99 |
| NU3 | 340 | 0 |
| 361 | 354,56 | 30 |
| 290 | 353,53 | 30 |
| NU4 | 340 | 0 |
| 369 | 344,46 | 40,54 |
| 354 | 344,63 | 40,37 |
| 355 | 342,72 | 42,28 |
| 368 | 343,12 | 36,88 |
| 374 | 348,32 | 36,68 |
| 376 | 348,26 | 36,74 |
| 378 | 345,23 | 39,77 |
| 377 | 345,19 | 37,81 |

Continúa nodos...

Optimización diámetros GESTAR 2010

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 391 | 334,98 | 35,02 |
| 387 | 334,22 | 45,78 |
| 389 | 334,78 | 35,22 |
| NU5 | 340 | 0 |
| 386 | 344,44 | 35 |
| 285 | 348,51 | 36,49 |
| 286 | 350,68 | 35 |
| 284 | 350,18 | 35 |
| NU6 | 340 | 0 |
| 287 | 339,97 | 45,03 |
| 385 | 339,95 | 42,05 |
| 384 | 339,52 | 35,48 |
| 393 | 338,61 | 37,39 |
| 383 | 338 | 38 |
| 382 | 340,96 | 39,04 |
| 379 | 343,5 | 35,5 |
| 394 | 344,11 | 38,89 |
| 212 | 349,56 | 35 |
| 211 | 351,84 | 34 |
| 220 | 333,06 | 35,94 |
| 217 | 340,52 | 35,48 |
| 218 | 340,56 | 35 |
| 223 | 340,93 | 38,07 |
| 215 | 342,57 | 36,43 |
| 225 | 344,94 | 41,06 |
| 408 | 345,21 | 35 |
| 409 | 345,24 | 35 |
| 410 | 344,85 | 35 |
| 413 | 335,59 | 35,41 |
| 412 | 339,26 | 35 |
| NU9 | 340 | 0 |
| 405 | 334,73 | 44,27 |
| 411 | 322,84 | 42,16 |
| 407 | 324,96 | 39,04 |
| 406 | 326,84 | 37,16 |
| 404 | 328,42 | 41,58 |
| NU10 | 340 | 0 |
| 403 | 330,97 | 46,03 |
| 402 | 329,69 | 36,31 |
| 401 | 331,15 | 48,85 |
| 224 | 342,8 | 41,2 |
| NU8 | 340 | 0 |
| 400 | 362,91 | 20 |
| NU7 | 340 | 0 |
| NU11 | 340 | 0 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| TU180 | 0 | NU11 | 3065,4 | 61,308 | 0,01 | 0,015 | 1372 | 1400 | |
| TU178 | NU11 | NU7 | 1672,2 | 33,444 | 0,01 | 0,015 | 981 | 1000 | |
| | 251 | 259 | 36,215 | 0,72431 | -- | 0,01861 | -- | -- | 0 |
| | NU1 | 251 | 552,55 | 11,051 | -- | 0,06916 | -- | -- | 0 |
| | 258 | NU1 | 329,21 | 6,5841 | -- | 0,11069 | -- | -- | 0 |
| | 262 | 263 | 91,778 | 1,8356 | -- | 0,015 | -- | -- | 0 |
| | 261 | 262 | 24,545 | 0,49091 | -- | 0,03 | -- | -- | 0 |
| | 261 | 264 | 30,144 | 0,60287 | -- | 0,015 | -- | -- | 0 |
| | 258 | 261 | 160,94 | 3,2189 | -- | 0,06 | -- | -- | 0 |
| | 265 | 258 | 35,306 | 0,70612 | -- | 0,15778 | -- | -- | 0 |
| | NU2 | 265 | 239,29 | 4,7857 | -- | 0,16693 | -- | -- | 0 |
| | 270 | 269 | 359,69 | 7,1938 | -- | 0,015 | -- | -- | 0 |
| | 271 | 270 | 408,1 | 8,1619 | -- | 0,03 | -- | -- | 0 |
| | 272 | 271 | 378,11 | 7,5621 | -- | 0,04689 | -- | -- | 0 |
| | 273 | 272 | 253,56 | 5,0712 | -- | 0,06409 | -- | -- | 0 |
| | NU2 | 273 | 67,434 | 1,3487 | -- | 0,06509 | -- | -- | 0 |
| | 275 | 282 | 391,14 | 7,8228 | -- | 0,015 | -- | -- | 0 |
| | 274 | 275 | 31,876 | 0,63752 | -- | 0,03 | -- | -- | 0 |
| | NU2 | 274 | 195,53 | 3,9105 | -- | 0,045 | -- | -- | 0 |

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Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | 277 | NU2 | 23,69 | 0,4738 | -- | 0,22431 | -- | -- | 0 |
| | 280 | 277 | 317,79 | 6,3558 | -- | 0,23503 | -- | -- | 0 |
| | 281 | 283 | 392,02 | 7,8405 | -- | 0,015 | -- | -- | 0 |
| | 280 | 281 | 327,95 | 6,559 | -- | 0,03 | -- | -- | 0 |
| | 280 | 278 | 183,59 | 3,6717 | -- | 0,015 | -- | -- | 0 |
| | NU3 | 280 | 45,324 | 0,90648 | -- | 0,25821 | -- | -- | 0 |
| | NU3 | 307 | 254,44 | 5,0888 | -- | 0,015 | -- | -- | 0 |
| | 290 | NU3 | 358,49 | 7,1699 | -- | 0,26408 | -- | -- | 0 |
| | NU4 | 361 | 405,37 | 8,1074 | -- | 0,015 | -- | -- | 0 |
| | NU4 | 290 | 29,942 | 0,59884 | -- | 0,26727 | -- | -- | 0 |
| | 355 | NU4 | 239,83 | 4,7965 | -- | 0,26977 | -- | -- | 0 |
| | 354 | 369 | 35,111 | 0,70222 | -- | 0,015 | -- | -- | 0 |
| | 355 | 354 | 531,99 | 10,64 | -- | 0,03 | -- | -- | 0 |
| | 368 | 355 | 37,582 | 0,75165 | -- | 0,30112 | -- | -- | 0 |
| | 377 | 368 | 554,17 | 11,083 | -- | 0,31794 | -- | -- | 0 |
| | 376 | 374 | 18,983 | 0,37966 | -- | 0,015 | -- | -- | 0 |
| | 377 | 376 | 302,85 | 6,057 | -- | 0,03 | -- | -- | 0 |
| | 377 | 378 | 38,524 | 0,77047 | -- | 0,015 | -- | -- | 0 |
| | 394 | 377 | 199,49 | 3,9898 | -- | 0,35071 | -- | -- | 0 |
| | NU5 | 391 | 310,6 | 6,212 | -- | 0,015 | -- | -- | 0 |
| | 389 | 387 | 33,41 | 0,6682 | -- | 0,015 | -- | -- | 0 |
| | NU5 | 389 | 281,69 | 5,6337 | -- | 0,03 | -- | -- | 0 |
| | 386 | NU5 | 152,76 | 3,0553 | -- | 0,045 | -- | -- | 0 |
| | 285 | 386 | 36,948 | 0,73896 | -- | 0,06 | -- | -- | 0 |
| | NU6 | 285 | 167,1 | 3,3421 | -- | 0,06 | -- | -- | 0 |
| | 284 | 286 | 32,138 | 0,64277 | -- | 0,015 | -- | -- | 0 |
| | NU6 | 284 | 202,43 | 4,0486 | -- | 0,05327 | -- | -- | 0 |
| | 384 | NU6 | 450,04 | 9,0008 | -- | 0,09392 | -- | -- | 0 |
| | 385 | 287 | 22,651 | 0,45302 | -- | 0,015 | -- | -- | 0 |
| | 384 | 385 | 32,566 | 0,65131 | -- | 0,03509 | -- | -- | 0 |
| | 382 | 384 | 470,58 | 9,4115 | -- | 0,12778 | -- | -- | 0 |
| | 383 | 393 | 42,484 | 0,84967 | -- | 0,015 | -- | -- | 0 |
| | 382 | 383 | 355,37 | 7,1073 | -- | 0,03111 | -- | -- | 0 |
| | 379 | 382 | 261,66 | 5,2332 | -- | 0,14698 | -- | -- | 0 |
| | 394 | 379 | 35,956 | 0,71913 | -- | 0,15262 | -- | -- | 0 |
| | 212 | 394 | 166,12 | 3,3224 | -- | 0,47433 | -- | -- | 0 |
| | 211 | 212 | 225,03 | 4,5005 | -- | 0,47653 | -- | -- | 0 |
| | NU7 | 211 | 321,75 | 6,435 | -- | 0,48144 | -- | -- | 0 |
| | 218 | 220 | 553,64 | 11,073 | -- | 0,015 | -- | -- | 0 |
| | 218 | 217 | 32,4 | 0,64799 | -- | 0,015 | -- | -- | 0 |
| | 223 | 218 | 189,18 | 3,7835 | -- | 0,045 | -- | -- | 0 |
| | 225 | 223 | 192,22 | 3,8444 | -- | 0,06 | -- | -- | 0 |
| | 225 | 215 | 28,157 | 0,56314 | -- | 0,015 | -- | -- | 0 |
| | NU8 | 225 | 207,87 | 4,1575 | -- | 0,06126 | -- | -- | 0 |
| | 409 | 408 | 230,65 | 4,613 | -- | 0,015 | -- | -- | 0 |
| | 410 | 409 | 111,27 | 2,2254 | -- | 0,03 | -- | -- | 0 |
| | NU9 | 410 | 322,06 | 6,4412 | -- | 0,06347 | -- | -- | 0 |
| | 412 | 413 | 294,58 | 5,8915 | -- | 0,02114 | -- | -- | 0 |
| | NU9 | 412 | 320,64 | 6,4128 | -- | 0,03614 | -- | -- | 0 |
| | 405 | NU9 | 430,6 | 8,6121 | -- | 0,0893 | -- | -- | 0 |
| | NU10 | 405 | 413,01 | 8,2603 | -- | 0,10167 | -- | -- | 0 |
| | 407 | 411 | 489,57 | 9,7914 | -- | 0,01527 | -- | -- | 0 |
| | 406 | 407 | 486,75 | 9,735 | -- | 0,05472 | -- | -- | 0 |
| | NU10 | 406 | 378,48 | 7,5695 | -- | 0,06972 | -- | -- | 0 |
| | NU10 | 404 | 48,449 | 0,96899 | -- | 0,04137 | -- | -- | 0 |
| | 403 | NU10 | 342,97 | 6,8594 | -- | 0,18451 | -- | -- | 0 |
| | 401 | 403 | 30,305 | 0,6061 | -- | 0,2057 | -- | -- | 0 |
| | 401 | 402 | 59,603 | 1,1921 | -- | 0,01571 | -- | -- | 0 |
| | 224 | 401 | 1280 | 25,6 | -- | 0,22636 | -- | -- | 0 |
| | NU8 | 224 | 399,66 | 7,9932 | -- | 0,2289 | -- | -- | 0 |
| | NU7 | NU8 | 839,72 | 16,794 | -- | 0,26615 | -- | -- | 0 |
| | NU11 | 400 | 915,19 | 18,304 | -- | 0,68764 | -- | -- | 0 |
| | 254 | 253 | 26,582 | 0,53164 | -- | 0,015 | -- | -- | 0 |
| | 255 | 254 | 239,16 | 4,7833 | -- | 0,03 | -- | -- | 0 |
| | 255 | 267 | 30,711 | 0,61423 | -- | 0,015 | -- | -- | 0 |
| | 256 | 255 | 320,91 | 6,4181 | -- | 0,06 | -- | -- | 0 |
| | 257 | 256 | 188,84 | 3,7767 | -- | 0,06 | -- | -- | 0 |

Continúa tuberías...

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TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | 257 | 266 | 34,634 | 0,69268 | -- | 0,015 | -- | -- | 0 |
| | NU1 | 257 | 283,44 | 5,6687 | -- | 0,07634 | -- | -- | 0 |
| | 251 | 252 | 309,35 | 6,187 | -- | 0,015 | -- | -- | 0 |
| | 251 | 250 | 246,47 | 4,9294 | -- | 0,015 | -- | -- | 0 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |

Continúa materiales...

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Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 200 | | | |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |

Optimización diámetros GESTAR 2010

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Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 388,5

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU180 | 0 | NU11 | 1400 | 3065,4 | 0,9387 | --------- | 48,5 | 47,338 |
| TU178 | NU11 | NU7 | 1000 | 1672,2 | 0,92628 | --------- | 48,5 | 46,422 |
| TU100 | 251 | 259 | 125-(PVC-10) | 36,215 | 1,7793 | 135,08 | 45,88 | 39,204 |
| TU101 | NU1 | 251 | 315-(PVC-10) | 552,55 | 1,0413 | 11670 | 45,64 | 39,803 |
| TU102 | 258 | NU1 | 400-(PVC-10) | 329,21 | 1,0324 | 12339 | 48,5 | 44,247 |
| TU103 | 262 | 263 | 125-(PVC-10) | 91,778 | 1,4341 | 342,33 | 45,2 | 38,709 |
| TU104 | 261 | 262 | 160-(PVC-10) | 24,545 | 1,7533 | 148,25 | 44,79 | 39,731 |
| TU105 | 261 | 264 | 110-(PVC-10) | 30,144 | 1,8502 | 102,49 | 45,01 | 39,488 |
| TU106 | 258 | 261 | 250-(PVC-10) | 160,94 | 1,4341 | 2182,4 | 44,83 | 40,182 |
| TU107 | 265 | 258 | 400-(PVC-10) | 35,306 | 1,4716 | 1323,3 | 44,51 | 40,956 |
| TU108 | NU2 | 265 | 500-(PVC-10) | 239,29 | 0,99664 | 17329 | 44,61 | 41,199 |
| TU109 | 270 | 269 | 315-(PVC-10) | 359,69 | 0,22585 | 7596,6 | 37,22 | 33,433 |
| TU110 | 271 | 270 | 315-(PVC-10) | 408,1 | 0,45169 | 8619 | 41,36 | 37,638 |
| TU111 | 272 | 271 | 400-(PVC-10) | 378,11 | 0,43735 | 14171 | 43,32 | 39,854 |
| TU112 | 273 | 272 | 400-(PVC-10) | 253,56 | 0,59778 | 9503,4 | 43,48 | 40,182 |
| TU113 | NU2 | 273 | 400-(PVC-10) | 67,434 | 0,60711 | 2527,4 | 45,13 | 42,03 |
| TU114 | 275 | 282 | 125-(PVC-10) | 391,14 | 1,4341 | 1459 | 49,48 | 39,541 |
| TU115 | 274 | 275 | 160-(PVC-10) | 31,876 | 1,7533 | 192,53 | 46,58 | 42,744 |
| TU116 | NU2 | 274 | 315-(PVC-10) | 195,53 | 0,67754 | 4129,5 | 46,21 | 42,909 |
| TU117 | 277 | NU2 | 700-(PRFV-10) | 23,69 | 0,60689 | 3172,6 | 48,5 | 45,455 |
| TU118 | 280 | 277 | 700-(PRFV-10) | 317,79 | 0,63589 | 42559 | 45,34 | 42,304 |
| TU119 | 281 | 283 | 125-(PVC-10) | 392,02 | 1,4341 | 1462,3 | 46,76 | 37,535 |
| TU120 | 280 | 281 | 315-(PVC-10) | 327,95 | 0,45169 | 6926,3 | 44,88 | 41,771 |
| TU121 | 280 | 278 | 125-(PVC-10) | 183,59 | 1,4341 | 684,78 | 42,95 | 37,183 |
| TU122 | NU3 | 280 | 700-(PRFV-10) | 45,324 | 0,69861 | 6069,8 | 43,55 | 40,647 |
| TU123 | NU3 | 307 | 160-(PVC-10) | 254,44 | 0,87665 | 1536,8 | 42,49 | 38,406 |
| TU124 | 290 | NU3 | 700-(PRFV-10) | 358,49 | 0,71449 | 48010 | 48,5 | 45,62 |
| TU125 | NU4 | 361 | 200-(PVC-10) | 405,37 | 0,56045 | 3721,3 | 33,94 | 30,61 |
| TU126 | NU4 | 290 | 700-(PRFV-10) | 29,942 | 0,72312 | 4009,8 | 34,97 | 32,276 |
| TU127 | 355 | NU4 | 700-(PRFV-10) | 239,83 | 0,72989 | 32118 | 48,5 | 45,822 |
| TU128 | 354 | 369 | 200-(PVC-10) | 35,111 | 0,56045 | 322,32 | 44,04 | 41,1 |
| TU129 | 355 | 354 | 315-(PVC-10) | 531,99 | 0,45169 | 11236 | 43,87 | 40,987 |
| TU130 | 368 | 355 | 800-(PRFV-10) | 37,582 | 0,62535 | 6395 | 45,78 | 43,231 |
| TU131 | 377 | 368 | 800-(PRFV-10) | 554,17 | 0,66029 | 94297 | 45,38 | 42,844 |
| TU132 | 376 | 374 | 160-(PVC-10) | 18,983 | 0,87665 | 114,66 | 40,18 | 37,187 |
| TU133 | 377 | 376 | 250-(PVC-10) | 302,85 | 0,71707 | 4106,6 | 40,24 | 37,337 |
| TU134 | 377 | 378 | 110-(PVC-10) | 38,524 | 1,8502 | 130,98 | 43,27 | 39,829 |
| TU135 | 394 | 377 | 900-(PRFV-10) | 199,49 | 0,57271 | 40822 | 43,31 | 40,987 |
| TU136 | NU5 | 391 | 110-(PVC-10) | 310,6 | 1,8502 | 1056 | 53,52 | 39,396 |
| TU137 | 389 | 387 | 140-(PVC-10) | 33,41 | 1,1441 | 154,02 | 54,28 | 47,274 |
| TU138 | NU5 | 389 | 200-(PVC-10) | 281,69 | 1,1209 | 2585,9 | 53,72 | 47,015 |
| TU139 | 386 | NU5 | 200-(PVC-10) | 152,76 | 1,6814 | 1402,4 | 48,5 | 43,387 |
| TU140 | 285 | 386 | 250-(PVC-10) | 36,948 | 1,4341 | 501,02 | 44,06 | 40,762 |
| TU141 | NU6 | 285 | 315-(PVC-10) | 167,1 | 0,90338 | 3529,2 | 39,99 | 36,943 |
| TU142 | 284 | 286 | 315-(PVC-10) | 32,138 | 0,22585 | 678,76 | 37,82 | 35,098 |
| TU143 | NU6 | 284 | 500-(PVC-10) | 202,43 | 0,31804 | 14660 | 38,32 | 35,604 |
| TU144 | 384 | NU6 | 500-(PRFV-10) | 450,04 | 0,46891 | 37110 | 48,5 | 45,823 |
| TU145 | 385 | 287 | 125-(PVC-10) | 22,651 | 1,4341 | 84,487 | 48,53 | 45,41 |
| TU146 | 384 | 385 | 200-(PVC-10) | 32,566 | 1,3111 | 298,95 | 48,55 | 45,783 |
| TU147 | 382 | 384 | 600-(PRFV-10) | 470,58 | 0,47056 | 50257 | 48,98 | 46,458 |
| TU148 | 383 | 393 | 110-(PVC-10) | 42,484 | 1,8502 | 144,44 | 49,89 | 39,899 |
| TU149 | 382 | 383 | 160-(PVC-10) | 355,37 | 1,8182 | 2146,4 | 50,5 | 41,742 |
| TU150 | 379 | 382 | 600-(PRFV-10) | 261,66 | 0,54127 | 27945 | 47,54 | 45,155 |
| TU151 | 394 | 379 | 600-(PRFV-10) | 35,956 | 0,56204 | 3840,1 | 45 | 42,714 |
| TU152 | 212 | 394 | 1000-(PRFV-10) | 166,12 | 0,62756 | 39194 | 44,39 | 42,118 |
| TU153 | 211 | 212 | 1000-(PRFV-10) | 225,03 | 0,63047 | 53093 | 38,94 | 36,713 |
| TU154 | NU7 | 211 | 1000-(PRFV-10) | 321,75 | 0,63696 | 75914 | 36,66 | 34,493 |
| TU155 | 218 | 220 | 125-(PVC-10) | 553,64 | 1,4341 | 2065,1 | 55,44 | 40,886 |
| TU156 | 218 | 217 | 110-(PVC-10) | 32,4 | 1,8502 | 110,16 | 47,98 | 41,124 |
| TU157 | 223 | 218 | 200-(PVC-10) | 189,18 | 1,6814 | 1736,6 | 47,94 | 42,024 |
| TU158 | 225 | 223 | 250-(PVC-10) | 192,22 | 1,4341 | 2606,5 | 47,57 | 43,902 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU159 | 225 | 215 | 110-(PVC-10) | 28,157 | 1,8502 | 95,733 | 45,93 | 42,751 |
| TU160 | NU8 | 225 | 500-(PVC-10) | 207,87 | 0,36575 | 15054 | 43,56 | 41,198 |
| TU161 | 409 | 408 | 250-(PVC-10) | 230,65 | 0,35853 | 3127,6 | 43,29 | 35,01 |
| TU162 | 410 | 409 | 315-(PVC-10) | 111,27 | 0,45169 | 2350 | 43,26 | 35,107 |
| TU163 | NU9 | 410 | 315-(PVC-10) | 322,06 | 0,95563 | 6801,9 | 43,65 | 35,566 |
| TU164 | 412 | 413 | 140-(PVC-10) | 294,58 | 1,6125 | 1358 | 52,91 | 38,096 |
| TU165 | NU9 | 412 | 200-(PVC-10) | 320,64 | 1,3503 | 2943,5 | 49,24 | 39,398 |
| TU166 | 405 | NU9 | 400-(PVC-10) | 430,6 | 0,83292 | 16139 | 48,5 | 41,206 |
| TU167 | NU10 | 405 | 400-(PVC-10) | 413,01 | 0,9483 | 15480 | 53,77 | 47,093 |
| TU168 | 407 | 411 | 140-(PVC-10) | 489,57 | 1,1647 | 2256,9 | 65,66 | 48,992 |
| TU169 | 406 | 407 | 250-(PVC-10) | 486,75 | 1,3079 | 6600,3 | 63,54 | 51,431 |
| TU170 | NU10 | 406 | 250-(PVC-10) | 378,48 | 1,6665 | 5132,1 | 61,66 | 52,344 |
| TU171 | NU10 | 404 | 200-(PVC-10) | 48,449 | 1,5457 | 444,76 | 60,08 | 53,66 |
| TU172 | 403 | NU10 | 500-(PVC-10) | 342,97 | 1,1016 | 24838 | 48,5 | 42,573 |
| TU173 | 401 | 403 | 500-(PVC-10) | 30,305 | 1,2281 | 2194,7 | 57,53 | 52,232 |
| TU174 | 401 | 402 | 110-(PVC-10) | 59,603 | 1,9378 | 202,65 | 58,81 | 51,697 |
| TU175 | 224 | 401 | 500-(PRFV-10) | 1280 | 1,1301 | 105550 | 57,35 | 52,12 |
| TU176 | NU8 | 224 | 500-(PRFV-10) | 399,66 | 1,1428 | 32956 | 45,7 | 42,684 |
| TU177 | NU7 | NU8 | 800-(PRFV-10) | 839,72 | 0,55273 | 142887 | 48,5 | 46,189 |
| TU179 | NU11 | 400 | 700-(PRFV-10) | 915,19 | 1,8605 | 122562 | 25,59 | 21,656 |
| TU91 | 254 | 253 | 110-(PVC-10) | 26,582 | 1,8502 | 90,378 | 41,67 | 35,529 |
| TU92 | 255 | 254 | 250-(PVC-10) | 239,16 | 0,71707 | 3243,1 | 41,29 | 35,92 |
| TU93 | 255 | 267 | 125-(PVC-10) | 30,711 | 1,4341 | 114,55 | 41,45 | 36,059 |
| TU94 | 256 | 255 | 400-(PVC-10) | 320,91 | 0,55963 | 12028 | 41,58 | 36,668 |
| TU95 | 257 | 256 | 400-(PVC-10) | 188,84 | 0,55963 | 7077,6 | 43,32 | 38,631 |
| TU96 | 257 | 266 | 110-(PVC-10) | 34,634 | 1,8502 | 117,75 | 43,82 | 38,257 |
| TU97 | NU1 | 257 | 400-(PVC-10) | 283,44 | 0,71204 | 10623 | 44,29 | 39,732 |
| TU98 | 251 | 252 | 160-(PVC-10) | 309,35 | 0,87665 | 1868,5 | 44,59 | 37,29 |
| TU99 | 251 | 250 | 125-(PVC-10) | 246,47 | 1,4341 | 919,34 | 46,27 | 36,587 |

** ¡Atención! Elementos TU109 , TU110 , TU111 , TU120 , TU129 , TU142 , TU143 , TU144 , TU147 , TU160 , TU161 , TU162 , Velocidad

** Información El Nodo 286 es el más desfavorable.

P Min de la Red (Dinámica) = 21,656 m (Nodo: 400)
P Max de la Red (Estática) = 65,66 m (Nodo: 411)
Caudal de Inyección en Cabecera = 1,3878 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 110-(PVC-10) | 3,40 | 603 | 2.050,63 |
| | | 250-(PVC-10) | 13,56 | 2.028 | 27.499,68 |
| | | 125-(PVC-10) | 3,73 | 1.948 | 7.266,84 |
| | | 400-(PVC-10) | 37,48 | 2.700 | 101.211,40 |
| | | 160-(PVC-10) | 6,04 | 995 | 6.007,15 |
| | | 315-(PVC-10) | 21,12 | 3.008 | 63.536,84 |
| | | 500-(PVC-10) | 72,42 | 1.023 | 74.075,77 |
| | | 700-(PRFV-10) | 133,92 | 1.930 | 258.499,60 |
| | | 200-(PVC-10) | 9,18 | 1.466 | 13.455,71 |
| | | 800-(PRFV-10) | 170,16 | 1.431 | 243.578,60 |
| | | 900-(PRFV-10) | 204,63 | 199 | 40.821,99 |
| | | 140-(PVC-10) | 4,61 | 818 | 3.768,95 |
| | | 500-(PRFV-10) | 82,46 | 2.130 | 175.616,50 |
| | | 600-(PRFV-10) | 106,80 | 768 | 82.042,65 |
| | | 1000-(PRFV-10) | 235,94 | 713 | 168.200,90 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **1.267.633,18 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **89.941,70 €** |
| **COSTE TOTAL ANUAL** | **89.941,70 €** |

## 3.2 RED BOMBEO 1. ALTERNATIVAS 1.1., 1.2. Y 1.3.

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Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 5 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 425 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 230 | 355,89 | 36,112 |
| 353 | 351,92 | 42,077 |
| 352 | 350,91 | 39,089 |
| 370 | 351,27 | 35,732 |
| 375 | 350,87 | 36,131 |
| 55 | 353,05 | 37,949 |
| NU1 | 360 | 0 |
| 60 | 353,9 | 36,103 |
| 59 | 355,37 | 38,63 |
| 58 | 355,39 | 43,606 |
| 56 | 360,65 | 38,35 |
| 1 | 355,98 | 43,015 |
| 2 | 355,29 | 35,715 |
| 4 | 355,63 | 38,368 |
| 6 | 354,9 | 46,101 |
| 40 | 355,52 | 39,485 |
| 39 | 356,28 | 51,725 |
| 7 | 354,27 | 35 |
| NU2 | 360 | 0 |
| 16 | 354,86 | 40,141 |
| 268 | 350,4 | 36,604 |
| 327 | 350,45 | 40,554 |
| 288 | 345,33 | 41,673 |
| 289 | 344,98 | 43,023 |
| 305 | 355,21 | 35 |
| 310 | 347,1 | 40,897 |
| 312 | 351,56 | 39,442 |
| 330 | 355,46 | 39,543 |
| NU3 | 360 | 0 |
| 332 | 361,49 | 35,511 |
| 347 | 361,12 | 35,883 |
| 349 | 360,3 | 42,701 |
| 350 | 360,9 | 35 |
| 44 | 384,74 | 30 |
| NU4 | 360 | 0 |
| 46 | 363,05 | 46,952 |
| 54 | 362,15 | 35 |
| 47 | 363,02 | 39,98 |
| 48 | 371,92 | 41,076 |
| 52 | 365,38 | 49,618 |
| 12 | 364,4 | 39,597 |
| 9 | 360,65 | 36,348 |
| NU6 | 360 | 0 |
| 19 | 361,11 | 51,889 |
| 18 | 361,53 | 39,466 |

Continúa nodos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 13 | 363,33 | 40,671 |
| 17 | 362,24 | 39,761 |
| 14 | 361,7 | 48,297 |
| 25 | 363,61 | 43,388 |
| 27 | 376,08 | 38,917 |
| 29 | 369,31 | 38,688 |
| 36 | 369,17 | 37,825 |
| 37 | 374,34 | 40,658 |
| 50 | 376,77 | 38,23 |
| NU5 | 360 | 0 |
| 106 | 362,15 | 43,85 |
| 109 | 366,79 | 35 |
| 108 | 367,49 | 35,508 |
| 151 | 367,42 | 40,581 |
| 227 | 352,95 | 36,051 |
| 214 | 352,96 | 35 |
| 213 | 352,94 | 35,058 |
| 229 | 356,86 | 35 |
| NU8 | 360 | 0 |
| 231 | 357,05 | 36,95 |
| 210 | 354,6 | 35 |
| 209 | 356,18 | 35 |
| 233 | 357,15 | 36,851 |
| 201 | 355,06 | 35 |
| 207 | 350,02 | 40,98 |
| 206 | 358,98 | 36,016 |
| 202 | 359,26 | 35 |
| 203 | 359,27 | 36,733 |
| 160 | 356,4 | 38,596 |
| 169 | 356,81 | 35,192 |
| 170 | 356,25 | 36,753 |
| 162 | 356,35 | 38,646 |
| 171 | 356,25 | 38,747 |
| 158 | 362,79 | 35 |
| 157 | 364,45 | 35,548 |
| 164 | 359,02 | 46,98 |
| 166 | 358,2 | 48,801 |
| NU9 | 360 | 0 |
| 234 | 363,08 | 35,921 |
| 235 | 362,82 | 36,179 |
| 174 | 359,42 | 46,579 |
| 172 | 359,42 | 35 |
| 168 | 359,03 | 36,974 |
| 155 | 365,31 | 35,693 |
| 154 | 366,16 | 38,837 |
| 156 | 366,4 | 35 |
| NU10 | 360 | 0 |
| NU7 | 360 | 0 |
| 180 | 374,03 | 40,966 |
| 175 | 373,3 | 35,701 |
| 153 | 373,88 | 36,121 |
| 152 | 373,88 | 35,123 |
| 177 | 374,63 | 40,372 |
| 105 | 377,66 | 35 |
| 103 | 371,47 | 40,533 |
| 101 | 378,82 | 36,179 |
| 107 | 373,32 | 35 |
| 102 | 373,4 | 37,599 |
| 150 | 373,7 | 35,295 |
| 118 | 377,88 | 36,125 |
| 111 | 375,97 | 35,026 |
| 146 | 377,56 | 37,437 |
| NU11 | 360 | 0 |
| 149 | 376,2 | 35 |
| 176 | 376,48 | 35,52 |
| 139 | 377,34 | 37,66 |
| N207 | 350,02 | 0 |

Continúa nodos...

Página 3
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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 200 | 350,62 | 37,38 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | 352 | 353 | 155,23 | 3,1046 | -- | 0,015 | -- | -- | 5 |
| | 58 | 59 | 38,291 | 0,76581 | -- | 0,088 | -- | -- | 5 |
| | 176 | 177 | 514,07 | 10,281 | -- | 0,98443 | -- | -- | 5 |
| | 103 | 105 | 264,9 | 5,2981 | -- | 0,015 | -- | -- | 5 |
| | 102 | 103 | 160,18 | 3,2037 | -- | 0,03 | -- | -- | 5 |
| | 102 | 101 | 246,33 | 4,9265 | -- | 0,015 | -- | -- | 5 |
| | 102 | 107 | 32,365 | 0,6473 | -- | 0,0289 | -- | -- | 5 |
| | 111 | 102 | 318,54 | 6,3707 | -- | 0,0665 | -- | -- | 5 |
| | 111 | 150 | 155,99 | 3,1198 | -- | 0,015 | -- | -- | 5 |
| | 111 | 118 | 68,565 | 1,3713 | -- | 0,015 | -- | -- | 5 |
| | NU11 | 111 | 151,33 | 3,0267 | -- | 0,08576 | -- | -- | 5 |
| | NU11 | 146 | 35,304 | 0,70608 | -- | 0,015 | -- | -- | 5 |
| | 2 | 1 | 271,48 | 5,4296 | -- | 0,0156 | -- | -- | 5 |
| | 149 | NU11 | 150,96 | 3,0192 | -- | 0,09281 | -- | -- | 5 |
| | 176 | 149 | 200,52 | 4,0103 | -- | 0,10067 | -- | -- | 5 |
| | 139 | 176 | 36,983 | 0,73965 | -- | 1,0519 | -- | -- | 5 |
| | 0 | 139 | 1821,9 | 36,438 | -- | 1,0571 | -- | -- | 5 |
| | 52 | 56 | 268,85 | 5,377 | -- | 0,10259 | -- | -- | 5 |
| | 6 | 4 | 109,43 | 2,1887 | -- | 0,04581 | -- | -- | 5 |
| | 4 | 2 | 200,94 | 4,0188 | -- | 0,0306 | -- | -- | 5 |
| | 39 | 40 | 46,807 | 0,93614 | -- | 0,015 | -- | -- | 5 |
| | NU2 | 6 | 593,76 | 11,875 | -- | 0,06081 | -- | -- | 5 |
| | NU2 | 7 | 76,59 | 1,5318 | -- | 0,015 | -- | -- | 5 |
| | NU2 | 39 | 406,97 | 8,1394 | -- | 0,05381 | -- | -- | 5 |
| | 327 | 16 | 371,01 | 7,4202 | -- | 0,11837 | -- | -- | 5 |
| | 209 | 230 | 41,507 | 0,83013 | -- | 0,015 | -- | -- | 5 |
| | 16 | NU2 | 163,39 | 3,2678 | -- | 0,10927 | -- | -- | 5 |
| | 312 | 327 | 377,16 | 7,5431 | -- | 0,13486 | -- | -- | 5 |
| | 327 | 268 | 54,86 | 1,0972 | -- | 0,015 | -- | -- | 5 |
| | 310 | 289 | 575,02 | 11,5 | -- | 0,03153 | -- | -- | 5 |
| | 289 | 288 | 225,61 | 4,5121 | -- | 0,01653 | -- | -- | 5 |
| | 312 | 310 | 999,89 | 19,998 | -- | 0,06153 | -- | -- | 5 |
| | 310 | 305 | 148,97 | 2,9793 | -- | 0,015 | -- | -- | 5 |
| | NU3 | 330 | 37,526 | 0,75052 | -- | 0,015 | -- | -- | 5 |
| | NU3 | 312 | 174,41 | 3,4882 | -- | 0,16528 | -- | -- | 5 |
| | 349 | 332 | 119,66 | 2,3932 | -- | 0,18253 | -- | -- | 5 |
| | NU1 | 370 | 156,55 | 3,1311 | -- | 0,045 | -- | -- | 5 |
| | 332 | NU3 | 344,44 | 6,8888 | -- | 0,17397 | -- | -- | 5 |
| | 350 | 349 | 448,95 | 8,979 | -- | 0,20008 | -- | -- | 5 |
| | 349 | 347 | 29,492 | 0,58984 | -- | 0,015 | -- | -- | 5 |
| | NU4 | 350 | 271,72 | 5,4344 | -- | 0,20441 | -- | -- | 5 |
| | NU4 | 44 | 156,77 | 3,1354 | -- | 0,015 | -- | -- | 5 |
| | 46 | NU4 | 133,72 | 2,6744 | -- | 0,20441 | -- | -- | 5 |
| | 47 | 46 | 34,903 | 0,69806 | -- | 0,209 | -- | -- | 5 |
| | 47 | 54 | 38,328 | 0,76657 | -- | 0,02301 | -- | -- | 5 |
| | 48 | 47 | 292,02 | 5,8404 | -- | 0,23028 | -- | -- | 5 |
| | 52 | 48 | 651,55 | 13,031 | -- | 0,24098 | -- | -- | 5 |
| | 370 | 352 | 193,49 | 3,8698 | -- | 0,03 | -- | -- | 5 |
| | NU5 | 52 | 324,89 | 6,4977 | -- | 0,33206 | -- | -- | 5 |
| | NU6 | 12 | 347,65 | 6,953 | -- | 0,015 | -- | -- | 5 |
| | NU6 | 9 | 48,347 | 0,96694 | -- | 0,015 | -- | -- | 5 |
| | 19 | NU6 | 128,92 | 2,5784 | -- | 0,03 | -- | -- | 5 |
| | 18 | 19 | 142,4 | 2,8481 | -- | 0,045 | -- | -- | 5 |
| | 17 | 18 | 502,18 | 10,044 | -- | 0,06 | -- | -- | 5 |
| | 17 | 13 | 49,879 | 0,99759 | -- | 0,03121 | -- | -- | 5 |
| | 14 | 17 | 280,1 | 5,602 | -- | 0,08598 | -- | -- | 5 |
| | 25 | 14 | 276,13 | 5,5226 | -- | 0,14071 | -- | -- | 5 |
| | 27 | 25 | 431,87 | 8,6374 | -- | 0,16875 | -- | -- | 5 |
| | NU1 | 55 | 63,272 | 1,2654 | -- | 0,015 | -- | -- | 5 |
| | 29 | 27 | 114,22 | 2,2845 | -- | 0,18198 | -- | -- | 5 |
| | 36 | 29 | 53,151 | 1,063 | -- | 0,19973 | -- | -- | 5 |
| | 37 | 36 | 507,56 | 10,151 | -- | 0,19973 | -- | -- | 5 |
| | 50 | 37 | 51,736 | 1,0347 | -- | 0,22973 | -- | -- | 5 |

Continúa tuberías...

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Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | NU5 | 50 | 539,14 | 10,783 | -- | 0,27234 | -- | -- | 5 |
| | 106 | NU5 | 200,98 | 4,0196 | -- | 0,55677 | -- | -- | 5 |
| | 108 | 106 | 439,9 | 8,798 | -- | 0,57591 | -- | -- | 5 |
| | 108 | 109 | 68,943 | 1,3788 | -- | 0,015 | -- | -- | 5 |
| | 151 | 108 | 40,58 | 0,81159 | -- | 0,59152 | -- | -- | 5 |
| | NU7 | 151 | 382,63 | 7,6526 | -- | 0,602 | -- | -- | 5 |
| | NU1 | 375 | 57,603 | 1,1521 | -- | 0,015 | -- | -- | 5 |
| | 214 | 227 | 30,287 | 0,60573 | -- | 0,015 | -- | -- | 5 |
| | 213 | 214 | 17,745 | 0,35491 | -- | 0,03058 | -- | -- | 5 |
| | NU8 | 213 | 446,18 | 8,9237 | -- | 0,05631 | -- | -- | 5 |
| | NU8 | 229 | 281,65 | 5,6329 | -- | 0,01503 | -- | -- | 5 |
| | 231 | NU8 | 269,99 | 5,3998 | -- | 0,07134 | -- | -- | 5 |
| | 233 | 231 | 36,96 | 0,7392 | -- | 0,07858 | -- | -- | 5 |
| | 210 | N207 | 103,45 | 2,069 | -- | 0,01577 | -- | -- | 5 |
| | N207 | 200 | 64,793 | 1,2959 | -- | 0,01577 | -- | -- | 5 |
| | 209 | 210 | 281,67 | 5,6334 | -- | 0,03077 | -- | -- | 5 |
| | 233 | 209 | 147,14 | 2,9429 | -- | 0,06077 | -- | -- | 5 |
| | 59 | 60 | 163,64 | 3,2728 | -- | 0,08021 | -- | -- | 5 |
| | 206 | 233 | 493,56 | 9,8712 | -- | 0,12339 | -- | -- | 5 |
| | 207 | 201 | 161,81 | 3,2362 | -- | 0,015 | -- | -- | 5 |
| | 206 | 207 | 316,91 | 6,3382 | -- | 0,03 | -- | -- | 5 |
| | 202 | 206 | 44,53 | 0,8906 | -- | 0,13833 | -- | -- | 5 |
| | 203 | 202 | 19,368 | 0,38736 | -- | 0,14569 | -- | -- | 5 |
| | 172 | 203 | 534,52 | 10,69 | -- | 0,15041 | -- | -- | 5 |
| | 169 | 160 | 32,788 | 0,65576 | -- | 0,02351 | -- | -- | 5 |
| | 170 | 169 | 268,64 | 5,3729 | -- | 0,03851 | -- | -- | 5 |
| | 171 | 170 | 30,765 | 0,61531 | -- | 0,05351 | -- | -- | 5 |
| | 171 | 162 | 32,76 | 0,6552 | -- | 0,02044 | -- | -- | 5 |
| | 60 | NU1 | 754,18 | 15,084 | -- | 0,06214 | -- | -- | 5 |
| | NU9 | 171 | 72,202 | 1,444 | -- | 0,07579 | -- | -- | 5 |
| | 164 | 158 | 149,16 | 2,9832 | -- | 0,015 | -- | -- | 5 |
| | 164 | 157 | 273,54 | 5,4709 | -- | 0,015 | -- | -- | 5 |
| | 166 | 164 | 179,52 | 3,5904 | -- | 0,045 | -- | -- | 5 |
| | NU9 | 166 | 341,81 | 6,8362 | -- | 0,06 | -- | -- | 5 |
| | 172 | NU9 | 313,41 | 6,2682 | -- | 0,10576 | -- | -- | 5 |
| | 235 | 234 | 16,311 | 0,32621 | -- | 0,015 | -- | -- | 5 |
| | 174 | 235 | 560,34 | 11,207 | -- | 0,03 | -- | -- | 5 |
| | 172 | 174 | 31,771 | 0,63543 | -- | 0,10274 | -- | -- | 5 |
| | 168 | 172 | 36,038 | 0,72076 | -- | 0,30061 | -- | -- | 5 |
| | 56 | 58 | 387,08 | 7,7415 | -- | 0,09502 | -- | -- | 5 |
| | 155 | 168 | 311,74 | 6,2349 | -- | 0,30483 | -- | -- | 5 |
| | 154 | 155 | 32,807 | 0,65613 | -- | 0,30897 | -- | -- | 5 |
| | NU10 | 154 | 62,079 | 1,2416 | -- | 0,31637 | -- | -- | 5 |
| | NU10 | 156 | 73,925 | 1,4785 | -- | 0,01524 | -- | -- | 5 |
| | NU7 | NU10 | 744,57 | 14,891 | -- | 0,32554 | -- | -- | 5 |
| | 152 | NU7 | 158,5 | 3,1699 | -- | 0,87858 | -- | -- | 5 |
| | 175 | 180 | 48,58 | 0,9716 | -- | 0,07884 | -- | -- | 5 |
| | 153 | 175 | 35,524 | 0,71049 | -- | 0,1043 | -- | -- | 5 |
| | 152 | 153 | 403,31 | 8,0661 | -- | 0,1193 | -- | -- | 5 |
| | 177 | 152 | 63,722 | 1,2744 | -- | 0,96994 | -- | -- | 5 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |

Continúa materiales...

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Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 100 | | | |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |

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Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 425

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | 352 | 353 | 140-(PVC-10) | 155,23 | 1,1441 | 715,61 | 73,077 | 47,518 |
| TU10 | 58 | 59 | 315-(PVC-10) | 38,291 | 1,325 | 808,7 | 69,63 | 57,939 |
| TU100 | 176 | 177 | 900-(PRFV-10) | 514,07 | 1,6076 | 105195 | 50,372 | 45,845 |
| TU101 | 103 | 105 | 140-(PVC-10) | 264,9 | 1,1441 | 1221,2 | 47,341 | 35,258 |
| TU102 | 102 | 103 | 200-(PVC-10) | 160,18 | 1,1209 | 1470,5 | 53,533 | 43,837 |
| TU103 | 102 | 101 | 160-(PVC-10) | 246,33 | 0,87665 | 1487,8 | 46,179 | 36,224 |
| TU104 | 102 | 107 | 160-(PVC-10) | 32,365 | 1,689 | 195,48 | 51,684 | 42,387 |
| TU105 | 111 | 102 | 250-(PVC-10) | 318,54 | 1,5895 | 4319,4 | 51,599 | 42,809 |
| TU106 | 111 | 150 | 110-(PVC-10) | 155,99 | 1,8502 | 530,36 | 51,295 | 40,595 |
| TU107 | 111 | 118 | 110-(PVC-10) | 68,565 | 1,8502 | 233,12 | 47,125 | 38,96 |
| TU108 | NU11 | 111 | 315-(PVC-10) | 151,33 | 1,2912 | 3196,1 | 49,026 | 42,85 |
| TU109 | NU11 | 146 | 110-(PVC-10) | 35,304 | 1,8502 | 120,03 | 47,437 | 40,881 |
| TU11 | 2 | 1 | 160-(PVC-10) | 271,48 | 0,91172 | 1639,7 | 69,016 | 44,272 |
| TU110 | 149 | NU11 | 315-(PVC-10) | 150,96 | 1,3974 | 3188,2 | 65 | 59,468 |
| TU111 | 176 | 149 | 315-(PVC-10) | 200,52 | 1,5157 | 4234,9 | 48,795 | 44,006 |
| TU112 | 139 | 176 | 900-(PRFV-10) | 36,983 | 1,7177 | 7567,8 | 48,52 | 44,876 |
| TU113 | 0 | 139 | 900-(PRFV-10) | 1821,9 | 1,7263 | 372811 | 47,66 | 44,088 |
| TU12 | 52 | 56 | 315-(PVC-10) | 268,85 | 1,5446 | 5678,2 | 64,35 | 54,818 |
| TU13 | 6 | 4 | 200-(PVC-10) | 109,43 | 1,7116 | 1004,6 | 69,368 | 47,181 |
| TU14 | 4 | 2 | 200-(PVC-10) | 200,94 | 1,1433 | 1844,6 | 69,715 | 46,35 |
| TU15 | 39 | 40 | 110-(PVC-10) | 46,807 | 1,8502 | 159,14 | 69,485 | 51,186 |
| TU16 | NU2 | 6 | 250-(PVC-10) | 593,76 | 1,4535 | 8051,4 | 70,101 | 49,257 |
| TU17 | NU2 | 7 | 110-(PVC-10) | 76,59 | 1,8502 | 260,4 | 70,733 | 51,802 |
| TU18 | NU2 | 39 | 400-(PVC-10) | 406,97 | 0,5019 | 15253 | 68,725 | 51,784 |
| TU19 | 327 | 16 | 400-(PVC-10) | 371,01 | 1,1041 | 13906 | 70,141 | 53,77 |
| TU2 | 209 | 230 | 110-(PVC-10) | 41,507 | 1,8502 | 141,12 | 69,112 | 49,582 |
| TU20 | 16 | NU2 | 400-(PVC-10) | 163,39 | 1,0192 | 6123,8 | 65 | 48,291 |
| TU21 | 312 | 327 | 400-(PVC-10) | 377,16 | 1,2579 | 14136 | 74,554 | 59,074 |
| TU22 | 327 | 268 | 110-(PVC-10) | 54,86 | 1,8502 | 186,53 | 74,604 | 57,533 |
| TU23 | 310 | 289 | 160-(PVC-10) | 575,02 | 1,8427 | 3473,1 | 80,023 | 48,008 |
| TU24 | 289 | 288 | 140-(PVC-10) | 225,61 | 1,2608 | 1040 | 79,673 | 45,23 |
| TU25 | 312 | 310 | 250-(PVC-10) | 999,89 | 1,4707 | 13559 | 77,897 | 56,453 |
| TU26 | 310 | 305 | 110-(PVC-10) | 148,97 | 1,8502 | 506,48 | 69,794 | 44,028 |
| TU27 | NU3 | 330 | 110-(PVC-10) | 37,526 | 1,8502 | 127,59 | 69,543 | 54,898 |
| TU28 | NU3 | 312 | 400-(PVC-10) | 174,41 | 1,5416 | 6536,9 | 73,442 | 59,112 |
| TU29 | 349 | 332 | 500-(PVC-10) | 119,66 | 1,0898 | 8665,8 | 63,511 | 51,634 |
| TU3 | NU1 | 370 | 200-(PVC-10) | 156,55 | 1,6814 | 1437,2 | 73,732 | 52,819 |
| TU30 | 332 | NU3 | 400-(PVC-10) | 344,44 | 1,6227 | 12910 | 65 | 51,444 |
| TU31 | 350 | 349 | 500-(PVC-10) | 448,95 | 1,1946 | 32513 | 64,701 | 53,039 |
| TU32 | 349 | 347 | 110-(PVC-10) | 29,492 | 1,8502 | 100,27 | 63,883 | 51,366 |
| TU33 | NU4 | 350 | 500-(PVC-10) | 271,72 | 1,2204 | 19678 | 64,098 | 53,393 |
| TU34 | NU4 | 44 | 250-(PVC-10) | 156,77 | 0,35853 | 2125,8 | 40,262 | 30,072 |
| TU35 | 46 | NU4 | 500-(PVC-10) | 133,72 | 1,2204 | 9683,8 | 65 | 54,896 |
| TU36 | 47 | 46 | 500-(PVC-10) | 34,903 | 1,2478 | 2527,7 | 61,952 | 52,144 |
| TU37 | 47 | 54 | 140-(PVC-10) | 38,328 | 1,7551 | 176,69 | 62,849 | 52,366 |
| TU38 | 48 | 47 | 500-(PRFV-10) | 292,02 | 1,1497 | 24080 | 61,98 | 52,252 |
| TU39 | 52 | 48 | 500-(PRFV-10) | 651,55 | 1,2031 | 53727 | 53,076 | 43,869 |
| TU4 | 370 | 352 | 160-(PVC-10) | 193,49 | 1,7533 | 1168,7 | 74,089 | 49,93 |
| TU40 | NU5 | 52 | 600-(PRFV-10) | 324,89 | 1,2228 | 34698 | 59,618 | 51,676 |
| TU41 | NU6 | 12 | 125-(PVC-10) | 347,65 | 1,4341 | 1296,7 | 60,597 | 41,652 |
| TU42 | NU6 | 9 | 110-(PVC-10) | 48,347 | 1,8502 | 164,38 | 64,348 | 49,424 |
| TU43 | 19 | NU6 | 160-(PVC-10) | 128,92 | 1,7533 | 778,68 | 65 | 51,479 |
| TU44 | 18 | 19 | 315-(PVC-10) | 142,4 | 0,67754 | 3007,6 | 63,889 | 52,531 |
| TU45 | 17 | 18 | 400-(PVC-10) | 502,18 | 0,55963 | 18822 | 63,466 | 52,294 |
| TU46 | 17 | 13 | 160-(PVC-10) | 49,879 | 1,824 | 301,27 | 61,671 | 49,948 |
| TU47 | 14 | 17 | 400-(PVC-10) | 280,1 | 0,80195 | 10498 | 62,761 | 51,938 |
| TU48 | 25 | 14 | 500-(PVC-10) | 276,13 | 0,84009 | 19997 | 63,297 | 52,848 |
| TU49 | 27 | 25 | 500-(PRFV-10) | 431,87 | 0,8425 | 35612 | 61,388 | 51,247 |
| TU5 | NU1 | 55 | 110-(PVC-10) | 63,272 | 1,8502 | 215,12 | 71,949 | 51,061 |
| TU50 | 29 | 27 | 500-(PRFV-10) | 114,22 | 0,90855 | 9418,9 | 48,917 | 39,212 |
| TU51 | 36 | 29 | 500-(PRFV-10) | 53,151 | 0,99717 | 4382,8 | 55,688 | 46,115 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU52 | 37 | 36 | 500-(PRFV-10) | 507,56 | 0,99717 | 41853 | 55,825 | 46,326 |
| TU53 | 50 | 37 | 500-(PRFV-10) | 51,736 | 1,147 | 4266,1 | 50,658 | 41,856 |
| TU54 | NU5 | 50 | 500-(PRFV-10) | 539,14 | 1,3597 | 44457 | 48,23 | 39,52 |
| TU55 | 106 | NU5 | 700-(PRFV-10) | 200,98 | 1,5064 | 26915 | 65 | 57,601 |
| TU56 | 108 | 106 | 700-(PRFV-10) | 439,9 | 1,5582 | 58912 | 62,85 | 55,863 |
| TU57 | 108 | 109 | 110-(PVC-10) | 68,943 | 1,8502 | 234,4 | 58,207 | 50,179 |
| TU58 | 151 | 108 | 700-(PRFV-10) | 40,58 | 1,6004 | 5434,4 | 57,508 | 51,48 |
| TU59 | NU7 | 151 | 700-(PRFV-10) | 382,63 | 1,6288 | 51242 | 57,581 | 51,645 |
| TU6 | NU1 | 375 | 110-(PVC-10) | 57,603 | 1,8502 | 195,85 | 74,131 | 53,407 |
| TU60 | 214 | 227 | 110-(PVC-10) | 30,287 | 1,8502 | 102,97 | 72,051 | 47,929 |
| TU61 | 213 | 214 | 160-(PVC-10) | 17,745 | 1,7872 | 107,18 | 72,039 | 48,796 |
| TU62 | NU8 | 213 | 250-(PVC-10) | 446,18 | 1,3459 | 6050,2 | 72,058 | 49,122 |
| TU63 | NU8 | 229 | 160-(PVC-10) | 281,65 | 0,87841 | 1701,1 | 68,142 | 46,567 |
| TU64 | 231 | NU8 | 250-(PVC-10) | 269,99 | 1,7052 | 3661,1 | 65 | 44,762 |
| TU65 | 233 | 231 | 250-(PVC-10) | 36,96 | 1,8782 | 501,18 | 67,949 | 50,234 |
| TU66 | 210 | N207 | 110-(PVC-10) | 103,45 | 1,9452 | 351,73 | 74,98 | 48,413 |
| TU67 | N207 | 200 | 110-(PVC-10) | 64,793 | 1,9452 | 220,3 | 74,38 | 45,752 |
| TU68 | 209 | 210 | 160-(PVC-10) | 281,67 | 1,7983 | 1701,3 | 70,396 | 47,119 |
| TU69 | 233 | 209 | 250-(PVC-10) | 147,14 | 1,4525 | 1995,3 | 68,823 | 50,497 |
| TU7 | 59 | 60 | 250-(PVC-10) | 163,64 | 1,9172 | 2218,9 | 71,103 | 57,515 |
| TU70 | 206 | 233 | 315-(PVC-10) | 493,56 | 1,8578 | 10424 | 67,851 | 50,548 |
| TU71 | 207 | 201 | 110-(PVC-10) | 161,81 | 1,8502 | 550,15 | 69,939 | 46,729 |
| TU72 | 206 | 207 | 160-(PVC-10) | 316,91 | 1,7533 | 1914,1 | 74,98 | 56,465 |
| TU73 | 202 | 206 | 400-(PVC-10) | 44,53 | 1,2902 | 1669 | 66,016 | 52,817 |
| TU74 | 203 | 202 | 400-(PVC-10) | 19,368 | 1,3589 | 725,92 | 65,74 | 52,683 |
| TU75 | 172 | 203 | 400-(PVC-10) | 534,52 | 1,4029 | 20034 | 65,733 | 52,745 |
| TU76 | 169 | 160 | 140-(PVC-10) | 32,788 | 1,7932 | 151,15 | 68,596 | 51,312 |
| TU77 | 170 | 169 | 200-(PVC-10) | 268,64 | 1,4389 | 2466,2 | 68,192 | 51,581 |
| TU78 | 171 | 170 | 200-(PVC-10) | 30,765 | 1,9993 | 282,43 | 68,753 | 54,539 |
| TU79 | 171 | 162 | 125-(PVC-10) | 32,76 | 1,9542 | 122,19 | 68,646 | 54,034 |
| TU8 | 60 | NU1 | 250-(PVC-10) | 754,18 | 1,4853 | 10227 | 65 | 45,947 |
| TU80 | NU9 | 171 | 250-(PVC-10) | 72,202 | 1,8116 | 979,06 | 68,747 | 55,037 |
| TU81 | 164 | 158 | 110-(PVC-10) | 149,16 | 1,8502 | 507,14 | 62,214 | 41,889 |
| TU82 | 164 | 157 | 110-(PVC-10) | 273,54 | 1,8502 | 930,05 | 60,548 | 36,614 |
| TU83 | 166 | 164 | 250-(PVC-10) | 179,52 | 1,0756 | 2434,3 | 65,98 | 49,981 |
| TU84 | NU9 | 166 | 250-(PVC-10) | 341,81 | 1,4341 | 4634,9 | 66,801 | 51,522 |
| TU85 | 172 | NU9 | 315-(PVC-10) | 313,41 | 1,5924 | 6619,2 | 65 | 52,044 |
| TU86 | 235 | 234 | 110-(PVC-10) | 16,311 | 1,8502 | 55,456 | 61,921 | 40,864 |
| TU87 | 174 | 235 | 160-(PVC-10) | 560,34 | 1,7533 | 3384,5 | 62,179 | 41,594 |
| TU88 | 172 | 174 | 315-(PVC-10) | 31,771 | 1,5469 | 671,01 | 65,579 | 54,395 |
| TU89 | 168 | 172 | 500-(PVC-10) | 36,038 | 1,7948 | 2609,9 | 65,579 | 54,584 |
| TU9 | 56 | 58 | 315-(PVC-10) | 387,08 | 1,4307 | 8175 | 69,605 | 58,086 |
| TU90 | 155 | 168 | 500-(PVC-10) | 311,74 | 1,82 | 22576 | 65,974 | 55,141 |
| TU91 | 154 | 155 | 500-(PVC-10) | 32,807 | 1,8447 | 2375,9 | 59,693 | 50,304 |
| TU92 | NU10 | 154 | 500-(PVC-10) | 62,079 | 1,8889 | 4495,8 | 58,837 | 49,603 |
| TU93 | NU10 | 156 | 110-(PVC-10) | 73,925 | 1,8798 | 251,35 | 58,595 | 47,462 |
| TU94 | NU7 | NU10 | 500-(PVC-10) | 744,57 | 1,9436 | 53922 | 65 | 56,075 |
| TU95 | 152 | NU7 | 800-(PRFV-10) | 158,5 | 1,8246 | 26970 | 65 | 59,97 |
| TU96 | 175 | 180 | 250-(PVC-10) | 48,58 | 1,8845 | 658,74 | 50,966 | 42,42 |
| TU97 | 153 | 175 | 315-(PVC-10) | 35,524 | 1,5704 | 750,27 | 51,701 | 43,7 |
| TU98 | 152 | 153 | 315-(PVC-10) | 403,31 | 1,7962 | 8517,8 | 51,121 | 43,337 |
| TU99 | 177 | 152 | 900-(PRFV-10) | 63,722 | 1,5839 | 13039 | 51,123 | 46,489 |

** ¡Atención! Elementos TU34, Velocidad de Diseño inferior a la Mínima.

** Información El Nodo 19 es el más desfavorable.

P Min de la Red (Dinámica) = 30,072 m (Nodo: 44)
P Max de la Red (Estática) = 80,023 m (Nodo: 289)
Caudal de Inyección en Cabecera = 1,0571 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|

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Entidad: CINGRAL Proyecto: LICENCIA_1

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 110-(PVC-10) | 3,40 | 1.807 | 6.143,95 |
| | | 140-(PVC-10) | 4,61 | 717 | 3.304,70 |
| | | 160-(PVC-10) | 6,04 | 2.956 | 17.853,01 |
| | | 200-(PVC-10) | 9,18 | 927 | 8.505,49 |
| | | 250-(PVC-10) | 13,56 | 4.529 | 61.415,51 |
| | | 315-(PVC-10) | 21,12 | 2.617 | 55.271,09 |
| | | 400-(PVC-10) | 37,48 | 3.218 | 120.613,60 |
| | | 500-(PVC-10) | 72,42 | 2.472 | 179.045,30 |
| | | 500-(PRFV-10) | 82,46 | 2.641 | 217.797,00 |
| | | 600-(PRFV-10) | 106,80 | 325 | 34.697,84 |
| | | 125-(PVC-10) | 3,73 | 380 | 1.418,93 |
| | | 700-(PRFV-10) | 133,92 | 1.064 | 142.502,90 |
| | | 800-(PRFV-10) | 170,16 | 158 | 26.969,54 |
| | | 900-(PRFV-10) | 204,63 | 2.437 | 498.612,60 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **1.374.151,49 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **97.499,43 €** |
| **COSTE TOTAL ANUAL** | **97.499,43 €** |

Optimización diámetro 2020 GESTAR

## 3.3 RED BOMBEO 2. ALTERNATIVAS 1.1., 1.2., 1.3., 2.1., 2.2. Y 2.3.

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Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 5 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 442 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 24 | 374,25 | 47,752 |
| 64 | 382,69 | 41,306 |
| 62 | 381,58 | 35,422 |
| 65 | 386,77 | 37,23 |
| 66 | 383,92 | 40,081 |
| 61 | 378,59 | 35 |
| 67 | 379,46 | 43,54 |
| 35 | 378,83 | 41,171 |
| 33 | 382,57 | 40,429 |
| 31 | 379,33 | 36,672 |
| NU2 | 380 | 0 |
| 34 | 376,23 | 42,774 |
| 26 | 377,99 | 41,012 |
| NU3 | 380 | 0 |
| 68 | 385,83 | 38,167 |
| NU1 | 380 | 0 |
| 71 | 391,61 | 32,394 |
| NU4 | 380 | 0 |
| 72 | 382,22 | 41,785 |
| 69 | 379,45 | 44,553 |
| 83 | 387,73 | 36,271 |
| 84 | 387,91 | 36,089 |
| 85 | 383,55 | 40,448 |
| 93 | 383,1 | 40,896 |
| 124 | 379,68 | 37,321 |
| 127 | 382,02 | 36,985 |
| NU5 | 380 | 0 |
| 181 | 386,01 | 37,989 |
| 182 | 385,74 | 38,257 |
| 183 | 380,61 | 37,387 |
| NU7 | 380 | 0 |
| 134 | 386,75 | 38,25 |
| 133 | 387,82 | 36,183 |
| 186 | 380,45 | 38,549 |
| 136 | 383,99 | 40,012 |
| 179 | 383,39 | 35,606 |
| 178 | 383,21 | 35 |
| 137 | 382,08 | 36,921 |
| NU8 | 380 | 0 |
| 132 | 382,55 | 39,45 |
| NU9 | 380 | 0 |
| 131 | 384,31 | 39,689 |
| NU6 | 380 | 0 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|

Continúa tuberías...

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Entidad: CINGRAL Proyecto: LICENCIA_1

TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | 26 | 24 | 1054,2 | 21,085 | -- | 0,07121 | -- | -- | 5 |
| | NU2 | 31 | 34,725 | 0,6945 | -- | 0,015 | -- | -- | 5 |
| | 34 | NU2 | 95,663 | 1,9133 | -- | 0,045 | -- | -- | 5 |
| | NU3 | 34 | 173,32 | 3,4664 | -- | 0,06272 | -- | -- | 5 |
| | NU3 | 26 | 34,045 | 0,6809 | -- | 0,13112 | -- | -- | 5 |
| | NU1 | NU3 | 293,99 | 5,8798 | -- | 0,18043 | -- | -- | 5 |
| | NU1 | 68 | 117,34 | 2,3468 | -- | 0,015 | -- | -- | 5 |
| | NU4 | NU1 | 589,12 | 11,782 | -- | 0,25427 | -- | -- | 5 |
| | NU4 | 71 | 124,14 | 2,4828 | -- | 0,015 | -- | -- | 5 |
| | 69 | NU4 | 337,36 | 6,7472 | -- | 0,25601 | -- | -- | 5 |
| | 69 | 72 | 42,203 | 0,84407 | -- | 0,015 | -- | -- | 5 |
| | 62 | 64 | 44,106 | 0,88213 | -- | 0,02255 | -- | -- | 5 |
| | 83 | 69 | 314,59 | 6,2918 | -- | 0,28731 | -- | -- | 5 |
| | 85 | 83 | 181,09 | 3,6218 | -- | 0,29441 | -- | -- | 5 |
| | 85 | 84 | 201,61 | 4,0323 | -- | 0,015 | -- | -- | 5 |
| | 93 | 85 | 31,006 | 0,62013 | -- | 0,30792 | -- | -- | 5 |
| | NU5 | 93 | 274 | 5,4799 | -- | 0,31692 | -- | -- | 5 |
| | 127 | 124 | 333,27 | 6,6654 | -- | 0,015 | -- | -- | 5 |
| | NU5 | 127 | 118,22 | 2,3643 | -- | 0,03 | -- | -- | 5 |
| | NU6 | NU5 | 175,4 | 3,508 | -- | 0,32426 | -- | -- | 5 |
| | 182 | 181 | 36,443 | 0,72887 | -- | 0,02477 | -- | -- | 5 |
| | NU7 | 182 | 175,85 | 3,5171 | -- | 0,03977 | -- | -- | 5 |
| | 66 | 62 | 187,82 | 3,7565 | -- | 0,03755 | -- | -- | 5 |
| | NU7 | 183 | 283,35 | 5,667 | -- | 0,015 | -- | -- | 5 |
| | 134 | NU7 | 137,52 | 2,7504 | -- | 0,05477 | -- | -- | 5 |
| | 133 | 134 | 35,619 | 0,71239 | -- | 0,06977 | -- | -- | 5 |
| | NU8 | 133 | 358,62 | 7,1724 | -- | 0,06977 | -- | -- | 5 |
| | 136 | 186 | 151,49 | 3,0297 | -- | 0,015 | -- | -- | 5 |
| | 137 | 136 | 57,57 | 1,1514 | -- | 0,03 | -- | -- | 5 |
| | 178 | 179 | 39,566 | 0,79131 | -- | 0,015 | -- | -- | 5 |
| | 137 | 178 | 48,548 | 0,97095 | -- | 0,03636 | -- | -- | 5 |
| | NU8 | 137 | 436,93 | 8,7386 | -- | 0,07015 | -- | -- | 5 |
| | NU9 | NU8 | 665,32 | 13,306 | -- | 0,10512 | -- | -- | 5 |
| | 66 | 65 | 38,588 | 0,77177 | -- | 0,015 | -- | -- | 5 |
| | NU9 | 132 | 35,455 | 0,7091 | -- | 0,02591 | -- | -- | 5 |
| | 131 | NU9 | 282,22 | 5,6444 | -- | 0,11591 | -- | -- | 5 |
| | NU6 | 131 | 66,011 | 1,3202 | -- | 0,12446 | -- | -- | 5 |
| | 0 | NU6 | 1922,7 | 38,454 | -- | 0,41539 | -- | -- | 5 |
| | 61 | 66 | 499,21 | 9,9843 | -- | 0,10133 | -- | -- | 5 |
| | 67 | 61 | 35,488 | 0,70976 | -- | 0,10888 | -- | -- | 5 |
| | NU1 | 67 | 542,15 | 10,843 | -- | 0,11476 | -- | -- | 5 |
| | 33 | 35 | 33,193 | 0,66387 | -- | 0,015 | -- | -- | 5 |
| | NU2 | 33 | 350,07 | 7,0015 | -- | 0,03 | -- | -- | 5 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |

Continúa materiales...

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Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 100 | | | |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |

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**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 442

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU1 | 26 | 24 | 315-(PVC-10) | 1054,2 | 1,0722 | 22265 | 67,752 | 50,261 |
| TU10 | NU2 | 31 | 110-(PVC-10) | 34,725 | 1,8502 | 118,07 | 62,672 | 45,265 |
| TU11 | 34 | NU2 | 200-(PVC-10) | 95,663 | 1,6814 | 878,18 | 62 | 45,601 |
| TU12 | NU3 | 34 | 250-(PVC-10) | 173,32 | 1,4991 | 2350,2 | 65,774 | 50,511 |
| TU13 | NU3 | 26 | 315-(PVC-10) | 34,045 | 1,9742 | 719,03 | 64,012 | 49,71 |
| TU14 | NU1 | NU3 | 400-(PVC-10) | 293,99 | 1,6829 | 11019 | 62 | 48,015 |
| TU15 | NU1 | 68 | 110-(PVC-10) | 117,34 | 1,8502 | 398,96 | 56,167 | 40,311 |
| TU16 | NU4 | NU1 | 500-(PVC-10) | 589,12 | 1,5181 | 42664 | 62 | 49,548 |
| TU17 | NU4 | 71 | 110-(PVC-10) | 124,14 | 1,8502 | 422,07 | 50,394 | 36,291 |
| TU18 | 69 | NU4 | 500-(PVC-10) | 337,36 | 1,5285 | 24432 | 62 | 51,499 |
| TU19 | 69 | 72 | 110-(PVC-10) | 42,203 | 1,8502 | 143,49 | 59,785 | 49,191 |
| TU2 | 62 | 64 | 250-(PVC-10) | 44,106 | 0,539 | 598,08 | 59,306 | 41,913 |
| TU20 | 83 | 69 | 500-(PVC-10) | 314,59 | 1,7154 | 22782 | 62,553 | 53,184 |
| TU21 | 85 | 83 | 500-(PVC-10) | 181,09 | 1,7577 | 13114 | 54,271 | 46,207 |
| TU22 | 85 | 84 | 110-(PVC-10) | 201,61 | 1,8502 | 685,49 | 54,089 | 40,962 |
| TU23 | 93 | 85 | 500-(PVC-10) | 31,006 | 1,8384 | 2245,5 | 58,448 | 51,17 |
| TU24 | NU5 | 93 | 500-(PVC-10) | 274 | 1,8921 | 19843 | 58,896 | 51,764 |
| TU25 | 127 | 124 | 110-(PVC-10) | 333,27 | 1,8502 | 1133,1 | 62,321 | 44,902 |
| TU26 | NU5 | 127 | 160-(PVC-10) | 118,22 | 1,7533 | 714,02 | 59,985 | 52,234 |
| TU27 | NU6 | NU5 | 500-(PVC-10) | 175,4 | 1,936 | 12703 | 62 | 56,233 |
| TU28 | 182 | 181 | 200-(PVC-10) | 36,443 | 0,92549 | 334,55 | 55,989 | 38,233 |
| TU29 | NU7 | 182 | 200-(PVC-10) | 175,85 | 1,4859 | 1614,3 | 56,258 | 38,647 |
| TU3 | 66 | 62 | 250-(PVC-10) | 187,82 | 0,89753 | 2546,9 | 60,422 | 43,08 |
| TU30 | NU7 | 183 | 125-(PVC-10) | 283,35 | 1,4341 | 1056,9 | 61,387 | 41,021 |
| TU31 | 134 | NU7 | 250-(PVC-10) | 137,52 | 1,3091 | 1864,8 | 62 | 46,055 |
| TU32 | 133 | 134 | 250-(PVC-10) | 35,619 | 1,6677 | 483 | 55,25 | 40,095 |
| TU33 | NU8 | 133 | 250-(PVC-10) | 358,62 | 1,6677 | 4862,9 | 54,183 | 39,347 |
| TU34 | 136 | 186 | 110-(PVC-10) | 151,49 | 1,8502 | 515,05 | 61,549 | 40,611 |
| TU35 | 137 | 136 | 160-(PVC-10) | 57,57 | 1,7533 | 347,72 | 58,012 | 41,469 |
| TU36 | 178 | 179 | 110-(PVC-10) | 39,566 | 1,8502 | 134,52 | 58,606 | 41,491 |
| TU37 | 137 | 178 | 200-(PVC-10) | 48,548 | 1,3585 | 445,67 | 58,791 | 42,823 |
| TU38 | NU8 | 137 | 250-(PVC-10) | 436,93 | 1,6767 | 5924,8 | 59,921 | 44,344 |
| TU39 | NU9 | NU8 | 315-(PVC-10) | 665,32 | 1,5827 | 14052 | 62 | 50,38 |
| TU4 | 66 | 65 | 110-(PVC-10) | 38,588 | 1,8502 | 131,2 | 55,23 | 37,309 |
| TU40 | NU9 | 132 | 140-(PVC-10) | 35,455 | 1,9763 | 163,45 | 59,45 | 51,076 |
| TU41 | 131 | NU9 | 315-(PVC-10) | 282,22 | 1,7452 | 5960,4 | 62 | 54,495 |
| TU42 | NU6 | 131 | 315-(PVC-10) | 66,011 | 1,8739 | 1394,1 | 57,689 | 52,275 |
| TU43 | 0 | NU6 | 600-(PRFV-10) | 1922,7 | 1,5297 | 205342 | 62 | 57,144 |
| TU5 | 61 | 66 | 315-(PVC-10) | 499,21 | 1,5257 | 10543 | 58,081 | 41,279 |
| TU6 | 67 | 61 | 315-(PVC-10) | 35,488 | 1,6393 | 749,51 | 63,409 | 49,493 |
| TU7 | NU1 | 67 | 400-(PVC-10) | 542,15 | 1,0704 | 20320 | 62,54 | 48,859 |
| TU8 | 33 | 35 | 110-(PVC-10) | 33,193 | 1,8502 | 112,86 | 63,171 | 43,83 |
| TU9 | NU2 | 33 | 200-(PVC-10) | 350,07 | 1,1209 | 3213,7 | 59,429 | 41,051 |

** Información El Nodo 64 es el más desfavorable.

P Min de la Red (Dinámica) = 36,291 m (Nodo: 71)
P Max de la Red (Estática) = 67,752 m (Nodo: 24)
Caudal de Inyección en Cabecera = 0,41539 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 315-(PVC-10) | 21,12 | 2.637 | 55.683,37 |
| | | 250-(PVC-10) | 13,56 | 1.374 | 18.630,63 |
| | | 110-(PVC-10) | 3,40 | 1.116 | 3.794,83 |
| | | 400-(PVC-10) | 37,48 | 836 | 31.338,74 |

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| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | | 200-(PVC-10) | 9,18 | 707 | 6.486,41 |
| | | 500-(PVC-10) | 72,42 | 1.903 | 137.783,60 |
| | | 160-(PVC-10) | 6,04 | 176 | 1.061,75 |
| | | 125-(PVC-10) | 3,73 | 283 | 1.056,89 |
| | | 140-(PVC-10) | 4,61 | 35 | 163,45 |
| | | 600-(PRFV-10) | 106,80 | 1.923 | 205.341,80 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **461.341,51 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **32.733,31 €** |
| **COSTE TOTAL ANUAL** | **32.733,31 €** |

## 3.4 RED BOMBEO 1. ALTERNATIVAS 2.1., 2.2. Y 2.3.

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Entidad: CINGRAL Proyecto: LICENCIA_1

### DATOS DE ENTRADA EN LA OPTIMIZACIÓN

Método Optimización Mejorado
Fórmulación de Pérdidas: Darcy-Weisbach
Gravedad: 9.81 m/s2
Viscosidad: 0,001 kg/m s
Densidad: 1000 kg/m3
Margen de Seguridad en los Timbrajes: 5 m
Velocidad Máxima: 2 m/s
Velocidad mínima: 0,5 m/s
Pendiente Hidráulica Mínima: 1,5 ‰
Pendien Hid. Min (Bifurcaciones):1,5 ‰

DATOS ECONÓMICOS
Periodo de amortización: 25 años
Tasa de interés: 5 %

ALIMENTACIÓN
Impulsión: NO
Cota Entrada: 425 m

NODOS

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| 253 | 346,83 | 35 |
| 255 | 346,92 | 35,08 |
| 267 | 347,05 | 35,95 |
| 256 | 345,18 | 35,82 |
| 257 | 344,21 | 35 |
| 266 | 344,68 | 37,32 |
| 251 | 342,86 | 35,14 |
| 250 | 342,23 | 35 |
| 259 | 342,62 | 35,38 |
| 263 | 343,3 | 35,7 |
| 262 | 343,71 | 35 |
| 264 | 343,49 | 35 |
| 261 | 343,67 | 35,33 |
| 258 | 343,99 | 35,01 |
| 265 | 343,89 | 35,11 |
| 270 | 347,14 | 37 |
| 271 | 345,18 | 35,82 |
| 272 | 345,02 | 35 |
| 273 | 343,37 | 35,63 |
| NU2 | 340 | 0 |
| 282 | 339,02 | 37,98 |
| 275 | 341,92 | 35,08 |
| 274 | 342,29 | 42,71 |
| 277 | 343,16 | 42 |
| 283 | 341,74 | 35 |
| 281 | 343,62 | 41,38 |
| 280 | 344,95 | 40,05 |
| 361 | 354,56 | 30 |
| 290 | 353,53 | 30 |
| NU4 | 340 | 0 |
| 354 | 344,63 | 40,37 |
| 355 | 342,72 | 42,28 |
| 368 | 343,12 | 36,88 |
| 376 | 348,26 | 36,74 |
| 377 | 345,19 | 37,81 |
| 378 | 345,23 | 39,77 |
| 394 | 344,11 | 38,89 |
| 391 | 334,98 | 35,02 |
| 387 | 334,22 | 45,78 |
| 389 | 334,78 | 35,22 |
| NU5 | 340 | 0 |
| 386 | 344,44 | 35 |
| 285 | 348,51 | 36,49 |
| 286 | 350,68 | 35 |
| 284 | 350,18 | 35 |

Continúa nodos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| NU6 | 340 | 0 |
| 287 | 339,97 | 45,03 |
| 385 | 339,95 | 42,05 |
| 393 | 338,61 | 37,39 |
| 383 | 338 | 38 |
| 382 | 340,96 | 39,04 |
| 379 | 343,5 | 35,5 |
| 212 | 349,56 | 35 |
| 211 | 351,84 | 34 |
| 220 | 333,06 | 35,94 |
| 217 | 340,52 | 35,48 |
| 218 | 340,56 | 35 |
| 223 | 340,93 | 38,07 |
| 215 | 342,57 | 36,43 |
| 225 | 344,94 | 41,06 |
| 408 | 345,21 | 35 |
| 409 | 345,24 | 35 |
| 410 | 344,85 | 35 |
| 413 | 335,59 | 35,41 |
| 412 | 339,26 | 35 |
| NU9 | 340 | 0 |
| 405 | 334,73 | 44,27 |
| 411 | 322,84 | 42,16 |
| 407 | 324,96 | 39,04 |
| 406 | 326,84 | 37,16 |
| 404 | 328,42 | 41,58 |
| NU10 | 340 | 0 |
| 403 | 330,97 | 46,03 |
| 402 | 329,69 | 36,31 |
| 401 | 331,15 | 48,85 |
| 224 | 342,8 | 41,2 |
| B230 | 355,89 | 36,112 |
| B353 | 351,92 | 42,077 |
| B352 | 350,91 | 39,089 |
| B370 | 351,27 | 35,732 |
| B375 | 350,87 | 36,131 |
| B55 | 353,05 | 37,949 |
| BNU1 | 360 | 0 |
| B60 | 353,9 | 36,103 |
| B59 | 355,37 | 38,63 |
| B58 | 355,39 | 43,606 |
| B56 | 360,65 | 38,35 |
| B1 | 355,98 | 43,015 |
| B2 | 355,29 | 35,715 |
| B4 | 355,63 | 38,368 |
| B6 | 354,9 | 46,101 |
| B40 | 355,52 | 39,485 |
| B39 | 356,28 | 51,725 |
| B7 | 354,27 | 35 |
| BNU2 | 360 | 0 |
| B16 | 354,86 | 40,141 |
| B268 | 350,4 | 36,604 |
| B327 | 350,45 | 40,554 |
| B288 | 345,33 | 41,673 |
| B305 | 355,21 | 35 |
| B312 | 351,56 | 39,442 |
| B330 | 355,46 | 39,543 |
| BNU3 | 360 | 0 |
| B332 | 361,49 | 35,511 |
| B347 | 361,12 | 35,883 |
| B349 | 360,3 | 42,701 |
| B350 | 360,9 | 35 |
| B44 | 384,74 | 30 |
| BNU4 | 360 | 0 |
| B46 | 363,05 | 46,952 |
| B54 | 362,15 | 35 |
| B47 | 363,02 | 39,98 |

Continúa nodos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| B48 | 371,92 | 41,076 |
| B52 | 365,38 | 49,618 |
| B12 | 364,4 | 39,597 |
| B9 | 360,65 | 36,348 |
| BNU6 | 360 | 0 |
| B19 | 361,11 | 51,889 |
| B18 | 361,53 | 39,466 |
| B13 | 363,33 | 40,671 |
| B17 | 362,24 | 39,761 |
| B14 | 361,7 | 48,297 |
| B25 | 363,61 | 43,388 |
| B27 | 376,08 | 38,917 |
| B29 | 369,31 | 38,688 |
| B36 | 369,17 | 37,825 |
| B37 | 374,34 | 40,658 |
| B50 | 376,77 | 38,23 |
| BNU5 | 360 | 0 |
| B106 | 362,15 | 43,85 |
| B109 | 366,79 | 35 |
| B108 | 367,49 | 35,508 |
| B151 | 367,42 | 40,581 |
| B227 | 352,95 | 36,051 |
| B213 | 352,94 | 35,058 |
| B229 | 356,86 | 35 |
| BNU8 | 360 | 0 |
| B231 | 357,05 | 36,95 |
| B210 | 354,6 | 35 |
| B209 | 356,18 | 35 |
| B233 | 357,15 | 36,851 |
| B201 | 355,06 | 35 |
| B207 | 350,02 | 40,98 |
| B206 | 358,98 | 36,016 |
| B202 | 359,26 | 35 |
| B203 | 359,27 | 36,733 |
| B160 | 356,4 | 38,596 |
| B169 | 356,81 | 35,192 |
| B170 | 356,25 | 36,753 |
| B162 | 356,35 | 38,646 |
| B171 | 356,25 | 38,747 |
| B158 | 362,79 | 35 |
| B157 | 364,45 | 35,548 |
| B164 | 359,02 | 46,98 |
| B166 | 358,2 | 48,801 |
| BNU9 | 360 | 0 |
| B234 | 363,08 | 35,921 |
| B174 | 359,42 | 46,579 |
| B172 | 359,42 | 35 |
| B168 | 359,03 | 36,974 |
| B155 | 365,31 | 35,693 |
| B154 | 366,16 | 38,837 |
| B156 | 366,4 | 35 |
| BNU10 | 360 | 0 |
| BNU7 | 360 | 0 |
| B180 | 374,03 | 40,966 |
| B175 | 373,3 | 35,701 |
| B153 | 373,88 | 36,121 |
| B152 | 373,88 | 35,123 |
| B177 | 374,63 | 40,372 |
| B105 | 377,66 | 35 |
| B103 | 371,47 | 40,533 |
| B101 | 378,82 | 36,179 |
| B107 | 373,32 | 35 |
| B102 | 373,4 | 37,599 |
| B150 | 373,7 | 35,295 |
| B118 | 377,88 | 36,125 |
| B111 | 375,97 | 35,026 |
| B146 | 377,56 | 37,437 |

Continúa nodos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

NODOS CONTINUACIÓN

| ID | COTA m | PRESIÓN MIN m |
|---|---|---|
| BNU11 | 360 | 0 |
| B149 | 376,2 | 35 |
| B176 | 376,48 | 35,52 |
| B139 | 377,34 | 37,66 |
| BN207 | 350,02 | 0 |
| B200 | 350,62 | 37,38 |
| NU12 | 359 | 0 |
| B235 | 362,82 | 36,179 |
| 400 | 362,91 | 20 |
| NU8 | 340 | 0 |
| NU11 | 359 | 0 |
| B214 | 352,96 | 35 |
| NU7 | 340 | 0 |
| 374 | 348,32 | 36,68 |
| 384 | 339,52 | 35,48 |
| 369 | 344,46 | 40,54 |
| 254 | 347,21 | 35,79 |
| 252 | 343,91 | 36,09 |
| 278 | 345,55 | 35,45 |
| 269 | 351,28 | 33 |
| B310 | 347,1 | 40,897 |
| 307 | 346 | 37,99 |
| B289 | 344,98 | 43,023 |

TUBERÍAS

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | B352 | B353 | 155,23 | 3,1046 | -- | 0,1877 | -- | -- | 5 |
| | B58 | B59 | 38,291 | 0,76581 | -- | 0,30236 | -- | -- | 5 |
| | B176 | B177 | 514,07 | 10,281 | -- | 2,3647 | -- | -- | 5 |
| | B103 | B105 | 264,9 | 5,2981 | -- | 0,015 | -- | -- | 5 |
| | B102 | B103 | 160,18 | 3,2037 | -- | 0,03 | -- | -- | 5 |
| | B102 | B101 | 246,33 | 4,9265 | -- | 0,015 | -- | -- | 5 |
| | B102 | B107 | 32,365 | 0,6473 | -- | 0,0289 | -- | -- | 5 |
| | B111 | B102 | 318,54 | 6,3707 | -- | 0,0665 | -- | -- | 5 |
| | B111 | B150 | 155,99 | 3,1198 | -- | 0,015 | -- | -- | 5 |
| | B111 | B118 | 68,565 | 1,3713 | -- | 0,015 | -- | -- | 5 |
| | BNU11 | B111 | 151,33 | 3,0267 | -- | 0,08576 | -- | -- | 5 |
| | BNU11 | B146 | 35,304 | 0,70608 | -- | 0,015 | -- | -- | 5 |
| | B2 | B1 | 271,48 | 5,4296 | -- | 0,0156 | -- | -- | 5 |
| | B149 | BNU11 | 150,96 | 3,0192 | -- | 0,09281 | -- | -- | 5 |
| | B176 | B149 | 200,52 | 4,0103 | -- | 0,10067 | -- | -- | 5 |
| | B139 | B176 | 36,983 | 0,73965 | -- | 2,4295 | -- | -- | 5 |
| | 0 | B139 | 1821,9 | 36,438 | -- | 2,4345 | -- | -- | 5 |
| | B52 | B56 | 268,85 | 5,377 | -- | 0,31449 | -- | -- | 5 |
| | B6 | B4 | 109,43 | 2,1887 | -- | 0,04581 | -- | -- | 5 |
| | B4 | B2 | 200,94 | 4,0188 | -- | 0,0306 | -- | -- | 5 |
| | B39 | B40 | 46,807 | 0,93614 | -- | 0,015 | -- | -- | 5 |
| | BNU2 | B6 | 593,76 | 11,875 | -- | 0,06081 | -- | -- | 5 |
| | BNU2 | B7 | 76,59 | 1,5318 | -- | 0,015 | -- | -- | 5 |
| | BNU2 | B39 | 406,97 | 8,1394 | -- | 0,05381 | -- | -- | 5 |
| | B327 | B16 | 371,01 | 7,4202 | -- | 0,11837 | -- | -- | 5 |
| | B209 | B230 | 41,507 | 0,83013 | -- | 0,015 | -- | -- | 5 |
| | B16 | BNU2 | 163,39 | 3,2678 | -- | 0,10927 | -- | -- | 5 |
| | B312 | B327 | 377,16 | 7,5431 | -- | 0,13486 | -- | -- | 5 |
| | B327 | B268 | 54,86 | 1,0972 | -- | 0,015 | -- | -- | 5 |
| | B289 | B288 | 225,61 | 4,5121 | -- | 0,01653 | -- | -- | 5 |
| | B310 | B305 | 148,97 | 2,9793 | -- | 0,015 | -- | -- | 5 |
| | BNU3 | B330 | 37,526 | 0,75052 | -- | 0,015 | -- | -- | 5 |
| | BNU3 | B312 | 174,41 | 3,4882 | -- | 0,3969 | -- | -- | 5 |
| | B349 | B332 | 119,66 | 2,3932 | -- | 0,41316 | -- | -- | 5 |
| | BNU1 | B370 | 156,55 | 3,1311 | -- | 0,26703 | -- | -- | 5 |
| | B332 | BNU3 | 344,44 | 6,8888 | -- | 0,40509 | -- | -- | 5 |
| | B350 | B349 | 448,95 | 8,979 | -- | 0,4298 | -- | -- | 5 |
| | B349 | B347 | 29,492 | 0,58984 | -- | 0,015 | -- | -- | 5 |
| | BNU4 | B350 | 271,72 | 5,4344 | -- | 0,43381 | -- | -- | 5 |
| | BNU4 | B44 | 156,77 | 3,1354 | -- | 0,015 | -- | -- | 5 |
| | B46 | BNU4 | 133,72 | 2,6744 | -- | 0,43554 | -- | -- | 5 |

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TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | B47 | B46 | 34,903 | 0,69806 | -- | 0,44284 | -- | -- | 5 |
| | B47 | B54 | 38,328 | 0,76657 | -- | 0,02301 | -- | -- | 5 |
| | B48 | B47 | 292,02 | 5,8404 | -- | 0,46316 | -- | -- | 5 |
| | B52 | B48 | 651,55 | 13,031 | -- | 0,47351 | -- | -- | 5 |
| | B370 | B352 | 193,49 | 3,8698 | -- | 0,197 | -- | -- | 5 |
| | BNU5 | B52 | 324,89 | 6,4977 | -- | 0,76537 | -- | -- | 5 |
| | BNU6 | B12 | 347,65 | 6,953 | -- | 0,015 | -- | -- | 5 |
| | BNU6 | B9 | 48,347 | 0,96694 | -- | 0,015 | -- | -- | 5 |
| | B19 | BNU6 | 128,92 | 2,5784 | -- | 0,03 | -- | -- | 5 |
| | B18 | B19 | 142,4 | 2,8481 | -- | 0,045 | -- | -- | 5 |
| | B17 | B18 | 502,18 | 10,044 | -- | 0,06 | -- | -- | 5 |
| | B17 | B13 | 49,879 | 0,99759 | -- | 0,03121 | -- | -- | 5 |
| | B14 | B17 | 280,1 | 5,602 | -- | 0,08598 | -- | -- | 5 |
| | B25 | B14 | 276,13 | 5,5226 | -- | 0,14071 | -- | -- | 5 |
| | B27 | B25 | 431,87 | 8,6374 | -- | 0,16875 | -- | -- | 5 |
| | BNU1 | B55 | 63,272 | 1,2654 | -- | 0,015 | -- | -- | 5 |
| | B29 | B27 | 114,22 | 2,2845 | -- | 0,18198 | -- | -- | 5 |
| | B36 | B29 | 53,151 | 1,063 | -- | 0,19973 | -- | -- | 5 |
| | B37 | B36 | 507,56 | 10,151 | -- | 0,19973 | -- | -- | 5 |
| | B50 | B37 | 51,736 | 1,0347 | -- | 0,22973 | -- | -- | 5 |
| | BNU5 | B50 | 539,14 | 10,783 | -- | 0,27234 | -- | -- | 5 |
| | B106 | BNU5 | 200,98 | 4,0196 | -- | 0,98037 | -- | -- | 5 |
| | B108 | B106 | 439,9 | 8,798 | -- | 0,99908 | -- | -- | 5 |
| | B108 | B109 | 68,943 | 1,3788 | -- | 0,015 | -- | -- | 5 |
| | B151 | B108 | 40,58 | 0,81159 | -- | 1,0145 | -- | -- | 5 |
| | BNU7 | B151 | 382,63 | 7,6526 | -- | 1,0249 | -- | -- | 5 |
| | BNU1 | B375 | 57,603 | 1,1521 | -- | 0,015 | -- | -- | 5 |
| | B214 | B227 | 30,287 | 0,60574 | -- | 0,26685 | -- | -- | 5 |
| | B214 | B213 | 17,745 | 0,3549 | -- | 0,02573 | -- | -- | 5 |
| | BNU8 | B229 | 281,65 | 5,6329 | -- | 0,01503 | -- | -- | 5 |
| | B231 | BNU8 | 269,99 | 5,3998 | -- | 0,30903 | -- | -- | 5 |
| | B233 | B231 | 36,96 | 0,7392 | -- | 0,31805 | -- | -- | 5 |
| | B210 | BN207 | 103,45 | 2,069 | -- | 0,01577 | -- | -- | 5 |
| | BN207 | B200 | 64,793 | 1,2959 | -- | 0,01577 | -- | -- | 5 |
| | B209 | B210 | 281,67 | 5,6334 | -- | 0,03077 | -- | -- | 5 |
| | B233 | B209 | 147,14 | 2,9429 | -- | 0,06077 | -- | -- | 5 |
| | B59 | B60 | 163,64 | 3,2728 | -- | 0,29598 | -- | -- | 5 |
| | B206 | B233 | 493,56 | 9,8712 | -- | 0,35615 | -- | -- | 5 |
| | B207 | B201 | 161,81 | 3,2362 | -- | 0,015 | -- | -- | 5 |
| | B206 | B207 | 316,91 | 6,3382 | -- | 0,03 | -- | -- | 5 |
| | B202 | B206 | 44,53 | 0,8906 | -- | 0,37483 | -- | -- | 5 |
| | B203 | B202 | 19,368 | 0,38736 | -- | 0,38147 | -- | -- | 5 |
| | B172 | B203 | 534,52 | 10,69 | -- | 0,38566 | -- | -- | 5 |
| | B169 | B160 | 32,788 | 0,65576 | -- | 0,02351 | -- | -- | 5 |
| | B170 | B169 | 268,64 | 5,3729 | -- | 0,03851 | -- | -- | 5 |
| | B171 | B170 | 30,765 | 0,61531 | -- | 0,05351 | -- | -- | 5 |
| | B171 | B162 | 32,76 | 0,6552 | -- | 0,02044 | -- | -- | 5 |
| | B60 | BNU1 | 754,18 | 15,084 | -- | 0,28183 | -- | -- | 5 |
| | BNU9 | B171 | 72,202 | 1,444 | -- | 0,07579 | -- | -- | 5 |
| | B164 | B158 | 149,16 | 2,9832 | -- | 0,015 | -- | -- | 5 |
| | B164 | B157 | 273,54 | 5,4709 | -- | 0,015 | -- | -- | 5 |
| | B166 | B164 | 179,52 | 3,5904 | -- | 0,045 | -- | -- | 5 |
| | BNU9 | B166 | 341,81 | 6,8362 | -- | 0,06 | -- | -- | 5 |
| | B172 | BNU9 | 313,41 | 6,2682 | -- | 0,10576 | -- | -- | 5 |
| | B235 | B234 | 16,311 | 0,32621 | -- | 0,015 | -- | -- | 5 |
| | B172 | B174 | 31,771 | 0,63543 | -- | 0,79074 | -- | -- | 5 |
| | B168 | B172 | 36,038 | 0,72076 | -- | 1,3293 | -- | -- | 5 |
| | B56 | B58 | 387,08 | 7,7415 | -- | 0,30814 | -- | -- | 5 |
| | B155 | B168 | 311,74 | 6,2349 | -- | 1,3331 | -- | -- | 5 |
| | B154 | B155 | 32,807 | 0,65613 | -- | 1,3369 | -- | -- | 5 |
| | BNU10 | B154 | 62,079 | 1,2416 | -- | 1,3437 | -- | -- | 5 |
| | BNU10 | B156 | 73,925 | 1,4785 | -- | 0,01524 | -- | -- | 5 |
| | BNU7 | BNU10 | 744,57 | 14,891 | -- | 1,3524 | -- | -- | 5 |
| | B152 | BNU7 | 158,5 | 3,1699 | -- | 2,2682 | -- | -- | 5 |
| | B175 | B180 | 48,58 | 0,9716 | -- | 0,07884 | -- | -- | 5 |
| | B153 | B175 | 35,524 | 0,71049 | -- | 0,1043 | -- | -- | 5 |
| | B152 | B153 | 403,31 | 8,0661 | -- | 0,1193 | -- | -- | 5 |

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TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | B177 | B152 | 63,722 | 1,2744 | -- | 2,3508 | -- | -- | 5 |
| | B174 | NU12 | 433 | 8,66 | -- | 0,718 | -- | -- | 5 |
| | B353 | 369 | 350 | 7 | -- | 0,17837 | -- | -- | 5 |
| | 251 | 259 | 36,215 | 0,72431 | -- | 0,01861 | -- | -- | 5 |
| | 262 | 263 | 91,778 | 1,8356 | -- | 0,015 | -- | -- | 5 |
| | 261 | 262 | 24,545 | 0,49091 | -- | 0,03 | -- | -- | 5 |
| | 261 | 264 | 30,144 | 0,60287 | -- | 0,015 | -- | -- | 5 |
| | 258 | 261 | 160,94 | 3,2189 | -- | 0,06 | -- | -- | 5 |
| | 265 | 258 | 35,306 | 0,70612 | -- | 0,07016 | -- | -- | 5 |
| | NU2 | 265 | 239,29 | 4,7857 | -- | 0,08032 | -- | -- | 5 |
| | 269 | 270 | 359,69 | 7,1938 | -- | 0,20332 | -- | -- | 5 |
| | 269 | 254 | 638 | 12,76 | -- | 0,11069 | -- | -- | 5 |
| | 270 | 271 | 408,1 | 8,162 | -- | 0,1957 | -- | -- | 5 |
| | 271 | 272 | 378,11 | 7,5622 | -- | 0,18504 | -- | -- | 5 |
| | 272 | 273 | 253,56 | 5,0712 | -- | 0,11565 | -- | -- | 5 |
| | 273 | NU2 | 67,434 | 1,3487 | -- | 0,11565 | -- | -- | 5 |
| | 275 | 282 | 391,14 | 7,8228 | -- | 0,015 | -- | -- | 5 |
| | 274 | 275 | 31,876 | 0,63752 | -- | 0,03 | -- | -- | 5 |
| | NU2 | 274 | 195,53 | 3,9105 | -- | 0,045 | -- | -- | 5 |
| | NU2 | 277 | 23,69 | 0,4738 | -- | 0,02 | -- | -- | 5 |
| | 281 | 283 | 392,02 | 7,8405 | -- | 0,015 | -- | -- | 5 |
| | 253 | 252 | 670 | 13,4 | -- | 0,06916 | -- | -- | 5 |
| | 280 | 281 | 327,95 | 6,559 | -- | 0,03 | -- | -- | 5 |
| | 278 | 280 | 183,59 | 3,6718 | -- | 0,04543 | -- | -- | 5 |
| | NU4 | 361 | 405,37 | 8,1074 | -- | 0,015 | -- | -- | 5 |
| | NU4 | 290 | 29,942 | 0,59884 | -- | 0,015 | -- | -- | 5 |
| | 355 | NU4 | 239,83 | 4,7966 | -- | 0,03 | -- | -- | 5 |
| | 369 | 354 | 35,111 | 0,70222 | -- | 0,17093 | -- | -- | 5 |
| | 354 | 355 | 531,99 | 10,64 | -- | 0,1625 | -- | -- | 5 |
| | 272 | 278 | 280 | 5,6 | -- | 0,06043 | -- | -- | 5 |
| | 355 | 368 | 37,582 | 0,75164 | -- | 0,13935 | -- | -- | 5 |
| | 374 | 376 | 18,983 | 0,37966 | -- | 0,09407 | -- | -- | 5 |
| | 376 | 377 | 302,85 | 6,057 | -- | 0,08463 | -- | -- | 5 |
| | 377 | 378 | 38,524 | 0,77047 | -- | 0,015 | -- | -- | 5 |
| | 377 | 394 | 199,49 | 3,9898 | -- | 0,06273 | -- | -- | 5 |
| | NU5 | 391 | 310,6 | 6,212 | -- | 0,015 | -- | -- | 5 |
| | 389 | 387 | 33,41 | 0,6682 | -- | 0,015 | -- | -- | 5 |
| | NU5 | 389 | 281,69 | 5,6337 | -- | 0,03 | -- | -- | 5 |
| | 386 | NU5 | 152,76 | 3,0553 | -- | 0,045 | -- | -- | 5 |
| | B312 | 269 | 20 | 0,4 | -- | 0,29539 | -- | -- | 5 |
| | 285 | 386 | 36,948 | 0,73896 | -- | 0,06 | -- | -- | 5 |
| | NU6 | 285 | 167,1 | 3,3421 | -- | 0,06 | -- | -- | 5 |
| | 284 | 286 | 32,138 | 0,64277 | -- | 0,015 | -- | -- | 5 |
| | NU6 | 284 | 202,43 | 4,0486 | -- | 0,05327 | -- | -- | 5 |
| | 384 | NU6 | 450,04 | 9,0008 | -- | 0,09392 | -- | -- | 5 |
| | 385 | 287 | 22,651 | 0,45302 | -- | 0,015 | -- | -- | 5 |
| | 384 | 385 | 32,566 | 0,65132 | -- | 0,03509 | -- | -- | 5 |
| | 383 | 393 | 42,484 | 0,84967 | -- | 0,015 | -- | -- | 5 |
| | 382 | 383 | 355,37 | 7,1073 | -- | 0,03111 | -- | -- | 5 |
| | 272 | B310 | 20 | 0,4 | -- | 0,0602 | -- | -- | 5 |
| | 379 | 382 | 261,66 | 5,2332 | -- | 0,04773 | -- | -- | 5 |
| | 394 | 379 | 35,956 | 0,71913 | -- | 0,06273 | -- | -- | 5 |
| | 211 | 212 | 225,03 | 4,5005 | -- | 0,015 | -- | -- | 5 |
| | NU7 | 211 | 321,75 | 6,435 | -- | 0,03 | -- | -- | 5 |
| | 218 | 220 | 553,64 | 11,073 | -- | 0,015 | -- | -- | 5 |
| | 218 | 217 | 32,4 | 0,64799 | -- | 0,015 | -- | -- | 5 |
| | 223 | 218 | 189,18 | 3,7835 | -- | 0,045 | -- | -- | 5 |
| | 225 | 223 | 192,22 | 3,8444 | -- | 0,06 | -- | -- | 5 |
| | 225 | 215 | 28,157 | 0,56314 | -- | 0,015 | -- | -- | 5 |
| | B310 | 307 | 250 | 5 | -- | 0,04653 | -- | -- | 5 |
| | NU8 | 225 | 207,87 | 4,1575 | -- | 0,06126 | -- | -- | 5 |
| | 409 | 408 | 230,65 | 4,613 | -- | 0,015 | -- | -- | 5 |
| | 410 | 409 | 111,27 | 2,2254 | -- | 0,03 | -- | -- | 5 |
| | NU9 | 410 | 322,06 | 6,4412 | -- | 0,06347 | -- | -- | 5 |
| | 412 | 413 | 294,58 | 5,8915 | -- | 0,02114 | -- | -- | 5 |
| | NU9 | 412 | 320,64 | 6,4128 | -- | 0,03614 | -- | -- | 5 |
| | 405 | NU9 | 430,6 | 8,6121 | -- | 0,0893 | -- | -- | 5 |

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TUBERÍAS continuación

| ID | N.In | N.Fin | L(m) | L. Eq.(m) | Ru (mm) | Q. Dis.(m3/s) | D(mm) | DN | Marg.Tim (m) |
|---|---|---|---|---|---|---|---|---|---|
| | NU10 | 405 | 413,01 | 8,2603 | -- | 0,10167 | -- | -- | 5 |
| | 407 | 411 | 489,57 | 9,7914 | -- | 0,01527 | -- | -- | 5 |
| | 406 | 407 | 486,75 | 9,735 | -- | 0,05472 | -- | -- | 5 |
| | 307 | B289 | 300 | 6 | -- | 0,03153 | -- | -- | 5 |
| | NU10 | 406 | 378,48 | 7,5695 | -- | 0,06972 | -- | -- | 5 |
| | NU10 | 404 | 48,449 | 0,96899 | -- | 0,04137 | -- | -- | 5 |
| | 403 | NU10 | 342,97 | 6,8594 | -- | 0,18451 | -- | -- | 5 |
| | 401 | 403 | 30,305 | 0,6061 | -- | 0,2057 | -- | -- | 5 |
| | 401 | 402 | 59,603 | 1,1921 | -- | 0,01571 | -- | -- | 5 |
| | 224 | 401 | 1280 | 25,6 | -- | 0,22636 | -- | -- | 5 |
| | NU8 | 224 | 399,66 | 7,9932 | -- | 0,2289 | -- | -- | 5 |
| | NU12 | B235 | 136 | 2,72 | -- | 0,03 | -- | -- | 5 |
| | NU12 | 400 | 482 | 9,64 | -- | 0,688 | -- | -- | 5 |
| | B227 | NU8 | 662 | 13,24 | -- | 0,26615 | -- | -- | 5 |
| | BNU8 | NU11 | 284 | 5,68 | -- | 0,29996 | -- | -- | 5 |
| | NU11 | B214 | 156 | 3,12 | -- | 0,29272 | -- | -- | 5 |
| | NU11 | NU7 | 5 | 0,1 | -- | 0,03 | -- | -- | 5 |
| | B370 | 374 | 600 | 12 | -- | 0,09862 | -- | -- | 5 |
| | 368 | 384 | 493 | 9,86 | -- | 0,12778 | -- | -- | 5 |
| | 254 | 253 | 26,582 | 0,53164 | -- | 0,06916 | -- | -- | 5 |
| | 254 | 255 | 239,16 | 4,7832 | -- | 0,06615 | -- | -- | 5 |
| | 255 | 267 | 30,711 | 0,61423 | -- | 0,015 | -- | -- | 5 |
| | 255 | 256 | 320,91 | 6,4182 | -- | 0,04739 | -- | -- | 5 |
| | 256 | 257 | 188,84 | 3,7768 | -- | 0,03 | -- | -- | 5 |
| | 257 | 266 | 34,634 | 0,69268 | -- | 0,015 | -- | -- | 5 |
| | 252 | 251 | 309,35 | 6,187 | -- | 0,05416 | -- | -- | 5 |
| | 251 | 250 | 246,47 | 4,9294 | -- | 0,015 | -- | -- | 5 |

MATERIALES

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | 100 | 40-(PVC-10) | 36,2 | 0,66 |
| | | | | 50-(PVC-10) | 45,2 | 0,92 |
| | | | | 63-(PVC-10) | 57 | 1,45 |
| | | | | 75-(PVC-10) | 67,8 | 2,06 |
| | | | | 90-(PVC-10) | 81,4 | 2,95 |
| | | | | 110-(PVC-10) | 101,6 | 3,4 |
| | | | | 125-(PVC-10) | 115,4 | 3,73 |
| | | | | 140-(PVC-10) | 129,2 | 4,61 |
| | | | | 160-(PVC-10) | 147,6 | 6,04 |
| | | | | 200-(PVC-10) | 184,6 | 9,18 |
| | | | | 250-(PVC-10) | 230,8 | 13,56 |
| | | | | 315-(PVC-10) | 290,8 | 21,12 |
| | | | | 400-(PVC-10) | 369,47 | 37,48 |
| | | | | 500-(PVC-10) | 461,8 | 72,42 |
| | | | | 500-(PRFV-10) | 505 | 82,46 |
| | | | | 600-(PRFV-10) | 588 | 106,8 |
| | | | | 700-(PRFV-10) | 686 | 133,92 |
| | | | | 800-(PRFV-10) | 783 | 170,16 |
| | | | | 900-(PRFV-10) | 883 | 204,63 |
| | | | | 1000-(PRFV-10) | 981 | 235,94 |
| | | | | 1200-(PRFV-10) | 1176 | 326,64 |
| | | | | 1400-(PRFV-10) | 1372 | 416,25 |
| | | | | 1600-(PRFV-10) | 1568 | 540,51 |
| | | | | 1800-(PRFV-10) | 1763 | 100000 |
| | | | | 2000-(PRFV-10) | 1960 | 120000 |
| | | | | 2200-(PRFV-10) | 2160 | 2200 |
| | | | | 2400-(PRFV-10) | 2360 | 2400 |
| | | | 160 | 40-(PVC-16) | 34 | 89 |
| | | | | 50-(PVC-16) | 42,6 | 1,26 |
| | | | | 63-(PVC-16) | 53,6 | 2,04 |
| | | | | 75-(PVC-16) | 63,8 | 2,89 |
| | | | | 90-(PVC-16) | 76,6 | 4,13 |
| | | | | 110-(PVC-16) | 96,8 | 4,85 |
| | | | | 125-PVC-16) | 110,2 | 5,84 |
| | | | | 140-(PVC-16) | 123,4 | 7,32 |
| | | | | 160-(PVC-16) | 141 | 9,56 |

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Entidad: CINGRAL Proyecto: LICENCIA_1

MATERIALES continuación

| MATERIAL | FAB. | RU. mm | TIMB. m | REF. DIAM. | D. INT. mm | PRECIO €€ |
|---|---|---|---|---|---|---|
| PVC | TRAGSA | 0,01 | | | | |
| | | | 160 | | | |
| | | | | 200-(PVC-16) | 176,2 | 14,9 |
| | | | | 250-(PVC-16) | 220,4 | 23,15 |
| | | | | 315-(PVC-16) | 277,6 | 38,48 |
| | | | | 400-(PVC-16) | 352,6 | 61,86 |
| | | | | 500(PVC-16) | 440,6 | 65,89 |
| | | | | 500-(PRFV-16) | 503 | 89,33 |
| | | | | 600-(PRFV-16) | 585 | 113,43 |
| | | | | 700-(PRFV-16) | 682 | 149,76 |
| | | | | 800-(PRFV-16) | 779 | 192,02 |
| | | | | 900-(PRFV-16) | 879 | 223,6 |
| | | | | 1000-(PRFV-16) | 977 | 255,32 |
| | | | | 1200-(PRFV-16) | 1171 | 68489 |
| | | | | 1400-(PRFV-16) | 1367 | 92512 |
| | | | | 1600-(PRFV-16) | 1562 | 120000 |
| | | | | 2000-(PRFV-16) | 1757 | 130000 |
| | | | 200 | 40-(PVC-20) | 32,6 | 2,47 |
| | | | | 50-(PVC-20) | 40,8 | 2,47 |
| | | | | 63-(PVC-20) | 51,4 | 2,47 |
| | | | | 75-(PVC-20) | 61,4 | 3,44 |
| | | | | 90-(PVC-20) | 73,6 | 4,99 |
| | | | | 110-(PVC-20) | 83,8 | 6,15 |
| | | | | 125-(PVC-20) | 106,6 | 7,92 |
| | | | | 140-(PVC-20) | 119,4 | 9,91 |
| | | | | 160-(PVC-20) | 136,4 | 12,93 |
| | | | | 200-(PVC-20) | 170,6 | 20,12 |
| | | | | 250-(PVC-20) | 213,2 | 31,46 |
| | | | | 315-(PVC-20) | 268,6 | 49,93 |
| | | | | 400-(PVC-20) | 341,2 | 63,02 |
| | | | | 500-(PRFV-20) | 497 | 97,55 |
| | | | | 600-(PRFV-20) | 580 | 132,83 |
| | | | | 700-(PRFV-20) | 676 | 165,37 |
| | | | | 800-(PRFV-20) | 773 | 208,94 |

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Entidad: CINGRAL Proyecto: LICENCIA_1

**LISTADO DE RESULTADOS TRAS LA OPTIMIZACIÓN**

Alimentación por Gravedad

Cota límite libre = 425

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| BTU1 | B352 | B353 | 400-(PVC-10) | 155,23 | 1,7507 | 5818 | 73,077 | 58,128 |
| BTU10 | B58 | B59 | 500-(PVC-10) | 38,291 | 1,8052 | 2773 | 69,63 | 61,045 |
| BTU100 | B176 | B177 | 1400-(PRFV-10) | 514,07 | 1,5995 | 213983 | 50,372 | 47,854 |
| BTU101 | B103 | B105 | 140-(PVC-10) | 264,9 | 1,1441 | 1221,2 | 47,341 | 35,125 |
| BTU102 | B102 | B103 | 160-(PVC-10) | 160,18 | 1,7533 | 967,51 | 53,533 | 43,704 |
| BTU103 | B102 | B101 | 160-(PVC-10) | 246,33 | 0,87665 | 1487,8 | 46,179 | 37,873 |
| BTU104 | B102 | B107 | 160-(PVC-10) | 32,365 | 1,689 | 195,48 | 51,684 | 44,036 |
| BTU105 | B111 | B102 | 250-(PVC-10) | 318,54 | 1,5895 | 4319,4 | 51,599 | 44,458 |
| BTU106 | B111 | B150 | 110-(PVC-10) | 155,99 | 1,8502 | 530,36 | 51,295 | 42,243 |
| BTU107 | B111 | B118 | 110-(PVC-10) | 68,565 | 1,8502 | 233,12 | 47,125 | 40,609 |
| BTU108 | BNU11 | B111 | 315-(PVC-10) | 151,33 | 1,2912 | 3196,1 | 49,026 | 44,499 |
| BTU109 | BNU11 | B146 | 110-(PVC-10) | 35,304 | 1,8502 | 120,03 | 47,437 | 42,53 |
| BTU11 | B2 | B1 | 160-(PVC-10) | 271,48 | 0,91172 | 1639,7 | 69,016 | 43,621 |
| BTU110 | B149 | BNU11 | 315-(PVC-10) | 150,96 | 1,3974 | 3188,2 | 65 | 61,117 |
| BTU111 | B176 | B149 | 315-(PVC-10) | 200,52 | 1,5157 | 4234,9 | 48,795 | 45,654 |
| BTU112 | B139 | B176 | 1400-(PRFV-10) | 36,983 | 1,6433 | 15394 | 48,52 | 46,525 |
| BTU113 | 0 | B139 | 1400-(PRFV-10) | 1821,9 | 1,6467 | 758356 | 47,66 | 45,704 |
| BTU12 | B52 | B56 | 500-(PVC-10) | 268,85 | 1,8776 | 19470 | 64,35 | 57,769 |
| BTU13 | B6 | B4 | 200-(PVC-10) | 109,43 | 1,7116 | 1004,6 | 69,368 | 48,848 |
| BTU14 | B4 | B2 | 160-(PVC-10) | 200,94 | 1,7884 | 1213,7 | 69,715 | 45,699 |
| BTU15 | B39 | B40 | 110-(PVC-10) | 46,807 | 1,8502 | 159,14 | 69,485 | 52,348 |
| BTU16 | BNU2 | B6 | 250-(PVC-10) | 593,76 | 1,4535 | 8051,4 | 70,101 | 50,925 |
| BTU17 | BNU2 | B7 | 110-(PVC-10) | 76,59 | 1,8502 | 260,4 | 70,733 | 53,47 |
| BTU18 | BNU2 | B39 | 315-(PVC-10) | 406,97 | 0,81019 | 8595,2 | 68,725 | 52,946 |
| BTU19 | B327 | B16 | 400-(PVC-10) | 371,01 | 1,1041 | 13906 | 70,141 | 55,438 |
| BTU2 | B209 | B230 | 110-(PVC-10) | 41,507 | 1,8502 | 141,12 | 69,112 | 57,246 |
| BTU20 | B16 | BNU2 | 400-(PVC-10) | 163,39 | 1,0192 | 6123,8 | 65 | 49,959 |
| BTU21 | B312 | B327 | 400-(PVC-10) | 377,16 | 1,2579 | 14136 | 74,554 | 60,742 |
| BTU22 | B327 | B268 | 110-(PVC-10) | 54,86 | 1,8502 | 186,53 | 74,604 | 59,2 |
| BTU24 | B289 | B288 | 160-(PVC-10) | 225,61 | 0,96607 | 1362,7 | 79,673 | 53,619 |
| BTU26 | B310 | B305 | 110-(PVC-10) | 148,97 | 1,8502 | 506,48 | 69,794 | 45,707 |
| BTU27 | BNU3 | B330 | 110-(PVC-10) | 37,526 | 1,8502 | 127,59 | 69,543 | 56,644 |
| BTU28 | BNU3 | B312 | 500-(PRFV-10) | 174,41 | 1,9816 | 14382 | 73,442 | 60,78 |
| BTU29 | B349 | B332 | 600-(PRFV-10) | 119,66 | 1,5215 | 12780 | 63,511 | 52,531 |
| BTU3 | BNU1 | B370 | 500-(PVC-10) | 156,55 | 1,5943 | 11338 | 73,732 | 60,841 |
| BTU30 | B332 | BNU3 | 600-(PRFV-10) | 344,44 | 1,4918 | 36786 | 65 | 53,189 |
| BTU31 | B350 | B349 | 600-(PRFV-10) | 448,95 | 1,5828 | 47948 | 64,701 | 54,02 |
| BTU32 | B349 | B347 | 110-(PVC-10) | 29,492 | 1,8502 | 100,27 | 63,883 | 52,346 |
| BTU33 | BNU4 | B350 | 600-(PRFV-10) | 271,72 | 1,5976 | 29020 | 64,098 | 54,625 |
| BTU34 | BNU4 | B44 | 140-(PVC-10) | 156,77 | 1,1441 | 722,72 | 40,262 | 30,119 |
| BTU35 | B46 | BNU4 | 600-(PRFV-10) | 133,72 | 1,6039 | 14281 | 65 | 56,271 |
| BTU36 | B47 | B46 | 600-(PRFV-10) | 34,903 | 1,6308 | 3727,7 | 61,952 | 53,591 |
| BTU37 | B47 | B54 | 140-(PVC-10) | 38,328 | 1,7551 | 176,69 | 62,849 | 53,832 |
| BTU38 | B48 | B47 | 600-(PRFV-10) | 292,02 | 1,7056 | 31188 | 61,98 | 53,718 |
| BTU39 | B52 | B48 | 600-(PRFV-10) | 651,55 | 1,7438 | 69586 | 53,076 | 45,717 |
| BTU4 | B370 | B352 | 400-(PVC-10) | 193,49 | 1,8375 | 7252 | 74,089 | 60,011 |
| BTU40 | BNU5 | B52 | 800-(PRFV-10) | 324,89 | 1,5895 | 55283 | 59,618 | 54,356 |
| BTU41 | BNU6 | B12 | 110-(PVC-10) | 347,65 | 1,8502 | 1182 | 60,597 | 40,726 |
| BTU42 | BNU6 | B9 | 110-(PVC-10) | 48,347 | 1,8502 | 164,38 | 64,348 | 53,16 |
| BTU43 | B19 | BNU6 | 160-(PVC-10) | 128,92 | 1,7533 | 778,68 | 65 | 55,215 |
| BTU44 | B18 | B19 | 400-(PVC-10) | 142,4 | 0,41972 | 5337,3 | 63,889 | 56,267 |
| BTU45 | B17 | B18 | 400-(PVC-10) | 502,18 | 0,55963 | 18822 | 63,466 | 55,903 |
| BTU46 | B17 | B13 | 160-(PVC-10) | 49,879 | 1,824 | 301,27 | 61,671 | 53,556 |
| BTU47 | B14 | B17 | 400-(PVC-10) | 280,1 | 0,80195 | 10498 | 62,761 | 55,547 |
| BTU48 | B25 | B14 | 500-(PRFV-10) | 276,13 | 0,70251 | 22770 | 63,297 | 56,457 |
| BTU49 | B27 | B25 | 500-(PRFV-10) | 431,87 | 0,8425 | 35612 | 61,388 | 54,747 |
| BTU5 | BNU1 | B55 | 110-(PVC-10) | 63,272 | 1,8502 | 215,12 | 71,949 | 57,79 |
| BTU50 | B29 | B27 | 500-(PRFV-10) | 114,22 | 0,90855 | 9418,9 | 48,917 | 42,712 |
| BTU51 | B36 | B29 | 500-(PRFV-10) | 53,151 | 0,99717 | 4382,8 | 55,688 | 49,615 |
| BTU52 | B37 | B36 | 500-(PRFV-10) | 507,56 | 0,99717 | 41853 | 55,825 | 49,826 |
| BTU53 | B50 | B37 | 600-(PRFV-10) | 51,736 | 0,84601 | 5525,4 | 50,658 | 45,356 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| BTU54 | BNU5 | B50 | 600-(PRFV-10) | 539,14 | 1,0029 | 57580 | 48,23 | 42,972 |
| BTU55 | B106 | BNU5 | 900-(PRFV-10) | 200,98 | 1,601 | 41126 | 65 | 60,367 |
| BTU56 | B108 | B106 | 900-(PRFV-10) | 439,9 | 1,6315 | 90017 | 62,85 | 58,56 |
| BTU57 | B108 | B109 | 110-(PVC-10) | 68,943 | 1,8502 | 234,4 | 58,207 | 52,694 |
| BTU58 | B151 | B108 | 900-(PRFV-10) | 40,58 | 1,6567 | 8303,8 | 57,508 | 53,995 |
| BTU59 | BNU7 | B151 | 900-(PRFV-10) | 382,63 | 1,6736 | 78298 | 57,581 | 54,141 |
| BTU6 | BNU1 | B375 | 110-(PVC-10) | 57,603 | 1,8502 | 195,85 | 74,131 | 60,137 |
| BTU60 | B214 | B227 | 500-(PVC-10) | 30,287 | 1,5932 | 2193,4 | 72,051 | 58,888 |
| BTU61 | B214 | B213 | 140-(PVC-10) | 17,745 | 1,9626 | 81,804 | 72,058 | 58,575 |
| BTU63 | BNU8 | B229 | 110-(PVC-10) | 281,65 | 1,8539 | 957,6 | 68,142 | 48,834 |
| BTU64 | B231 | BNU8 | 500-(PVC-10) | 269,99 | 1,845 | 19553 | 65 | 53,894 |
| BTU65 | B233 | B231 | 500-(PVC-10) | 36,96 | 1,8989 | 2676,7 | 67,949 | 58,126 |
| BTU66 | B210 | BN207 | 110-(PVC-10) | 103,45 | 1,9452 | 351,73 | 74,98 | 56,077 |
| BTU67 | BN207 | B200 | 110-(PVC-10) | 64,793 | 1,9452 | 220,3 | 74,38 | 53,416 |
| BTU68 | B209 | B210 | 160-(PVC-10) | 281,67 | 1,7983 | 1701,3 | 70,396 | 54,784 |
| BTU69 | B233 | B209 | 250-(PVC-10) | 147,14 | 1,4525 | 1995,3 | 68,823 | 58,161 |
| BTU7 | B59 | B60 | 500-(PVC-10) | 163,64 | 1,7671 | 11851 | 71,103 | 61,801 |
| BTU70 | B206 | B233 | 500-(PRFV-10) | 493,56 | 1,7781 | 40699 | 67,851 | 58,212 |
| BTU71 | B207 | B201 | 110-(PVC-10) | 161,81 | 1,8502 | 550,15 | 69,939 | 52,26 |
| BTU72 | B206 | B207 | 160-(PVC-10) | 316,91 | 1,7533 | 1914,1 | 74,98 | 61,996 |
| BTU73 | B202 | B206 | 500-(PRFV-10) | 44,53 | 1,8714 | 3671,9 | 66,016 | 58,348 |
| BTU74 | B203 | B202 | 500-(PRFV-10) | 19,368 | 1,9045 | 1597,1 | 65,74 | 58,267 |
| BTU75 | B172 | B203 | 500-(PRFV-10) | 534,52 | 1,9254 | 44077 | 65,733 | 58,348 |
| BTU76 | B169 | B160 | 140-(PVC-10) | 32,788 | 1,7932 | 151,15 | 68,596 | 57,397 |
| BTU77 | B170 | B169 | 200-(PVC-10) | 268,64 | 1,4389 | 2466,2 | 68,192 | 57,665 |
| BTU78 | B171 | B170 | 200-(PVC-10) | 30,765 | 1,9993 | 282,43 | 68,753 | 60,624 |
| BTU79 | B171 | B162 | 125-(PVC-10) | 32,76 | 1,9542 | 122,19 | 68,646 | 60,118 |
| BTU8 | B60 | BNU1 | 500-(PVC-10) | 754,18 | 1,6826 | 54618 | 65 | 52,677 |
| BTU80 | BNU9 | B171 | 250-(PVC-10) | 72,202 | 1,8116 | 979,06 | 68,747 | 61,121 |
| BTU81 | B164 | B158 | 110-(PVC-10) | 149,16 | 1,8502 | 507,14 | 62,214 | 46,56 |
| BTU82 | B164 | B157 | 110-(PVC-10) | 273,54 | 1,8502 | 930,05 | 60,548 | 41,285 |
| BTU83 | B166 | B164 | 200-(PVC-10) | 179,52 | 1,6814 | 1648 | 65,98 | 54,652 |
| BTU84 | BNU9 | B166 | 250-(PVC-10) | 341,81 | 1,4341 | 4634,9 | 66,801 | 57,607 |
| BTU85 | B172 | BNU9 | 315-(PVC-10) | 313,41 | 1,5924 | 6619,2 | 65 | 58,128 |
| BTU86 | B235 | B234 | 160-(PVC-10) | 16,311 | 0,87665 | 98,516 | 61,921 | 53,165 |
| BTU88 | B172 | B174 | 800-(PRFV-10) | 31,771 | 1,6422 | 5406,2 | 65,579 | 60,602 |
| BTU89 | B168 | B172 | 1000-(PRFV-10) | 36,038 | 1,7587 | 8502,8 | 65,579 | 60,668 |
| BTU9 | B56 | B58 | 500-(PVC-10) | 387,08 | 1,8397 | 28032 | 69,605 | 61,195 |
| BTU90 | B155 | B168 | 1000-(PRFV-10) | 311,74 | 1,7638 | 73553 | 65,974 | 61,127 |
| BTU91 | B154 | B155 | 1000-(PRFV-10) | 32,807 | 1,7687 | 7740,4 | 59,693 | 55,409 |
| BTU92 | BNU10 | B154 | 1000-(PRFV-10) | 62,079 | 1,7778 | 14647 | 58,837 | 54,612 |
| BTU93 | BNU10 | B156 | 110-(PVC-10) | 73,925 | 1,8798 | 251,35 | 58,595 | 52,276 |
| BTU94 | BNU7 | BNU10 | 1000-(PRFV-10) | 744,57 | 1,7892 | 175673 | 65 | 60,889 |
| BTU95 | B152 | BNU7 | 1400-(PRFV-10) | 158,5 | 1,5342 | 65974 | 65 | 62,269 |
| BTU96 | B175 | B180 | 250-(PVC-10) | 48,58 | 1,8845 | 658,74 | 50,966 | 44,471 |
| BTU97 | B153 | B175 | 315-(PVC-10) | 35,524 | 1,5704 | 750,27 | 51,701 | 45,751 |
| BTU98 | B152 | B153 | 315-(PVC-10) | 403,31 | 1,7962 | 8517,8 | 51,121 | 45,388 |
| BTU99 | B177 | B152 | 1400-(PRFV-10) | 63,722 | 1,5901 | 26524 | 51,123 | 48,54 |
| TU1 | B174 | NU12 | 700-(PRFV-10) | 433 | 1,9426 | 57987 | 66 | 59,602 |
| TU10 | B353 | 369 | 400-(PVC-10) | 350 | 1,6637 | 13118 | 80,54 | 63,804 |
| TU100 | 251 | 259 | 125-(PVC-10) | 36,215 | 1,7793 | 135,08 | 82,38 | 56,564 |
| TU103 | 262 | 263 | 110-(PVC-10) | 91,778 | 1,8502 | 312,05 | 81,7 | 52,434 |
| TU104 | 261 | 262 | 160-(PVC-10) | 24,545 | 1,7533 | 148,25 | 81,29 | 54,687 |
| TU105 | 261 | 264 | 110-(PVC-10) | 30,144 | 1,8502 | 102,49 | 81,51 | 54,444 |
| TU106 | 258 | 261 | 250-(PVC-10) | 160,94 | 1,4341 | 2182,4 | 81,33 | 55,138 |
| TU107 | 265 | 258 | 250-(PVC-10) | 35,306 | 1,677 | 478,75 | 81,01 | 55,912 |
| TU108 | NU2 | 265 | 250-(PVC-10) | 239,29 | 1,9198 | 3244,7 | 81,11 | 56,332 |
| TU109 | 269 | 270 | 400-(PVC-10) | 359,69 | 1,8964 | 13481 | 77,86 | 62,771 |
| TU11 | 269 | 254 | 315-(PVC-10) | 638 | 1,6666 | 13475 | 77,79 | 60,7 |
| TU110 | 270 | 271 | 400-(PVC-10) | 408,1 | 1,8253 | 15296 | 79,82 | 62,258 |
| TU111 | 271 | 272 | 400-(PVC-10) | 378,11 | 1,7259 | 14172 | 79,98 | 60,352 |
| TU112 | 272 | 273 | 315-(PVC-10) | 253,56 | 1,7413 | 5355,2 | 81,63 | 60,131 |
| TU113 | 273 | NU2 | 315-(PVC-10) | 67,434 | 1,7413 | 1424,2 | 85 | 63,004 |
| TU114 | 275 | 282 | 125-(PVC-10) | 391,14 | 1,4341 | 1459 | 85,98 | 55,023 |
| TU115 | 274 | 275 | 160-(PVC-10) | 31,876 | 1,7533 | 192,53 | 83,08 | 58,225 |
| TU116 | NU2 | 274 | 200-(PVC-10) | 195,53 | 1,6814 | 1794,9 | 82,71 | 58,39 |
| TU117 | NU2 | 277 | 125-(PVC-10) | 23,69 | 1,9122 | 88,364 | 81,84 | 59,217 |
| TU119 | 281 | 283 | 110-(PVC-10) | 392,02 | 1,8502 | 1332,9 | 83,26 | 42,609 |
| TU12 | 253 | 252 | 250-(PVC-10) | 670 | 1,6531 | 9085,2 | 81,09 | 57,854 |

Continúa resultados por tramos...

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Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU120 | 280 | 281 | 160-(PVC-10) | 327,95 | 1,7533 | 1980,8 | 81,38 | 52,102 |
| TU121 | 278 | 280 | 200-(PVC-10) | 183,59 | 1,6974 | 1685,4 | 80,05 | 56,274 |
| TU125 | NU4 | 361 | 110-(PVC-10) | 405,37 | 1,8502 | 1378,3 | 70,44 | 35,468 |
| TU126 | NU4 | 290 | 110-(PVC-10) | 29,942 | 1,8502 | 101,8 | 71,47 | 47,39 |
| TU127 | 355 | NU4 | 160-(PVC-10) | 239,83 | 1,7533 | 1448,6 | 85 | 61,788 |
| TU128 | 369 | 354 | 400-(PVC-10) | 35,111 | 1,5943 | 1316 | 80,37 | 63,469 |
| TU129 | 354 | 355 | 400-(PVC-10) | 531,99 | 1,5157 | 19939 | 82,28 | 63,092 |
| TU13 | 272 | 278 | 250-(PVC-10) | 280 | 1,4444 | 3796,8 | 79,45 | 57,894 |
| TU130 | 355 | 368 | 400-(PVC-10) | 37,582 | 1,2997 | 1408,6 | 81,88 | 62,57 |
| TU132 | 374 | 376 | 315-(PVC-10) | 18,983 | 1,4164 | 400,92 | 76,74 | 60,454 |
| TU133 | 376 | 377 | 315-(PVC-10) | 302,85 | 1,2742 | 6396,2 | 79,81 | 62,267 |
| TU134 | 377 | 378 | 110-(PVC-10) | 38,524 | 1,8502 | 130,98 | 79,77 | 61,109 |
| TU135 | 377 | 394 | 250-(PVC-10) | 199,49 | 1,4994 | 2705,1 | 80,89 | 61,876 |
| TU136 | NU5 | 391 | 110-(PVC-10) | 310,6 | 1,8502 | 1056 | 90,02 | 51,862 |
| TU137 | 389 | 387 | 110-(PVC-10) | 33,41 | 1,8502 | 113,59 | 90,78 | 55,938 |
| TU138 | NU5 | 389 | 160-(PVC-10) | 281,69 | 1,7533 | 1701,4 | 90,22 | 56,348 |
| TU139 | 386 | NU5 | 200-(PVC-10) | 152,76 | 1,6814 | 1402,4 | 85 | 55,853 |
| TU14 | B312 | 269 | 500-(PVC-10) | 20 | 1,7636 | 1448,4 | 73,72 | 60,971 |
| TU140 | 285 | 386 | 250-(PVC-10) | 36,948 | 1,4341 | 501,02 | 80,56 | 53,228 |
| TU141 | NU6 | 285 | 250-(PVC-10) | 167,1 | 1,4341 | 2265,9 | 76,49 | 49,409 |
| TU142 | 284 | 286 | 160-(PVC-10) | 32,138 | 0,87665 | 194,12 | 74,32 | 47,117 |
| TU143 | NU6 | 284 | 250-(PVC-10) | 202,43 | 1,2733 | 2744,9 | 74,82 | 47,769 |
| TU144 | 384 | NU6 | 315-(PVC-10) | 450,04 | 1,4141 | 9504,9 | 85 | 59,055 |
| TU145 | 385 | 287 | 110-(PVC-10) | 22,651 | 1,8502 | 77,013 | 85,03 | 60,445 |
| TU146 | 384 | 385 | 200-(PVC-10) | 32,566 | 1,3111 | 298,96 | 85,05 | 61,122 |
| TU148 | 383 | 393 | 140-(PVC-10) | 42,484 | 1,1441 | 195,85 | 86,39 | 56,889 |
| TU149 | 382 | 383 | 160-(PVC-10) | 355,37 | 1,8182 | 2146,4 | 87 | 57,882 |
| TU15 | 272 | B310 | 250-(PVC-10) | 20 | 1,4389 | 271,2 | 77,897 | 58,132 |
| TU150 | 379 | 382 | 200-(PVC-10) | 261,66 | 1,7834 | 2402 | 84,04 | 61,296 |
| TU151 | 394 | 379 | 250-(PVC-10) | 35,956 | 1,4994 | 487,57 | 81,5 | 62,221 |
| TU153 | 211 | 212 | 110-(PVC-10) | 225,03 | 1,8502 | 765,09 | 75,44 | 51,047 |
| TU154 | NU7 | 211 | 160-(PVC-10) | 321,75 | 1,7533 | 1943,4 | 73,16 | 55,295 |
| TU155 | 218 | 220 | 110-(PVC-10) | 553,64 | 1,8502 | 1882,4 | 91,94 | 55,309 |
| TU156 | 218 | 217 | 110-(PVC-10) | 32,4 | 1,8502 | 110,16 | 84,48 | 62,971 |
| TU157 | 223 | 218 | 200-(PVC-10) | 189,18 | 1,6814 | 1736,6 | 84,44 | 63,871 |
| TU158 | 225 | 223 | 250-(PVC-10) | 192,22 | 1,4341 | 2606,5 | 84,07 | 65,749 |
| TU159 | 225 | 215 | 110-(PVC-10) | 28,157 | 1,8502 | 95,733 | 82,43 | 64,598 |
| TU16 | B310 | 307 | 200-(PVC-10) | 250 | 1,7385 | 2295 | 79 | 56,076 |
| TU160 | NU8 | 225 | 250-(PVC-10) | 207,87 | 1,4643 | 2818,8 | 80,06 | 63,045 |
| TU161 | 409 | 408 | 200-(PVC-10) | 230,65 | 0,56045 | 2117,4 | 79,79 | 51,918 |
| TU162 | 410 | 409 | 250-(PVC-10) | 111,27 | 0,71707 | 1508,8 | 79,76 | 52,258 |
| TU163 | NU9 | 410 | 315-(PVC-10) | 322,06 | 0,95563 | 6801,9 | 80,15 | 52,861 |
| TU164 | 412 | 413 | 140-(PVC-10) | 294,58 | 1,6125 | 1358 | 89,41 | 55,391 |
| TU165 | NU9 | 412 | 200-(PVC-10) | 320,64 | 1,3503 | 2943,5 | 85,74 | 56,693 |
| TU166 | 405 | NU9 | 315-(PVC-10) | 430,6 | 1,3445 | 9094,4 | 85 | 58,501 |
| TU167 | NU10 | 405 | 315-(PVC-10) | 413,01 | 1,5308 | 8722,9 | 90,27 | 65,743 |
| TU168 | 407 | 411 | 125-PVC-16) | 489,57 | 1,601 | 2859,1 | 102,16 | 62,421 |
| TU169 | 406 | 407 | 250-(PVC-16) | 486,75 | 1,4343 | 11268 | 100,04 | 70,177 |
| TU17 | 307 | B289 | 200-(PVC-10) | 300 | 1,1781 | 2754 | 80,023 | 55,242 |
| TU170 | NU10 | 406 | 250-(PVC-16) | 378,48 | 1,8274 | 8761,7 | 98,16 | 71,792 |
| TU171 | NU10 | 404 | 200-(PVC-16) | 48,449 | 1,6966 | 721,89 | 96,58 | 73,837 |
| TU172 | 403 | NU10 | 400-(PVC-10) | 342,97 | 1,721 | 12854 | 85 | 62,876 |
| TU173 | 401 | 403 | 400-(PVC-10) | 30,305 | 1,9186 | 1135,8 | 94,03 | 73,77 |
| TU174 | 401 | 402 | 125-PVC-16) | 59,603 | 1,6471 | 348,08 | 95,31 | 73,985 |
| TU175 | 224 | 401 | 500-(PVC-10) | 1280 | 1,3515 | 92699 | 93,85 | 73,791 |
| TU176 | NU8 | 224 | 500-(PVC-10) | 399,66 | 1,3666 | 28943 | 82,2 | 65,562 |
| TU2 | NU12 | B235 | 160-(PVC-10) | 136 | 1,7533 | 821,44 | 62,179 | 53,499 |
| TU3 | NU12 | 400 | 700-(PRFV-10) | 482 | 1,8614 | 64549 | 62,09 | 54,231 |
| TU4 | B227 | NU8 | 500-(PVC-10) | 662 | 1,589 | 47942 | 85 | 69,452 |
| TU5 | BNU8 | NU11 | 500-(PVC-10) | 284 | 1,7909 | 20567 | 66 | 53,617 |
| TU6 | NU11 | B214 | 500-(PVC-10) | 156 | 1,7477 | 11298 | 72,039 | 58,986 |
| TU7 | NU11 | NU7 | 160-(PVC-10) | 5 | 1,7533 | 30,2 | 85 | 72,533 |
| TU8 | B370 | 374 | 315-(PVC-10) | 600 | 1,4849 | 12672 | 76,68 | 60,49 |
| TU9 | 368 | 384 | 315-(PVC-10) | 493 | 1,9239 | 10412 | 85,48 | 61,797 |
| TU91 | 254 | 253 | 250-(PVC-10) | 26,582 | 1,6531 | 360,45 | 78,17 | 60,845 |
| TU92 | 254 | 255 | 250-(PVC-10) | 239,16 | 1,5811 | 3243 | 78,08 | 59,046 |
| TU93 | 255 | 267 | 110-(PVC-10) | 30,711 | 1,8502 | 104,42 | 77,95 | 58,025 |
| TU94 | 255 | 256 | 200-(PVC-10) | 320,91 | 1,7707 | 2946 | 79,82 | 56,591 |
| TU95 | 256 | 257 | 160-(PVC-10) | 188,84 | 1,7533 | 1140,6 | 80,79 | 54,393 |

Continúa resultados por tramos...

Página 12
Gestar2014GESTAR _2014 rev.0 17/12/2020
Entidad: CINGRAL Proyecto: LICENCIA_1

| TRAMO | N.ini | N.fin | DN | L m | VEL. m/s | COSTE €€ | P. EST. m | P. DIN. m |
|---|---|---|---|---|---|---|---|---|
| TU96 | 257 | 266 | 110-(PVC-10) | 34,634 | 1,8502 | 117,75 | 80,32 | 52,919 |
| TU98 | 252 | 251 | 250-(PVC-10) | 309,35 | 1,2945 | 4194,8 | 82,14 | 57,163 |
| TU99 | 251 | 250 | 140-(PVC-10) | 246,47 | 1,1441 | 1136,2 | 82,77 | 55,571 |

** ¡Atención! Elementos BTU44, Velocidad de Diseño inferior a la Mínima.

** Información El Nodo B19 es el más desfavorable.

P Mín de la Red (Dinámica) = 30,119 m (Nodo: B44)
P Max de la Red (Estática) = 102,16 m (Nodo: 411)
Caudal de Inyección en Cabecera = 2,4345 m3/s

DESGLOSE ECONÓMICO TUBERÍAS

| MATERIAL | TIMB. | REFERENCIA | COSTE U. €/m | LONGITUD m | COSTE TOTAL € |
|---|---|---|---|---|---|
| PVC | 100,0 | 250-(PVC-10) | 13,56 | 4.656 | 63.134,73 |
| | | 110-(PVC-10) | 3,40 | 4.649 | 15.805,76 |
| | | 200-(PVC-10) | 9,18 | 3.026 | 27.777,26 |
| | | 160-(PVC-10) | 6,04 | 3.876 | 23.408,48 |
| | | 140-(PVC-10) | 4,61 | 1.094 | 5.043,65 |
| | | 125-(PVC-10) | 3,73 | 484 | 1.804,60 |
| | | 400-(PVC-10) | 37,48 | 4.659 | 174.612,60 |
| | | 315-(PVC-10) | 21,12 | 5.652 | 119.361,00 |
| | | 500-(PVC-10) | 72,42 | 4.908 | 355.401,50 |
| | | 500-(PRFV-10) | 82,46 | 2.649 | 218.463,10 |
| | | 600-(PRFV-10) | 106,80 | 2.888 | 308.420,90 |
| | | 800-(PRFV-10) | 170,16 | 357 | 60.688,86 |
| | | 900-(PRFV-10) | 204,63 | 1.064 | 217.744,80 |
| | | 1000-(PRFV-10) | 235,94 | 1.187 | 280.116,30 |
| | | 1400-(PRFV-10) | 416,25 | 2.595 | 1.080.231,00 |
| | | 700-(PRFV-10) | 133,92 | 915 | 122.536,80 |
| | 160,0 | 125-PVC-16) | 5,84 | 549 | 3.207,19 |
| | | 250-(PVC-16) | 23,15 | 865 | 20.029,95 |
| | | 200-(PVC-16) | 14,90 | 48 | 721,89 |

| | |
|---|---|
| **COSTE TOTAL de las TUBERÍAS** | **3.098.510,18 €** |
| **AMORTIZACIÓN ANUAL TUBERÍAS** | **219.846,90 €** |
| **COSTE TOTAL ANUAL** | **219.846,90 €** |

# 4 CALCULOS COSTES ENERGÉTICOS. 2ª FASE

## 4.1 ALTERNATIVAS 1.1. Y 1.2. BOMBEO 1. 123 H

**BOMBEO A BALSA- - P6**

**DATOS**

| | |
|---|---|
| Superficies [ha] | 1104 |
| Caudal [l/s] | 1011 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 561 |
| Contratada | 646 |

**NECESIDAES HÍDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,76 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,76 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 87,12 | 0,00 | 0,00 | 0,00 | 0,00 | 87,12 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 26,21 | 101,19 | 121,09 | 208,45 | 324,56 | 389,71 | 0,00 | 244,18 | 52,17 | 1,82 | 0,00 | 1469,39 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 645,53 | 561,33 | 561,33 |

**CONSUMO [kWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 86873,8 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 86873,8 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 48903,7 | 0,0 | 0,0 | 0,0 | 0,0 | 48903,7 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 14711,3 | ####### | 67971,5 | ######## | 182188,2 | 218759,8 | 218759,8 | 137066,8 | 29286,3 | 1021,6 | 0,0 | 1043576,3 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |

**TÉRMINO DE ENERGÍA**

| | COSTE | | | | TÉRMINO DE POTENCIA | | COSTES TOTALES |
|---|---|---|---|---|---|---|---|
| | TOTAL | Tarifa €/kW | Coste | | POTEN Contra | Tarifa €/kW | Coste | |
| | 0,0 | 0,137322 | 0,00 € | | 0 | 39,139427 | 0,00 € | 0,00 € |
| | 86873,8 | 0,114125 | ######## | | 646 | 19,586654 | ######## | 22.558,31 € |
| | 0,0 | 0,101906 | 0,00 € | | 646 | 14,334178 | ######## | 9.253,20 € |
| | 48903,7 | 0,088886 | ######## | | 646 | 14,334178 | ######## | 13.600,05 € |
| | 0,0 | 0,081456 | 0,00 € | | 646 | 14,334178 | ######## | 9.253,20 € |
| | 1043576,3 | 0,064648 | ######## | | 646 | 6,540177 | ######## | 71.687,02 € |
| | 0,0 | | | | | | | |
| | 0,0 | | | | | | | |
| | 0,0 | | | | | | | |
| | | | ######## | | | | ######## | **126.351,78 €** |
| **Coste Anual Antes de Impuestos eléctricos sin IVA** | | | | | | | | 5.490,99 € |
| **Impuesto Eléctrico** | | | | | | | | **131.842,76 €** |
| **COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA [ € ]** | | | | | | | | 27.686,98 € |
| **IVA 21 %** | | | | | | | | **159.529,74 €** |
| **COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]** | | | | | | | | **0,02086** |

## 4.2 ALTERNATIVAS 1.1., 1.2., 2.1. Y 2.2. BOMBEO 2. 123 H

### BOMBEO A BALSA- - P6

NECESIDAES HÍDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 231,10 | 588,85 | 1282,84 | 1080,99 | 395,19 | 0,00 | 0,00 | 0,00 | 3578,97 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 70,10 | 178,62 | 389,12 | 0,00 | 119,87 | 0,00 | 0,00 | 0,00 | 757,71 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 645,53 | 561,33 | 561,33 |

TÉRMINO DE ENERGÍA

CONSUMO [kWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 39348,7 | 100263,5 | 218427,7 | 184060,0 | 67288,4 | 0,0 | 0,0 | 0,0 | 609388,4 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |

COSTE

| | Tarifa €/Kw | Coste |
|---|---|---|
| | 0,137322 | 0,00 € |
| | 0,114125 | 0,00 € |
| | 0,101906 | 0,00 € |
| | 0,088886 | 0,00 € |
| | 0,081456 | 0,00 € |
| | 0,064648 | ######## |
| | | |
| | | |
| | | |
| | | |
| | | ######## |

TÉRMINO DE POTENCIA

| | POTEN Contra | Tarifa €/kw | COSTES Coste |
|---|---|---|---|
| | 0 | 39,139427 | 0,00 € |
| | 0 | 19,586654 | 0,00 € |
| | 0 | 14,334178 | 0,00 € |
| | 0 | 14,334178 | 0,00 € |
| | 0 | 14,334178 | 0,00 € |
| | 646 | 6,540177 | ######## |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | ######## |

COSTES TOTALES

| |
|---|
| 0,00 € |
| 0,00 € |
| 0,00 € |
| 0,00 € |
| 0,00 € |
| 43.617,65 € |
| |
| |
| |
| |
| 43.617,65 € |
| |
| |
| |
| |
| 43.617,65 € |
| 1.895,53 € |
| 45.513,18 € |
| 9.557,77 € |
| 55.070,95 € |

DATOS

| | |
|---|---|
| Superficies [ha] | 1104 |
| Caudal [l/s] | 1011 |
| Altura bombeo m | 43 |
| Potencias [kW] | 561 |
| Consumida | 646 |
| Contratada | |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 4.3 ALTERNATIVA 1.3. BOMBEO 1. 88 H + SOLAR

### BOMBEO A BALSA- - P6

NECESIDAES HÍDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 231,10 | 588,85 | 1282,84 | 1080,99 | 395,19 | 0,00 | 0,00 | 0,00 | 3578,97 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 70,10 | 178,62 | 389,12 | 0,00 | 119,87 | 0,00 | 0,00 | 0,00 | 757,71 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 561,33 | 645,53 | 561,33 | 561,33 |

TÉRMINO DE ENERGÍA

CONSUMO [kWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 39348,7 | 100263,5 | 218427,7 | 184060,0 | 67288,4 | 0,0 | 0,0 | 0,0 | 609388,4 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |

COSTE

| | Tarifa €/Kw | Coste |
|---|---|---|
| | 0,137322 | 0,00 € |
| | 0,114125 | 0,00 € |
| | 0,101906 | 0,00 € |
| | 0,088886 | 0,00 € |
| | 0,081456 | 0,00 € |
| | 0,064648 | ######## |
| | | |
| | | |
| | | |
| | | |
| | | ######## |

TÉRMINO DE POTENCIA

| | POTEN Contra | Tarifa €/kw | COSTES Coste |
|---|---|---|---|
| | 0 | 39,139427 | 0,00 € |
| | 0 | 19,586654 | 0,00 € |
| | 0 | 14,334178 | 0,00 € |
| | 0 | 14,334178 | 0,00 € |
| | 0 | 14,334178 | 0,00 € |
| | 646 | 6,540177 | ######## |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | ######## |

COSTES TOTALES

| |
|---|
| 0,00 € |
| 0,00 € |
| 0,00 € |
| 0,00 € |
| 0,00 € |
| 43.617,65 € |
| |
| |
| |
| |
| 43.617,65 € |
| |
| |
| |
| |
| 43.617,65 € |
| 1.895,53 € |
| 45.513,18 € |
| 9.557,77 € |
| 55.070,95 € |

DATOS

| | |
|---|---|
| Superficies [ha] | 1104 |
| Caudal [l/s] | 1011 |
| Altura bombeo m | 43 |
| Potencias [kW] | 561 |
| Consumida | 646 |
| Contratada | |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

### BOMBEO A BALSA- - P6

NECESIDAES HÍDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 26,18 | 101,09 | 120,97 | 208,24 | 324,24 | 389,71 | 0,00 | 243,94 | 52,12 | 1,82 | 0,00 | 1468,32 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 320,07 | 278,32 | 278,32 |

TÉRMINO DE ENERGÍA

CONSUMO [kWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 42923,6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 42923,6 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 24116,0 | 0,0 | 0,0 | 0,0 | 0,0 | 24116,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 7286,9 | ######## | 33668,0 | 57957,5 | 90242,4 | 108464,4 | 108464,4 | 67892,6 | 14506,3 | 506,0 | 0,0 | 517123,9 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |
| | | | | | | | | | | | | | 0,0 |

COSTE

| | Tarifa €/Kw | Coste |
|---|---|---|
| | 0,137322 | 0,00 € |
| | 0,114125 | ######## |
| | 0,101906 | 0,00 € |
| | 0,088886 | ######## |
| | 0,081456 | 0,00 € |
| | 0,064648 | ######## |
| | | |
| | | |
| | | |
| | | |
| | | ######## |

TÉRMINO DE POTENCIA

| | POTEN Contra | Tarifa €/kw | COSTES Coste |
|---|---|---|---|
| | 0 | 39,139427 | 0,00 € |
| | 320 | 19,586654 | ######## |
| | 320 | 14,334178 | ######## |
| | 320 | 14,334178 | ######## |
| | 320 | 14,334178 | ######## |
| | 320 | 6,540177 | ######## |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | ######## |

COSTES TOTALES

| |
|---|
| 0,00 € |
| 11.167,66 € |
| 4.587,87 € |
| 6.731,45 € |
| 4.587,87 € |
| 35.524,31 € |
| |
| |
| |
| |
| 62.599,17 € |
| 2.720,43 € |
| 65.319,60 € |
| 13.717,12 € |
| 79.036,72 € |
| 0,03067 |

DATOS

| | |
|---|---|
| Superficies [ha] | 372 |
| Caudal [l/s] | 341 |
| Altura bombeo m | 64 |
| Potencias [kW] | 278 |
| Consumida | 320 |
| Contratada | |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 4.4 ALTERNATIVA 1.3. BOMBEO 2. 88 H + SOLAR

### BOMBEO A BALSA- - P6

**NECESIDADES HÍDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 582,00 | 1273,80 | 1071,65 | 408,80 | 0,00 | 0,00 | 3567,94 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 320,07 | 278,32 | 278,32 |

**TÉRMINO DE ENERGÍA**

**CONSUMO [kWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |

**COSTE**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | Tarifa €/Kw | Coste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,114125 | 0,00 € |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,088886 | 0,00 € |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 19540,1 | 107430,7 | 90381,3 | 34478,0 | 0,0 | 0,0 | 0,0 | 300915,0 | 0,064648 | ######## |

**TÉRMINO DE POTENCIA**

| | POTEN | Contrat | Tarifa €/kw | Coste |
|---|---|---|---|---|
| P1 | | 0 | 39,139427 | 0,00 € |
| P2 | | 0 | 19,586654 | ######## |
| P3 | | 1400 | 14,334178 | ######## |
| P4 | | 1400 | 14,334178 | ######## |
| P5 | | 1400 | 14,334178 | ######## |
| P6 | | 320 | 6,540177 | ######## |

**COSTES TOTALES**

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 0,00 € |
| P3 | 0,00 € |
| P4 | 0,00 € |
| P5 | 0,00 € |
| P6 | 0,00 € |
| | ######## |
| | 21.546,84 € |
| | 936,38 € |
| | 22.483,22 € |
| | 4.721,48 € |
| | 27.204,69 € |
| | 0,02050 |

**DATOS**

| | |
|---|---|
| Superficies [ha] | 372 |
| Caudal [l/s] | 341 |
| Altura bombeo m | 64 |
| Potencias [kW] | 278 |
| Consumida | 278 |
| Contratada | 320 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 4.5 ALTERNATIVAS 2.1. Y 2.2. BOMBEO 1. 123 H

### BOMBEO A BALSA- - P6

**NECESIDADES HÍDRICAS [m^3/ha]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 86,40 | 333,60 | 399,20 | 687,20 | 1070,00 | 1795,00 | 1572,00 | 805,00 | 172,00 | 6,00 | 0,00 | 6926,40 |

**HORAS DE RIEGO [horas/año]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,85 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 154,85 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 87,19 | 0,00 | 0,00 | 0,00 | 0,00 | 87,19 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 26,21 | 101,21 | 121,11 | 208,48 | 324,61 | 389,71 | 0,00 | 244,22 | 52,18 | 1,82 | 0,00 | 1469,55 |

**POTENCIA CONSUMIDA KW**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1217,06 | 1217,06 | ###### | 1217,06 | 1217,06 | 1217,06 | 1217,06 | 1217,06 | 1217,06 | 1399,61 | 1217,06 | 1217,06 |

**TÉRMINO DE ENERGÍA**

**CONSUMO [kWh]**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 188455,6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 188455,6 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 106118,3 | 0,0 | 0,0 | 0,0 | 0,0 | 106118,3 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 31901,1 | ###### | ###### | ###### | 39507,2 | 47430,4,0 | 47430,4,0 | 29722,6,5 | 63506,8 | 2215,4 | 0,0 | 226282,9,0 |

**COSTE**

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | Tarifa €/Kw | Coste |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,114125 | ######## |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,088886 | ######## |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,064648 | ######## |

**TÉRMINO DE POTENCIA**

| | POTEN | Contrat | Tarifa €/kw | Coste |
|---|---|---|---|---|
| P1 | | 0 | 39,139427 | 0,00 € |
| P2 | | 0 | 19,586654 | ######## |
| P3 | | 1400 | 14,334178 | ######## |
| P4 | | 1400 | 14,334178 | ######## |
| P5 | | 1400 | 14,334178 | ######## |
| P6 | | 1400 | 6,540177 | ######## |

**COSTES TOTALES**

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 0,00 € |
| P3 | 0,00 € |
| P4 | 0,00 € |
| P5 | 0,00 € |
| P6 | 0,00 € |
| | ######## |
| | 273.981,73 € |
| | 11.906,68 € |
| | 285.888,41 € |
| | 60.036,57 € |
| | 345.924,98 € |
| | 0,02086 |

**DATOS**

| | |
|---|---|
| Superficies [ha] | 2394 |
| Caudal [l/s] | 2192 |
| Altura bombeo m | 43 |
| Potencias [kW] | |
| Consumida | 1217 |
| Contratada | 1400 |

Coste Anual Antes de Impuestos eléctricos sin IVA

Impuesto Eléctrico

IVA 21 %

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ]

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ]

## 4.6 ALTERNATIVA 2.3. BOMBEO 1. 88 H + SOLAR

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 215,81 | 575,73 | 1275,91 | 1071,86 | 387,99 | 0,00 | 0,00 | 0,00 | 3527,30 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 65,47 | 174,66 | 387,08 | 0,00 | 117,71 | 0,00 | 0,00 | 0,00 | 744,92 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1217,06 | 1217,06 | ###### | 1217,06 | 1217,06 | 1217,06 | 1217,06 | 1217,06 | 1217,06 | 1399,61 | 1217,06 | 1217,06 |

TÉRMINO DE ENERGÍA

CONSUMO [kWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 79683,3 | 212572,8 | 471099,9 | 395758,4 | 143255,5 | 0,0 | 0,0 | 0,0 | 1302370,0 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTEN Contrat | Tarifa €/kW | COSTES Coste |
|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € |
| P5 | 0 | 14,334178 | 0,00 € |
| P6 | 1400 | 6,540177 | ######## |

COSTES TOTALES

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 0,00 € |
| P3 | 0,00 € |
| P4 | 0,00 € |
| P5 | 0,00 € |
| P6 | ######## |

DATOS

| | |
|---|---|
| Superficies [ha] | 2394 |
| Caudal [l/s] | 2192 |
| Altura bombeo m | 43 |
| Potencias [kW] | 1217 |
| Consumida | 1217 |
| Contratada | 1400 |

Coste Anual Antes de Impuestos eléctricos sin IVA 93.349,34 €

Impuesto Eléctrico 4.056,77 €

IVA 21 % 97.406,11 €

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ] 20.455,28 €

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ] 117.861,39 €

0,01396

## 4.7 ALTERNATIVA 2.3. BOMBEO 2. 88 H + SOLAR

### BOMBEO A BALSA- - P6

NECESIDADES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 231,69 | 582,00 | 1273,80 | 1071,65 | 408,80 | 0,00 | 0,00 | 0,00 | 3567,94 |

HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 70,21 | 176,36 | 386,00 | 0,00 | 123,88 | 0,00 | 0,00 | 0,00 | 756,45 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |

POTENCIA CONSUMIDA KW

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 278,32 | 320,07 | 278,32 | 278,32 |

TÉRMINO DE ENERGÍA

CONSUMO [kWh]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 19540,1 | 49084,9 | 107430,7 | 90381,3 | 34478,0 | 0,0 | 0,0 | 0,0 | 300915,0 |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |

COSTE

| | Tarifa €/kW | Coste |
|---|---|---|
| P1 | 0,137322 | 0,00 € |
| P2 | 0,114125 | 0,00 € |
| P3 | 0,101906 | 0,00 € |
| P4 | 0,088886 | 0,00 € |
| P5 | 0,081456 | 0,00 € |
| P6 | 0,064648 | ######## |

TÉRMINO DE POTENCIA

| | POTEN Contrat | Tarifa €/kW | COSTES Coste |
|---|---|---|---|
| P1 | 0 | 39,139427 | 0,00 € |
| P2 | 0 | 19,586654 | 0,00 € |
| P3 | 0 | 14,334178 | 0,00 € |
| P4 | 0 | 14,334178 | 0,00 € |
| P5 | 320 | 6,540177 | ######## |
| P6 | | | |

COSTES TOTALES

| | |
|---|---|
| P1 | 0,00 € |
| P2 | 0,00 € |
| P3 | 0,00 € |
| P4 | 0,00 € |
| P5 | 21.546,84 € |
| P6 | ######## |

DATOS

| | |
|---|---|
| Superficies [ha] | 372 |
| Caudal [l/s] | 341 |
| Altura bombeo m | 64 |
| Potencias [kW] | 278 |
| Consumida | 278 |
| Contratada | 320 |

Coste Anual Antes de Impuestos eléctricos sin IVA 21.546,84 €

Impuesto Eléctrico 936,38 €

IVA 21 % 22.483,22 €

COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ] 4.721,48 €

COSTE ENERGÉTICO UNITARIO CON IMPUESTO E IVA [ €/m^3 ] 27.204,69 €

0,02050

# ANEJO Nº 5.- DATOS TOPOGRÁFICOS

**ANEJO Nº 5.- DATOS TOPOGRÁFICOS ..... 1**
**1 INTRODUCCIÓN Y OBJETO DEL ANEJO ..... 1**
**2 METODOLOGÍA EMPLEADA PARA LA MEDICIÓN GPS ..... 1**
**3 DATOS DE LA ESTACIÓN PERMANENTE EMPLEADA ..... 1**

**APÉNDICE 1.- LISTADO DE PUNTOS**
**APÉNDICE 2.- DEFINICIÓN GEOMETRICA DE LA RED**

# ANEJO Nº 5.- DATOS TOPOGRÁFICOS

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

Como información de apoyo para la realización del presente proyecto se utilizó la siguiente documentación:

- Ortofotos en formato .ecw, en proyección UTM (ETRS89) huso 30.
- Cartografía con curvas de nivel cada 2 y 5 metros en proyección UTM (ETRS89) huso 30.
- Modelo Digital de Elevaciones LIDAR, nubes de puntos.

Dicha cartografía ha sido completada con la toma directa en campo, por procedimientos de topografía, mediante GPS Leica VIVA CS15, de los distintos elementos que componen la solución proyectada, fundamentalmente, puntos singulares y perfil longitudinal de las redes. Asimismo, se han realizado levantamientos específicos en las zonas de ubicación de las balsas, estación de bombeo, admisión, impulsión y cruces de carreteras y ferrocarril.

## 2 METODOLOGÍA EMPLEADA PARA LA MEDICIÓN GPS

Para la toma de puntos con GPS se utiliza la conexión a La Red de Geodesia Activa de Aragón (ARAGEA) mediante conexión vía modem GPRS/UMTS para obtener las correcciones a tiempo real, consiguiendo un posicionamiento preciso en el mismo instante en que se efectúa el trabajo de campo.

El acceso a los datos en tiempo real se realiza a través del Caster NTRIP (Networked Transport of RTCM via Internet Protocol). NTRIP es un protocolo estándar diseñado para difundir en tiempo real los datos procedentes de receptores GNSS en Internet. Las correcciones suministradas por esta red son recibidas por el receptor GNSS que dispone de un cliente NTRIP, consiguiendo las correcciones diferenciales en tiempo real.

La Red de Geodesia Activa de Aragón (ARAGEA) está compuesta por veintidós estaciones propias distribuidas por el territorio de la Comunidad Autónoma de Aragón, dando respuesta a una creciente demanda en servicios de posicionamiento por satélite. Es un servicio libre y gratuito de posicionamiento de alta precisión con receptores GNSS (Sistema de Navegación por Satélite) dentro del territorio de Aragón en datum ETRS89, dentro de un marco coherente con la Red REGENTE y las estaciones permanentes del IGN y otros suministradores externos pero públicos. Dicha red proporciona correcciones de código y fase para los sistemas de navegación GPS, GLONASS y la futura GALILEO, tanto en tiempo real RTK como en postproceso a través de ficheros RINEX.

Al mismo tiempo, el sistema constituye un marco de referencia geodésico activo en ETRS89, que sustituye y complementa con ventajas a las tradicionales redes geodésicas basadas en vértices fijos.

Los vértices más empleados para la corrección son los más cercanos a la zona de proyecto, estación permanente de Huesca (OSCA) y estación permanente de Zuera (ZUER).

## 3 DATOS DE LA ESTACIÓN PERMANENTE EMPLEADA

A continuación, se incluye la ficha de la estación permanente utilizada como referencia para la corrección topográfica en tiempo real de la red.

GOBIERNO DE ARAGON

Instituto Geográfico de Aragón

ARAGEA

# Estación permanente de Huesca (OSCA)

## UBICACIÓN

| | |
|---|---|
| Código estación: | OSCA |
| Nombre RINEX3: | OSCA3 |
| Nombre: | Huesca |
| DOMES: | 17008M001 |
| Redes Pertenece: | ARAGEA |
| Instituciones Pertenece: | IGEAR |
| Localización: | Plaza Cervantes 3, 22003 Huesca ARAGÓN |
| Fecha Instalación: | 03/08/2017 |
| Tipo instalación: | Basada ajustable anclada azotea. Nivelada y orientada a norte. |

## COORDENADAS ETRS89

| Cartesianas (x, y, z) | Geográficas (ϕ, λ, h) | UTM (x,y,huso) |
|---|---|---|
| 4736901,05 | 42º 8' 22,0849'' N | 713719 |
| -34214,28 | 0º 24' 49,8093'' W | 4668498,71 |
| 4257470,34 | 546,7057 m. | 30 |

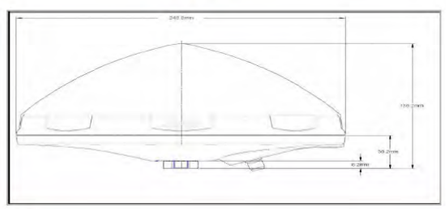
## INSTRUMENTACIÓN

| | |
|---|---|
| Receptor: | LEICA GR10 |
| Antena: | Leica AR10 (LEIAR10 NONE) |
| Altura Antena: | 0 metros. |
| Observaciones: | GPS, GLONASS, GALILEO y BEIDOU |
| Frecuencias: | L1, L2 y L2C |

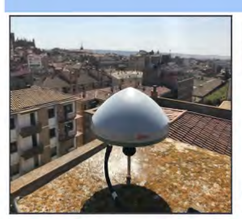
## INFORMACIÓN ADICIONAL

Rinex Horarios cada 1 segundo, y Diarios cada 30 segundos.

| | |
|---|---|
| Caser NTRIP: | **http://ntrip.aragon.es:2101** |
| RINEX y LOG | **http://gnss.aragon.es** |
| e-mail / Web: | **aragea@aragon.es / http://gnss.aragon.es** |
| Última actualización | **16/12/2020** |



## FOTOS



GOBIERNO DE ARAGON

Instituto Geográfico de Aragón

ARAGEA

# Estación permanente de Zuera (ZUER)

## UBICACIÓN

| | |
|---|---|
| Código estación: | ZUER |
| Nombre RINEX3: | ZUER3 |
| Nombre: | Zuera |
| DOMES: | 19359M001 |
| Redes Pertenece: | ARAGEA |
| Instituciones Pertenece: | IGEAR |
| Localización: | C/ Puilatos 26-28, 50800 Zuera (Zargoza) ARAGÓN |
| Fecha Instalación: | 04/08/2010 |
| Tipo instalación: | Mástil de 1,5 m. anclado a tejado (a cornisa) y reforzado con vientos. Nivelada y orientada al norte. |

## COORDENADAS ETRS89

| Cartesianas (x, y, z) | Geográficas (ϕ, λ, h) | UTM (x,y,huso) |
|---|---|---|
| 4756718,9036 | 41º 51' 58,86874'' N | 683379,942 |
| -65624,8245 | 0º 47' 25,49776'' W | 4637298,179 |
| 4234786,9946 | 339,151 m. | 30 |

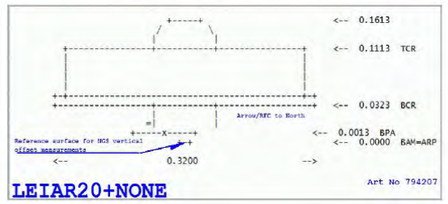
## INSTRUMENTACIÓN

| | |
|---|---|
| Receptor: | LEICA GR50 |
| Antena: | Leica AR20 (LEIAR20 NONE) |
| Altura Antena: | 0 metros. |
| Observaciones: | GPS, GLONASS, GALILEO y BEIDOU |
| Frecuencias: | L1, L2 y L2C |

## INFORMACIÓN ADICIONAL

Rinex Horarios cada 1 segundo, y Diarios cada 30 segundos.

| | |
|---|---|
| Caser NTRIP: | **http://ntrip.aragon.es:2101** |
| RINEX y LOG | **http://gnss.aragon.es** |
| e-mail / Web: | **aragea@aragon.es / http://gnss.aragon.es** |
| Última actualización | **16/12/2020** |




## FOTOS

# APÉNDICE 1.- LISTADO DE PUNTOS

## LISTADO DE PUNTOS

Las coordenadas (ETRS89 UTM-Huso 30) de los puntos utilizados en el Modelo Digital del Terreno generado para el presente proyecto son las relacionadas en la siguiente tabla:

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1 | 705.883,230 | 4.645.147,634 | 384,719 | ACEQUIA |
| 2 | 709.684,180 | 4.646.799,960 | 352,670 | |
| 3 | 709.686,310 | 4.646.798,430 | 352,560 | |
| 4 | 708.162,867 | 4.645.700,556 | 362,784 | |
| 5 | 708.151,871 | 4.645.699,612 | 362,872 | |
| 6 | 709.689,710 | 4.646.804,720 | 351,270 | |
| 7 | 709.686,190 | 4.646.810,540 | 350,730 | |
| 8 | 709.688,120 | 4.646.808,760 | 351,240 | |
| 9 | 709.677,250 | 4.646.813,920 | 350,980 | |
| 10 | 709.680,620 | 4.646.813,070 | 350,970 | |
| 11 | 709.687,430 | 4.646.816,100 | 350,730 | |
| 12 | 708.149,484 | 4.645.708,046 | 361,717 | |
| 13 | 709.679,300 | 4.646.817,710 | 351,030 | |
| 14 | 709.684,580 | 4.646.818,710 | 350,630 | |
| 15 | 709.687,400 | 4.646.817,610 | 350,770 | |
| 16 | 713.680,608 | 4.645.010,196 | 325,430 | ACEQUIA |
| 17 | 709.698,620 | 4.646.799,320 | 349,400 | |
| 18 | 709.703,600 | 4.646.799,540 | 349,190 | |
| 19 | 709.707,280 | 4.646.799,780 | 349,350 | |
| 20 | 709.710,690 | 4.646.799,290 | 348,370 | |
| 21 | 709.694,490 | 4.646.802,610 | 350,020 | |
| 22 | 708.162,782 | 4.645.624,467 | 363,989 | |
| 23 | 709.708,960 | 4.646.803,830 | 348,600 | |
| 24 | 713.531,807 | 4.645.127,050 | 325,940 | ACEQUIA |
| 25 | 713.495,396 | 4.645.093,493 | 326,270 | ACEQUIA |
| 26 | 709.739,600 | 4.646.801,700 | 347,370 | |
| 27 | 709.725,010 | 4.646.805,650 | 348,380 | |
| 28 | 705.898,109 | 4.645.116,810 | 384,778 | ACEQUIA |
| 29 | 708.188,243 | 4.645.533,712 | 365,448 | |
| 30 | 709.743,570 | 4.646.807,160 | 347,280 | |
| 31 | 709.749,480 | 4.646.804,270 | 347,260 | |
| 32 | 709.763,230 | 4.646.804,780 | 347,280 | |
| 33 | 709.755,320 | 4.646.809,540 | 347,280 | |
| 34 | 709.769,390 | 4.646.810,670 | 347,260 | |
| 35 | 713.364,021 | 4.644.420,610 | 337,730 | ACEQUIA |
| 36 | 709.780,940 | 4.646.811,640 | 347,250 | |
| 37 | 713.369,564 | 4.644.426,007 | 334,990 | ACEQUIA |
| 38 | 709.789,250 | 4.646.813,290 | 347,510 | |
| 39 | 709.793,900 | 4.646.813,200 | 346,090 | |
| 40 | 708.227,884 | 4.645.419,643 | 368,134 | |
| 41 | 709.807,710 | 4.646.809,730 | 345,990 | |
| 42 | 708.247,035 | 4.645.398,171 | 368,465 | |
| 43 | 708.260,588 | 4.645.385,199 | 367,987 | |
| 44 | 709.804,580 | 4.646.814,300 | 345,990 | |
| 45 | 712.503,439 | 4.644.998,360 | 340,510 | ACEQUIA |
| 46 | 709.832,630 | 4.646.812,140 | 345,980 | |
| 47 | 709.842,350 | 4.646.814,150 | 346,000 | |
| 48 | 710.911,578 | 4.646.661,711 | 340,020 | ACEQUIA |
| 49 | 709.842,270 | 4.646.818,560 | 346,030 | |
| 50 | 709.847,440 | 4.646.819,520 | 346,130 | |
| 51 | 709.851,890 | 4.646.814,480 | 346,250 | |
| 52 | 709.856,180 | 4.646.815,660 | 345,430 | |
| 53 | 708.295,061 | 4.645.341,548 | 367,076 | |
| 54 | 709.852,820 | 4.646.819,210 | 345,690 | |
| 55 | 710.965,419 | 4.646.674,661 | 341,420 | ACEQUIA |
| 56 | 709.879,580 | 4.646.817,620 | 344,920 | |
| 57 | 709.895,670 | 4.646.820,110 | 344,990 | |
| 58 | 709.913,040 | 4.646.820,230 | 345,030 | |
| 59 | 709.677,620 | 4.646.822,300 | 350,530 | |
| 60 | 709.682,640 | 4.646.821,020 | 350,730 | |
| 61 | 709.670,070 | 4.646.824,870 | 352,120 | |
| 62 | 709.965,293 | 4.646.931,753 | 343,230 | ACEQUIA |
| 63 | 709.670,790 | 4.646.831,830 | 350,710 | |
| 64 | 709.667,350 | 4.646.828,980 | 352,130 | |
| 65 | 709.674,110 | 4.646.830,520 | 350,580 | |
| 66 | 708.370,546 | 4.645.247,208 | 367,845 | |
| 67 | 709.549,088 | 4.646.669,053 | 348,900 | ACEQUIA |
| 68 | 709.871,670 | 4.646.822,500 | 344,930 | |
| 69 | 709.885,330 | 4.646.823,770 | 344,950 | |
| 70 | 709.897,660 | 4.646.825,040 | 345,030 | |
| 71 | 709.916,520 | 4.646.821,420 | 345,250 | |
| 72 | 708.409,396 | 4.645.217,664 | 368,052 | |
| 73 | 709.906,710 | 4.646.827,120 | 345,060 | |
| 74 | 709.910,040 | 4.646.827,540 | 345,230 | |
| 75 | 709.918,120 | 4.646.827,150 | 344,740 | |
| 76 | 709.935,130 | 4.646.824,340 | 344,530 | |
| 77 | 709.952,110 | 4.646.826,340 | 344,500 | |
| 78 | 708.397,919 | 4.645.208,270 | 366,634 | |
| 79 | 709.952,840 | 4.646.830,930 | 344,540 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 80 | 709.968,100 | 4.646.828,130 | 344,560 | |
| 81 | 707.603,928 | 4.646.001,033 | 363,980 | ACEQUIA |
| 82 | 709.976,880 | 4.646.829,420 | 344,560 | |
| 83 | 709.980,520 | 4.646.829,570 | 344,680 | |
| 84 | 709.972,690 | 4.646.833,760 | 344,600 | |
| 85 | 709.976,770 | 4.646.833,940 | 344,540 | |
| 86 | 709.989,580 | 4.646.830,400 | 344,470 | |
| 87 | 709.998,080 | 4.646.830,850 | 344,440 | |
| 88 | 709.986,720 | 4.646.834,220 | 344,510 | |
| 89 | 709.997,910 | 4.646.834,800 | 344,490 | |
| 90 | 709.682,220 | 4.646.846,220 | 350,280 | |
| 91 | 709.689,040 | 4.646.846,130 | 350,320 | |
| 92 | 709.689,880 | 4.646.862,110 | 350,470 | |
| 93 | 709.695,770 | 4.646.856,280 | 350,270 | |
| 94 | 707.734,133 | 4.644.983,182 | 367,900 | ACEQUIA |
| 95 | 707.723,333 | 4.644.986,627 | 367,970 | ACEQUIA |
| 96 | 709.703,650 | 4.646.892,110 | 350,360 | |
| 97 | 709.712,630 | 4.646.893,610 | 350,370 | |
| 98 | 709.712,400 | 4.646.908,470 | 350,340 | |
| 99 | 709.717,330 | 4.646.921,790 | 350,320 | |
| 100 | 708.313,478 | 4.645.094,829 | 368,110 | ACEQUIA |
| 101 | 711.198,617 | 4.647.384,728 | 341,990 | PT |
| 102 | 711.202,027 | 4.647.380,471 | 342,050 | PT |
| 103 | 709.736,250 | 4.646.945,170 | 350,360 | |
| 104 | 711.175,570 | 4.647.383,972 | 342,230 | PT |
| 105 | 711.148,524 | 4.647.392,536 | 342,410 | PT |
| 106 | 708.814,352 | 4.645.175,351 | 356,340 | ACEQUIA |
| 107 | 711.119,329 | 4.647.399,238 | 342,450 | PT |
| 108 | 708.406,337 | 4.645.138,920 | 366,233 | |
| 109 | 709.757,310 | 4.646.988,350 | 350,360 | |
| 110 | 709.751,460 | 4.646.994,420 | 350,220 | |
| 111 | 709.764,820 | 4.647.001,490 | 350,220 | |
| 112 | 708.413,808 | 4.645.133,873 | 365,982 | |
| 113 | 709.770,060 | 4.647.031,650 | 350,330 | |
| 114 | 711.063,124 | 4.647.420,842 | 343,490 | CABE |
| 115 | 711.036,075 | 4.647.428,614 | 343,420 | PT |
| 116 | 709.779,050 | 4.647.048,190 | 350,370 | |
| 117 | 711.005,358 | 4.647.429,061 | 343,360 | PT |
| 118 | 709.787,630 | 4.647.065,990 | 350,320 | |
| 119 | 708.937,354 | 4.645.748,027 | 356,540 | ACEQUIA |
| 120 | 710.982,592 | 4.647.432,296 | 343,380 | PT |
| 121 | 710.961,296 | 4.647.437,159 | 343,420 | PIE |
| 122 | 709.805,810 | 4.647.103,930 | 350,340 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 123 | 709.816,440 | 4.647.111,510 | 350,370 | |
| 124 | 710.958,799 | 4.647.448,928 | 343,840 | PISTA |
| 125 | 709.245,090 | 4.645.228,856 | 359,390 | ACEQUIA |
| 126 | 709.779,010 | 4.647.135,230 | 351,660 | |
| 127 | 710.925,323 | 4.647.447,702 | 343,850 | PT |
| 128 | 710.928,272 | 4.647.457,015 | 343,850 | PT |
| 129 | 710.891,675 | 4.647.466,259 | 343,940 | PT |
| 130 | 710.889,263 | 4.647.455,731 | 343,900 | PT |
| 131 | 709.805,600 | 4.647.120,040 | 350,280 | |
| 132 | 708.355,079 | 4.645.064,846 | 369,262 | |
| 133 | 710.807,994 | 4.647.487,036 | 344,090 | PT |
| 134 | 710.805,151 | 4.647.477,355 | 344,050 | PT |
| 135 | 708.937,957 | 4.645.185,273 | 357,780 | ACEQUIA |
| 136 | 709.815,000 | 4.647.124,440 | 350,180 | |
| 137 | 709.799,310 | 4.647.130,870 | 351,530 | |
| 138 | 709.834,340 | 4.647.115,180 | 348,660 | |
| 139 | 709.836,670 | 4.647.114,450 | 349,620 | |
| 140 | 710.725,071 | 4.647.497,183 | 344,370 | CABE |
| 141 | 710.721,792 | 4.647.497,689 | 344,740 | CABE |
| 142 | 709.836,580 | 4.647.119,290 | 349,570 | |
| 143 | 710.695,997 | 4.647.515,297 | 344,660 | PT |
| 144 | 709.829,120 | 4.647.121,940 | 349,300 | |
| 145 | 710.651,958 | 4.647.517,156 | 344,750 | PT |
| 146 | 709.834,140 | 4.647.122,720 | 349,690 | |
| 147 | 709.836,520 | 4.647.122,510 | 349,560 | |
| 148 | 710.623,424 | 4.647.524,516 | 344,970 | PT |
| 149 | 709.844,370 | 4.647.122,810 | 349,470 | |
| 150 | 710.622,044 | 4.647.535,598 | 345,140 | PT |
| 151 | 710.605,695 | 4.647.539,877 | 345,030 | PT |
| 152 | 710.602,473 | 4.647.529,566 | 345,050 | PT |
| 153 | 710.580,493 | 4.647.544,888 | 345,060 | PT |
| 154 | 709.895,860 | 4.647.124,740 | 349,470 | |
| 155 | 709.903,150 | 4.647.131,250 | 349,450 | |
| 156 | 709.918,640 | 4.647.127,740 | 349,480 | |
| 157 | 709.923,820 | 4.647.133,630 | 349,430 | |
| 158 | 709.935,070 | 4.647.128,110 | 349,460 | |
| 159 | 709.898,860 | 4.645.351,723 | 357,260 | ACEQUIA |
| 160 | 710.538,378 | 4.647.557,896 | 345,170 | PT |
| 161 | 710.525,158 | 4.647.561,276 | 345,280 | PT |
| 162 | 709.908,200 | 4.645.337,779 | 357,210 | ACEQUIA |
| 163 | 710.524,367 | 4.647.553,973 | 345,280 | PT |
| 164 | 708.204,526 | 4.645.005,581 | 369,618 | |
| 165 | 710.499,541 | 4.647.561,156 | 345,380 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 166 | 709.737,990 | 4.647.158,780 | 353,740 | |
| 167 | 710.488,732 | 4.647.572,259 | 345,510 | CANALETA |
| 168 | 709.726,090 | 4.647.163,800 | 353,980 | |
| 169 | 709.766,230 | 4.647.141,980 | 352,860 | |
| 170 | 710.546,926 | 4.645.472,209 | 352,650 | ACEQUIA |
| 171 | 710.802,498 | 4.645.503,958 | 350,650 | ACEQUIA |
| 172 | 709.772,620 | 4.647.145,350 | 351,560 | |
| 173 | 709.748,560 | 4.647.151,920 | 352,870 | |
| 174 | 709.752,260 | 4.647.150,640 | 352,690 | |
| 175 | 710.452,677 | 4.647.584,192 | 345,350 | PT |
| 176 | 709.750,990 | 4.647.157,490 | 352,790 | |
| 177 | 709.777,880 | 4.647.142,280 | 351,560 | |
| 178 | 710.449,278 | 4.647.586,958 | 345,600 | CABE |
| 179 | 710.448,147 | 4.647.586,683 | 344,820 | ACEQ |
| 180 | 710.446,286 | 4.647.587,347 | 345,750 | CABE |
| 181 | 711.687,857 | 4.645.500,119 | 342,660 | ACEQUIA |
| 182 | 710.446,436 | 4.647.576,442 | 344,850 | ACEQ |
| 183 | 708.061,512 | 4.644.947,576 | 370,686 | |
| 184 | 709.549,960 | 4.647.179,220 | 361,470 | |
| 185 | 710.414,653 | 4.647.595,178 | 345,660 | PT |
| 186 | 708.056,594 | 4.644.955,286 | 370,836 | |
| 187 | 710.387,800 | 4.647.594,470 | 345,650 | PT |
| 188 | 709.544,590 | 4.647.185,500 | 361,490 | |
| 189 | 709.563,970 | 4.647.183,610 | 361,300 | |
| 190 | 709.573,300 | 4.647.187,170 | 361,280 | |
| 191 | 710.344,356 | 4.647.553,214 | 345,870 | PT |
| 192 | 710.335,887 | 4.647.552,829 | 345,960 | CABE2 |
| 193 | 709.666,280 | 4.647.187,440 | 357,850 | |
| 194 | 710.337,493 | 4.647.557,815 | 346,240 | PISTA |
| 195 | 710.451,403 | 4.645.741,092 | 349,900 | ACEQUIA |
| 196 | 709.689,910 | 4.647.184,920 | 356,000 | |
| 197 | 709.673,260 | 4.647.185,250 | 357,860 | |
| 198 | 709.682,830 | 4.647.187,150 | 355,820 | |
| 199 | 709.675,620 | 4.647.190,520 | 357,760 | |
| 200 | 710.333,117 | 4.647.545,086 | 346,280 | CABE |
| 201 | 710.324,917 | 4.647.549,102 | 346,200 | PT |
| 202 | 710.454,784 | 4.645.475,884 | 354,070 | ACEQUIA |
| 203 | 709.924,281 | 4.645.474,955 | 356,180 | ACEQUIA |
| 204 | 709.718,570 | 4.647.179,840 | 354,970 | |
| 205 | 710.312,993 | 4.647.528,740 | 346,210 | PT |
| 206 | 709.711,450 | 4.647.182,780 | 355,220 | |
| 207 | 710.308,891 | 4.647.508,499 | 346,170 | PT |
| 208 | 707.950,052 | 4.644.861,459 | 375,196 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 209 | 709.714,850 | 4.647.187,670 | 355,130 | |
| 210 | 709.719,290 | 4.647.186,270 | 354,870 | |
| 211 | 710.296,704 | 4.647.489,015 | 346,290 | PT |
| 212 | 709.736,990 | 4.647.164,650 | 353,810 | |
| 213 | 709.723,700 | 4.647.170,870 | 354,880 | |
| 214 | 709.727,420 | 4.647.169,200 | 354,450 | |
| 215 | 710.283,829 | 4.647.483,681 | 346,410 | CABE |
| 216 | 710.272,408 | 4.647.466,171 | 346,840 | PT |
| 217 | 710.279,921 | 4.647.461,301 | 346,830 | PT |
| 218 | 710.273,603 | 4.647.450,486 | 346,890 | CABE |
| 219 | 710.266,336 | 4.647.453,374 | 346,830 | CABE |
| 220 | 708.364,073 | 4.644.983,479 | 368,887 | |
| 221 | 710.272,887 | 4.647.448,268 | 348,320 | CABE2 |
| 222 | 708.367,733 | 4.644.983,487 | 368,560 | |
| 223 | 709.587,550 | 4.647.197,740 | 359,590 | |
| 224 | 710.249,897 | 4.647.427,741 | 348,210 | CABE |
| 225 | 708.410,332 | 4.644.981,148 | 368,250 | |
| 226 | 709.610,980 | 4.647.203,500 | 359,850 | |
| 227 | 709.609,130 | 4.647.215,560 | 359,720 | |
| 228 | 707.600,944 | 4.644.954,392 | 374,390 | ACEQUIA |
| 229 | 710.251,747 | 4.647.406,245 | 350,990 | PT |
| 230 | 710.240,557 | 4.647.396,221 | 351,230 | CABE |
| 231 | 709.622,410 | 4.647.201,660 | 359,570 | |
| 232 | 709.632,170 | 4.647.203,680 | 358,400 | |
| 233 | 709.638,460 | 4.647.203,900 | 357,810 | |
| 234 | 710.239,819 | 4.647.371,242 | 354,670 | PT |
| 235 | 710.232,895 | 4.647.376,859 | 354,740 | PT |
| 236 | 710.226,343 | 4.647.358,141 | 354,780 | PT |
| 237 | 709.625,420 | 4.647.209,840 | 358,450 | |
| 238 | 710.230,525 | 4.647.338,253 | 354,850 | CABE2 |
| 239 | 708.544,568 | 4.644.979,862 | 365,679 | |
| 240 | 710.230,197 | 4.647.335,511 | 354,800 | CABE |
| 241 | 710.219,280 | 4.647.335,582 | 354,860 | CABE |
| 242 | 709.715,710 | 4.647.192,170 | 355,010 | |
| 243 | 710.219,179 | 4.647.336,700 | 354,510 | ACEQ |
| 244 | 706.573,929 | 4.644.836,601 | 377,910 | ACEQUIA |
| 245 | 709.729,120 | 4.647.198,520 | 355,080 | |
| 246 | 710.216,737 | 4.647.291,379 | 354,700 | PT |
| 247 | 708.583,928 | 4.644.990,554 | 363,726 | |
| 248 | 710.205,298 | 4.647.291,654 | 354,740 | PT |
| 249 | 710.189,433 | 4.647.297,166 | 354,740 | PT |
| 250 | 709.594,400 | 4.647.227,800 | 359,740 | |
| 251 | 706.296,945 | 4.644.866,053 | 380,070 | ACEQUIA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 252 | 710.172,338 | 4.647.312,907 | 354,930 | PT |
| 253 | 709.613,940 | 4.647.218,190 | 359,580 | |
| 254 | 709.434,570 | 4.647.250,660 | 361,050 | |
| 255 | 709.446,010 | 4.647.254,380 | 361,520 | |
| 256 | 710.138,427 | 4.647.316,046 | 354,950 | PT |
| 257 | 710.114,128 | 4.647.325,339 | 354,950 | PT |
| 258 | 706.145,065 | 4.644.927,299 | 381,710 | ACEQUIA |
| 259 | 706.154,455 | 4.644.944,073 | 381,630 | ACEQUIA |
| 260 | 709.482,070 | 4.647.259,260 | 361,750 | |
| 261 | 710.093,806 | 4.647.335,374 | 354,800 | ACEQ |
| 262 | 708.637,863 | 4.644.992,665 | 362,083 | |
| 263 | 709.482,050 | 4.647.269,520 | 361,910 | |
| 264 | 709.566,990 | 4.647.253,220 | 359,510 | |
| 265 | 710.088,982 | 4.647.344,717 | 355,130 | PT |
| 266 | 709.560,910 | 4.647.263,730 | 359,520 | |
| 267 | 710.061,297 | 4.647.355,314 | 355,230 | PT |
| 268 | 709.556,840 | 4.647.281,450 | 359,670 | |
| 269 | 709.560,730 | 4.647.284,810 | 359,640 | |
| 270 | 710.016,080 | 4.647.366,740 | 355,670 | PT |
| 271 | 710.018,304 | 4.647.375,765 | 355,310 | PT |
| 272 | 709.547,050 | 4.647.314,250 | 359,760 | |
| 273 | 709.553,350 | 4.647.317,180 | 359,730 | |
| 274 | 709.988,651 | 4.647.397,813 | 355,670 | PT |
| 275 | 709.550,510 | 4.647.330,990 | 360,650 | |
| 276 | 709.539,650 | 4.647.343,960 | 360,660 | |
| 277 | 706.905,260 | 4.644.460,491 | 381,250 | ACEQUIA |
| 278 | 709.545,310 | 4.647.356,140 | 360,730 | |
| 279 | 709.537,480 | 4.647.357,220 | 360,690 | |
| 280 | 709.533,510 | 4.647.404,060 | 358,680 | |
| 281 | 709.979,032 | 4.647.432,978 | 353,160 | PT |
| 282 | 709.980,523 | 4.647.424,599 | 353,630 | CABE2 |
| 283 | 710.107,515 | 4.647.606,382 | 347,470 | ACEQUIA |
| 284 | 709.531,830 | 4.647.415,020 | 357,580 | |
| 285 | 709.532,800 | 4.647.426,190 | 357,580 | |
| 286 | 709.539,500 | 4.647.405,630 | 358,750 | |
| 287 | 709.538,080 | 4.647.413,030 | 357,270 | |
| 288 | 709.537,980 | 4.647.416,160 | 357,600 | |
| 289 | 709.976,887 | 4.647.473,964 | 352,570 | PT |
| 290 | 709.976,551 | 4.647.477,691 | 352,800 | CABE |
| 291 | 709.967,484 | 4.647.474,684 | 352,790 | CABE |
| 292 | 709.967,291 | 4.647.475,678 | 352,670 | CUNETA |
| 293 | 710.611,877 | 4.647.448,909 | 343,740 | ACEQUIA |
| 294 | 709.974,322 | 4.647.480,434 | 353,090 | CARRETERA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 295 | 709.972,773 | 4.647.484,957 | 353,080 | CARRETERA |
| 296 | 709.963,762 | 4.647.482,220 | 353,410 | CARRETERA |
| 297 | 710.916,293 | 4.647.353,532 | 345,270 | ACEQUIA |
| 298 | 709.963,800 | 4.647.483,185 | 353,050 | CUNETA |
| 299 | 709.535,890 | 4.647.450,730 | 356,640 | |
| 300 | 711.210,085 | 4.647.373,011 | 340,240 | ACEQUIA |
| 301 | 709.976,861 | 4.647.487,741 | 352,630 | CUNETA |
| 302 | 709.970,263 | 4.647.495,369 | 352,850 | PT |
| 303 | 709.484,220 | 4.647.483,760 | 356,970 | |
| 304 | 709.496,610 | 4.647.480,960 | 356,720 | |
| 305 | 709.529,930 | 4.647.460,310 | 356,670 | |
| 306 | 710.476,386 | 4.647.567,313 | 345,570 | ACEQUIA |
| 307 | 709.516,870 | 4.647.467,600 | 356,650 | |
| 308 | 710.213,501 | 4.647.284,316 | 354,650 | CABE |
| 309 | 710.446,324 | 4.647.575,867 | 344,420 | ACEQUIA |
| 310 | 709.510,170 | 4.647.471,040 | 356,640 | |
| 311 | 710.203,587 | 4.647.282,587 | 354,980 | CABE2 |
| 312 | 710.211,735 | 4.647.635,515 | 346,010 | ACEQUIA |
| 313 | 710.200,916 | 4.647.638,324 | 346,100 | ACEQUIA |
| 314 | 710.203,347 | 4.647.277,048 | 354,740 | PT |
| 315 | 709.450,460 | 4.647.501,440 | 356,310 | |
| 316 | 709.476,130 | 4.647.487,280 | 356,340 | |
| 317 | 709.469,590 | 4.647.490,750 | 356,260 | |
| 318 | 710.198,031 | 4.647.605,525 | 344,880 | ACEQUIA |
| 319 | 709.473,470 | 4.647.493,430 | 356,660 | |
| 320 | 710.190,531 | 4.647.228,642 | 354,760 | PT |
| 321 | 710.188,167 | 4.647.222,229 | 354,840 | PT |
| 322 | 709.488,940 | 4.647.486,740 | 356,930 | |
| 323 | 710.199,536 | 4.647.661,264 | 344,770 | ACEQUIA |
| 324 | 710.187,433 | 4.647.221,025 | 354,750 | CANALETA |
| 325 | 710.191,468 | 4.647.654,340 | 345,040 | ACEQUIA |
| 326 | 709.434,940 | 4.647.534,620 | 356,270 | |
| 327 | 710.116,307 | 4.647.674,922 | 344,510 | ACEQUIA |
| 328 | 710.191,936 | 4.647.211,148 | 354,950 | CARRETERA |
| 329 | 710.115,652 | 4.647.686,838 | 344,180 | ACEQUIA |
| 330 | 710.012,490 | 4.646.837,650 | 344,500 | |
| 331 | 710.183,073 | 4.647.204,591 | 354,140 | PT |
| 332 | 710.034,270 | 4.646.835,340 | 344,580 | |
| 333 | 710.037,220 | 4.646.835,160 | 344,710 | |
| 334 | 710.045,990 | 4.646.836,600 | 344,540 | |
| 335 | 710.028,720 | 4.646.839,720 | 344,490 | |
| 336 | 710.216,364 | 4.647.213,259 | 354,710 | PT |
| 337 | 710.236,298 | 4.647.213,076 | 354,720 | CABE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 338 | 710.233,288 | 4.647.208,583 | 354,720 | CABE |
| 339 | 710.238,086 | 4.647.207,813 | 354,260 | CABE2 |
| 340 | 709.292,785 | 4.647.924,620 | 348,630 | ACEQUIA |
| 341 | 710.255,411 | 4.647.208,249 | 354,240 | PT |
| 342 | 710.254,456 | 4.647.201,523 | 354,360 | PT |
| 343 | 710.271,965 | 4.647.197,046 | 354,550 | PT |
| 344 | 709.189,415 | 4.647.952,807 | 351,270 | ACEQUIA |
| 345 | 710.087,010 | 4.646.850,780 | 344,570 | |
| 346 | 710.110,530 | 4.646.853,190 | 344,480 | |
| 347 | 710.104,340 | 4.646.855,380 | 344,460 | |
| 348 | 710.301,046 | 4.647.192,223 | 354,080 | PT |
| 349 | 709.024,462 | 4.648.003,430 | 349,750 | ACEQUIA |
| 350 | 710.317,543 | 4.647.181,466 | 354,140 | PT |
| 351 | 708.682,920 | 4.648.106,722 | 349,750 | ACEQUIA |
| 352 | 710.329,518 | 4.647.177,634 | 354,220 | PT |
| 353 | 710.139,570 | 4.646.861,910 | 344,660 | |
| 354 | 710.141,820 | 4.646.862,360 | 344,330 | |
| 355 | 710.137,530 | 4.646.866,660 | 344,410 | |
| 356 | 708.508,091 | 4.648.169,584 | 353,020 | ACEQUIA |
| 357 | 710.496,296 | 4.647.113,782 | 353,480 | CARRETERA |
| 358 | 710.176,310 | 4.646.871,570 | 344,290 | |
| 359 | 710.174,750 | 4.646.878,250 | 344,320 | |
| 360 | 710.188,520 | 4.646.877,120 | 344,450 | |
| 361 | 710.488,124 | 4.647.113,066 | 354,040 | CABE2 |
| 362 | 710.195,870 | 4.646.877,080 | 344,040 | |
| 363 | 708.149,222 | 4.648.279,319 | 352,730 | ACEQUIA |
| 364 | 710.187,260 | 4.646.881,000 | 344,380 | |
| 365 | 708.148,499 | 4.648.272,181 | 352,740 | ACEQUIA |
| 366 | 710.529,210 | 4.647.094,735 | 352,870 | PT |
| 367 | 710.548,937 | 4.647.087,487 | 352,870 | PT |
| 368 | 710.551,570 | 4.647.092,832 | 352,840 | PT |
| 369 | 710.563,953 | 4.647.083,688 | 352,890 | CABE |
| 370 | 710.562,861 | 4.647.090,271 | 353,050 | CABE |
| 371 | 707.701,657 | 4.648.388,809 | 354,710 | ACEQUIA |
| 372 | 710.072,960 | 4.647.152,300 | 349,520 | |
| 373 | 710.089,270 | 4.647.148,230 | 349,480 | |
| 374 | 707.696,254 | 4.648.381,519 | 354,400 | ACEQUIA |
| 375 | 710.093,660 | 4.647.157,110 | 349,580 | |
| 376 | 710.098,690 | 4.647.160,010 | 350,460 | |
| 377 | 710.119,030 | 4.647.156,820 | 350,220 | |
| 378 | 707.205,248 | 4.648.515,143 | 363,760 | ACEQUIA |
| 379 | 710.576,449 | 4.647.080,793 | 351,790 | PISTA |
| 380 | 710.576,093 | 4.647.072,638 | 351,220 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 381 | 710.125,770 | 4.647.171,000 | 351,960 | |
| 382 | 710.584,262 | 4.647.053,686 | 350,600 | PT |
| 383 | 707.253,884 | 4.648.026,703 | 361,150 | ACEQUIA |
| 384 | 710.135,520 | 4.647.172,490 | 352,570 | |
| 385 | 710.585,817 | 4.647.076,575 | 350,850 | CABE |
| 386 | 710.586,336 | 4.647.078,083 | 350,180 | ACEQ |
| 387 | 707.368,971 | 4.647.893,198 | 361,540 | ACEQUIA |
| 388 | 710.579,363 | 4.647.078,487 | 350,830 | CABE |
| 389 | 710.578,418 | 4.647.049,133 | 350,360 | PT |
| 390 | 710.583,787 | 4.647.050,053 | 350,680 | PT |
| 391 | 710.583,232 | 4.647.045,298 | 349,670 | PT |
| 392 | 707.431,696 | 4.647.792,433 | 362,530 | ACEQUIA |
| 393 | 710.581,611 | 4.647.036,833 | 349,500 | PT |
| 394 | 707.415,296 | 4.647.781,559 | 362,180 | ACEQUIA |
| 395 | 707.408,620 | 4.647.776,527 | 362,120 | ACEQUIA |
| 396 | 710.574,671 | 4.647.018,873 | 348,880 | PT |
| 397 | 707.733,217 | 4.647.644,758 | 358,170 | ACEQUIA |
| 398 | 710.564,542 | 4.647.001,761 | 348,260 | PT |
| 399 | 710.570,055 | 4.646.998,945 | 348,080 | PT |
| 400 | 710.556,713 | 4.646.989,615 | 347,740 | PT |
| 401 | 710.553,469 | 4.646.995,706 | 348,140 | PT |
| 402 | 707.464,513 | 4.647.558,325 | 360,740 | ACEQUIA |
| 403 | 710.545,517 | 4.646.984,147 | 347,440 | PT |
| 404 | 710.578,274 | 4.647.093,536 | 352,920 | CARRETERA |
| 405 | 710.578,289 | 4.647.099,229 | 352,840 | CARRETERA |
| 406 | 710.583,952 | 4.647.099,197 | 352,940 | CARRETERA |
| 407 | 710.584,736 | 4.647.093,778 | 352,860 | CARRETERA |
| 408 | 707.136,712 | 4.647.116,363 | 376,420 | ACEQUIA |
| 409 | 707.367,653 | 4.646.558,679 | 375,460 | ACEQUIA |
| 410 | 710.577,686 | 4.647.103,337 | 352,810 | ACEQ |
| 411 | 710.584,175 | 4.647.103,681 | 352,870 | ACEQ |
| 412 | 707.353,826 | 4.646.557,566 | 375,660 | ACEQUIA |
| 413 | 710.575,753 | 4.647.104,416 | 353,140 | CABE |
| 414 | 710.577,605 | 4.647.111,185 | 352,930 | |
| 415 | 710.583,109 | 4.647.110,965 | 352,950 | |
| 416 | 710.583,162 | 4.647.104,776 | 353,150 | |
| 417 | 710.599,278 | 4.647.106,187 | 353,100 | |
| 418 | 708.133,929 | 4.646.318,953 | 369,560 | ACEQUIA |
| 419 | 710.623,923 | 4.647.113,153 | 352,950 | |
| 420 | 710.624,548 | 4.647.105,853 | 353,020 | |
| 421 | 710.648,320 | 4.647.106,579 | 352,860 | |
| 422 | 708.178,609 | 4.646.379,573 | 372,840 | ACEQUIA |
| 423 | 710.660,527 | 4.647.114,996 | 352,860 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 424 | 710.660,581 | 4.647.106,263 | 352,800 | |
| 425 | 710.664,558 | 4.647.131,462 | 352,850 | |
| 426 | 708.648,438 | 4.646.977,759 | 369,500 | ACEQUIA |
| 427 | 710.662,914 | 4.647.150,541 | 352,890 | CABE |
| 428 | 708.630,635 | 4.646.983,683 | 369,480 | ACEQUIA |
| 429 | 710.667,869 | 4.647.150,992 | 352,350 | ACEQ |
| 430 | 708.519,842 | 4.646.790,848 | 361,740 | ACEQUIA |
| 431 | 710.662,323 | 4.647.156,068 | 353,400 | CABE2 |
| 432 | 708.821,064 | 4.646.978,910 | 364,480 | ACEQUIA |
| 433 | 710.671,892 | 4.647.161,296 | 353,090 | PT |
| 434 | 708.812,934 | 4.646.981,890 | 364,930 | ACEQUIA |
| 435 | 709.097,926 | 4.647.267,917 | 361,500 | ACEQUIA |
| 436 | 710.680,717 | 4.647.107,586 | 352,790 | PT |
| 437 | 710.694,132 | 4.647.109,378 | 353,020 | CANALETA |
| 438 | 710.695,024 | 4.647.114,982 | 352,930 | CANALETA |
| 439 | 710.696,435 | 4.647.115,178 | 352,590 | CABE |
| 440 | 710.695,751 | 4.647.108,819 | 352,600 | CABE |
| 441 | 710.709,148 | 4.647.108,953 | 352,420 | PT |
| 442 | 710.710,136 | 4.647.114,089 | 352,430 | PT |
| 443 | 710.722,396 | 4.647.110,453 | 352,430 | PT |
| 444 | 710.721,192 | 4.647.105,381 | 352,540 | PT |
| 445 | 710.741,222 | 4.647.099,162 | 352,640 | PT |
| 446 | 710.744,569 | 4.647.104,838 | 352,530 | PT |
| 447 | 710.756,879 | 4.647.099,863 | 352,420 | PT |
| 448 | 710.754,855 | 4.647.094,636 | 352,530 | PT |
| 449 | 710.590,560 | 4.647.090,813 | 352,060 | PT |
| 450 | 710.593,347 | 4.647.084,564 | 351,630 | PT |
| 451 | 710.616,503 | 4.647.086,920 | 352,420 | PT |
| 452 | 709.215,883 | 4.647.773,897 | 355,300 | ACEQUIA |
| 453 | 709.209,155 | 4.647.775,106 | 354,680 | ACEQUIA |
| 454 | 710.644,441 | 4.647.087,341 | 352,410 | PT |
| 455 | 710.667,248 | 4.647.088,442 | 352,390 | PT |
| 456 | 710.667,372 | 4.647.094,589 | 352,400 | PT |
| 457 | 709.167,319 | 4.648.452,039 | 347,990 | ACEQUIA |
| 458 | 710.689,019 | 4.647.090,268 | 352,350 | PT |
| 459 | 710.689,277 | 4.647.097,770 | 352,330 | PT |
| 460 | 710.704,198 | 4.647.094,154 | 352,470 | CABE |
| 461 | 709.824,996 | 4.648.815,274 | 342,280 | ACEQUIA |
| 462 | 710.703,408 | 4.647.090,005 | 351,670 | ACEQ |
| 463 | 710.704,951 | 4.647.092,648 | 351,700 | ACEQ |
| 464 | 710.706,810 | 4.647.093,177 | 352,460 | CABE2 |
| 465 | 710.705,804 | 4.647.089,340 | 352,420 | CABE2 |
| 466 | 710.706,760 | 4.647.095,621 | 352,660 | CABE2 |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 467 | 710.221,829 | 4.648.759,866 | 341,820 | ACEQUIA |
| 468 | 710.711,623 | 4.647.088,879 | 352,370 | PT |
| 469 | 710.727,036 | 4.647.085,713 | 352,410 | PT |
| 470 | 710.223,117 | 4.648.763,659 | 342,030 | ACEQUIA |
| 471 | 709.904,602 | 4.648.222,920 | 344,150 | ACEQUIA |
| 472 | 710.734,221 | 4.647.082,270 | 352,540 | PT |
| 473 | 710.750,485 | 4.647.078,451 | 352,390 | PT |
| 474 | 710.751,696 | 4.647.082,960 | 352,320 | PT |
| 475 | 710.761,146 | 4.647.078,337 | 352,300 | PT |
| 476 | 705.329,632 | 4.647.263,731 | 380,620 | ACEQUIA |
| 477 | 710.787,270 | 4.647.070,770 | 352,740 | PT |
| 478 | 710.785,771 | 4.647.064,982 | 352,460 | PT |
| 479 | 710.803,614 | 4.647.060,756 | 352,500 | PT |
| 480 | 706.081,492 | 4.646.946,539 | 387,580 | ACEQUIA |
| 481 | 710.808,068 | 4.647.064,055 | 352,070 | PT |
| 482 | 706.075,791 | 4.646.944,975 | 387,440 | ACEQUIA |
| 483 | 710.823,201 | 4.647.059,089 | 352,190 | PT |
| 484 | 710.822,052 | 4.647.055,054 | 352,130 | PT |
| 485 | 710.839,023 | 4.647.050,533 | 351,780 | PT |
| 486 | 706.202,489 | 4.646.718,436 | 379,940 | ACEQUIA |
| 487 | 710.875,630 | 4.647.042,239 | 351,910 | PT |
| 488 | 710.874,368 | 4.647.037,026 | 351,990 | PT |
| 489 | 706.434,879 | 4.647.101,619 | 381,130 | ACEQUIA |
| 490 | 710.882,590 | 4.647.040,882 | 351,820 | PT |
| 491 | 710.904,913 | 4.647.033,893 | 351,850 | PT |
| 492 | 710.903,214 | 4.647.027,652 | 351,810 | PT |
| 493 | 710.904,347 | 4.647.026,820 | 351,770 | ASPERSOR |
| 494 | 710.921,184 | 4.647.021,670 | 351,820 | ASPERSOR |
| 495 | 706.843,975 | 4.646.513,080 | 381,360 | ACEQUIA |
| 496 | 710.930,673 | 4.647.025,888 | 351,870 | PT |
| 497 | 710.938,681 | 4.647.016,376 | 351,870 | ASPERSOR |
| 498 | 710.947,976 | 4.647.013,108 | 351,810 | PT |
| 499 | 710.951,646 | 4.647.019,624 | 351,850 | PT |
| 500 | 710.956,042 | 4.647.010,986 | 351,700 | ASPERSOR |
| 501 | 710.966,150 | 4.647.009,479 | 351,520 | PT |
| 502 | 710.970,898 | 4.647.015,161 | 351,580 | PT |
| 503 | 706.292,836 | 4.645.998,364 | 387,310 | ACEQUIA |
| 504 | 710.991,442 | 4.647.005,358 | 351,610 | ASPERSOR |
| 505 | 710.993,279 | 4.647.012,247 | 351,680 | PT |
| 506 | 706.298,972 | 4.645.822,553 | 382,960 | ACEQUIA |
| 507 | 711.018,878 | 4.647.008,866 | 351,730 | PT |
| 508 | 711.026,980 | 4.646.999,703 | 351,600 | ASPERSOR |
| 509 | 711.034,083 | 4.646.997,223 | 351,790 | CABE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 510 | 711.036,395 | 4.647.003,768 | 351,670 | CABE |
| 511 | 711.038,235 | 4.647.001,632 | 351,110 | CUNETA |
| 512 | 711.036,075 | 4.646.997,121 | 351,160 | CUNETA |
| 513 | 711.038,198 | 4.646.997,833 | 351,700 | CARRETERA |
| 514 | 711.043,623 | 4.646.995,997 | 351,760 | CARRETERA |
| 515 | 711.049,904 | 4.647.003,959 | 351,660 | CARRETERA |
| 516 | 711.045,382 | 4.647.007,340 | 351,700 | CARRETERA |
| 517 | 711.057,682 | 4.647.003,035 | 351,360 | CANALETA |
| 518 | 711.047,221 | 4.646.995,480 | 351,550 | CANALETA |
| 519 | 711.052,468 | 4.646.992,302 | 351,500 | PT |
| 520 | 711.066,179 | 4.646.986,134 | 351,450 | PT |
| 521 | 711.068,880 | 4.646.979,556 | 351,300 | PT |
| 522 | 711.057,536 | 4.646.987,530 | 351,380 | PT |
| 523 | 711.061,146 | 4.646.977,642 | 351,330 | PT |
| 524 | 710.656,440 | 4.648.161,980 | 343,515 | ACEQUIA |
| 525 | 711.069,088 | 4.646.968,006 | 351,350 | PT |
| 526 | 711.071,849 | 4.646.953,106 | 351,320 | PT |
| 527 | 711.065,711 | 4.646.952,132 | 351,320 | PT |
| 528 | 711.067,940 | 4.646.933,131 | 351,340 | PT |
| 529 | 710.548,346 | 4.647.105,231 | 353,444 | ACEQUIA |
| 530 | 711.075,441 | 4.646.917,503 | 351,320 | PT |
| 531 | 711.069,489 | 4.646.918,549 | 351,350 | PT |
| 532 | 710.555,016 | 4.647.103,247 | 353,532 | ACEQUIA |
| 533 | 711.076,698 | 4.646.909,577 | 351,270 | CABE |
| 534 | 711.075,777 | 4.646.907,903 | 351,420 | CANALETA |
| 535 | 711.071,118 | 4.646.909,515 | 351,410 | CANALETA |
| 536 | 706.150,407 | 4.646.676,179 | 384,195 | ACEQUIA |
| 537 | 711.074,266 | 4.646.906,602 | 352,110 | CABE2 |
| 538 | 706.136,746 | 4.645.618,349 | 387,368 | ACEQUIA |
| 539 | 706.007,117 | 4.645.374,415 | 382,810 | ACEQUIA |
| 540 | 711.073,511 | 4.646.891,200 | 351,370 | PT |
| 541 | 706.011,327 | 4.645.372,772 | 382,709 | ACEQUIA |
| 542 | 711.080,469 | 4.646.878,734 | 351,380 | PT |
| 543 | 711.074,357 | 4.646.878,432 | 351,420 | PT |
| 544 | 711.075,681 | 4.646.862,143 | 351,450 | PT |
| 545 | 711.082,580 | 4.646.861,816 | 351,390 | PT |
| 546 | 711.083,905 | 4.646.843,373 | 351,440 | PT |
| 547 | 706.273,925 | 4.644.900,466 | 381,976 | ACEQUIA |
| 548 | 711.079,989 | 4.646.823,404 | 351,430 | PT |
| 549 | 711.088,472 | 4.646.824,799 | 351,440 | PT |
| 550 | 711.051,509 | 4.646.996,748 | 350,510 | DESAGUE |
| 551 | 706.700,185 | 4.645.136,317 | 376,789 | ACEQUIA |
| 552 | 711.062,747 | 4.647.000,959 | 350,890 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 553 | 711.075,585 | 4.646.998,697 | 350,720 | PT |
| 554 | 711.074,504 | 4.646.993,933 | 350,580 | DESAGUE |
| 555 | 711.080,547 | 4.646.989,869 | 350,610 | PT |
| 556 | 711.085,798 | 4.646.991,209 | 350,650 | PT |
| 557 | 711.086,608 | 4.646.997,449 | 350,810 | PT |
| 558 | 711.103,241 | 4.646.993,569 | 350,620 | PT |
| 559 | 711.103,599 | 4.646.988,602 | 350,530 | PT |
| 560 | 706.747,719 | 4.645.248,172 | 376,121 | ACEQUIA |
| 561 | 711.128,563 | 4.646.982,928 | 350,560 | PT |
| 562 | 711.151,391 | 4.646.979,679 | 350,570 | PT |
| 563 | 711.153,815 | 4.646.987,473 | 350,680 | PT |
| 564 | 706.800,585 | 4.645.389,064 | 375,387 | ACEQUIA |
| 565 | 711.167,438 | 4.646.984,976 | 350,670 | PT |
| 566 | 706.849,398 | 4.645.529,847 | 376,512 | ACEQUIA |
| 567 | 711.176,953 | 4.646.983,781 | 350,660 | CABE |
| 568 | 711.169,446 | 4.646.985,098 | 350,750 | CABE |
| 569 | 711.169,661 | 4.646.988,174 | 350,390 | CUNETA |
| 570 | 711.179,714 | 4.646.985,942 | 350,290 | CUNETA |
| 571 | 711.180,004 | 4.646.986,856 | 350,570 | PISTA |
| 572 | 711.182,006 | 4.646.990,974 | 350,630 | PISTA |
| 573 | 711.174,542 | 4.646.992,781 | 350,720 | PISTA |
| 574 | 711.173,002 | 4.646.988,405 | 350,610 | PISTA |
| 575 | 711.172,947 | 4.646.995,239 | 350,440 | CANALETA |
| 576 | 711.183,374 | 4.646.993,444 | 350,190 | CANALETA |
| 577 | 711.184,310 | 4.646.995,063 | 349,860 | PIE |
| 578 | 711.176,066 | 4.646.996,522 | 349,830 | PIE |
| 579 | 711.178,701 | 4.646.997,889 | 350,350 | CABE2 |
| 580 | 711.185,861 | 4.646.995,259 | 350,250 | CABE2 |
| 581 | 711.192,121 | 4.647.001,204 | 350,310 | PT |
| 582 | 713.512,627 | 4.645.105,808 | 325,960 | ACEQUIA |
| 583 | 711.199,198 | 4.647.017,786 | 350,260 | PT |
| 584 | 713.183,428 | 4.645.054,281 | 329,040 | ACEQUIA |
| 585 | 711.217,215 | 4.647.031,349 | 350,150 | PT |
| 586 | 713.174,505 | 4.645.045,721 | 329,160 | ACEQUIA |
| 587 | 711.226,229 | 4.647.049,330 | 350,310 | PT |
| 588 | 711.230,109 | 4.647.044,860 | 350,020 | PT |
| 589 | 711.247,709 | 4.647.066,173 | 350,340 | PT |
| 590 | 712.819,928 | 4.645.101,357 | 329,680 | ACEQUIA |
| 591 | 711.255,929 | 4.647.084,543 | 350,110 | PT |
| 592 | 711.261,234 | 4.647.081,874 | 350,040 | PT |
| 593 | 711.266,900 | 4.647.091,982 | 350,140 | CORONA |
| 594 | 711.266,401 | 4.647.084,262 | 350,300 | CORONA |
| 595 | 711.269,828 | 4.647.098,317 | 349,680 | CORONA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 596 | 712.957,392 | 4.644.567,785 | 337,290 | ACEQUIA |
| 597 | 711.280,777 | 4.647.105,452 | 348,620 | CORONA |
| 598 | 711.285,663 | 4.647.107,245 | 348,260 | CORONA |
| 599 | 711.290,860 | 4.647.111,956 | 347,790 | PT |
| 600 | 711.301,649 | 4.647.119,996 | 347,030 | PT |
| 601 | 711.310,822 | 4.647.123,888 | 346,600 | PT |
| 602 | 711.319,277 | 4.647.126,552 | 346,200 | PT |
| 603 | 711.323,299 | 4.647.122,420 | 346,160 | PT |
| 604 | 711.326,539 | 4.647.115,276 | 346,040 | CORONA |
| 605 | 711.333,911 | 4.647.113,447 | 345,470 | CORONA |
| 606 | 711.340,324 | 4.647.108,238 | 345,200 | CORONA |
| 607 | 711.343,756 | 4.647.103,248 | 345,150 | CORONA |
| 608 | 711.320,762 | 4.647.115,690 | 346,410 | CORONA |
| 609 | 711.641,001 | 4.646.482,266 | 337,540 | ACEQUIA |
| 610 | 711.306,867 | 4.647.113,690 | 347,000 | CORONA |
| 611 | 711.297,730 | 4.647.111,121 | 347,430 | CORONA |
| 612 | 711.649,489 | 4.646.497,869 | 338,030 | ACEQUIA |
| 613 | 711.282,265 | 4.647.105,927 | 348,460 | CORONA |
| 614 | 711.118,287 | 4.646.858,161 | 351,070 | ACEQUIA |
| 615 | 711.272,487 | 4.647.100,939 | 349,290 | CORONA |
| 616 | 711.269,446 | 4.647.097,790 | 349,660 | CORONA |
| 617 | 711.266,818 | 4.647.092,538 | 350,110 | CORONA |
| 618 | 711.266,582 | 4.647.085,412 | 350,330 | CORONA |
| 619 | 711.178,399 | 4.646.980,847 | 350,240 | PT |
| 620 | 711.177,032 | 4.646.974,274 | 350,410 | PT |
| 621 | 711.191,021 | 4.646.971,739 | 350,490 | PT |
| 622 | 711.194,394 | 4.646.976,750 | 350,640 | PT |
| 623 | 711.214,082 | 4.646.966,069 | 350,590 | PT |
| 624 | 711.211,761 | 4.646.959,733 | 350,510 | PT |
| 625 | 711.222,220 | 4.646.954,143 | 350,520 | PT |
| 626 | 711.224,986 | 4.646.959,588 | 350,490 | PT |
| 627 | 711.238,640 | 4.646.948,589 | 350,630 | PT |
| 628 | 708.431,963 | 4.646.040,316 | 356,700 | ACEQUIA |
| 629 | 711.254,651 | 4.646.933,646 | 350,510 | PT |
| 630 | 711.249,237 | 4.646.923,001 | 350,450 | PT |
| 631 | 711.266,945 | 4.646.913,297 | 350,470 | PT |
| 632 | 711.263,914 | 4.646.903,778 | 350,540 | PT |
| 633 | 711.274,432 | 4.646.890,211 | 350,520 | PT |
| 634 | 711.282,180 | 4.646.886,531 | 350,560 | PT |
| 635 | 711.287,027 | 4.646.880,246 | 350,540 | PT |
| 636 | 711.279,672 | 4.646.878,318 | 350,580 | PT |
| 637 | 711.289,582 | 4.646.860,551 | 350,570 | PT |
| 638 | 707.614,430 | 4.645.826,562 | 361,380 | ACEQUIA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 639 | 711.309,925 | 4.646.844,033 | 350,540 | PT |
| 640 | 711.301,865 | 4.646.841,005 | 350,530 | PT |
| 641 | 708.451,590 | 4.645.810,835 | 362,150 | ACEQUIA |
| 642 | 711.319,455 | 4.646.827,769 | 350,520 | PT |
| 643 | 711.320,703 | 4.646.821,272 | 350,590 | PT |
| 644 | 711.322,596 | 4.646.813,714 | 350,360 | PISTA |
| 645 | 711.321,729 | 4.646.804,067 | 350,400 | PISTA |
| 646 | 711.326,899 | 4.646.804,044 | 350,480 | PISTA |
| 647 | 711.327,230 | 4.646.811,547 | 350,430 | PISTA |
| 648 | 711.320,429 | 4.646.811,529 | 350,790 | CABE |
| 649 | 711.318,464 | 4.646.802,573 | 350,670 | CABE |
| 650 | 709.896,121 | 4.645.340,397 | 357,390 | ACEQUIA |
| 651 | 711.317,071 | 4.646.792,540 | 349,970 | PT |
| 652 | 709.910,523 | 4.645.346,767 | 357,090 | ACEQUIA |
| 653 | 711.310,641 | 4.646.775,558 | 348,730 | PT |
| 654 | 711.316,718 | 4.646.774,086 | 347,260 | PT |
| 655 | 711.310,671 | 4.646.759,611 | 347,080 | PT |
| 656 | 711.316,358 | 4.646.752,174 | 347,110 | PT |
| 657 | 710.451,479 | 4.645.461,943 | 354,130 | ACEQUIA |
| 658 | 711.313,617 | 4.646.737,101 | 347,080 | PT |
| 659 | 710.449,269 | 4.645.454,097 | 354,170 | ACEQUIA |
| 660 | 711.316,566 | 4.646.724,201 | 347,240 | PT |
| 661 | 710.545,450 | 4.645.479,309 | 353,820 | ACEQUIA |
| 662 | 711.319,372 | 4.646.708,785 | 348,330 | PT |
| 663 | 710.549,424 | 4.645.484,374 | 352,580 | ACEQUIA |
| 664 | 711.329,267 | 4.646.702,231 | 348,340 | PT |
| 665 | 711.323,999 | 4.646.700,998 | 348,630 | PT |
| 666 | 711.328,430 | 4.646.698,142 | 348,880 | PT |
| 667 | 711.333,529 | 4.646.699,783 | 348,320 | PT |
| 668 | 711.340,418 | 4.646.695,556 | 348,220 | PT |
| 669 | 711.337,964 | 4.646.692,867 | 348,390 | PT |
| 670 | 711.350,390 | 4.646.690,914 | 347,780 | PT |
| 671 | 711.349,428 | 4.646.686,683 | 347,930 | PT |
| 672 | 711.695,576 | 4.645.496,829 | 342,640 | ACEQUIA |
| 673 | 711.360,534 | 4.646.687,875 | 346,980 | PT |
| 674 | 709.058,053 | 4.644.304,775 | 363,035 | ARQUETA |
| 675 | 711.362,193 | 4.646.680,953 | 349,640 | PISTA |
| 676 | 711.366,258 | 4.646.678,932 | 349,580 | PISTA |
| 677 | 711.368,595 | 4.646.685,608 | 349,890 | PISTA |
| 678 | 711.371,856 | 4.646.683,613 | 349,490 | CANALETA |
| 679 | 711.370,053 | 4.646.678,837 | 349,310 | CANALETA |
| 680 | 712.576,937 | 4.644.731,478 | 341,617 | ASPERSOR |
| 681 | 711.373,766 | 4.646.682,358 | 349,770 | CABE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 682 | 711.377,092 | 4.646.675,609 | 348,260 | PIE |
| 683 | 711.385,008 | 4.646.679,944 | 348,180 | PIE |
| 684 | 712.600,688 | 4.644.718,303 | 341,687 | ASPERSOR |
| 685 | 712.631,109 | 4.644.699,098 | 341,865 | ASPERSOR |
| 686 | 711.407,903 | 4.646.668,915 | 347,770 | PT |
| 687 | 711.410,397 | 4.646.673,974 | 347,700 | PT |
| 688 | 711.432,338 | 4.646.668,763 | 347,750 | PT |
| 689 | 711.430,569 | 4.646.660,592 | 347,610 | PT |
| 690 | 711.449,890 | 4.646.655,273 | 347,930 | CABE |
| 691 | 711.449,735 | 4.646.663,821 | 348,010 | CABE |
| 692 | 710.810,453 | 4.645.505,273 | 350,760 | BALSA |
| 693 | 711.455,205 | 4.646.656,259 | 345,640 | PIE |
| 694 | 706.668,759 | 4.644.823,330 | 378,580 | BALSA |
| 695 | 711.463,754 | 4.646.659,060 | 343,470 | PT |
| 696 | 711.481,019 | 4.646.648,291 | 345,340 | PT |
| 697 | 711.482,393 | 4.646.654,111 | 345,650 | PT |
| 698 | 711.503,996 | 4.646.642,532 | 345,340 | PT |
| 699 | 711.505,284 | 4.646.647,549 | 345,570 | PT |
| 700 | 706.566,777 | 4.644.825,690 | 378,090 | BALSA |
| 701 | 711.528,383 | 4.646.637,448 | 345,300 | PT |
| 702 | 706.531,812 | 4.644.840,659 | 379,020 | BALSA |
| 703 | 711.539,362 | 4.646.633,293 | 345,510 | CABE |
| 704 | 711.558,941 | 4.646.633,090 | 344,420 | PIE |
| 705 | 711.546,593 | 4.646.631,976 | 344,340 | PIE |
| 706 | 711.567,463 | 4.646.625,460 | 344,240 | PT |
| 707 | 711.569,880 | 4.646.630,925 | 344,330 | PT |
| 708 | 710.823,506 | 4.645.500,914 | 350,700 | BALSA |
| 709 | 711.595,266 | 4.646.621,870 | 344,330 | CABE2 |
| 710 | 711.607,033 | 4.646.619,648 | 343,170 | PIE |
| 711 | 711.596,545 | 4.646.619,303 | 343,180 | PIE |
| 712 | 711.619,593 | 4.646.611,670 | 342,410 | PT |
| 713 | 705.876,159 | 4.644.731,177 | 391,718 | CA |
| 714 | 711.632,884 | 4.646.608,185 | 342,750 | CABE |
| 715 | 711.643,601 | 4.646.609,457 | 342,890 | CABE |
| 716 | 705.533,178 | 4.645.363,677 | 388,150 | CA |
| 717 | 711.656,042 | 4.646.607,048 | 341,750 | PIE |
| 718 | 705.525,167 | 4.645.363,642 | 391,796 | CA |
| 719 | 711.666,837 | 4.646.597,397 | 341,730 | PT |
| 720 | 711.685,883 | 4.646.593,696 | 341,910 | PT |
| 721 | 711.690,415 | 4.646.598,571 | 341,980 | PT |
| 722 | 711.688,841 | 4.646.599,780 | 341,960 | ARBOL |
| 723 | 711.691,106 | 4.646.597,331 | 341,890 | PISTA |
| 724 | 711.694,593 | 4.646.595,110 | 341,750 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 725 | 711.696,400 | 4.646.593,250 | 340,840 | CANALETA |
| 726 | 704.908,707 | 4.644.720,670 | 431,427 | CA |
| 727 | 705.509,399 | 4.645.072,713 | 391,771 | CA |
| 728 | 711.688,351 | 4.646.589,116 | 341,300 | PISTA |
| 729 | 711.696,904 | 4.646.584,662 | 338,440 | PIE |
| 730 | 711.700,540 | 4.646.589,563 | 338,460 | PIE |
| 731 | 711.709,136 | 4.646.584,381 | 338,510 | PT |
| 732 | 711.705,786 | 4.646.580,054 | 338,510 | PT |
| 733 | 711.720,214 | 4.646.571,711 | 338,490 | PT |
| 734 | 705.901,220 | 4.645.081,170 | 384,988 | CA |
| 735 | 711.743,609 | 4.646.565,171 | 338,480 | PT |
| 736 | 711.738,738 | 4.646.561,049 | 338,480 | PT |
| 737 | 705.546,926 | 4.645.118,179 | 391,958 | CA |
| 738 | 711.767,863 | 4.646.550,831 | 338,900 | CABE2 |
| 739 | 711.770,114 | 4.646.548,554 | 336,660 | PIE |
| 740 | 705.899,129 | 4.645.142,385 | 383,488 | CA |
| 741 | 711.775,195 | 4.646.538,653 | 336,840 | PT |
| 742 | 711.779,333 | 4.646.543,432 | 336,870 | PT |
| 743 | 711.787,621 | 4.646.537,431 | 336,910 | CABE |
| 744 | 711.781,495 | 4.646.533,347 | 337,190 | CABE |
| 745 | 711.793,376 | 4.646.534,727 | 336,100 | PIE |
| 746 | 705.554,348 | 4.645.166,970 | 391,777 | CA |
| 747 | 711.807,627 | 4.646.518,660 | 335,950 | PT |
| 748 | 711.811,815 | 4.646.524,554 | 335,980 | PT |
| 749 | 711.833,244 | 4.646.513,392 | 335,900 | PT |
| 750 | 711.826,806 | 4.646.506,693 | 335,940 | PT |
| 751 | 705.558,667 | 4.645.250,546 | 391,797 | CA |
| 752 | 711.840,347 | 4.646.505,779 | 336,330 | CABE |
| 753 | 711.844,141 | 4.646.501,788 | 335,530 | PIE |
| 754 | 711.836,537 | 4.646.499,965 | 335,050 | PIE |
| 755 | 711.859,189 | 4.646.486,787 | 334,990 | PT |
| 756 | 704.277,468 | 4.644.441,793 | 435,619 | CA |
| 757 | 705.644,497 | 4.645.218,959 | 390,112 | CA |
| 758 | 711.876,587 | 4.646.475,575 | 334,970 | PT |
| 759 | 711.884,565 | 4.646.469,050 | 335,090 | CABE2 |
| 760 | 705.826,313 | 4.645.478,165 | 387,417 | CA |
| 761 | 705.831,736 | 4.645.479,045 | 387,404 | CA |
| 762 | 711.888,226 | 4.646.467,835 | 334,810 | PIE |
| 763 | 705.843,138 | 4.645.471,067 | 386,777 | CA |
| 764 | 711.903,790 | 4.646.468,014 | 334,770 | PT |
| 765 | 711.894,693 | 4.646.454,204 | 334,780 | PT |
| 766 | 711.904,870 | 4.646.454,833 | 334,780 | PT |
| 767 | 711.904,659 | 4.646.439,443 | 334,760 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 768 | 711.893,840 | 4.646.440,113 | 334,790 | PT |
| 769 | 705.899,610 | 4.645.453,348 | 385,155 | CA |
| 770 | 711.904,737 | 4.646.424,627 | 334,750 | CABE2 |
| 771 | 711.906,325 | 4.646.422,544 | 334,470 | PIE |
| 772 | 705.903,490 | 4.645.448,196 | 385,390 | CA |
| 773 | 711.893,266 | 4.646.401,389 | 334,460 | PT |
| 774 | 705.938,869 | 4.645.474,330 | 384,022 | CA |
| 775 | 711.902,009 | 4.646.391,081 | 334,510 | CABE2 |
| 776 | 705.889,446 | 4.645.480,521 | 387,088 | CA |
| 777 | 711.893,132 | 4.646.384,307 | 334,010 | PIE |
| 778 | 711.901,563 | 4.646.388,954 | 334,030 | PIE |
| 779 | 705.822,312 | 4.645.499,046 | 388,216 | CA |
| 780 | 711.891,865 | 4.646.366,173 | 333,960 | PT |
| 781 | 706.081,420 | 4.645.246,580 | 382,498 | CA |
| 782 | 711.889,276 | 4.646.340,398 | 334,320 | PISTA |
| 783 | 711.889,493 | 4.646.338,886 | 332,520 | DESAGUE |
| 784 | 711.900,287 | 4.646.339,827 | 332,370 | DESAGUE |
| 785 | 705.215,024 | 4.644.651,201 | 423,779 | CA |
| 786 | 711.900,206 | 4.646.344,999 | 334,160 | PISTA |
| 787 | 711.899,402 | 4.646.336,376 | 334,240 | CABE |
| 788 | 711.893,042 | 4.646.335,175 | 334,020 | CABE |
| 789 | 711.888,693 | 4.646.328,252 | 334,050 | PT |
| 790 | 711.898,008 | 4.646.326,510 | 334,040 | PT |
| 791 | 711.895,914 | 4.646.310,142 | 334,000 | PT |
| 792 | 705.979,316 | 4.645.210,058 | 383,175 | CA |
| 793 | 705.964,493 | 4.645.214,317 | 383,178 | CA |
| 794 | 711.896,442 | 4.646.287,184 | 334,020 | PT |
| 795 | 711.361,928 | 4.646.677,525 | 349,870 | PISTA |
| 796 | 705.951,645 | 4.645.209,451 | 383,428 | CA |
| 797 | 711.351,478 | 4.646.657,790 | 349,790 | PISTA |
| 798 | 705.936,189 | 4.645.208,713 | 383,632 | CA |
| 799 | 711.338,801 | 4.646.641,400 | 349,830 | PISTA |
| 800 | 707.859,410 | 4.644.778,810 | 373,900 | |
| 801 | 711.333,168 | 4.646.623,783 | 347,830 | PT |
| 802 | 707.868,420 | 4.644.789,040 | 373,890 | |
| 803 | 705.970,992 | 4.645.203,680 | 382,882 | CA |
| 804 | 711.323,485 | 4.646.628,838 | 348,520 | PISTA |
| 805 | 711.322,750 | 4.646.625,330 | 348,450 | PISTA |
| 806 | 711.332,799 | 4.646.622,348 | 348,270 | PISTA |
| 807 | 711.333,823 | 4.646.627,684 | 348,680 | PISTA |
| 808 | 711.327,918 | 4.646.631,021 | 348,680 | ACEQ |
| 809 | 705.941,126 | 4.645.181,098 | 382,781 | CA |
| 810 | 711.330,505 | 4.646.639,041 | 350,070 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 811 | 711.334,101 | 4.646.643,731 | 350,780 | PT |
| 812 | 711.340,060 | 4.646.653,025 | 351,190 | PT |
| 813 | 711.346,224 | 4.646.662,262 | 351,140 | PT |
| 814 | 711.350,840 | 4.646.669,838 | 351,230 | PT |
| 815 | 705.896,746 | 4.645.207,507 | 383,653 | CA |
| 816 | 711.355,552 | 4.646.682,620 | 351,330 | PT |
| 817 | 711.261,964 | 4.647.091,887 | 350,450 | PT |
| 818 | 707.949,020 | 4.644.872,650 | 374,680 | |
| 819 | 711.274,622 | 4.647.109,480 | 348,690 | PT |
| 820 | 711.286,922 | 4.647.115,990 | 346,880 | PT |
| 821 | 711.299,259 | 4.647.125,313 | 346,380 | PT |
| 822 | 711.314,997 | 4.647.131,479 | 346,250 | PT |
| 823 | 706.076,648 | 4.645.264,553 | 382,436 | CA |
| 824 | 711.333,228 | 4.647.130,880 | 345,670 | PT |
| 825 | 706.030,017 | 4.645.239,561 | 382,522 | CA |
| 826 | 711.351,350 | 4.647.105,357 | 344,810 | PT |
| 827 | 709.055,650 | 4.644.332,990 | 365,080 | |
| 828 | 711.363,112 | 4.647.072,803 | 344,700 | PT |
| 829 | 711.364,650 | 4.647.069,767 | 345,620 | PT |
| 830 | 711.360,030 | 4.647.069,611 | 345,010 | CORONA |
| 831 | 705.969,819 | 4.645.228,251 | 383,225 | CA |
| 832 | 711.351,950 | 4.647.089,177 | 344,480 | CORONA |
| 833 | 708.932,681 | 4.648.027,194 | 349,550 | PT |
| 834 | 709.063,980 | 4.644.358,050 | 365,100 | |
| 835 | 705.946,522 | 4.645.227,045 | 383,249 | CA |
| 836 | 708.986,528 | 4.648.011,748 | 349,540 | PT |
| 837 | 709.001,831 | 4.648.006,764 | 349,580 | PT |
| 838 | 705.923,337 | 4.645.227,406 | 384,194 | CA |
| 839 | 709.021,499 | 4.648.001,821 | 349,610 | CANALETA |
| 840 | 709.024,425 | 4.647.999,732 | 351,110 | CABE |
| 841 | 709.038,278 | 4.647.996,942 | 351,190 | PT |
| 842 | 709.048,532 | 4.647.996,380 | 351,120 | PT |
| 843 | 709.060,234 | 4.648.007,142 | 351,170 | PT |
| 844 | 705.898,628 | 4.645.225,689 | 384,124 | CA |
| 845 | 709.045,589 | 4.648.012,744 | 349,740 | CANALETA |
| 846 | 705.558,786 | 4.645.355,189 | 391,757 | CA |
| 847 | 705.845,026 | 4.645.203,608 | 384,610 | CA |
| 848 | 709.008,334 | 4.648.024,301 | 349,580 | PT |
| 849 | 708.994,291 | 4.648.028,844 | 349,580 | PT |
| 850 | 708.978,732 | 4.648.033,926 | 349,560 | PT |
| 851 | 708.963,821 | 4.648.038,922 | 349,550 | PT |
| 852 | 708.948,221 | 4.648.043,249 | 349,560 | PT |
| 853 | 708.936,163 | 4.648.045,996 | 349,520 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 854 | 708.923,454 | 4.648.053,003 | 349,720 | CABE |
| 855 | 708.922,283 | 4.648.053,703 | 347,750 | DESAGUE |
| 856 | 708.919,022 | 4.648.042,004 | 347,900 | DESAGUE |
| 857 | 708.920,810 | 4.648.041,127 | 349,800 | CABE |
| 858 | 708.910,891 | 4.648.043,396 | 350,280 | CABE |
| 859 | 708.562,650 | 4.644.432,130 | 369,480 | |
| 860 | 708.916,350 | 4.648.058,599 | 347,470 | DESAGUE |
| 861 | 708.914,454 | 4.648.059,279 | 349,840 | CABE |
| 862 | 705.555,718 | 4.645.280,549 | 392,092 | CA |
| 863 | 708.902,274 | 4.648.052,175 | 349,700 | PT |
| 864 | 705.889,567 | 4.645.125,930 | 384,543 | CA |
| 865 | 708.887,630 | 4.648.049,354 | 351,110 | PT |
| 866 | 708.886,885 | 4.648.062,519 | 351,060 | PT |
| 867 | 708.872,634 | 4.648.064,435 | 351,050 | PT |
| 868 | 705.556,387 | 4.645.204,303 | 391,771 | CA |
| 869 | 708.865,166 | 4.648.056,602 | 351,050 | PIE |
| 870 | 708.863,590 | 4.648.057,817 | 351,430 | CABE |
| 871 | 705.778,279 | 4.645.198,438 | 386,579 | CA |
| 872 | 708.863,545 | 4.648.070,467 | 351,120 | PIE |
| 873 | 708.849,981 | 4.648.072,910 | 351,150 | PT |
| 874 | 708.847,948 | 4.648.065,578 | 351,110 | PT |
| 875 | 705.895,838 | 4.645.482,074 | 386,761 | CA |
| 876 | 708.831,681 | 4.648.078,239 | 351,120 | PT |
| 877 | 708.815,843 | 4.648.084,954 | 351,150 | PIE |
| 878 | 708.814,612 | 4.648.085,235 | 351,430 | CABE |
| 879 | 708.814,889 | 4.648.075,599 | 351,400 | CABE |
| 880 | 708.816,731 | 4.648.075,734 | 351,240 | PIE |
| 881 | 708.798,281 | 4.648.079,084 | 351,340 | PT |
| 882 | 708.799,612 | 4.648.087,382 | 351,300 | PT |
| 883 | 708.783,543 | 4.648.091,949 | 351,340 | PT |
| 884 | 708.596,980 | 4.644.427,520 | 369,460 | |
| 885 | 708.769,707 | 4.648.088,762 | 349,880 | PIE |
| 886 | 708.590,290 | 4.644.429,010 | 369,490 | |
| 887 | 708.766,881 | 4.648.098,280 | 350,230 | CABE |
| 888 | 708.601,280 | 4.644.431,310 | 369,490 | |
| 889 | 708.751,232 | 4.648.103,117 | 350,110 | PT |
| 890 | 708.748,122 | 4.648.095,893 | 350,530 | PT |
| 891 | 708.733,582 | 4.648.099,202 | 350,560 | PT |
| 892 | 708.734,997 | 4.648.108,051 | 350,540 | PT |
| 893 | 708.719,365 | 4.648.113,479 | 350,530 | PIE |
| 894 | 708.612,120 | 4.644.433,240 | 369,540 | |
| 895 | 708.624,240 | 4.644.435,760 | 369,480 | |
| 896 | 708.720,097 | 4.648.105,540 | 350,630 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 897 | 708.639,910 | 4.644.434,490 | 369,530 | |
| 898 | 708.704,920 | 4.648.117,480 | 350,260 | PT |
| 899 | 705.842,008 | 4.645.467,538 | 386,769 | CA |
| 900 | 708.685,306 | 4.648.113,838 | 350,700 | CABE |
| 901 | 708.681,552 | 4.648.112,687 | 350,150 | ACEQ |
| 902 | 708.676,014 | 4.648.122,884 | 350,160 | ACEQ |
| 903 | 705.906,043 | 4.645.453,016 | 384,966 | CA |
| 904 | 708.678,512 | 4.648.114,438 | 351,010 | CABE |
| 905 | 708.661,781 | 4.648.119,804 | 350,940 | PT |
| 906 | 708.515,660 | 4.644.447,020 | 369,900 | |
| 907 | 708.661,238 | 4.648.130,674 | 350,820 | PIE |
| 908 | 708.648,853 | 4.648.126,962 | 350,950 | PIE |
| 909 | 708.511,400 | 4.644.453,680 | 369,850 | |
| 910 | 708.650,578 | 4.648.132,519 | 353,040 | CABE |
| 911 | 705.911,918 | 4.645.466,298 | 384,363 | CA |
| 912 | 708.627,171 | 4.648.128,851 | 352,910 | PT |
| 913 | 708.605,139 | 4.648.137,645 | 352,940 | PT |
| 914 | 708.608,071 | 4.648.147,057 | 352,930 | PT |
| 915 | 708.586,427 | 4.648.153,668 | 352,970 | PT |
| 916 | 708.582,381 | 4.648.143,351 | 352,990 | PT |
| 917 | 708.561,816 | 4.648.149,779 | 353,040 | PT |
| 918 | 706.028,518 | 4.645.222,188 | 382,871 | CA |
| 919 | 708.540,807 | 4.648.167,004 | 353,070 | PT |
| 920 | 708.529,100 | 4.644.441,660 | 369,960 | |
| 921 | 708.514,310 | 4.648.162,040 | 353,180 | PIE |
| 922 | 708.509,037 | 4.648.172,551 | 353,380 | PIE |
| 923 | 708.507,362 | 4.648.171,997 | 353,030 | ACEQ |
| 924 | 708.508,472 | 4.648.167,428 | 353,000 | ACEQ |
| 925 | 708.506,306 | 4.648.167,056 | 354,230 | CABE |
| 926 | 706.121,188 | 4.645.280,873 | 382,234 | CA |
| 927 | 708.494,114 | 4.648.179,668 | 354,040 | PT |
| 928 | 708.491,000 | 4.648.171,351 | 354,050 | PT |
| 929 | 708.503,369 | 4.648.176,615 | 354,100 | ARBOL |
| 930 | 708.535,990 | 4.644.443,260 | 369,440 | |
| 931 | 708.521,340 | 4.644.449,060 | 369,830 | |
| 932 | 708.474,134 | 4.648.175,078 | 354,030 | PT |
| 933 | 708.529,410 | 4.644.445,920 | 369,890 | |
| 934 | 708.454,997 | 4.648.191,602 | 354,050 | PT |
| 935 | 708.442,966 | 4.648.194,853 | 354,060 | PT |
| 936 | 708.440,318 | 4.648.186,988 | 354,050 | PT |
| 937 | 708.415,354 | 4.648.194,701 | 354,070 | PT |
| 938 | 705.981,303 | 4.645.228,407 | 382,806 | CA |
| 939 | 708.390,568 | 4.648.212,563 | 354,090 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 940 | 708.650,640 | 4.644.440,010 | 367,350 | |
| 941 | 708.653,360 | 4.644.438,970 | 367,400 | |
| 942 | 708.369,523 | 4.648.217,421 | 354,100 | PT |
| 943 | 708.350,748 | 4.648.224,512 | 354,370 | CANALETA |
| 944 | 708.348,653 | 4.648.225,319 | 353,990 | PIE |
| 945 | 708.346,634 | 4.648.216,006 | 354,350 | CANALETA |
| 946 | 708.343,905 | 4.648.216,416 | 353,900 | PIE |
| 947 | 705.840,875 | 4.645.223,106 | 385,369 | CA |
| 948 | 708.328,386 | 4.648.217,980 | 353,390 | PT |
| 949 | 708.328,535 | 4.648.229,368 | 353,290 | PT |
| 950 | 704.888,138 | 4.644.720,445 | 431,216 | CA |
| 951 | 705.524,539 | 4.645.350,841 | 391,843 | CA |
| 952 | 708.286,638 | 4.648.230,956 | 353,550 | PT |
| 953 | 708.288,615 | 4.648.242,097 | 353,530 | PT |
| 954 | 708.280,828 | 4.648.246,892 | 353,690 | PISTA |
| 955 | 708.277,483 | 4.648.248,490 | 353,710 | PISTA |
| 956 | 708.272,884 | 4.648.236,779 | 353,650 | PISTA |
| 957 | 708.276,521 | 4.648.235,194 | 353,570 | PISTA |
| 958 | 708.275,565 | 4.648.246,535 | 353,570 | PT |
| 959 | 708.267,454 | 4.648.245,640 | 353,120 | PT |
| 960 | 708.267,917 | 4.648.260,723 | 353,280 | PT |
| 961 | 708.672,980 | 4.644.445,720 | 367,350 | |
| 962 | 708.273,886 | 4.648.272,457 | 353,510 | PT |
| 963 | 708.265,960 | 4.648.274,506 | 353,380 | PT |
| 964 | 708.267,534 | 4.648.294,439 | 353,250 | PT |
| 965 | 708.681,230 | 4.644.445,710 | 366,930 | |
| 966 | 708.277,426 | 4.648.312,123 | 353,440 | PT |
| 967 | 708.266,345 | 4.648.315,364 | 353,390 | PT |
| 968 | 708.689,580 | 4.644.443,900 | 366,940 | |
| 969 | 708.275,689 | 4.648.336,401 | 353,190 | PT |
| 970 | 705.886,140 | 4.645.117,141 | 384,730 | CA |
| 971 | 708.275,768 | 4.648.354,255 | 353,080 | PIE |
| 972 | 708.265,731 | 4.648.356,245 | 353,060 | PIE |
| 973 | 708.265,321 | 4.648.355,274 | 353,340 | CABE |
| 974 | 708.266,161 | 4.648.374,664 | 352,950 | PT |
| 975 | 708.710,380 | 4.644.449,370 | 366,970 | |
| 976 | 708.275,565 | 4.648.393,405 | 353,160 | CABE |
| 977 | 708.275,364 | 4.648.396,319 | 351,100 | DESAGUE |
| 978 | 708.716,740 | 4.644.453,070 | 366,900 | |
| 979 | 708.266,386 | 4.648.395,758 | 353,190 | CABE |
| 980 | 708.732,100 | 4.644.453,350 | 366,880 | |
| 981 | 708.735,440 | 4.644.456,470 | 366,790 | |
| 982 | 708.272,366 | 4.648.405,794 | 350,910 | DESAGUE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 983 | 705.613,868 | 4.645.225,696 | 390,131 | CA |
| 984 | 708.280,999 | 4.648.414,999 | 353,260 | PT |
| 985 | 705.615,261 | 4.645.220,326 | 390,236 | CA |
| 986 | 708.278,369 | 4.648.439,696 | 353,250 | PIE |
| 987 | 708.279,202 | 4.648.441,434 | 353,580 | CABE |
| 988 | 708.286,839 | 4.648.439,366 | 353,610 | CABE |
| 989 | 708.285,793 | 4.648.436,520 | 353,280 | PIE |
| 990 | 705.631,085 | 4.645.224,852 | 390,263 | CA |
| 991 | 708.287,431 | 4.648.458,672 | 353,460 | PT |
| 992 | 705.642,763 | 4.645.423,406 | 389,097 | CA |
| 993 | 705.784,781 | 4.645.485,054 | 388,396 | CA |
| 994 | 708.299,706 | 4.648.489,284 | 353,640 | PIE |
| 995 | 708.293,793 | 4.648.491,729 | 353,580 | PIE |
| 996 | 708.294,747 | 4.648.495,686 | 355,230 | CABE |
| 997 | 708.300,336 | 4.648.495,251 | 355,110 | CABE |
| 998 | 708.301,498 | 4.648.501,421 | 354,920 | PT |
| 999 | 708.296,792 | 4.648.502,356 | 355,060 | PT |
| 1000 | 708.296,458 | 4.648.507,685 | 355,070 | PIE |
| 1001 | 705.858,257 | 4.645.208,639 | 384,160 | CA |
| 1002 | 708.302,762 | 4.648.512,321 | 356,340 | CABE |
| 1003 | 708.297,708 | 4.648.512,535 | 356,820 | CABE |
| 1004 | 708.301,142 | 4.648.522,217 | 356,690 | PT |
| 1005 | 708.304,944 | 4.648.523,391 | 356,690 | PT |
| 1006 | 708.308,341 | 4.648.538,341 | 356,750 | PT |
| 1007 | 704.812,792 | 4.644.700,458 | 430,447 | CA |
| 1008 | 708.306,704 | 4.648.554,335 | 356,610 | PT |
| 1009 | 708.311,772 | 4.648.553,906 | 356,720 | PT |
| 1010 | 708.312,378 | 4.648.563,415 | 357,030 | PIE |
| 1011 | 708.306,545 | 4.648.567,228 | 356,790 | PIE |
| 1012 | 708.306,304 | 4.648.571,202 | 358,650 | CABE |
| 1013 | 708.313,081 | 4.648.570,723 | 358,620 | CABE |
| 1014 | 705.512,994 | 4.645.138,214 | 391,773 | CA |
| 1015 | 708.308,719 | 4.648.589,276 | 358,500 | PT |
| 1016 | 708.311,268 | 4.648.608,622 | 358,720 | PIE |
| 1017 | 708.317,768 | 4.648.604,626 | 358,620 | PIE |
| 1018 | 708.320,509 | 4.648.606,691 | 360,620 | CABE |
| 1019 | 705.513,418 | 4.645.240,240 | 391,949 | CA |
| 1020 | 708.315,094 | 4.648.629,637 | 360,360 | PIE |
| 1021 | 705.559,151 | 4.645.340,677 | 391,950 | CA |
| 1022 | 708.320,757 | 4.648.631,355 | 362,180 | CABE |
| 1023 | 708.314,484 | 4.648.636,462 | 362,110 | CABE |
| 1024 | 708.439,590 | 4.644.481,130 | 369,540 | |
| 1025 | 708.323,624 | 4.648.644,545 | 362,750 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1026 | 705.548,381 | 4.645.164,102 | 391,759 | CA |
| 1027 | 708.324,705 | 4.648.650,262 | 363,130 | CUNETA |
| 1028 | 708.322,028 | 4.648.655,443 | 363,060 | CUNETA |
| 1029 | 708.320,591 | 4.648.655,251 | 364,050 | CABE |
| 1030 | 708.323,051 | 4.648.660,692 | 364,880 | CABE |
| 1031 | 708.325,496 | 4.648.655,577 | 364,870 | CABE |
| 1032 | 705.896,331 | 4.645.143,975 | 383,674 | CA |
| 1033 | 708.324,086 | 4.648.663,694 | 365,330 | PT |
| 1034 | 705.835,577 | 4.645.205,754 | 384,843 | CA |
| 1035 | 708.328,314 | 4.648.669,200 | 365,780 | PT |
| 1036 | 708.785,700 | 4.644.465,760 | 367,090 | |
| 1037 | 708.319,246 | 4.648.675,940 | 365,070 | PT |
| 1038 | 705.803,162 | 4.645.199,217 | 386,081 | CA |
| 1039 | 708.318,779 | 4.648.691,049 | 365,800 | PT |
| 1040 | 705.791,630 | 4.645.199,479 | 386,362 | CA |
| 1041 | 705.905,607 | 4.645.479,668 | 385,174 | CA |
| 1042 | 708.310,753 | 4.648.708,084 | 366,140 | PT |
| 1043 | 708.303,003 | 4.648.725,289 | 366,370 | PT |
| 1044 | 708.297,295 | 4.648.721,469 | 365,690 | PT |
| 1045 | 705.750,258 | 4.645.196,100 | 386,576 | CA |
| 1046 | 708.294,888 | 4.648.739,064 | 366,480 | PT |
| 1047 | 708.279,066 | 4.648.764,353 | 366,130 | ASPERSOR |
| 1048 | 708.279,917 | 4.648.761,945 | 366,110 | ASPERSOR |
| 1049 | 708.280,938 | 4.648.758,412 | 365,950 | ASPERSOR |
| 1050 | 708.852,540 | 4.644.476,200 | 366,340 | |
| 1051 | 708.282,675 | 4.648.752,366 | 365,840 | ASPERSOR |
| 1052 | 708.283,444 | 4.648.747,265 | 365,830 | ASPERSOR |
| 1053 | 708.284,099 | 4.648.744,127 | 365,760 | ASPERSOR |
| 1054 | 708.284,980 | 4.648.740,657 | 365,740 | ASPERSOR |
| 1055 | 705.806,032 | 4.645.514,012 | 388,691 | CA |
| 1056 | 708.286,362 | 4.648.738,226 | 365,820 | ASPERSOR |
| 1057 | 708.287,205 | 4.648.737,272 | 365,960 | ASPERSOR |
| 1058 | 708.287,908 | 4.648.740,249 | 365,880 | PT |
| 1059 | 708.292,078 | 4.648.742,949 | 366,440 | PT |
| 1060 | 708.289,261 | 4.648.747,936 | 366,540 | PT |
| 1061 | 708.287,183 | 4.648.749,779 | 365,930 | PT |
| 1062 | 708.285,295 | 4.648.753,162 | 365,940 | PT |
| 1063 | 708.280,108 | 4.648.742,029 | 365,610 | PT |
| 1064 | 708.899,680 | 4.644.483,640 | 365,790 | |
| 1065 | 708.892,070 | 4.644.486,570 | 365,870 | |
| 1066 | 708.275,229 | 4.648.748,394 | 365,620 | PT |
| 1067 | 708.903,240 | 4.644.487,970 | 365,760 | |
| 1068 | 708.277,119 | 4.648.763,361 | 366,010 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1069 | 708.271,996 | 4.648.761,439 | 365,840 | PT |
| 1070 | 708.266,953 | 4.648.768,040 | 365,900 | PT |
| 1071 | 708.271,296 | 4.648.773,836 | 366,190 | PT |
| 1072 | 708.266,379 | 4.648.780,831 | 366,200 | PT |
| 1073 | 708.260,885 | 4.648.779,676 | 365,820 | PT |
| 1074 | 708.255,902 | 4.648.797,587 | 365,800 | PT |
| 1075 | 708.248,205 | 4.648.794,110 | 365,500 | PT |
| 1076 | 708.238,157 | 4.648.808,899 | 365,520 | PT |
| 1077 | 708.243,778 | 4.648.813,574 | 365,700 | PT |
| 1078 | 708.355,520 | 4.644.516,690 | 370,580 | |
| 1079 | 708.226,658 | 4.648.820,966 | 364,080 | PT |
| 1080 | 708.229,122 | 4.648.823,035 | 364,470 | PIE |
| 1081 | 708.231,334 | 4.648.815,748 | 363,980 | PIE |
| 1082 | 708.221,747 | 4.648.831,817 | 364,430 | PT |
| 1083 | 708.217,480 | 4.648.826,367 | 364,260 | PT |
| 1084 | 708.205,910 | 4.648.832,850 | 364,360 | PT |
| 1085 | 707.291,222 | 4.644.295,266 | 382,766 | CA |
| 1086 | 708.194,912 | 4.648.848,056 | 364,480 | PT |
| 1087 | 708.377,270 | 4.644.510,720 | 371,250 | |
| 1088 | 708.174,198 | 4.648.853,336 | 364,470 | PT |
| 1089 | 708.175,342 | 4.648.863,491 | 364,520 | PT |
| 1090 | 708.371,670 | 4.644.511,170 | 370,810 | |
| 1091 | 708.156,604 | 4.648.864,817 | 364,480 | PT |
| 1092 | 708.375,660 | 4.644.513,190 | 370,830 | |
| 1093 | 708.149,464 | 4.648.877,613 | 365,330 | PT |
| 1094 | 708.149,637 | 4.648.876,696 | 365,240 | CASA |
| 1095 | 708.152,472 | 4.648.877,269 | 365,240 | CASA |
| 1096 | 708.153,402 | 4.648.874,953 | 365,060 | CASA |
| 1097 | 708.401,230 | 4.644.501,240 | 370,050 | |
| 1098 | 707.710,433 | 4.648.397,957 | 355,000 | PISTA |
| 1099 | 707.709,018 | 4.648.398,923 | 354,080 | CUNETA |
| 1100 | 708.383,990 | 4.644.505,070 | 370,730 | |
| 1101 | 708.383,810 | 4.644.510,280 | 370,100 | |
| 1102 | 707.706,386 | 4.648.383,539 | 355,160 | PISTA |
| 1103 | 707.714,019 | 4.648.388,596 | 354,550 | PT |
| 1104 | 707.711,437 | 4.648.382,364 | 354,590 | PT |
| 1105 | 707.730,733 | 4.648.376,704 | 354,650 | PT |
| 1106 | 707.734,853 | 4.648.385,141 | 355,090 | PT |
| 1107 | 707.760,808 | 4.648.379,881 | 355,270 | PT |
| 1108 | 707.757,007 | 4.648.372,554 | 355,250 | PT |
| 1109 | 707.761,435 | 4.648.371,373 | 354,830 | PT |
| 1110 | 707.765,159 | 4.648.378,338 | 354,780 | PT |
| 1111 | 707.784,153 | 4.648.376,503 | 354,760 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1112 | 707.783,762 | 4.648.366,672 | 354,700 | PT |
| 1113 | 707.804,130 | 4.648.362,382 | 354,710 | PT |
| 1114 | 708.929,080 | 4.644.493,270 | 365,630 | |
| 1115 | 705.884,338 | 4.645.130,950 | 384,310 | CA |
| 1116 | 707.831,105 | 4.648.354,441 | 354,690 | PT |
| 1117 | 707.865,637 | 4.648.348,992 | 354,970 | CABE |
| 1118 | 707.870,081 | 4.648.357,567 | 354,970 | CABE |
| 1119 | 707.873,348 | 4.648.357,328 | 354,500 | PIE |
| 1120 | 707.869,896 | 4.648.348,104 | 354,210 | PIE |
| 1121 | 705.889,170 | 4.645.133,697 | 384,068 | CA |
| 1122 | 707.897,182 | 4.648.352,740 | 354,170 | PT |
| 1123 | 707.925,383 | 4.648.346,383 | 354,250 | PT |
| 1124 | 707.923,861 | 4.648.337,249 | 353,350 | PT |
| 1125 | 707.953,938 | 4.648.333,100 | 354,260 | PT |
| 1126 | 707.955,727 | 4.648.340,855 | 354,210 | PT |
| 1127 | 707.982,107 | 4.648.335,547 | 354,310 | PT |
| 1128 | 705.549,763 | 4.645.077,455 | 391,754 | CA |
| 1129 | 708.983,780 | 4.644.503,090 | 365,380 | |
| 1130 | 708.002,596 | 4.648.331,711 | 354,330 | CANALETA |
| 1131 | 708.007,580 | 4.648.330,592 | 353,880 | PIE |
| 1132 | 708.004,903 | 4.648.321,283 | 353,830 | PIE |
| 1133 | 708.030,299 | 4.648.314,291 | 353,810 | PT |
| 1134 | 708.034,218 | 4.648.322,867 | 353,780 | PT |
| 1135 | 708.064,661 | 4.648.311,280 | 353,820 | PT |
| 1136 | 704.278,030 | 4.644.441,156 | 435,415 | CA |
| 1137 | 708.094,150 | 4.648.294,369 | 353,750 | PT |
| 1138 | 709.032,210 | 4.644.509,110 | 364,920 | |
| 1139 | 708.125,921 | 4.648.292,554 | 353,690 | PT |
| 1140 | 708.125,105 | 4.648.283,509 | 353,730 | PT |
| 1141 | 708.146,723 | 4.648.276,820 | 353,850 | CABE |
| 1142 | 708.148,003 | 4.648.276,706 | 353,050 | ACEQ |
| 1143 | 705.657,680 | 4.645.432,611 | 389,069 | CA |
| 1144 | 708.148,153 | 4.648.285,074 | 353,850 | CABE |
| 1145 | 708.151,819 | 4.648.285,678 | 353,670 | CABE |
| 1146 | 705.670,812 | 4.645.440,396 | 389,130 | CA |
| 1147 | 708.164,009 | 4.648.272,070 | 353,370 | PT |
| 1148 | 708.166,466 | 4.648.280,172 | 353,390 | PT |
| 1149 | 708.192,397 | 4.648.272,730 | 353,440 | PT |
| 1150 | 708.294,260 | 4.644.541,440 | 371,960 | |
| 1151 | 708.214,827 | 4.648.255,302 | 353,430 | PT |
| 1152 | 708.218,273 | 4.648.264,817 | 353,380 | PT |
| 1153 | 708.245,165 | 4.648.256,565 | 353,450 | PT |
| 1154 | 708.243,446 | 4.648.246,153 | 353,450 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1155 | 705.929,896 | 4.645.467,174 | 384,176 | CA |
| 1156 | 708.262,510 | 4.648.250,870 | 353,410 | PT |
| 1157 | 710.435,425 | 4.646.182,130 | 342,880 | PT |
| 1158 | 708.321,990 | 4.644.532,440 | 371,150 | |
| 1159 | 710.429,232 | 4.646.171,601 | 342,840 | PT |
| 1160 | 705.919,432 | 4.645.469,663 | 384,182 | CA |
| 1161 | 710.420,687 | 4.646.184,702 | 342,840 | PT |
| 1162 | 710.405,605 | 4.646.194,651 | 342,690 | PT |
| 1163 | 710.402,058 | 4.646.189,646 | 342,500 | PT |
| 1164 | 710.378,684 | 4.646.204,143 | 342,490 | PIE |
| 1165 | 710.377,209 | 4.646.204,507 | 343,310 | CABE |
| 1166 | 710.378,911 | 4.646.213,967 | 343,960 | CABE |
| 1167 | 708.303,280 | 4.644.544,670 | 371,640 | |
| 1168 | 710.366,503 | 4.646.222,064 | 343,860 | PT |
| 1169 | 710.362,829 | 4.646.217,528 | 343,820 | PT |
| 1170 | 705.813,390 | 4.645.509,767 | 388,209 | CA |
| 1171 | 710.352,387 | 4.646.231,962 | 343,830 | PT |
| 1172 | 710.339,648 | 4.646.240,498 | 344,070 | PIE |
| 1173 | 710.337,205 | 4.646.241,336 | 344,470 | CABE |
| 1174 | 710.337,586 | 4.646.234,780 | 344,410 | CABE |
| 1175 | 710.339,036 | 4.646.234,071 | 343,860 | PIE |
| 1176 | 710.321,852 | 4.646.245,851 | 343,620 | PT |
| 1177 | 710.324,862 | 4.646.251,563 | 343,380 | PT |
| 1178 | 708.349,090 | 4.644.523,920 | 371,200 | |
| 1179 | 710.308,316 | 4.646.255,684 | 344,110 | PIE |
| 1180 | 710.304,402 | 4.646.259,137 | 345,370 | CARRETERA |
| 1181 | 710.308,896 | 4.646.263,727 | 345,400 | CARRETERA |
| 1182 | 705.968,653 | 4.645.205,706 | 382,870 | CA |
| 1183 | 710.299,153 | 4.646.261,962 | 345,780 | CARRETERA |
| 1184 | 705.960,900 | 4.645.194,427 | 382,787 | CA |
| 1185 | 710.302,589 | 4.646.269,607 | 345,100 | PIE |
| 1186 | 710.293,188 | 4.646.273,254 | 345,120 | PT |
| 1187 | 709.078,240 | 4.644.519,270 | 365,020 | |
| 1188 | 710.279,546 | 4.646.263,505 | 345,070 | PT |
| 1189 | 709.083,330 | 4.644.523,870 | 365,350 | |
| 1190 | 710.262,866 | 4.646.267,027 | 345,060 | PT |
| 1191 | 710.263,821 | 4.646.259,660 | 345,080 | PT |
| 1192 | 709.112,850 | 4.644.528,650 | 365,440 | |
| 1193 | 710.243,037 | 4.646.263,961 | 345,080 | PT |
| 1194 | 710.222,852 | 4.646.259,194 | 345,080 | PT |
| 1195 | 706.014,362 | 4.645.232,835 | 382,750 | CA |
| 1196 | 710.204,947 | 4.646.246,881 | 345,110 | PT |
| 1197 | 710.203,182 | 4.646.253,112 | 345,020 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1198 | 705.982,112 | 4.645.225,195 | 382,796 | CA |
| 1199 | 710.184,805 | 4.646.248,667 | 345,680 | PIE |
| 1200 | 708.244,800 | 4.644.564,870 | 372,930 | |
| 1201 | 708.235,120 | 4.644.570,040 | 372,910 | |
| 1202 | 710.182,269 | 4.646.240,766 | 348,590 | CABE |
| 1203 | 708.260,670 | 4.644.557,780 | 372,960 | |
| 1204 | 705.923,682 | 4.645.224,774 | 384,083 | CA |
| 1205 | 710.147,478 | 4.646.236,932 | 348,310 | PT |
| 1206 | 710.143,452 | 4.646.242,873 | 348,290 | PT |
| 1207 | 710.131,523 | 4.646.243,916 | 348,330 | PT |
| 1208 | 710.132,195 | 4.646.237,207 | 348,220 | PT |
| 1209 | 710.112,002 | 4.646.240,698 | 348,230 | PT |
| 1210 | 710.111,620 | 4.646.247,704 | 348,230 | PT |
| 1211 | 710.089,127 | 4.646.250,168 | 348,240 | PT |
| 1212 | 710.088,078 | 4.646.243,767 | 348,190 | PT |
| 1213 | 710.074,250 | 4.646.244,527 | 348,390 | CABE |
| 1214 | 710.073,316 | 4.646.243,889 | 348,250 | ACEQ |
| 1215 | 710.064,304 | 4.646.256,372 | 348,770 | ACEQ |
| 1216 | 710.066,452 | 4.646.255,743 | 349,150 | CABE |
| 1217 | 708.281,450 | 4.644.548,060 | 372,200 | |
| 1218 | 710.071,132 | 4.646.243,811 | 349,110 | CABE2 |
| 1219 | 705.506,280 | 4.645.104,374 | 391,973 | CA |
| 1220 | 710.051,003 | 4.646.256,231 | 348,900 | PT |
| 1221 | 708.292,090 | 4.644.551,890 | 372,240 | |
| 1222 | 705.558,756 | 4.645.354,436 | 391,727 | CA |
| 1223 | 710.023,786 | 4.646.249,499 | 348,780 | PIE |
| 1224 | 710.022,190 | 4.646.249,266 | 349,500 | CABE |
| 1225 | 710.013,677 | 4.646.261,085 | 349,370 | CABE |
| 1226 | 710.017,013 | 4.646.260,904 | 348,890 | PIE |
| 1227 | 709.127,360 | 4.644.549,520 | 365,150 | |
| 1228 | 709.986,455 | 4.646.258,416 | 349,320 | PT |
| 1229 | 705.556,854 | 4.645.299,638 | 392,095 | CA |
| 1230 | 709.135,890 | 4.644.561,420 | 364,300 | |
| 1231 | 709.960,716 | 4.646.268,320 | 349,580 | CABE |
| 1232 | 709.139,560 | 4.644.571,220 | 364,740 | |
| 1233 | 709.944,454 | 4.646.272,440 | 349,580 | PT |
| 1234 | 705.552,092 | 4.645.210,708 | 391,905 | CA |
| 1235 | 709.928,215 | 4.646.267,449 | 349,530 | PT |
| 1236 | 709.929,070 | 4.646.274,659 | 349,570 | PT |
| 1237 | 709.918,679 | 4.646.267,003 | 349,500 | PIE |
| 1238 | 709.917,693 | 4.646.266,397 | 349,940 | CABE |
| 1239 | 709.910,267 | 4.646.275,986 | 349,950 | CABE |
| 1240 | 709.914,690 | 4.646.275,860 | 349,550 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1241 | 709.892,202 | 4.646.280,043 | 349,860 | PT |
| 1242 | 709.891,117 | 4.646.271,893 | 349,860 | PT |
| 1243 | 705.136,406 | 4.644.699,667 | 425,988 | CA |
| 1244 | 708.130,300 | 4.644.592,160 | 374,990 | |
| 1245 | 709.836,889 | 4.646.278,682 | 349,830 | PIE |
| 1246 | 709.835,855 | 4.646.278,086 | 350,210 | CABE |
| 1247 | 706.310,848 | 4.645.790,304 | 384,234 | CA |
| 1248 | 709.831,912 | 4.646.287,384 | 349,880 | PIE |
| 1249 | 709.809,563 | 4.646.290,804 | 350,150 | PIE |
| 1250 | 709.809,276 | 4.646.284,339 | 350,050 | PIE |
| 1251 | 706.084,525 | 4.646.745,319 | 387,339 | CA |
| 1252 | 709.785,237 | 4.646.293,997 | 350,260 | PT |
| 1253 | 706.518,901 | 4.645.378,816 | 381,129 | CA |
| 1254 | 709.775,086 | 4.646.289,452 | 350,280 | CABE |
| 1255 | 709.774,423 | 4.646.288,723 | 350,030 | ACEQ |
| 1256 | 708.177,530 | 4.644.594,300 | 373,530 | |
| 1257 | 709.766,430 | 4.646.298,323 | 350,100 | PISTA |
| 1258 | 709.766,855 | 4.646.291,697 | 349,930 | PISTA |
| 1259 | 709.750,485 | 4.646.294,044 | 349,990 | ARBOL |
| 1260 | 709.742,073 | 4.646.299,304 | 350,350 | ARBOL |
| 1261 | 709.731,189 | 4.646.297,437 | 352,440 | ARBOL |
| 1262 | 709.721,385 | 4.646.295,626 | 351,640 | ARBOL |
| 1263 | 709.725,051 | 4.646.301,471 | 350,870 | PISTA |
| 1264 | 709.725,935 | 4.646.306,544 | 350,560 | PISTA |
| 1265 | 709.734,336 | 4.646.305,451 | 350,410 | PISTA |
| 1266 | 709.734,204 | 4.646.300,232 | 350,880 | PISTA |
| 1267 | 709.744,145 | 4.646.304,604 | 350,710 | PISTA |
| 1268 | 709.757,490 | 4.646.302,393 | 350,670 | PISTA |
| 1269 | 709.710,864 | 4.646.306,155 | 351,080 | PISTA |
| 1270 | 709.708,909 | 4.646.299,862 | 351,320 | PISTA |
| 1271 | 708.227,370 | 4.644.573,370 | 373,250 | |
| 1272 | 709.701,947 | 4.646.297,678 | 351,520 | PISTA |
| 1273 | 709.698,360 | 4.646.303,405 | 351,330 | PISTA |
| 1274 | 709.688,155 | 4.646.300,886 | 351,590 | PISTA |
| 1275 | 709.688,145 | 4.646.300,884 | 351,590 | PISTA |
| 1276 | 709.690,046 | 4.646.292,479 | 351,770 | PISTA |
| 1277 | 708.226,030 | 4.644.578,930 | 373,630 | |
| 1278 | 709.703,165 | 4.646.311,098 | 351,240 | CANALETA |
| 1279 | 709.704,285 | 4.646.314,444 | 349,760 | PIE |
| 1280 | 709.694,977 | 4.646.313,716 | 349,740 | PIE |
| 1281 | 705.820,125 | 4.645.505,396 | 388,381 | CA |
| 1282 | 706.080,756 | 4.645.251,725 | 382,197 | CA |
| 1283 | 709.678,448 | 4.646.293,167 | 351,380 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1284 | 706.063,457 | 4.645.243,450 | 382,411 | CA |
| 1285 | 709.669,850 | 4.646.282,540 | 351,760 | PT |
| 1286 | 709.666,611 | 4.646.286,809 | 351,340 | PT |
| 1287 | 709.657,102 | 4.646.282,374 | 351,240 | CABE |
| 1288 | 706.003,915 | 4.645.217,439 | 382,758 | CA |
| 1289 | 709.655,449 | 4.646.276,664 | 350,540 | ACEQ |
| 1290 | 705.992,420 | 4.645.215,625 | 382,944 | CA |
| 1291 | 709.653,583 | 4.646.281,545 | 351,110 | CABE |
| 1292 | 709.652,184 | 4.646.273,565 | 351,040 | CABE |
| 1293 | 709.650,711 | 4.646.271,964 | 350,460 | PIE |
| 1294 | 709.649,149 | 4.646.278,267 | 350,740 | PIE |
| 1295 | 709.633,419 | 4.646.268,719 | 350,480 | PT |
| 1296 | 709.635,072 | 4.646.264,218 | 350,360 | PT |
| 1297 | 709.618,538 | 4.646.256,129 | 350,400 | PT |
| 1298 | 709.616,095 | 4.646.259,066 | 350,390 | PT |
| 1299 | 709.603,557 | 4.646.252,338 | 350,460 | PT |
| 1300 | 709.605,440 | 4.646.248,025 | 350,350 | PT |
| 1301 | 709.585,830 | 4.646.242,222 | 350,360 | PT |
| 1302 | 709.587,057 | 4.646.237,824 | 350,250 | PT |
| 1303 | 709.160,140 | 4.644.602,800 | 363,790 | |
| 1304 | 709.566,554 | 4.646.224,714 | 350,240 | PIE |
| 1305 | 709.564,415 | 4.646.223,955 | 350,550 | CABE |
| 1306 | 709.563,201 | 4.646.230,671 | 350,700 | CABE |
| 1307 | 706.033,806 | 4.645.234,221 | 380,537 | CA |
| 1308 | 709.547,418 | 4.646.216,238 | 350,300 | PT |
| 1309 | 709.533,668 | 4.646.207,413 | 350,360 | PT |
| 1310 | 709.530,517 | 4.646.211,609 | 350,510 | PT |
| 1311 | 709.172,510 | 4.644.609,810 | 363,390 | |
| 1312 | 706.075,525 | 4.645.260,668 | 382,379 | CA |
| 1313 | 709.517,392 | 4.646.197,483 | 351,260 | CABE |
| 1314 | 709.516,212 | 4.646.203,811 | 351,230 | CABE |
| 1315 | 709.501,133 | 4.646.196,026 | 351,340 | PT |
| 1316 | 709.502,685 | 4.646.190,023 | 351,020 | PT |
| 1317 | 709.489,726 | 4.646.183,436 | 351,010 | PT |
| 1318 | 709.487,388 | 4.646.187,599 | 351,230 | PT |
| 1319 | 709.474,641 | 4.646.179,917 | 351,260 | PIE |
| 1320 | 709.473,845 | 4.646.172,894 | 351,020 | PIE |
| 1321 | 709.471,046 | 4.646.172,337 | 351,990 | CABE |
| 1322 | 709.469,994 | 4.646.178,524 | 351,990 | CABE |
| 1323 | 709.457,285 | 4.646.170,874 | 351,930 | PT |
| 1324 | 709.458,256 | 4.646.166,229 | 351,620 | PT |
| 1325 | 709.441,088 | 4.646.156,401 | 351,680 | PT |
| 1326 | 709.183,630 | 4.644.622,760 | 364,390 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1327 | 709.428,827 | 4.646.153,439 | 351,760 | PIE |
| 1328 | 709.423,882 | 4.646.147,083 | 351,840 | PIE |
| 1329 | 709.193,480 | 4.644.625,430 | 364,310 | |
| 1330 | 709.418,084 | 4.646.149,862 | 353,290 | CABE |
| 1331 | 705.927,381 | 4.645.224,206 | 383,735 | CA |
| 1332 | 705.886,427 | 4.645.222,050 | 384,661 | CA |
| 1333 | 709.396,656 | 4.646.132,286 | 352,410 | PT |
| 1334 | 709.393,244 | 4.646.136,818 | 352,560 | PT |
| 1335 | 709.375,885 | 4.646.129,200 | 352,510 | PT |
| 1336 | 709.379,266 | 4.646.118,932 | 352,360 | PT |
| 1337 | 705.864,338 | 4.645.224,969 | 385,427 | CA |
| 1338 | 705.839,768 | 4.645.218,565 | 385,142 | CA |
| 1339 | 709.339,355 | 4.646.105,383 | 352,560 | PT |
| 1340 | 709.341,425 | 4.646.099,390 | 352,410 | PT |
| 1341 | 709.213,380 | 4.644.644,380 | 364,120 | |
| 1342 | 705.518,725 | 4.645.244,047 | 391,790 | CA |
| 1343 | 709.310,976 | 4.646.090,881 | 352,970 | PT |
| 1344 | 705.517,484 | 4.645.224,333 | 391,692 | CA |
| 1345 | 709.299,941 | 4.646.075,977 | 353,360 | PT |
| 1346 | 709.297,747 | 4.646.086,339 | 353,160 | PT |
| 1347 | 709.296,103 | 4.646.088,779 | 353,100 | CANALETA |
| 1348 | 709.288,269 | 4.646.084,300 | 353,400 | CANALETA |
| 1349 | 709.283,828 | 4.646.082,074 | 353,360 | CANALETA |
| 1350 | 709.283,009 | 4.646.085,284 | 352,790 | PIE |
| 1351 | 709.289,596 | 4.646.088,170 | 352,790 | PIE |
| 1352 | 709.274,349 | 4.646.093,813 | 352,760 | PT |
| 1353 | 709.270,080 | 4.644.680,860 | 363,710 | |
| 1354 | 709.252,445 | 4.646.093,993 | 353,080 | CABE |
| 1355 | 709.256,591 | 4.646.100,838 | 352,850 | CABE |
| 1356 | 709.248,773 | 4.646.092,456 | 352,190 | PISTA |
| 1357 | 709.245,764 | 4.646.093,140 | 352,080 | PISTA |
| 1358 | 709.246,487 | 4.646.099,883 | 351,470 | PISTA |
| 1359 | 709.249,215 | 4.646.100,239 | 351,490 | PISTA |
| 1360 | 705.554,682 | 4.645.280,785 | 391,861 | CA |
| 1361 | 709.248,940 | 4.646.106,880 | 350,990 | DESAGUE |
| 1362 | 709.251,340 | 4.646.106,381 | 351,100 | DESAGUE |
| 1363 | 709.269,630 | 4.644.685,450 | 362,920 | |
| 1364 | 709.270,500 | 4.644.683,790 | 363,020 | |
| 1365 | 709.251,965 | 4.646.110,908 | 352,130 | PT |
| 1366 | 705.543,846 | 4.645.057,968 | 391,896 | CA |
| 1367 | 709.244,162 | 4.646.114,470 | 352,350 | PT |
| 1368 | 709.241,828 | 4.646.118,700 | 352,560 | ARBOL |
| 1369 | 705.548,605 | 4.645.050,854 | 391,596 | CA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1370 | 709.250,261 | 4.646.123,292 | 352,560 | PT |
| 1371 | 709.248,555 | 4.646.124,517 | 353,130 | CABE |
| 1372 | 709.243,112 | 4.646.121,827 | 353,000 | CABE |
| 1373 | 705.803,752 | 4.645.203,553 | 385,757 | CA |
| 1374 | 709.295,640 | 4.644.706,210 | 362,790 | |
| 1375 | 709.245,827 | 4.646.129,632 | 352,160 | PT |
| 1376 | 709.242,631 | 4.646.127,326 | 352,130 | PT |
| 1377 | 705.565,453 | 4.645.361,914 | 392,061 | CA |
| 1378 | 709.336,077 | 4.646.429,682 | 351,910 | PT |
| 1379 | 709.331,248 | 4.646.446,490 | 351,990 | PT |
| 1380 | 709.324,264 | 4.646.444,314 | 352,060 | PT |
| 1381 | 709.315,739 | 4.646.461,077 | 352,250 | PT |
| 1382 | 709.299,390 | 4.644.707,580 | 362,710 | |
| 1383 | 709.312,606 | 4.646.485,682 | 352,100 | PT |
| 1384 | 709.306,042 | 4.646.481,070 | 352,080 | PT |
| 1385 | 709.296,251 | 4.646.507,331 | 352,060 | PT |
| 1386 | 705.709,549 | 4.645.466,248 | 388,896 | CA |
| 1387 | 709.291,180 | 4.646.535,066 | 352,080 | PT |
| 1388 | 709.283,679 | 4.646.531,707 | 352,110 | PT |
| 1389 | 705.712,448 | 4.645.461,756 | 388,732 | CA |
| 1390 | 709.272,081 | 4.646.555,372 | 352,340 | CABE |
| 1391 | 709.315,020 | 4.644.719,070 | 362,710 | |
| 1392 | 709.281,536 | 4.646.557,507 | 351,620 | CABE |
| 1393 | 705.728,002 | 4.645.470,919 | 388,761 | CA |
| 1394 | 709.282,462 | 4.646.563,805 | 351,950 | CABE |
| 1395 | 709.320,840 | 4.644.718,950 | 362,730 | |
| 1396 | 709.267,515 | 4.646.572,892 | 352,140 | PT |
| 1397 | 709.272,632 | 4.646.577,334 | 352,080 | PT |
| 1398 | 709.262,286 | 4.646.585,626 | 351,990 | PT |
| 1399 | 709.266,066 | 4.646.590,019 | 352,000 | PT |
| 1400 | 709.255,893 | 4.646.599,013 | 352,050 | CABE |
| 1401 | 709.258,212 | 4.646.605,836 | 351,940 | CABE |
| 1402 | 709.253,723 | 4.646.614,598 | 352,370 | ACEQ |
| 1403 | 709.251,234 | 4.646.621,540 | 353,370 | CABE |
| 1404 | 709.250,959 | 4.646.613,287 | 353,300 | CABE |
| 1405 | 709.250,673 | 4.646.613,252 | 353,430 | CABE |
| 1406 | 709.246,762 | 4.646.619,007 | 353,360 | PT |
| 1407 | 713.285,251 | 4.644.358,204 | 343,280 | CA |
| 1408 | 709.244,586 | 4.646.637,418 | 353,400 | PT |
| 1409 | 709.328,620 | 4.644.726,640 | 362,460 | |
| 1410 | 709.233,655 | 4.646.645,038 | 353,440 | PT |
| 1411 | 709.240,060 | 4.646.648,220 | 353,390 | PT |
| 1412 | 709.502,084 | 4.646.508,475 | 349,560 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1413 | 709.492,062 | 4.646.516,893 | 349,430 | PT |
| 1414 | 709.497,732 | 4.646.528,447 | 349,310 | PT |
| 1415 | 713.528,890 | 4.645.128,403 | 327,730 | CABEZA |
| 1416 | 709.337,780 | 4.644.732,830 | 362,400 | |
| 1417 | 709.507,658 | 4.646.554,916 | 349,220 | PT |
| 1418 | 713.472,710 | 4.645.067,332 | 327,380 | CABEZA |
| 1419 | 709.523,906 | 4.646.576,462 | 349,260 | PT |
| 1420 | 709.348,340 | 4.644.738,330 | 362,410 | |
| 1421 | 709.525,417 | 4.646.606,392 | 349,350 | PT |
| 1422 | 709.535,030 | 4.646.631,306 | 349,310 | PT |
| 1423 | 713.297,124 | 4.645.040,232 | 328,560 | CABEZA |
| 1424 | 709.550,863 | 4.646.648,018 | 349,270 | PT |
| 1425 | 713.282,053 | 4.645.046,896 | 328,820 | CABEZA |
| 1426 | 707.740,619 | 4.646.783,755 | 377,630 | PT |
| 1427 | 712.851,529 | 4.645.086,100 | 330,820 | CABEZA |
| 1428 | 707.748,957 | 4.646.775,339 | 377,880 | PT |
| 1429 | 712.852,341 | 4.645.074,939 | 331,250 | CABEZA |
| 1430 | 707.739,069 | 4.646.777,072 | 377,650 | PT |
| 1431 | 707.733,541 | 4.646.769,567 | 377,210 | PT |
| 1432 | 712.612,170 | 4.644.826,072 | 338,400 | CABEZA |
| 1433 | 707.733,287 | 4.646.760,282 | 377,270 | ASPERSOR |
| 1434 | 712.606,337 | 4.644.818,678 | 338,690 | CABEZA |
| 1435 | 707.727,721 | 4.646.765,663 | 377,140 | PT |
| 1436 | 709.394,230 | 4.644.766,030 | 362,150 | |
| 1437 | 707.719,257 | 4.646.746,839 | 377,190 | ASPERSOR |
| 1438 | 707.702,080 | 4.646.741,243 | 376,800 | ASPERSOR |
| 1439 | 712.995,941 | 4.644.564,855 | 338,750 | CABEZA |
| 1440 | 707.694,572 | 4.646.723,197 | 376,340 | PT |
| 1441 | 713.360,422 | 4.644.420,668 | 338,650 | CABEZA |
| 1442 | 707.676,187 | 4.646.715,895 | 375,990 | ASPERSOR |
| 1443 | 707.680,494 | 4.646.710,943 | 376,120 | PT |
| 1444 | 707.667,469 | 4.646.698,705 | 375,990 | PT |
| 1445 | 707.662,632 | 4.646.703,955 | 375,880 | ASPERSOR |
| 1446 | 713.247,146 | 4.644.173,747 | 341,450 | CABEZA |
| 1447 | 707.653,631 | 4.646.686,094 | 375,910 | PT |
| 1448 | 707.640,844 | 4.646.674,943 | 375,970 | PT |
| 1449 | 713.156,786 | 4.644.133,343 | 343,270 | CABEZA |
| 1450 | 713.720,895 | 4.644.250,036 | 339,330 | CABEZA |
| 1451 | 707.627,237 | 4.646.662,582 | 375,840 | PT |
| 1452 | 707.613,702 | 4.646.650,853 | 375,820 | PT |
| 1453 | 707.609,290 | 4.646.655,769 | 375,350 | ASPERSOR |
| 1454 | 709.454,510 | 4.644.804,810 | 361,860 | |
| 1455 | 707.601,806 | 4.646.647,561 | 375,230 | CABE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1456 | 709.456,300 | 4.644.803,130 | 361,840 | |
| 1457 | 707.603,816 | 4.646.642,945 | 375,070 | PIE |
| 1458 | 707.606,479 | 4.646.644,476 | 375,630 | CABE |
| 1459 | 714.151,178 | 4.644.670,580 | 325,180 | CABEZA |
| 1460 | 714.083,580 | 4.644.710,650 | 325,470 | CABEZA |
| 1461 | 707.586,770 | 4.646.625,850 | 374,860 | PT |
| 1462 | 707.582,249 | 4.646.630,139 | 374,720 | PT |
| 1463 | 713.881,636 | 4.644.800,284 | 325,290 | CABEZA |
| 1464 | 707.568,106 | 4.646.608,240 | 374,860 | PT |
| 1465 | 707.555,285 | 4.646.599,262 | 374,780 | PT |
| 1466 | 707.549,666 | 4.646.605,389 | 374,780 | PT |
| 1467 | 707.535,261 | 4.646.597,962 | 374,770 | PT |
| 1468 | 711.459,906 | 4.646.519,687 | 341,050 | CABEZA |
| 1469 | 707.522,314 | 4.646.586,185 | 374,760 | PT |
| 1470 | 707.519,299 | 4.646.594,681 | 374,750 | PT |
| 1471 | 711.478,165 | 4.646.523,704 | 340,900 | CABEZA |
| 1472 | 707.501,328 | 4.646.581,312 | 374,820 | PT |
| 1473 | 707.483,589 | 4.646.580,591 | 374,780 | PT |
| 1474 | 707.481,821 | 4.646.585,754 | 374,920 | CABE |
| 1475 | 707.481,299 | 4.646.587,310 | 374,280 | PIE |
| 1476 | 709.478,320 | 4.644.815,400 | 361,790 | |
| 1477 | 707.468,158 | 4.646.582,436 | 374,430 | PIE |
| 1478 | 711.557,323 | 4.646.541,636 | 340,830 | CABEZA |
| 1479 | 707.460,843 | 4.646.584,382 | 374,310 | PT |
| 1480 | 711.563,106 | 4.646.572,554 | 341,730 | CABEZA |
| 1481 | 707.445,010 | 4.646.578,006 | 374,310 | PT |
| 1482 | 707.443,540 | 4.646.583,844 | 374,240 | PT |
| 1483 | 709.454,920 | 4.644.831,430 | 361,140 | |
| 1484 | 711.560,298 | 4.646.596,079 | 343,210 | CABEZA |
| 1485 | 707.435,675 | 4.646.576,541 | 374,350 | ACEQ |
| 1486 | 709.446,150 | 4.644.841,590 | 360,620 | |
| 1487 | 707.428,639 | 4.646.581,098 | 374,620 | CABE |
| 1488 | 707.428,809 | 4.646.582,632 | 374,320 | PIE |
| 1489 | 709.447,210 | 4.644.840,790 | 360,500 | |
| 1490 | 707.430,035 | 4.646.576,475 | 375,190 | CABE2 |
| 1491 | 707.421,274 | 4.646.576,276 | 375,130 | PT |
| 1492 | 707.408,810 | 4.646.575,955 | 375,010 | PT |
| 1493 | 709.446,330 | 4.644.844,570 | 360,530 | |
| 1494 | 707.389,481 | 4.646.579,213 | 374,820 | PT |
| 1495 | 709.448,300 | 4.644.845,940 | 360,490 | |
| 1496 | 711.687,814 | 4.646.429,914 | 335,780 | CABEZA |
| 1497 | 707.385,901 | 4.646.579,067 | 374,350 | PT |
| 1498 | 707.370,456 | 4.646.575,512 | 374,210 | ASPERSOR |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1499 | 707.371,117 | 4.646.569,726 | 374,280 | PT |
| 1500 | 709.457,620 | 4.644.825,180 | 361,130 | |
| 1501 | 707.357,853 | 4.646.575,565 | 374,230 | PT |
| 1502 | 707.426,593 | 4.646.385,174 | 383,120 | PT |
| 1503 | 707.440,224 | 4.646.388,262 | 381,460 | PT |
| 1504 | 707.449,136 | 4.646.368,868 | 381,760 | PT |
| 1505 | 709.491,770 | 4.644.823,570 | 361,800 | |
| 1506 | 707.450,983 | 4.646.343,470 | 380,760 | PT |
| 1507 | 707.461,750 | 4.646.345,165 | 380,150 | PT |
| 1508 | 709.499,620 | 4.644.826,990 | 361,750 | |
| 1509 | 707.462,479 | 4.646.324,726 | 378,370 | PT |
| 1510 | 707.464,805 | 4.646.318,856 | 377,910 | PT |
| 1511 | 707.471,032 | 4.646.325,194 | 378,220 | PT |
| 1512 | 707.471,503 | 4.646.308,482 | 377,090 | PT |
| 1513 | 707.478,569 | 4.646.310,379 | 377,120 | PT |
| 1514 | 707.486,846 | 4.646.292,937 | 376,260 | CABE |
| 1515 | 707.477,265 | 4.646.295,468 | 376,280 | CABE |
| 1516 | 711.075,466 | 4.646.803,637 | 351,520 | CABEZA |
| 1517 | 707.486,576 | 4.646.289,692 | 375,370 | CANALETA |
| 1518 | 707.484,787 | 4.646.283,970 | 374,840 | PIE |
| 1519 | 707.487,317 | 4.646.285,005 | 374,920 | PIE |
| 1520 | 707.489,712 | 4.646.274,142 | 374,730 | CABE |
| 1521 | 707.491,490 | 4.646.275,461 | 373,870 | ACEQ |
| 1522 | 707.492,717 | 4.646.276,753 | 374,700 | CABE2 |
| 1523 | 707.500,059 | 4.646.268,074 | 373,940 | CABE2 |
| 1524 | 711.029,328 | 4.646.762,004 | 348,440 | CABEZA |
| 1525 | 707.496,351 | 4.646.265,166 | 373,180 | CABE |
| 1526 | 707.494,065 | 4.646.262,402 | 373,220 | PT |
| 1527 | 707.500,595 | 4.646.248,563 | 373,180 | PT |
| 1528 | 707.506,202 | 4.646.250,300 | 373,160 | PT |
| 1529 | 707.507,319 | 4.646.244,481 | 373,140 | CABE |
| 1530 | 711.008,111 | 4.646.713,884 | 345,030 | CABEZA |
| 1531 | 707.501,609 | 4.646.242,323 | 373,210 | CABE |
| 1532 | 707.502,624 | 4.646.239,285 | 371,970 | PIE |
| 1533 | 709.441,520 | 4.644.855,180 | 360,500 | |
| 1534 | 707.519,109 | 4.646.227,780 | 371,790 | PT |
| 1535 | 709.444,710 | 4.644.854,980 | 360,450 | |
| 1536 | 709.439,000 | 4.644.861,800 | 360,500 | |
| 1537 | 707.520,451 | 4.646.210,131 | 371,130 | PIE |
| 1538 | 707.528,312 | 4.646.210,751 | 371,180 | PIE |
| 1539 | 707.525,020 | 4.646.215,081 | 371,750 | CABE |
| 1540 | 707.532,012 | 4.646.203,374 | 371,080 | PT |
| 1541 | 707.524,462 | 4.646.199,477 | 370,930 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1542 | 710.945,582 | 4.646.646,002 | 340,900 | CABEZA |
| 1543 | 707.531,966 | 4.646.190,278 | 370,550 | PIE |
| 1544 | 707.537,552 | 4.646.190,282 | 370,580 | PIE |
| 1545 | 710.825,073 | 4.646.739,403 | 342,330 | CABEZA |
| 1546 | 707.542,918 | 4.646.183,005 | 370,380 | PT |
| 1547 | 710.817,957 | 4.646.733,062 | 342,390 | CABEZA |
| 1548 | 707.545,485 | 4.646.172,829 | 370,490 | CABE |
| 1549 | 710.032,831 | 4.646.903,396 | 344,520 | CABEZA |
| 1550 | 707.537,545 | 4.646.169,716 | 369,890 | PIE |
| 1551 | 709.432,930 | 4.644.876,880 | 360,240 | |
| 1552 | 707.551,375 | 4.646.159,775 | 369,880 | PT |
| 1553 | 707.546,115 | 4.646.158,484 | 370,040 | PT |
| 1554 | 707.554,422 | 4.646.152,317 | 369,350 | PT |
| 1555 | 707.549,844 | 4.646.150,190 | 369,370 | PT |
| 1556 | 707.554,578 | 4.646.144,410 | 368,810 | CABE |
| 1557 | 709.832,365 | 4.646.874,643 | 346,460 | CABEZA |
| 1558 | 709.783,433 | 4.646.856,007 | 347,730 | CABEZA |
| 1559 | 707.555,557 | 4.646.140,471 | 367,580 | PIE |
| 1560 | 707.562,125 | 4.646.126,393 | 367,400 | PT |
| 1561 | 707.567,506 | 4.646.128,457 | 367,360 | PT |
| 1562 | 707.575,038 | 4.646.117,415 | 367,540 | CABE |
| 1563 | 707.576,025 | 4.646.116,706 | 366,910 | PIE |
| 1564 | 707.570,661 | 4.646.110,868 | 366,920 | PIE |
| 1565 | 707.569,739 | 4.646.111,892 | 367,530 | CABE |
| 1566 | 707.581,630 | 4.646.099,972 | 366,830 | PT |
| 1567 | 707.576,667 | 4.646.096,972 | 366,880 | PT |
| 1568 | 707.583,814 | 4.646.082,695 | 367,060 | CABE |
| 1569 | 709.671,767 | 4.646.820,410 | 351,930 | CABEZA |
| 1570 | 707.589,989 | 4.646.087,675 | 366,220 | PIE |
| 1571 | 709.671,770 | 4.646.820,396 | 351,930 | CABEZA |
| 1572 | 707.597,493 | 4.646.073,500 | 366,140 | PT |
| 1573 | 709.594,153 | 4.646.774,567 | 352,970 | CABEZA |
| 1574 | 707.598,038 | 4.646.053,935 | 366,260 | CABE |
| 1575 | 707.599,087 | 4.646.053,062 | 365,430 | PIE |
| 1576 | 707.603,588 | 4.646.061,026 | 366,390 | CABE |
| 1577 | 709.584,294 | 4.646.744,511 | 352,230 | CABEZA |
| 1578 | 707.615,839 | 4.646.039,980 | 365,300 | PT |
| 1579 | 707.606,087 | 4.646.033,462 | 365,290 | PT |
| 1580 | 707.607,632 | 4.646.019,686 | 365,520 | CABE |
| 1581 | 709.550,770 | 4.646.671,806 | 350,870 | CABEZA |
| 1582 | 707.615,033 | 4.646.025,710 | 364,600 | PIE |
| 1583 | 707.609,185 | 4.646.018,098 | 364,560 | PIE |
| 1584 | 707.611,733 | 4.646.010,464 | 364,670 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1585 | 707.611,390 | 4.646.003,932 | 364,750 | PISTA |
| 1586 | 707.624,343 | 4.646.004,451 | 364,630 | PISTA |
| 1587 | 707.624,357 | 4.646.010,619 | 364,540 | PISTA |
| 1588 | 707.624,863 | 4.646.001,410 | 363,060 | CUNETA |
| 1589 | 707.613,535 | 4.646.000,844 | 363,210 | CUNETA |
| 1590 | 707.612,069 | 4.645.998,894 | 364,290 | CABE |
| 1591 | 707.622,327 | 4.645.999,141 | 364,200 | CABE |
| 1592 | 707.622,511 | 4.645.993,086 | 364,010 | PT |
| 1593 | 707.611,825 | 4.645.988,921 | 363,800 | PT |
| 1594 | 707.612,490 | 4.645.981,432 | 364,340 | PIE |
| 1595 | 707.622,374 | 4.645.981,449 | 363,990 | PIE |
| 1596 | 707.622,833 | 4.645.977,375 | 365,750 | TREN |
| 1597 | 707.623,176 | 4.645.974,201 | 365,710 | TREN |
| 1598 | 707.611,109 | 4.645.974,277 | 365,890 | TREN |
| 1599 | 707.610,643 | 4.645.977,147 | 365,920 | TREN |
| 1600 | 707.610,651 | 4.645.968,937 | 363,800 | PIE |
| 1601 | 707.621,502 | 4.645.966,386 | 362,730 | PIE |
| 1602 | 707.621,451 | 4.645.963,726 | 362,700 | CABE |
| 1603 | 707.613,755 | 4.645.963,001 | 362,970 | CABE |
| 1604 | 707.613,269 | 4.645.961,666 | 362,070 | PIE |
| 1605 | 707.623,751 | 4.645.962,149 | 361,880 | PIE |
| 1606 | 707.624,094 | 4.645.960,307 | 362,230 | CABE |
| 1607 | 709.619,330 | 4.644.905,560 | 360,440 | |
| 1608 | 710.500,942 | 4.646.174,135 | 342,320 | CABEZA |
| 1609 | 707.620,031 | 4.645.950,570 | 362,110 | PT |
| 1610 | 707.618,172 | 4.645.934,383 | 362,110 | PT |
| 1611 | 707.621,308 | 4.645.934,929 | 362,160 | ASPERSOR |
| 1612 | 707.610,492 | 4.645.932,829 | 362,290 | PT |
| 1613 | 709.422,780 | 4.644.906,000 | 360,170 | |
| 1614 | 707.612,558 | 4.645.916,990 | 362,400 | ASPERSOR**** |
| 1615 | 707.618,126 | 4.645.915,900 | 362,310 | PT |
| 1616 | 707.616,031 | 4.645.899,483 | 362,340 | PT |
| 1617 | 710.678,892 | 4.646.180,407 | 341,390 | CABEZA |
| 1618 | 707.603,694 | 4.645.898,686 | 362,460 | ASPERSOR |
| 1619 | 707.607,522 | 4.645.883,094 | 362,400 | PT |
| 1620 | 709.414,100 | 4.644.920,990 | 359,970 | |
| 1621 | 707.616,576 | 4.645.880,308 | 362,290 | PT |
| 1622 | 709.410,300 | 4.644.925,520 | 359,870 | |
| 1623 | 707.605,944 | 4.645.860,260 | 362,410 | PT |
| 1624 | 709.413,730 | 4.644.927,660 | 359,820 | |
| 1625 | 707.626,761 | 4.646.015,235 | 364,640 | PT |
| 1626 | 710.831,966 | 4.646.173,970 | 339,750 | CABEZA |
| 1627 | 707.637,242 | 4.646.021,227 | 364,790 | CABE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1628 | 707.638,907 | 4.646.020,267 | 364,090 | PIE |
| 1629 | 707.635,515 | 4.646.013,824 | 364,220 | PIE |
| 1630 | 707.629,926 | 4.646.015,423 | 364,670 | CABE |
| 1631 | 707.650,417 | 4.646.015,020 | 364,170 | PT |
| 1632 | 707.650,443 | 4.646.023,597 | 363,880 | PT |
| 1633 | 707.673,626 | 4.646.023,926 | 363,870 | PT |
| 1634 | 707.673,584 | 4.646.017,291 | 363,970 | PT |
| 1635 | 707.694,220 | 4.646.017,772 | 363,880 | PT |
| 1636 | 707.695,337 | 4.646.024,460 | 363,850 | PT |
| 1637 | 707.713,003 | 4.646.024,271 | 363,880 | PT |
| 1638 | 707.713,610 | 4.646.018,373 | 363,970 | PT |
| 1639 | 707.719,992 | 4.646.025,290 | 363,900 | PIE |
| 1640 | 707.721,784 | 4.646.026,353 | 364,660 | CABE |
| 1641 | 707.728,579 | 4.646.018,416 | 364,640 | CABE |
| 1642 | 707.726,812 | 4.646.017,253 | 364,040 | PIE |
| 1643 | 707.729,164 | 4.646.018,824 | 364,600 | CANALETA |
| 1644 | 707.724,575 | 4.646.024,651 | 364,650 | CANALETA |
| 1645 | 707.738,571 | 4.646.025,235 | 364,460 | PT |
| 1646 | 707.739,104 | 4.646.018,191 | 364,490 | PT |
| 1647 | 707.764,152 | 4.646.020,401 | 364,510 | PT |
| 1648 | 707.764,198 | 4.646.026,536 | 364,480 | PT |
| 1649 | 707.927,079 | 4.646.033,956 | 365,220 | CABEZA |
| 1650 | 707.856,346 | 4.646.039,686 | 365,530 | CABEZA |
| 1651 | 707.786,906 | 4.646.018,346 | 363,390 | ACEQ |
| 1652 | 708.074,750 | 4.644.958,820 | 370,620 | |
| 1653 | 707.794,606 | 4.646.028,272 | 364,880 | PISTA |
| 1654 | 707.798,888 | 4.646.027,847 | 364,890 | PISTA |
| 1655 | 707.796,635 | 4.646.019,633 | 364,840 | PISTA |
| 1656 | 707.791,162 | 4.646.019,964 | 364,670 | PISTA |
| 1657 | 707.812,208 | 4.646.021,866 | 364,670 | PT |
| 1658 | 707.812,315 | 4.646.028,058 | 364,660 | PT |
| 1659 | 707.835,454 | 4.646.027,738 | 364,630 | PT |
| 1660 | 709.403,160 | 4.644.947,420 | 359,800 | |
| 1661 | 707.862,816 | 4.646.020,936 | 364,630 | PT |
| 1662 | 709.403,390 | 4.644.951,950 | 359,770 | |
| 1663 | 707.895,409 | 4.646.030,705 | 365,150 | PT |
| 1664 | 707.896,205 | 4.646.022,546 | 365,180 | PT |
| 1665 | 707.912,793 | 4.646.022,399 | 365,100 | PT |
| 1666 | 709.663,750 | 4.644.937,560 | 360,490 | |
| 1667 | 707.911,548 | 4.646.033,128 | 364,890 | CABE |
| 1668 | 707.911,394 | 4.646.035,396 | 365,560 | CABE |
| 1669 | 709.665,100 | 4.644.942,030 | 360,410 | |
| 1670 | 707.605,868 | 4.645.702,631 | 365,740 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1671 | 707.919,509 | 4.646.040,455 | 365,370 | PT |
| 1672 | 707.929,051 | 4.646.030,686 | 364,720 | PISTA |
| 1673 | 707.934,976 | 4.646.029,573 | 364,750 | PISTA |
| 1674 | 707.922,720 | 4.646.024,338 | 364,630 | PISTA |
| 1675 | 709.680,660 | 4.644.950,550 | 360,530 | |
| 1676 | 707.624,019 | 4.645.629,459 | 366,280 | CABEZA |
| 1677 | 707.944,541 | 4.646.028,366 | 364,070 | PT |
| 1678 | 707.965,771 | 4.646.023,265 | 362,940 | PT |
| 1679 | 707.966,502 | 4.646.030,023 | 363,100 | PT |
| 1680 | 707.981,586 | 4.646.029,760 | 362,700 | PT |
| 1681 | 707.984,764 | 4.646.022,300 | 362,770 | PT |
| 1682 | 707.993,417 | 4.646.022,645 | 362,970 | PT |
| 1683 | 707.993,455 | 4.646.027,676 | 362,750 | PT |
| 1684 | 708.001,725 | 4.646.026,536 | 363,820 | PT |
| 1685 | 707.615,061 | 4.645.544,745 | 367,030 | CABEZA |
| 1686 | 707.631,353 | 4.645.497,296 | 367,210 | CABEZA |
| 1687 | 708.019,451 | 4.646.026,156 | 364,290 | PT |
| 1688 | 708.033,926 | 4.646.025,891 | 365,660 | PT |
| 1689 | 708.034,083 | 4.646.023,028 | 364,910 | PT |
| 1690 | 708.033,665 | 4.646.020,632 | 365,340 | PT |
| 1691 | 707.634,883 | 4.645.424,094 | 367,880 | CABEZA |
| 1692 | 707.637,871 | 4.645.264,054 | 367,390 | CABEZA |
| 1693 | 708.065,105 | 4.646.021,778 | 366,420 | PT |
| 1694 | 708.067,443 | 4.646.025,323 | 367,640 | ARBOL |
| 1695 | 708.089,345 | 4.646.021,850 | 366,850 | PT |
| 1696 | 708.089,775 | 4.646.025,937 | 368,000 | ARBOL |
| 1697 | 708.109,149 | 4.646.022,365 | 366,480 | PT |
| 1698 | 708.108,692 | 4.646.027,208 | 368,300 | ARBOL |
| 1699 | 708.431,470 | 4.644.986,920 | 368,030 | |
| 1700 | 707.644,394 | 4.645.057,194 | 369,550 | CABEZA |
| 1701 | 708.148,328 | 4.646.019,172 | 365,010 | PISTA |
| 1702 | 708.149,689 | 4.646.024,945 | 365,240 | PISTA |
| 1703 | 707.644,298 | 4.645.004,953 | 371,290 | CABEZA |
| 1704 | 708.158,287 | 4.646.027,005 | 365,650 | PT |
| 1705 | 708.156,854 | 4.646.030,289 | 365,300 | PT |
| 1706 | 708.163,801 | 4.646.030,718 | 364,230 | PT |
| 1707 | 708.166,865 | 4.646.025,825 | 363,970 | PT |
| 1708 | 708.493,640 | 4.644.983,680 | 367,230 | |
| 1709 | 708.174,096 | 4.646.035,204 | 362,260 | PT |
| 1710 | 708.184,712 | 4.646.032,613 | 361,510 | PT |
| 1711 | 707.731,163 | 4.644.987,733 | 368,650 | CABEZA |
| 1712 | 708.181,876 | 4.646.037,722 | 360,310 | PIE |
| 1713 | 707.749,248 | 4.644.981,929 | 368,400 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1714 | 707.936,836 | 4.645.023,355 | 367,830 | CABEZA |
| 1715 | 708.203,299 | 4.646.036,412 | 359,790 | PT |
| 1716 | 708.201,745 | 4.646.042,247 | 359,840 | PT |
| 1717 | 708.219,197 | 4.646.038,586 | 359,820 | PT |
| 1718 | 708.217,362 | 4.646.044,621 | 359,880 | PT |
| 1719 | 708.226,345 | 4.646.045,085 | 359,860 | PT |
| 1720 | 708.226,590 | 4.646.038,387 | 359,800 | PT |
| 1721 | 707.985,236 | 4.645.020,071 | 368,870 | CABEZA |
| 1722 | 707.962,803 | 4.646.084,450 | 364,690 | PT |
| 1723 | 709.396,260 | 4.644.963,830 | 359,750 | |
| 1724 | 708.034,818 | 4.645.030,187 | 370,890 | CABEZA |
| 1725 | 707.990,408 | 4.646.102,357 | 364,690 | PT |
| 1726 | 707.986,538 | 4.646.107,864 | 364,660 | PT |
| 1727 | 707.994,280 | 4.646.115,893 | 364,740 | PIE |
| 1728 | 707.999,422 | 4.646.110,610 | 364,940 | PIE |
| 1729 | 709.389,880 | 4.644.969,920 | 359,280 | |
| 1730 | 707.996,913 | 4.646.117,718 | 366,110 | CABE |
| 1731 | 708.072,042 | 4.645.046,020 | 370,920 | CABEZA |
| 1732 | 708.252,465 | 4.645.067,030 | 370,750 | CABEZA |
| 1733 | 708.016,345 | 4.646.128,990 | 366,100 | PIE |
| 1734 | 708.013,792 | 4.646.135,036 | 366,000 | PIE |
| 1735 | 708.015,228 | 4.646.137,847 | 367,470 | CABE |
| 1736 | 708.022,054 | 4.646.132,620 | 367,320 | CABE |
| 1737 | 708.030,632 | 4.646.142,903 | 367,240 | PT |
| 1738 | 708.027,559 | 4.646.147,084 | 367,150 | PT |
| 1739 | 708.039,902 | 4.646.159,589 | 367,160 | PT |
| 1740 | 708.044,706 | 4.646.155,256 | 367,400 | PT |
| 1741 | 708.476,682 | 4.645.103,732 | 365,710 | CABEZA |
| 1742 | 708.058,237 | 4.646.178,356 | 367,150 | PT |
| 1743 | 708.522,568 | 4.645.113,091 | 364,510 | CABEZA |
| 1744 | 709.389,340 | 4.644.979,700 | 359,770 | |
| 1745 | 708.096,732 | 4.646.205,958 | 367,320 | PT |
| 1746 | 708.091,161 | 4.646.212,535 | 367,160 | PT |
| 1747 | 708.099,604 | 4.646.220,239 | 367,210 | CABE |
| 1748 | 708.613,031 | 4.645.133,973 | 361,920 | CABEZA |
| 1749 | 708.109,117 | 4.646.218,064 | 368,990 | CABE |
| 1750 | 708.614,178 | 4.645.142,133 | 361,960 | CABEZA |
| 1751 | 708.117,875 | 4.646.226,833 | 369,070 | PT |
| 1752 | 708.662,540 | 4.645.148,498 | 361,700 | CABEZA |
| 1753 | 708.127,074 | 4.646.246,635 | 368,850 | PT |
| 1754 | 708.131,962 | 4.646.241,024 | 369,090 | PT |
| 1755 | 708.141,193 | 4.646.251,293 | 369,100 | PT |
| 1756 | 708.134,441 | 4.646.257,112 | 368,870 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1757 | 708.140,989 | 4.646.272,943 | 368,880 | PT |
| 1758 | 708.147,761 | 4.646.270,346 | 368,860 | PT |
| 1759 | 708.154,424 | 4.646.284,801 | 368,860 | PIE |
| 1760 | 708.718,860 | 4.645.514,315 | 357,290 | CABEZA |
| 1761 | 708.154,990 | 4.646.291,078 | 370,580 | CABE |
| 1762 | 708.150,983 | 4.646.297,476 | 370,570 | CABE |
| 1763 | 708.154,363 | 4.646.303,491 | 370,400 | PT |
| 1764 | 709.720,350 | 4.644.971,580 | 359,940 | |
| 1765 | 708.165,424 | 4.646.315,939 | 370,340 | PT |
| 1766 | 709.734,570 | 4.644.974,740 | 359,720 | |
| 1767 | 708.167,105 | 4.646.332,301 | 370,360 | PT |
| 1768 | 708.172,004 | 4.646.331,611 | 370,380 | PT |
| 1769 | 709.250,824 | 4.645.239,458 | 359,580 | CABEZA |
| 1770 | 708.172,896 | 4.646.350,383 | 370,320 | PT |
| 1771 | 708.177,667 | 4.646.360,098 | 370,540 | PIE |
| 1772 | 708.185,706 | 4.646.361,384 | 370,770 | PIE |
| 1773 | 708.187,183 | 4.646.367,240 | 372,170 | CABE |
| 1774 | 708.179,430 | 4.646.364,213 | 372,410 | CABE |
| 1775 | 708.218,443 | 4.646.411,051 | 372,830 | PT |
| 1776 | 708.213,185 | 4.646.416,159 | 372,800 | PT |
| 1777 | 708.223,028 | 4.646.425,750 | 372,810 | PT |
| 1778 | 708.228,709 | 4.646.420,460 | 372,820 | PT |
| 1779 | 708.240,123 | 4.646.434,332 | 372,810 | PT |
| 1780 | 708.234,683 | 4.646.440,338 | 372,800 | PT |
| 1781 | 708.165,350 | 4.644.993,710 | 370,620 | |
| 1782 | 708.254,078 | 4.646.447,926 | 372,820 | PT |
| 1783 | 708.270,460 | 4.646.462,642 | 372,820 | PT |
| 1784 | 708.266,769 | 4.646.468,723 | 372,810 | PT |
| 1785 | 708.187,870 | 4.645.003,220 | 370,600 | |
| 1786 | 708.930,266 | 4.645.177,542 | 360,110 | CABEZA |
| 1787 | 708.216,360 | 4.645.000,840 | 369,510 | |
| 1788 | 709.185,756 | 4.648.286,195 | 348,560 | PT |
| 1789 | 709.187,556 | 4.648.273,944 | 348,190 | PT |
| 1790 | 708.243,420 | 4.644.997,040 | 369,510 | |
| 1791 | 708.925,390 | 4.645.180,865 | 358,830 | CABEZA |
| 1792 | 709.201,716 | 4.648.237,349 | 348,100 | PT |
| 1793 | 708.890,138 | 4.645.177,629 | 358,670 | CABEZA |
| 1794 | 709.203,019 | 4.648.197,998 | 348,010 | PT |
| 1795 | 709.202,342 | 4.648.178,505 | 348,050 | PT |
| 1796 | 708.881,835 | 4.645.183,139 | 358,610 | CABEZA |
| 1797 | 709.202,163 | 4.648.162,770 | 346,430 | ACEQ |
| 1798 | 709.193,816 | 4.648.164,091 | 346,240 | ACEQ |
| 1799 | 708.816,333 | 4.645.175,589 | 358,710 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1800 | 709.193,620 | 4.648.160,098 | 348,620 | CABE |
| 1801 | 708.861,257 | 4.645.030,589 | 360,950 | CABEZA |
| 1802 | 709.203,921 | 4.648.140,042 | 347,630 | PT |
| 1803 | 709.204,949 | 4.648.114,819 | 347,660 | PT |
| 1804 | 708.324,090 | 4.644.992,340 | 368,750 | |
| 1805 | 709.207,882 | 4.648.070,991 | 348,360 | PT |
| 1806 | 709.208,584 | 4.648.052,926 | 348,390 | PT |
| 1807 | 709.207,537 | 4.648.033,530 | 348,430 | PIE |
| 1808 | 709.199,535 | 4.648.038,704 | 348,440 | PIE |
| 1809 | 709.199,586 | 4.648.033,378 | 350,450 | CABE |
| 1810 | 708.340,440 | 4.644.991,970 | 368,790 | |
| 1811 | 709.209,098 | 4.648.016,416 | 350,090 | PT |
| 1812 | 708.380,060 | 4.644.989,270 | 368,330 | |
| 1813 | 709.216,747 | 4.647.990,076 | 350,050 | PT |
| 1814 | 708.357,670 | 4.644.990,740 | 368,780 | |
| 1815 | 709.223,966 | 4.647.962,102 | 350,040 | PT |
| 1816 | 709.226,398 | 4.647.954,337 | 350,050 | PT |
| 1817 | 709.225,350 | 4.647.947,495 | 350,030 | PT |
| 1818 | 709.221,545 | 4.647.942,128 | 350,330 | CABE |
| 1819 | 709.220,319 | 4.647.939,905 | 349,670 | ACEQ |
| 1820 | 709.212,975 | 4.647.943,026 | 349,780 | ACEQ |
| 1821 | 709.213,393 | 4.647.945,257 | 350,460 | CABE |
| 1822 | 708.552,830 | 4.644.986,120 | 365,680 | |
| 1823 | 709.218,737 | 4.647.937,938 | 351,230 | CABE2 |
| 1824 | 709.218,041 | 4.647.936,314 | 350,880 | CANALETA |
| 1825 | 709.210,621 | 4.647.938,390 | 350,880 | CANALETA |
| 1826 | 709.093,442 | 4.644.543,010 | 364,300 | CABEZA |
| 1827 | 709.216,701 | 4.647.932,471 | 351,300 | CARRETERA |
| 1828 | 709.214,912 | 4.647.924,358 | 351,250 | CARRETERA |
| 1829 | 709.206,723 | 4.647.926,819 | 351,350 | CARRETERA |
| 1830 | 709.205,790 | 4.647.925,256 | 350,850 | CUNETA |
| 1831 | 709.215,624 | 4.647.921,989 | 350,930 | CUNETA |
| 1832 | 708.663,130 | 4.645.007,900 | 360,860 | |
| 1833 | 709.205,891 | 4.647.922,400 | 351,370 | CABE |
| 1834 | 709.206,029 | 4.647.919,815 | 351,080 | PIE |
| 1835 | 709.385,970 | 4.644.985,880 | 359,680 | |
| 1836 | 709.210,578 | 4.647.906,838 | 351,220 | PT |
| 1837 | 709.202,567 | 4.647.905,888 | 351,340 | PT |
| 1838 | 709.203,900 | 4.647.899,092 | 351,560 | PT |
| 1839 | 709.209,349 | 4.647.899,106 | 351,370 | PT |
| 1840 | 709.214,664 | 4.647.953,174 | 349,910 | PT |
| 1841 | 709.211,700 | 4.647.963,717 | 350,060 | PT |
| 1842 | 709.208,581 | 4.647.980,969 | 350,130 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1843 | 709.205,311 | 4.647.999,815 | 350,220 | PT |
| 1844 | 709.201,193 | 4.648.015,197 | 350,050 | PT |
| 1845 | 709.199,321 | 4.648.023,907 | 350,190 | PT |
| 1846 | 709.199,069 | 4.648.051,010 | 348,400 | PT |
| 1847 | 709.197,512 | 4.648.073,603 | 348,370 | PT |
| 1848 | 709.196,298 | 4.648.094,302 | 348,360 | PT |
| 1849 | 709.194,808 | 4.648.113,898 | 348,360 | PT |
| 1850 | 709.194,180 | 4.648.135,142 | 348,300 | PT |
| 1851 | 709.765,770 | 4.644.992,130 | 359,890 | |
| 1852 | 709.202,726 | 4.648.150,395 | 348,370 | PT |
| 1853 | 709.399,431 | 4.645.284,321 | 359,210 | CABEZA |
| 1854 | 709.191,609 | 4.648.199,550 | 348,060 | PT |
| 1855 | 709.376,599 | 4.645.254,781 | 359,570 | CABEZA |
| 1856 | 709.190,129 | 4.648.239,413 | 348,080 | PT |
| 1857 | 709.188,928 | 4.648.258,691 | 348,040 | PT |
| 1858 | 709.379,183 | 4.645.248,597 | 359,560 | CABEZA |
| 1859 | 709.187,082 | 4.648.300,920 | 348,150 | PT |
| 1860 | 709.197,927 | 4.648.304,791 | 348,040 | PT |
| 1861 | 709.199,072 | 4.648.332,315 | 348,160 | PT |
| 1862 | 709.188,999 | 4.648.332,920 | 348,110 | PT |
| 1863 | 709.186,604 | 4.648.377,675 | 348,200 | PT |
| 1864 | 709.790,320 | 4.645.000,810 | 359,490 | |
| 1865 | 709.522,540 | 4.645.284,937 | 357,620 | CABEZA |
| 1866 | 709.183,561 | 4.648.407,327 | 348,190 | PT |
| 1867 | 709.802,810 | 4.645.006,840 | 359,810 | |
| 1868 | 709.183,687 | 4.648.427,063 | 348,360 | PT |
| 1869 | 708.325,650 | 4.645.016,390 | 369,210 | |
| 1870 | 709.198,178 | 4.648.425,115 | 348,450 | CANALETA |
| 1871 | 709.187,110 | 4.648.429,118 | 348,480 | CANALETA |
| 1872 | 708.325,440 | 4.645.022,300 | 369,210 | |
| 1873 | 709.596,572 | 4.645.302,012 | 356,410 | CABEZA |
| 1874 | 709.187,673 | 4.648.438,856 | 348,260 | CANALETA |
| 1875 | 708.685,700 | 4.645.019,930 | 360,480 | |
| 1876 | 709.197,484 | 4.648.432,907 | 348,260 | PISTA |
| 1877 | 708.693,130 | 4.645.025,570 | 360,380 | |
| 1878 | 709.221,970 | 4.648.415,430 | 348,330 | PT |
| 1879 | 709.223,631 | 4.648.403,290 | 348,190 | PT |
| 1880 | 709.231,692 | 4.648.402,191 | 348,000 | PT |
| 1881 | 709.234,274 | 4.648.409,960 | 348,000 | PT |
| 1882 | 709.644,835 | 4.645.301,467 | 355,640 | CABEZA |
| 1883 | 709.256,928 | 4.648.399,636 | 347,740 | PIE |
| 1884 | 709.256,702 | 4.648.393,305 | 347,800 | PIE |
| 1885 | 709.698,109 | 4.645.309,907 | 356,910 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1886 | 709.255,124 | 4.648.404,126 | 348,160 | CABE |
| 1887 | 709.258,678 | 4.648.403,315 | 347,860 | PIE |
| 1888 | 709.280,317 | 4.648.396,653 | 347,790 | PT |
| 1889 | 709.737,591 | 4.645.328,830 | 358,270 | CABEZA |
| 1890 | 709.296,617 | 4.648.380,960 | 347,750 | PT |
| 1891 | 709.300,482 | 4.648.390,687 | 347,770 | PT |
| 1892 | 709.309,768 | 4.648.387,519 | 347,910 | CABE |
| 1893 | 709.785,428 | 4.645.333,889 | 357,700 | CABEZA |
| 1894 | 709.311,187 | 4.648.378,250 | 347,450 | PIE |
| 1895 | 709.372,460 | 4.645.023,790 | 359,790 | |
| 1896 | 709.328,957 | 4.648.375,268 | 347,440 | PT |
| 1897 | 709.330,762 | 4.648.381,396 | 347,460 | PT |
| 1898 | 709.343,963 | 4.648.377,234 | 347,590 | CABE |
| 1899 | 709.347,146 | 4.648.376,302 | 347,300 | PIE |
| 1900 | 708.368,520 | 4.645.067,110 | 369,150 | |
| 1901 | 709.346,363 | 4.648.375,888 | 347,300 | PIE |
| 1902 | 709.345,648 | 4.648.375,045 | 347,430 | PIE |
| 1903 | 709.932,659 | 4.645.352,751 | 357,090 | CABEZA |
| 1904 | 709.345,574 | 4.648.375,040 | 347,440 | PIE |
| 1905 | 709.345,196 | 4.648.367,588 | 347,230 | PIE |
| 1906 | 709.343,334 | 4.648.367,206 | 347,540 | CABE |
| 1907 | 708.741,000 | 4.645.067,530 | 360,070 | |
| 1908 | 709.380,964 | 4.648.366,523 | 347,220 | PT |
| 1909 | 709.387,065 | 4.648.364,343 | 347,270 | PT |
| 1910 | 709.387,243 | 4.648.356,363 | 347,280 | PT |
| 1911 | 709.402,096 | 4.648.352,760 | 346,980 | PT |
| 1912 | 709.404,938 | 4.648.361,344 | 347,130 | PT |
| 1913 | 709.356,940 | 4.645.052,650 | 359,800 | |
| 1914 | 709.421,543 | 4.648.348,189 | 347,040 | PT |
| 1915 | 709.423,511 | 4.648.347,683 | 346,620 | PIE |
| 1916 | 709.425,720 | 4.648.353,328 | 346,700 | PIE |
| 1917 | 709.448,891 | 4.648.350,512 | 346,870 | PIE |
| 1918 | 709.443,653 | 4.648.353,040 | 347,060 | PISTA |
| 1919 | 709.433,482 | 4.648.356,003 | 347,050 | PISTA |
| 1920 | 709.353,160 | 4.645.067,090 | 359,780 | |
| 1921 | 709.443,358 | 4.648.357,509 | 347,080 | PISTA |
| 1922 | 709.444,046 | 4.648.360,797 | 347,140 | CANALETA |
| 1923 | 709.436,538 | 4.648.363,435 | 346,990 | CANALETA |
| 1924 | 709.438,989 | 4.648.369,732 | 346,830 | PT |
| 1925 | 709.446,464 | 4.648.367,376 | 346,800 | PT |
| 1926 | 709.443,551 | 4.648.341,800 | 346,630 | PT |
| 1927 | 709.463,263 | 4.648.341,445 | 346,900 | CABE |
| 1928 | 710.706,389 | 4.645.486,699 | 352,690 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1929 | 709.340,540 | 4.645.092,170 | 359,820 | |
| 1930 | 709.464,036 | 4.648.334,706 | 346,880 | CABE |
| 1931 | 709.483,581 | 4.648.339,347 | 346,600 | PT |
| 1932 | 709.482,867 | 4.648.330,124 | 346,470 | PT |
| 1933 | 709.502,267 | 4.648.324,230 | 346,710 | CABE |
| 1934 | 709.503,988 | 4.648.323,705 | 346,180 | PIE |
| 1935 | 710.807,030 | 4.645.495,922 | 351,960 | CABEZA |
| 1936 | 709.501,385 | 4.648.331,097 | 346,660 | CABE |
| 1937 | 709.538,953 | 4.648.322,708 | 346,350 | PT |
| 1938 | 711.106,873 | 4.645.547,627 | 350,460 | CABEZA |
| 1939 | 709.577,288 | 4.648.310,964 | 346,440 | CABE |
| 1940 | 709.577,331 | 4.648.301,218 | 346,440 | CABE |
| 1941 | 711.136,642 | 4.645.552,347 | 350,140 | CABEZA |
| 1942 | 709.582,291 | 4.648.308,470 | 346,080 | PIE |
| 1943 | 709.595,020 | 4.648.304,856 | 345,930 | PT |
| 1944 | 709.594,657 | 4.648.297,240 | 345,920 | PT |
| 1945 | 709.610,377 | 4.648.298,018 | 346,060 | CABE |
| 1946 | 709.610,368 | 4.648.291,390 | 346,140 | CABE |
| 1947 | 711.310,957 | 4.645.649,993 | 349,510 | CABEZA |
| 1948 | 709.614,388 | 4.648.298,103 | 345,850 | PIE |
| 1949 | 709.633,164 | 4.648.293,663 | 345,680 | PT |
| 1950 | 709.631,816 | 4.648.285,641 | 345,580 | PT |
| 1951 | 709.657,674 | 4.648.285,802 | 345,820 | CABE |
| 1952 | 708.786,310 | 4.645.106,070 | 359,790 | |
| 1953 | 709.658,814 | 4.648.278,181 | 345,330 | PIE |
| 1954 | 709.661,054 | 4.648.284,066 | 345,620 | PIE |
| 1955 | 708.781,480 | 4.645.111,660 | 359,850 | |
| 1956 | 709.678,571 | 4.648.270,578 | 345,390 | PT |
| 1957 | 709.695,153 | 4.648.273,263 | 345,630 | PT |
| 1958 | 708.785,000 | 4.645.111,360 | 359,980 | |
| 1959 | 711.358,419 | 4.645.761,842 | 344,980 | CABEZA |
| 1960 | 709.702,326 | 4.648.273,054 | 345,330 | PT |
| 1961 | 709.723,158 | 4.648.266,674 | 345,320 | PT |
| 1962 | 709.721,463 | 4.648.257,536 | 345,140 | PT |
| 1963 | 709.723,254 | 4.648.268,043 | 345,650 | PISTA |
| 1964 | 709.724,667 | 4.648.272,678 | 345,550 | PISTA |
| 1965 | 709.725,378 | 4.648.274,635 | 345,480 | CANALETA |
| 1966 | 709.734,047 | 4.648.272,157 | 345,490 | CANALETA |
| 1967 | 709.733,932 | 4.648.269,419 | 345,640 | PISTA |
| 1968 | 711.477,579 | 4.645.782,119 | 342,120 | CABEZA |
| 1969 | 711.490,612 | 4.645.778,439 | 342,020 | CABEZA |
| 1970 | 709.736,333 | 4.648.280,273 | 345,080 | PT |
| 1971 | 709.767,710 | 4.648.269,034 | 345,280 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 1972 | 708.794,160 | 4.645.112,150 | 359,810 | |
| 1973 | 709.771,137 | 4.648.266,931 | 345,360 | EJE |
| 1974 | 709.768,177 | 4.648.259,012 | 345,680 | EJE |
| 1975 | 711.571,432 | 4.645.809,511 | 340,340 | CABEZA |
| 1976 | 709.774,409 | 4.648.257,057 | 345,720 | PISTA |
| 1977 | 709.773,433 | 4.648.252,704 | 345,670 | PISTA |
| 1978 | 711.583,015 | 4.645.811,198 | 340,400 | CABEZA |
| 1979 | 709.764,898 | 4.648.253,536 | 345,080 | PIE |
| 1980 | 709.328,970 | 4.645.120,090 | 359,870 | |
| 1981 | 710.425,012 | 4.645.948,415 | 351,540 | CABEZA |
| 1982 | 709.776,629 | 4.648.248,460 | 344,970 | PIE |
| 1983 | 709.774,254 | 4.648.240,572 | 345,240 | CABE |
| 1984 | 709.775,604 | 4.648.240,591 | 344,880 | PIE |
| 1985 | 709.795,582 | 4.648.243,937 | 344,910 | PT |
| 1986 | 710.451,158 | 4.645.742,098 | 351,720 | CABEZA |
| 1987 | 709.810,946 | 4.648.238,433 | 344,990 | CABE |
| 1988 | 709.814,240 | 4.648.237,000 | 344,720 | PIE |
| 1989 | 710.449,684 | 4.645.736,376 | 352,150 | CABEZA |
| 1990 | 709.810,338 | 4.648.231,454 | 345,040 | CABE |
| 1991 | 709.832,486 | 4.648.232,488 | 344,680 | PT |
| 1992 | 709.832,000 | 4.648.226,257 | 344,600 | PT |
| 1993 | 709.850,930 | 4.648.227,503 | 344,780 | CABE |
| 1994 | 709.850,238 | 4.648.220,489 | 344,770 | CABE |
| 1995 | 710.442,883 | 4.645.639,196 | 353,400 | CABEZA |
| 1996 | 709.854,673 | 4.648.225,026 | 344,440 | PIE |
| 1997 | 709.871,878 | 4.648.220,927 | 344,450 | PT |
| 1998 | 709.870,212 | 4.648.213,450 | 344,390 | PT |
| 1999 | 709.924,476 | 4.645.475,755 | 356,640 | CABEZA |
| 2000 | 709.892,163 | 4.648.206,108 | 344,690 | CABE |
| 2001 | 709.896,580 | 4.648.205,690 | 344,230 | PIE |
| 2002 | 709.934,035 | 4.645.471,510 | 356,660 | CABEZA |
| 2003 | 709.916,898 | 4.648.207,092 | 344,410 | PT |
| 2004 | 709.915,888 | 4.648.198,500 | 344,350 | PT |
| 2005 | 709.313,510 | 4.645.156,010 | 359,880 | |
| 2006 | 709.932,733 | 4.648.199,328 | 344,410 | PT |
| 2007 | 709.951,379 | 4.648.194,530 | 344,290 | PT |
| 2008 | 709.950,567 | 4.648.186,615 | 344,210 | PT |
| 2009 | 709.971,642 | 4.648.179,702 | 344,240 | PT |
| 2010 | 709.976,577 | 4.648.187,310 | 344,360 | PT |
| 2011 | 709.309,690 | 4.645.160,630 | 359,860 | |
| 2012 | 709.997,934 | 4.648.172,412 | 344,350 | PT |
| 2013 | 710.018,817 | 4.648.166,247 | 344,390 | PT |
| 2014 | 710.021,987 | 4.648.172,203 | 344,470 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2015 | 710.044,148 | 4.648.165,916 | 344,510 | PT |
| 2016 | 710.003,393 | 4.645.803,467 | 350,500 | CABEZA |
| 2017 | 710.063,276 | 4.648.151,882 | 344,490 | PT |
| 2018 | 709.559,144 | 4.645.544,989 | 356,540 | CABEZA |
| 2019 | 710.087,026 | 4.648.152,391 | 344,550 | PT |
| 2020 | 710.085,376 | 4.648.143,432 | 344,470 | PT |
| 2021 | 710.114,492 | 4.648.135,328 | 344,650 | PT |
| 2022 | 710.120,749 | 4.648.142,533 | 344,760 | PT |
| 2023 | 710.105,208 | 4.648.150,751 | 343,850 | PISTA |
| 2024 | 707.573,316 | 4.644.962,121 | 373,970 | CABEZA |
| 2025 | 710.091,327 | 4.648.159,583 | 343,840 | PISTA |
| 2026 | 707.570,333 | 4.644.954,128 | 373,950 | CABEZA |
| 2027 | 710.088,544 | 4.648.153,350 | 344,610 | CANALETA |
| 2028 | 710.092,365 | 4.648.162,734 | 344,130 | CANALETA |
| 2029 | 710.100,433 | 4.648.149,837 | 344,510 | CANALETA |
| 2030 | 710.102,199 | 4.648.159,979 | 344,290 | CANALETA |
| 2031 | 710.100,489 | 4.648.167,959 | 344,060 | PT |
| 2032 | 710.095,846 | 4.648.167,933 | 343,580 | PT |
| 2033 | 710.130,770 | 4.648.139,749 | 344,710 | PT |
| 2034 | 707.387,994 | 4.644.923,447 | 374,680 | CABEZA |
| 2035 | 710.156,132 | 4.648.123,844 | 344,620 | PT |
| 2036 | 709.294,920 | 4.645.171,330 | 359,880 | |
| 2037 | 710.184,315 | 4.648.123,634 | 344,600 | PT |
| 2038 | 710.182,972 | 4.648.115,469 | 344,650 | PT |
| 2039 | 707.379,450 | 4.644.921,413 | 373,660 | CABEZA |
| 2040 | 710.212,071 | 4.648.115,509 | 344,740 | PT |
| 2041 | 710.241,633 | 4.648.106,852 | 344,720 | PT |
| 2042 | 707.364,731 | 4.644.910,888 | 373,810 | CABEZA |
| 2043 | 707.347,147 | 4.644.918,652 | 373,890 | CABEZA |
| 2044 | 710.271,219 | 4.648.098,886 | 344,870 | PT |
| 2045 | 710.298,588 | 4.648.092,276 | 344,720 | PT |
| 2046 | 710.296,439 | 4.648.083,943 | 344,700 | PT |
| 2047 | 710.326,042 | 4.648.075,765 | 344,720 | PT |
| 2048 | 710.328,636 | 4.648.083,012 | 344,830 | PT |
| 2049 | 710.364,049 | 4.648.072,018 | 344,890 | PISTA |
| 2050 | 709.303,040 | 4.645.185,160 | 359,710 | |
| 2051 | 709.306,870 | 4.645.185,390 | 359,810 | |
| 2052 | 710.366,401 | 4.648.061,699 | 344,680 | PISTA |
| 2053 | 710.368,673 | 4.648.061,606 | 343,810 | PIE |
| 2054 | 710.370,965 | 4.648.067,307 | 343,830 | PIE |
| 2055 | 710.368,106 | 4.648.060,047 | 343,850 | PIE |
| 2056 | 710.392,384 | 4.648.053,689 | 343,740 | PT |
| 2057 | 709.311,270 | 4.645.198,860 | 359,700 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2058 | 710.423,687 | 4.648.052,437 | 343,740 | PT |
| 2059 | 709.312,800 | 4.645.200,050 | 359,580 | |
| 2060 | 710.445,857 | 4.648.039,835 | 343,700 | PT |
| 2061 | 710.447,173 | 4.648.047,358 | 343,850 | PT |
| 2062 | 710.466,123 | 4.648.044,788 | 343,690 | PT |
| 2063 | 710.467,287 | 4.648.036,531 | 343,700 | PT |
| 2064 | 710.504,997 | 4.648.042,563 | 343,730 | CANALETA |
| 2065 | 707.134,415 | 4.644.881,811 | 375,910 | CABEZA |
| 2066 | 710.506,766 | 4.648.052,189 | 343,710 | PT |
| 2067 | 710.510,064 | 4.648.046,137 | 343,650 | PT |
| 2068 | 709.331,790 | 4.645.186,700 | 359,570 | |
| 2069 | 710.515,760 | 4.648.060,043 | 343,640 | PT |
| 2070 | 710.540,893 | 4.648.075,272 | 343,620 | PT |
| 2071 | 710.545,842 | 4.648.069,038 | 343,610 | PT |
| 2072 | 710.570,121 | 4.648.084,995 | 343,510 | PT |
| 2073 | 710.566,555 | 4.648.092,095 | 343,560 | PT |
| 2074 | 710.577,473 | 4.648.098,297 | 343,520 | PIE |
| 2075 | 710.586,038 | 4.648.103,644 | 343,560 | PIE |
| 2076 | 710.585,301 | 4.648.105,796 | 344,150 | PISTA |
| 2077 | 710.582,192 | 4.648.109,666 | 344,170 | PISTA |
| 2078 | 710.576,288 | 4.648.099,749 | 344,230 | PISTA |
| 2079 | 710.573,323 | 4.648.103,970 | 344,190 | PISTA |
| 2080 | 710.572,133 | 4.648.106,061 | 343,960 | CANALETA |
| 2081 | 710.579,671 | 4.648.110,892 | 344,040 | CANALETA |
| 2082 | 710.576,288 | 4.648.119,651 | 343,830 | PT |
| 2083 | 710.566,764 | 4.648.114,570 | 343,800 | PT |
| 2084 | 709.321,120 | 4.645.211,950 | 359,500 | |
| 2085 | 710.605,889 | 4.648.106,525 | 343,510 | PT |
| 2086 | 706.397,624 | 4.644.839,040 | 379,920 | CABEZA |
| 2087 | 710.630,017 | 4.648.132,579 | 343,400 | PT |
| 2088 | 709.354,720 | 4.645.218,430 | 359,760 | |
| 2089 | 706.357,521 | 4.644.861,359 | 380,840 | CABEZA |
| 2090 | 710.694,990 | 4.648.163,605 | 343,230 | CABE |
| 2091 | 710.690,899 | 4.648.170,104 | 343,550 | CABE |
| 2092 | 710.695,203 | 4.648.172,306 | 342,310 | PIE |
| 2093 | 709.359,360 | 4.645.227,570 | 359,330 | |
| 2094 | 710.716,572 | 4.648.175,298 | 342,250 | PT |
| 2095 | 710.711,852 | 4.648.182,665 | 342,270 | PT |
| 2096 | 710.745,653 | 4.648.192,875 | 342,200 | PT |
| 2097 | 710.740,340 | 4.648.200,949 | 342,270 | PT |
| 2098 | 710.740,087 | 4.648.201,721 | 342,350 | PIE |
| 2099 | 710.731,652 | 4.648.195,914 | 342,250 | PIE |
| 2100 | 710.730,054 | 4.648.197,684 | 343,650 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2101 | 709.368,590 | 4.645.240,380 | 359,360 | |
| 2102 | 710.738,278 | 4.648.207,929 | 343,570 | PISTA |
| 2103 | 710.741,245 | 4.648.204,670 | 343,490 | PISTA |
| 2104 | 710.737,633 | 4.648.211,205 | 343,260 | CANALETA |
| 2105 | 710.727,367 | 4.648.204,818 | 343,190 | CANALETA |
| 2106 | 710.724,685 | 4.648.206,047 | 342,860 | PIE |
| 2107 | 710.734,362 | 4.648.212,319 | 342,890 | PIE |
| 2108 | 706.151,069 | 4.644.934,457 | 383,030 | CABEZA |
| 2109 | 710.722,409 | 4.648.214,869 | 343,260 | PT |
| 2110 | 708.334,540 | 4.645.305,390 | 367,280 | |
| 2111 | 710.676,150 | 4.648.596,292 | 341,100 | PT |
| 2112 | 710.651,059 | 4.648.611,899 | 341,140 | PT |
| 2113 | 710.655,687 | 4.648.621,143 | 341,170 | PT |
| 2114 | 710.630,277 | 4.648.636,910 | 341,090 | PT |
| 2115 | 710.624,407 | 4.648.628,425 | 341,100 | PT |
| 2116 | 710.598,206 | 4.648.642,991 | 341,120 | PT |
| 2117 | 710.601,879 | 4.648.654,903 | 341,210 | PT |
| 2118 | 706.170,445 | 4.645.191,483 | 382,420 | CABEZA |
| 2119 | 710.568,987 | 4.648.663,412 | 341,120 | PT |
| 2120 | 710.544,932 | 4.648.678,597 | 341,110 | PT |
| 2121 | 710.548,374 | 4.648.688,102 | 341,190 | PT |
| 2122 | 710.524,932 | 4.648.701,339 | 341,420 | PIE |
| 2123 | 710.519,045 | 4.648.697,105 | 341,200 | PIE |
| 2124 | 710.515,082 | 4.648.699,046 | 341,750 | CABE |
| 2125 | 710.521,356 | 4.648.705,258 | 341,940 | CABE |
| 2126 | 710.510,545 | 4.648.714,654 | 341,680 | PT |
| 2127 | 706.244,145 | 4.645.158,328 | 381,240 | CABEZA |
| 2128 | 710.483,054 | 4.648.728,761 | 341,660 | PT |
| 2129 | 706.279,413 | 4.645.147,573 | 381,000 | CABEZA |
| 2130 | 710.466,010 | 4.648.757,370 | 341,680 | PT |
| 2131 | 710.459,458 | 4.648.750,231 | 341,640 | PT |
| 2132 | 710.438,107 | 4.648.770,853 | 341,610 | PT |
| 2133 | 710.443,734 | 4.648.779,152 | 341,680 | PT |
| 2134 | 706.394,711 | 4.644.745,823 | 380,960 | CABEZA |
| 2135 | 710.405,963 | 4.648.800,813 | 341,650 | PT |
| 2136 | 710.382,748 | 4.648.823,057 | 341,740 | PT |
| 2137 | 710.388,245 | 4.648.830,905 | 341,740 | PT |
| 2138 | 710.368,969 | 4.648.846,659 | 342,190 | PIE |
| 2139 | 710.360,867 | 4.648.841,162 | 341,770 | PIE |
| 2140 | 710.358,113 | 4.648.842,029 | 342,520 | PISTA |
| 2141 | 710.353,847 | 4.648.846,341 | 342,470 | PISTA |
| 2142 | 710.364,364 | 4.648.849,485 | 342,660 | PISTA |
| 2143 | 708.197,160 | 4.645.472,400 | 365,940 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2144 | 710.356,834 | 4.648.858,730 | 342,320 | PT |
| 2145 | 710.349,317 | 4.648.853,426 | 342,120 | PT |
| 2146 | 710.352,424 | 4.648.848,988 | 342,300 | PT |
| 2147 | 706.625,835 | 4.644.567,757 | 382,240 | CABEZA |
| 2148 | 710.330,939 | 4.648.840,413 | 342,110 | PT |
| 2149 | 710.305,951 | 4.648.821,836 | 342,090 | PT |
| 2150 | 710.310,120 | 4.648.815,622 | 342,130 | PT |
| 2151 | 710.284,817 | 4.648.797,931 | 342,110 | PT |
| 2152 | 710.278,639 | 4.648.804,775 | 342,140 | PT |
| 2153 | 710.254,641 | 4.648.788,569 | 342,120 | PT |
| 2154 | 710.260,381 | 4.648.781,160 | 342,120 | PT |
| 2155 | 710.240,045 | 4.648.766,753 | 342,200 | PT |
| 2156 | 706.879,618 | 4.644.463,130 | 382,800 | CABEZA |
| 2157 | 710.227,709 | 4.648.768,678 | 342,220 | PIE |
| 2158 | 710.227,776 | 4.648.759,955 | 342,160 | PIE |
| 2159 | 710.224,484 | 4.648.760,419 | 342,760 | CABE |
| 2160 | 706.906,608 | 4.644.461,199 | 382,060 | CABEZA |
| 2161 | 709.414,675 | 4.648.670,594 | 345,690 | CANALETA |
| 2162 | 706.914,873 | 4.644.451,047 | 382,570 | CABEZA |
| 2163 | 709.402,608 | 4.648.670,937 | 345,450 | PT |
| 2164 | 707.009,013 | 4.644.436,494 | 383,570 | CABEZA |
| 2165 | 709.417,122 | 4.648.668,966 | 345,990 | PISTA |
| 2166 | 709.420,733 | 4.648.664,408 | 345,770 | PISTA |
| 2167 | 709.408,836 | 4.648.661,751 | 346,030 | PISTA |
| 2168 | 707.063,259 | 4.644.436,881 | 383,610 | CABEZA |
| 2169 | 709.411,832 | 4.648.655,411 | 345,230 | PIE |
| 2170 | 709.420,127 | 4.648.661,026 | 345,160 | PIE |
| 2171 | 709.428,952 | 4.648.651,591 | 345,220 | PT |
| 2172 | 709.419,194 | 4.648.643,167 | 345,210 | PT |
| 2173 | 709.411,928 | 4.648.649,401 | 345,240 | PT |
| 2174 | 709.398,580 | 4.648.639,675 | 345,170 | PIE |
| 2175 | 709.407,881 | 4.648.634,767 | 345,260 | PIE |
| 2176 | 707.264,733 | 4.644.301,822 | 383,440 | CABEZA |
| 2177 | 708.145,150 | 4.645.684,060 | 362,110 | |
| 2178 | 709.377,358 | 4.648.625,046 | 345,440 | PT |
| 2179 | 709.387,572 | 4.648.617,928 | 345,450 | PT |
| 2180 | 707.319,128 | 4.644.159,869 | 382,960 | CABEZA |
| 2181 | 709.380,497 | 4.648.606,340 | 345,870 | CABE |
| 2182 | 709.365,160 | 4.648.610,315 | 345,760 | CABE |
| 2183 | 709.366,711 | 4.648.614,684 | 345,450 | PIE |
| 2184 | 707.313,547 | 4.644.130,973 | 381,710 | CABEZA |
| 2185 | 709.357,008 | 4.648.591,191 | 345,670 | PT |
| 2186 | 709.351,095 | 4.648.582,093 | 345,740 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2187 | 709.349,784 | 4.648.580,418 | 346,040 | CABE |
| 2188 | 709.332,119 | 4.648.586,416 | 346,220 | CABE |
| 2189 | 709.335,128 | 4.648.589,681 | 345,950 | PIE |
| 2190 | 709.313,784 | 4.648.574,290 | 346,030 | PT |
| 2191 | 709.323,243 | 4.648.564,041 | 346,020 | PT |
| 2192 | 709.318,438 | 4.648.555,874 | 346,080 | PIE |
| 2193 | 709.317,738 | 4.648.554,187 | 346,300 | CABE |
| 2194 | 709.300,226 | 4.648.560,592 | 346,430 | CABE |
| 2195 | 709.304,008 | 4.648.563,586 | 346,090 | PIE |
| 2196 | 709.284,978 | 4.648.548,013 | 346,300 | PT |
| 2197 | 709.292,055 | 4.648.538,636 | 346,300 | PT |
| 2198 | 709.288,781 | 4.648.529,963 | 346,360 | PIE |
| 2199 | 707.774,736 | 4.644.792,378 | 374,510 | CABEZA |
| 2200 | 709.268,813 | 4.648.534,000 | 346,700 | CABE |
| 2201 | 709.273,393 | 4.648.537,590 | 346,320 | PIE |
| 2202 | 709.252,065 | 4.648.521,347 | 346,500 | PT |
| 2203 | 709.258,393 | 4.648.511,485 | 346,490 | PT |
| 2204 | 709.254,932 | 4.648.504,175 | 346,490 | PIE |
| 2205 | 709.253,456 | 4.648.501,817 | 346,670 | CABE |
| 2206 | 709.234,766 | 4.648.508,150 | 346,850 | CABE |
| 2207 | 708.874,433 | 4.647.991,586 | 351,200 | CABEZA |
| 2208 | 709.220,042 | 4.648.495,060 | 346,740 | PT |
| 2209 | 709.227,653 | 4.648.485,055 | 346,730 | PT |
| 2210 | 709.186,927 | 4.647.897,812 | 353,720 | CABEZA |
| 2211 | 709.187,266 | 4.647.909,718 | 353,810 | CABEZA |
| 2212 | 709.204,103 | 4.648.481,812 | 347,140 | CABE |
| 2213 | 709.209,096 | 4.648.484,758 | 346,830 | PIE |
| 2214 | 709.191,438 | 4.648.468,644 | 346,990 | PT |
| 2215 | 709.204,489 | 4.648.465,228 | 346,980 | PT |
| 2216 | 709.198,677 | 4.648.453,396 | 346,970 | PT |
| 2217 | 709.187,360 | 4.648.456,543 | 346,970 | PT |
| 2218 | 709.184,351 | 4.648.444,702 | 347,150 | PIE |
| 2219 | 709.199,566 | 4.648.437,773 | 346,980 | PIE |
| 2220 | 709.197,711 | 4.648.436,693 | 347,670 | CANALETA |
| 2221 | 709.186,808 | 4.648.438,820 | 348,040 | CANALETA |
| 2222 | 706.963,520 | 4.648.281,925 | 360,890 | PT |
| 2223 | 710.164,677 | 4.647.587,387 | 347,300 | CABEZA |
| 2224 | 706.938,435 | 4.648.285,613 | 360,550 | PT |
| 2225 | 706.943,568 | 4.648.276,787 | 360,530 | PT |
| 2226 | 706.933,332 | 4.648.269,880 | 360,600 | PIE |
| 2227 | 706.930,601 | 4.648.267,705 | 361,070 | CABE |
| 2228 | 706.921,264 | 4.648.277,237 | 361,190 | CABE |
| 2229 | 710.332,471 | 4.647.533,967 | 346,320 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2230 | 706.897,597 | 4.648.267,621 | 361,350 | PT |
| 2231 | 706.902,847 | 4.648.257,016 | 361,250 | PT |
| 2232 | 706.887,146 | 4.648.248,549 | 361,310 | PIE |
| 2233 | 706.883,646 | 4.648.245,796 | 362,250 | CABE |
| 2234 | 706.873,254 | 4.648.256,591 | 362,370 | CABE |
| 2235 | 706.879,734 | 4.648.259,702 | 361,450 | PIE |
| 2236 | 706.840,613 | 4.648.243,506 | 362,420 | PT |
| 2237 | 706.846,146 | 4.648.234,215 | 361,760 | PT |
| 2238 | 710.426,318 | 4.647.508,415 | 346,070 | CABEZA |
| 2239 | 706.828,975 | 4.648.224,400 | 362,340 | CABE |
| 2240 | 710.423,211 | 4.647.500,998 | 346,080 | CABEZA |
| 2241 | 706.826,573 | 4.648.235,488 | 361,470 | PIE |
| 2242 | 706.808,467 | 4.648.229,399 | 362,410 | PT |
| 2243 | 706.814,115 | 4.648.221,230 | 362,350 | PT |
| 2244 | 706.804,460 | 4.648.216,154 | 362,420 | PIE |
| 2245 | 706.800,897 | 4.648.213,963 | 363,290 | CABE |
| 2246 | 706.794,857 | 4.648.223,491 | 363,410 | CABE |
| 2247 | 706.799,212 | 4.648.224,666 | 362,470 | PIE |
| 2248 | 706.784,502 | 4.648.219,967 | 363,380 | PT |
| 2249 | 706.789,633 | 4.648.211,294 | 363,250 | PT |
| 2250 | 706.783,628 | 4.648.208,145 | 363,360 | PIE |
| 2251 | 706.780,577 | 4.648.205,182 | 363,870 | CABE |
| 2252 | 710.620,028 | 4.647.448,349 | 345,350 | CABEZA |
| 2253 | 710.699,269 | 4.647.419,344 | 345,340 | CABEZA |
| 2254 | 706.764,815 | 4.648.211,593 | 363,770 | PISTA |
| 2255 | 706.763,622 | 4.648.214,758 | 363,810 | PISTA |
| 2256 | 710.700,470 | 4.647.423,422 | 345,300 | CABEZA |
| 2257 | 706.776,508 | 4.648.221,973 | 361,680 | ACEQ |
| 2258 | 711.363,396 | 4.647.354,216 | 342,060 | CABEZA |
| 2259 | 706.778,928 | 4.648.217,527 | 362,950 | PISTA |
| 2260 | 706.772,309 | 4.648.223,967 | 362,930 | CABE |
| 2261 | 706.767,663 | 4.648.228,774 | 362,300 | PT |
| 2262 | 706.760,594 | 4.648.227,228 | 362,230 | PT |
| 2263 | 706.766,293 | 4.648.220,167 | 362,900 | CABE |
| 2264 | 706.918,274 | 4.648.366,942 | 360,180 | PT |
| 2265 | 706.911,409 | 4.648.372,873 | 360,120 | PT |
| 2266 | 711.221,725 | 4.647.380,662 | 342,560 | CABEZA |
| 2267 | 711.215,624 | 4.647.373,325 | 342,670 | CABEZA |
| 2268 | 706.920,075 | 4.648.417,103 | 359,010 | PT |
| 2269 | 711.209,474 | 4.647.373,385 | 341,720 | CABEZA |
| 2270 | 706.889,856 | 4.648.463,357 | 359,210 | CABE |
| 2271 | 706.881,279 | 4.648.457,655 | 359,200 | CABE |
| 2272 | 711.213,337 | 4.647.379,308 | 342,350 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2273 | 706.887,073 | 4.648.465,775 | 357,980 | PIE |
| 2274 | 706.864,903 | 4.648.488,053 | 357,980 | PT |
| 2275 | 706.859,656 | 4.648.482,691 | 357,900 | PT |
| 2276 | 711.055,670 | 4.647.394,400 | 343,560 | CABEZA |
| 2277 | 706.842,994 | 4.648.501,922 | 357,910 | PT |
| 2278 | 706.829,372 | 4.648.517,700 | 357,960 | PT |
| 2279 | 706.830,478 | 4.648.518,800 | 357,920 | PT |
| 2280 | 706.834,185 | 4.648.522,178 | 358,030 | PT |
| 2281 | 706.818,486 | 4.648.540,326 | 358,760 | PT |
| 2282 | 706.814,067 | 4.648.534,317 | 358,640 | PT |
| 2283 | 710.688,206 | 4.647.499,537 | 344,700 | CABEZA |
| 2284 | 706.918,340 | 4.648.356,981 | 358,740 | ACEQ |
| 2285 | 710.654,237 | 4.647.510,036 | 344,750 | CABEZA |
| 2286 | 706.913,521 | 4.648.352,479 | 361,030 | PISTA |
| 2287 | 706.906,718 | 4.648.357,970 | 361,000 | PISTA |
| 2288 | 710.655,065 | 4.647.515,438 | 344,800 | CABEZA |
| 2289 | 706.901,499 | 4.648.345,048 | 361,030 | PT |
| 2290 | 710.620,374 | 4.647.518,335 | 345,210 | CABEZA |
| 2291 | 707.026,667 | 4.648.242,629 | 360,360 | PT |
| 2292 | 710.621,059 | 4.647.525,544 | 345,190 | CABEZA |
| 2293 | 707.044,070 | 4.648.217,546 | 360,560 | PT |
| 2294 | 710.468,581 | 4.647.567,786 | 345,690 | CABEZA |
| 2295 | 707.060,780 | 4.648.210,564 | 361,510 | PT |
| 2296 | 707.054,966 | 4.648.206,066 | 361,500 | PT |
| 2297 | 707.073,691 | 4.648.203,833 | 361,590 | ASPERSOR**** |
| 2298 | 707.073,534 | 4.648.190,132 | 361,410 | PT |
| 2299 | 710.445,653 | 4.647.576,065 | 345,720 | CABEZA |
| 2300 | 707.093,317 | 4.648.172,869 | 361,530 | PT |
| 2301 | 707.100,706 | 4.648.179,494 | 361,690 | ASPERSOR |
| 2302 | 707.114,119 | 4.648.167,690 | 361,770 | ASPERSOR |
| 2303 | 707.127,910 | 4.648.155,656 | 361,750 | ASPERSOR |
| 2304 | 710.344,037 | 4.647.607,561 | 346,070 | CABEZA |
| 2305 | 707.140,860 | 4.648.143,763 | 361,890 | ASPERSOR |
| 2306 | 707.153,923 | 4.648.131,681 | 361,720 | ASPERSOR |
| 2307 | 710.170,864 | 4.647.547,584 | 347,250 | CABEZA |
| 2308 | 707.167,646 | 4.648.119,425 | 361,720 | ASPERSOR |
| 2309 | 707.181,182 | 4.648.107,357 | 361,780 | ASPERSOR |
| 2310 | 710.148,115 | 4.647.525,507 | 348,720 | CABEZA |
| 2311 | 707.194,396 | 4.648.095,298 | 361,580 | ASPERSOR |
| 2312 | 707.207,882 | 4.648.083,295 | 361,870 | ASPERSOR |
| 2313 | 710.129,747 | 4.647.497,321 | 350,260 | CABEZA |
| 2314 | 707.203,125 | 4.648.069,785 | 361,540 | PIE |
| 2315 | 710.137,799 | 4.647.491,179 | 350,580 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2316 | 707.211,766 | 4.648.073,185 | 361,800 | CABE |
| 2317 | 707.231,780 | 4.648.055,271 | 361,740 | PT |
| 2318 | 707.226,318 | 4.648.049,121 | 361,730 | PT |
| 2319 | 707.246,009 | 4.648.038,606 | 361,840 | PIE |
| 2320 | 707.246,609 | 4.648.028,415 | 361,980 | PIE |
| 2321 | 707.248,713 | 4.648.025,831 | 362,680 | CABE |
| 2322 | 707.252,565 | 4.648.035,085 | 362,940 | CABE |
| 2323 | 707.256,730 | 4.648.030,670 | 362,550 | CABE2 |
| 2324 | 707.257,335 | 4.648.030,170 | 360,910 | ACEQ |
| 2325 | 707.249,813 | 4.648.022,175 | 360,840 | ACEQ |
| 2326 | 710.194,329 | 4.647.651,176 | 346,230 | CABEZA |
| 2327 | 710.201,281 | 4.647.659,394 | 345,970 | CABEZA |
| 2328 | 707.252,862 | 4.648.019,872 | 362,180 | CABE |
| 2329 | 707.267,214 | 4.648.012,282 | 362,020 | PT |
| 2330 | 707.272,020 | 4.648.015,952 | 362,120 | PT |
| 2331 | 707.287,836 | 4.648.001,649 | 361,920 | PT |
| 2332 | 707.282,198 | 4.647.995,085 | 361,760 | PT |
| 2333 | 707.297,643 | 4.647.981,708 | 361,780 | PT |
| 2334 | 707.304,998 | 4.647.985,779 | 361,660 | PT |
| 2335 | 707.321,853 | 4.647.968,632 | 361,560 | PT |
| 2336 | 707.316,063 | 4.647.961,773 | 361,600 | PT |
| 2337 | 707.496,507 | 4.648.135,328 | 364,550 | PISTA |
| 2338 | 707.493,553 | 4.648.140,583 | 364,550 | PISTA |
| 2339 | 707.501,441 | 4.648.144,516 | 364,520 | PISTA |
| 2340 | 707.504,060 | 4.648.140,324 | 364,430 | PISTA |
| 2341 | 707.497,067 | 4.648.150,495 | 364,280 | PT |
| 2342 | 707.490,838 | 4.648.146,600 | 364,240 | PT |
| 2343 | 707.506,742 | 4.648.136,294 | 364,030 | PT |
| 2344 | 709.977,647 | 4.647.729,852 | 345,060 | CABEZA |
| 2345 | 707.531,678 | 4.648.145,056 | 364,260 | PIE |
| 2346 | 707.536,330 | 4.648.148,685 | 364,740 | CABE |
| 2347 | 707.542,972 | 4.648.152,205 | 364,930 | PT |
| 2348 | 707.536,479 | 4.648.156,861 | 364,870 | PT |
| 2349 | 707.526,207 | 4.648.149,788 | 364,600 | CABE |
| 2350 | 707.522,773 | 4.648.138,273 | 364,040 | PT |
| 2351 | 707.511,739 | 4.648.132,121 | 364,040 | PT |
| 2352 | 709.521,822 | 4.647.865,305 | 347,150 | CABEZA |
| 2353 | 709.489,313 | 4.647.867,981 | 347,360 | CABEZA |
| 2354 | 707.499,165 | 4.648.112,437 | 364,080 | PT |
| 2355 | 709.488,375 | 4.647.875,863 | 347,230 | CABEZA |
| 2356 | 707.504,659 | 4.648.087,613 | 364,120 | PT |
| 2357 | 707.497,105 | 4.648.086,833 | 364,210 | PT |
| 2358 | 707.495,770 | 4.648.061,522 | 364,160 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2359 | 707.502,970 | 4.648.060,962 | 364,160 | PT |
| 2360 | 707.501,667 | 4.648.033,727 | 364,300 | PT |
| 2361 | 709.415,550 | 4.647.890,811 | 347,850 | CABEZA |
| 2362 | 707.490,981 | 4.648.006,151 | 364,290 | PT |
| 2363 | 707.500,023 | 4.648.005,036 | 364,280 | PT |
| 2364 | 707.498,040 | 4.647.976,318 | 364,310 | PT |
| 2365 | 707.488,454 | 4.647.976,665 | 364,350 | PT |
| 2366 | 709.407,170 | 4.647.900,907 | 348,480 | CABEZA |
| 2367 | 707.496,194 | 4.647.956,570 | 364,270 | PT |
| 2368 | 707.496,506 | 4.647.939,862 | 364,510 | CABE |
| 2369 | 707.497,054 | 4.647.937,309 | 364,250 | CANALETA |
| 2370 | 707.488,786 | 4.647.933,987 | 364,200 | CANALETA |
| 2371 | 707.488,416 | 4.647.935,880 | 364,770 | CABE |
| 2372 | 707.486,270 | 4.647.929,509 | 364,740 | CABE |
| 2373 | 709.288,980 | 4.647.926,987 | 350,160 | CABEZA |
| 2374 | 707.496,113 | 4.647.925,088 | 364,440 | PT |
| 2375 | 709.289,026 | 4.647.934,622 | 350,360 | CABEZA |
| 2376 | 707.483,980 | 4.647.903,420 | 364,680 | PT |
| 2377 | 707.492,162 | 4.647.902,411 | 364,730 | PT |
| 2378 | 707.490,814 | 4.647.878,758 | 364,630 | PT |
| 2379 | 707.482,223 | 4.647.877,740 | 364,600 | PT |
| 2380 | 707.478,963 | 4.647.851,558 | 364,630 | PT |
| 2381 | 707.488,353 | 4.647.849,786 | 364,660 | PT |
| 2382 | 707.488,028 | 4.647.829,469 | 364,650 | PT |
| 2383 | 707.478,152 | 4.647.831,484 | 364,570 | PT |
| 2384 | 709.033,691 | 4.648.002,856 | 351,380 | CABEZA |
| 2385 | 708.921,152 | 4.648.044,695 | 349,760 | CABEZA |
| 2386 | 707.468,731 | 4.647.800,116 | 364,890 | CABE |
| 2387 | 707.468,667 | 4.647.797,677 | 363,890 | PIE |
| 2388 | 708.918,670 | 4.648.032,441 | 350,110 | CABEZA |
| 2389 | 707.456,881 | 4.647.805,332 | 364,890 | CABE |
| 2390 | 707.450,380 | 4.647.788,083 | 363,910 | PT |
| 2391 | 707.442,468 | 4.647.787,042 | 364,170 | CABE |
| 2392 | 707.437,924 | 4.647.786,319 | 362,670 | PISTA |
| 2393 | 708.685,012 | 4.648.115,392 | 351,270 | CABEZA |
| 2394 | 707.426,512 | 4.647.786,690 | 362,780 | PT |
| 2395 | 707.426,703 | 4.647.782,717 | 362,660 | PT |
| 2396 | 707.433,079 | 4.647.780,311 | 362,620 | PISTA |
| 2397 | 707.437,999 | 4.647.779,776 | 362,550 | PISTA |
| 2398 | 707.441,549 | 4.647.776,641 | 364,230 | CABE |
| 2399 | 707.448,360 | 4.647.777,689 | 363,920 | PT |
| 2400 | 708.677,606 | 4.648.116,258 | 351,100 | CABEZA |
| 2401 | 707.457,844 | 4.647.786,057 | 363,900 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2402 | 708.638,196 | 4.648.129,222 | 353,290 | CABEZA |
| 2403 | 708.622,946 | 4.648.124,736 | 353,250 | CABEZA |
| 2404 | 707.439,607 | 4.647.755,909 | 364,190 | CABE |
| 2405 | 707.447,370 | 4.647.752,473 | 364,340 | CABE |
| 2406 | 707.446,413 | 4.647.749,087 | 362,620 | PIE |
| 2407 | 707.438,024 | 4.647.751,943 | 362,730 | PIE |
| 2408 | 708.510,340 | 4.648.164,778 | 353,560 | CABEZA |
| 2409 | 707.438,404 | 4.647.724,551 | 362,580 | PT |
| 2410 | 708.507,298 | 4.648.163,697 | 354,330 | CABEZA |
| 2411 | 707.430,348 | 4.647.693,539 | 361,610 | PIE |
| 2412 | 707.420,707 | 4.647.697,211 | 361,630 | PIE |
| 2413 | 707.423,027 | 4.647.699,910 | 362,980 | CABE |
| 2414 | 708.150,359 | 4.648.278,845 | 353,680 | CABEZA |
| 2415 | 708.149,769 | 4.648.272,302 | 353,520 | CABEZA |
| 2416 | 707.420,710 | 4.647.664,624 | 361,430 | PT |
| 2417 | 708.147,483 | 4.648.282,527 | 353,860 | CABEZA |
| 2418 | 707.405,992 | 4.647.639,493 | 361,500 | PT |
| 2419 | 707.413,458 | 4.647.636,322 | 361,500 | PT |
| 2420 | 707.406,845 | 4.647.612,287 | 361,480 | PT |
| 2421 | 707.398,128 | 4.647.613,270 | 361,560 | PT |
| 2422 | 707.391,465 | 4.647.588,747 | 361,550 | PT |
| 2423 | 707.400,821 | 4.647.584,693 | 361,490 | PT |
| 2424 | 707.392,934 | 4.647.558,903 | 361,510 | PT |
| 2425 | 707.384,641 | 4.647.562,610 | 361,470 | PT |
| 2426 | 707.378,140 | 4.647.545,391 | 361,530 | PT |
| 2427 | 707.388,778 | 4.647.543,101 | 361,470 | PT |
| 2428 | 707.385,130 | 4.647.526,243 | 361,720 | CABE |
| 2429 | 707.384,384 | 4.647.523,511 | 361,580 | PIE |
| 2430 | 707.371,559 | 4.647.526,983 | 361,580 | PIE |
| 2431 | 707.865,083 | 4.648.342,168 | 355,200 | CABEZA |
| 2432 | 707.363,268 | 4.647.521,832 | 361,560 | PT |
| 2433 | 707.378,045 | 4.647.507,741 | 361,620 | PT |
| 2434 | 707.754,633 | 4.648.367,352 | 355,280 | CABEZA |
| 2435 | 707.394,119 | 4.647.523,158 | 361,560 | PT |
| 2436 | 707.747,868 | 4.648.354,460 | 355,580 | CABEZA |
| 2437 | 707.419,067 | 4.647.518,223 | 361,610 | PT |
| 2438 | 707.450,015 | 4.647.523,494 | 361,860 | CABE |
| 2439 | 707.451,872 | 4.647.523,046 | 360,980 | ACEQ |
| 2440 | 707.454,729 | 4.647.532,154 | 360,880 | ACEQ |
| 2441 | 707.453,277 | 4.647.533,116 | 361,700 | CABE |
| 2442 | 707.456,851 | 4.647.532,244 | 361,720 | CABE |
| 2443 | 707.453,739 | 4.647.522,388 | 361,750 | CABE |
| 2444 | 707.484,037 | 4.647.527,375 | 361,510 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2445 | 707.799,954 | 4.648.451,903 | 355,300 | CABEZA |
| 2446 | 707.510,831 | 4.647.537,490 | 361,510 | PT |
| 2447 | 707.809,244 | 4.648.469,954 | 355,350 | CABEZA |
| 2448 | 707.535,858 | 4.647.531,947 | 361,470 | PT |
| 2449 | 707.535,009 | 4.647.542,141 | 361,450 | PT |
| 2450 | 707.567,081 | 4.647.545,598 | 361,880 | CABE |
| 2451 | 707.561,955 | 4.647.537,508 | 361,950 | CABE |
| 2452 | 707.808,779 | 4.648.510,569 | 355,120 | CABEZA |
| 2453 | 707.811,728 | 4.648.523,775 | 355,440 | CABEZA |
| 2454 | 707.592,363 | 4.647.547,830 | 359,670 | PT |
| 2455 | 707.819,715 | 4.648.522,419 | 355,340 | CABEZA |
| 2456 | 707.619,919 | 4.647.546,169 | 359,710 | PT |
| 2457 | 707.620,192 | 4.647.553,562 | 359,740 | PT |
| 2458 | 707.646,051 | 4.647.556,044 | 359,720 | PT |
| 2459 | 707.197,768 | 4.648.503,768 | 364,030 | CABEZA |
| 2460 | 707.663,007 | 4.647.551,691 | 359,790 | PT |
| 2461 | 707.664,553 | 4.647.548,791 | 359,910 | PT |
| 2462 | 706.901,396 | 4.648.380,920 | 361,070 | CABEZA |
| 2463 | 706.885,374 | 4.648.395,718 | 361,560 | CABEZA |
| 2464 | 707.664,815 | 4.647.557,857 | 359,800 | PT |
| 2465 | 707.659,672 | 4.647.557,807 | 359,730 | PT |
| 2466 | 706.877,642 | 4.648.402,939 | 361,590 | CABEZA |
| 2467 | 707.372,364 | 4.647.508,947 | 361,520 | PT |
| 2468 | 706.947,375 | 4.648.298,927 | 361,250 | CABEZA |
| 2469 | 707.358,200 | 4.647.508,394 | 361,480 | PT |
| 2470 | 706.954,664 | 4.648.302,594 | 361,300 | CABEZA |
| 2471 | 707.355,786 | 4.647.497,686 | 361,650 | CABE |
| 2472 | 707.356,088 | 4.647.493,054 | 359,700 | DESAGUE |
| 2473 | 707.059,331 | 4.648.206,460 | 361,390 | CABEZA |
| 2474 | 707.332,470 | 4.647.494,797 | 360,590 | CABE |
| 2475 | 707.346,264 | 4.647.490,504 | 360,570 | CABE |
| 2476 | 707.346,149 | 4.647.488,922 | 360,780 | PISTA |
| 2477 | 707.343,635 | 4.647.485,380 | 360,850 | PISTA |
| 2478 | 707.329,244 | 4.647.489,859 | 361,180 | PISTA |
| 2479 | 707.328,524 | 4.647.493,927 | 361,630 | PISTA |
| 2480 | 707.331,611 | 4.647.482,167 | 361,390 | PT |
| 2481 | 707.322,092 | 4.647.480,339 | 361,370 | PT |
| 2482 | 707.248,160 | 4.648.030,940 | 362,100 | CABEZA |
| 2483 | 707.305,510 | 4.647.488,924 | 361,520 | PT |
| 2484 | 707.287,776 | 4.647.484,422 | 361,840 | ASPERSOR**** |
| 2485 | 707.250,639 | 4.648.017,133 | 361,030 | CABEZA |
| 2486 | 707.271,659 | 4.647.476,515 | 361,700 | PIE |
| 2487 | 707.274,593 | 4.647.485,388 | 361,840 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2488 | 707.367,874 | 4.647.893,738 | 362,340 | CABEZA |
| 2489 | 707.318,244 | 4.647.489,603 | 361,580 | ASPERSOR |
| 2490 | 707.335,834 | 4.647.485,487 | 361,450 | ASPERSOR |
| 2491 | 707.366,606 | 4.647.882,821 | 362,390 | CABEZA |
| 2492 | 707.270,642 | 4.647.484,392 | 362,560 | CABE |
| 2493 | 707.269,354 | 4.647.477,359 | 362,470 | CABE |
| 2494 | 707.249,571 | 4.647.476,857 | 362,320 | PT |
| 2495 | 707.247,722 | 4.647.485,420 | 362,240 | PT |
| 2496 | 707.220,390 | 4.647.484,272 | 362,350 | PT |
| 2497 | 707.217,564 | 4.647.474,392 | 362,240 | PT |
| 2498 | 707.420,562 | 4.647.846,564 | 363,170 | CABEZA |
| 2499 | 707.190,810 | 4.647.482,459 | 362,350 | PT |
| 2500 | 708.206,598 | 4.647.838,556 | 355,130 | CABEZA |
| 2501 | 708.215,613 | 4.647.841,469 | 355,110 | CABEZA |
| 2502 | 707.162,836 | 4.647.471,233 | 362,290 | PT |
| 2503 | 707.140,388 | 4.647.472,220 | 361,030 | PT |
| 2504 | 707.139,109 | 4.647.479,248 | 361,120 | PT |
| 2505 | 708.191,239 | 4.647.858,721 | 356,710 | CABEZA |
| 2506 | 707.118,082 | 4.647.470,424 | 362,580 | PIE |
| 2507 | 707.113,043 | 4.647.469,145 | 363,130 | CABE |
| 2508 | 707.118,455 | 4.647.476,193 | 363,040 | CABE |
| 2509 | 707.113,082 | 4.647.466,671 | 363,090 | PISTA |
| 2510 | 707.114,108 | 4.647.464,362 | 362,780 | PT |
| 2511 | 707.679,488 | 4.647.543,853 | 360,750 | CABEZA |
| 2512 | 707.120,564 | 4.647.445,477 | 362,630 | PT |
| 2513 | 707.112,874 | 4.647.447,050 | 362,660 | PT |
| 2514 | 707.672,384 | 4.647.531,674 | 360,860 | CABEZA |
| 2515 | 707.118,195 | 4.647.428,186 | 362,650 | PIE |
| 2516 | 707.116,133 | 4.647.425,204 | 363,230 | CABE |
| 2517 | 707.726,507 | 4.647.648,949 | 358,860 | CABEZA |
| 2518 | 707.105,267 | 4.647.410,830 | 363,140 | PT |
| 2519 | 707.725,177 | 4.647.645,798 | 359,260 | CABEZA |
| 2520 | 707.109,917 | 4.647.397,894 | 363,230 | PIE |
| 2521 | 707.109,089 | 4.647.395,246 | 364,010 | CABE |
| 2522 | 707.729,909 | 4.647.642,615 | 359,270 | CABEZA |
| 2523 | 707.101,776 | 4.647.401,667 | 363,250 | PIE |
| 2524 | 707.095,979 | 4.647.384,775 | 363,990 | PT |
| 2525 | 707.105,033 | 4.647.381,125 | 361,690 | PT |
| 2526 | 707.663,894 | 4.647.556,521 | 359,750 | CABEZA |
| 2527 | 707.101,773 | 4.647.366,824 | 365,140 | CABE |
| 2528 | 707.666,105 | 4.647.549,588 | 359,740 | CABEZA |
| 2529 | 707.097,364 | 4.647.370,834 | 364,210 | PIE |
| 2530 | 707.091,341 | 4.647.357,302 | 365,060 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2531 | 707.575,317 | 4.647.569,221 | 361,820 | CABEZA |
| 2532 | 707.096,422 | 4.647.341,069 | 365,180 | PIE |
| 2533 | 707.089,782 | 4.647.343,467 | 365,140 | PIE |
| 2534 | 707.572,049 | 4.647.556,905 | 361,840 | CABEZA |
| 2535 | 707.467,559 | 4.647.557,696 | 361,700 | CABEZA |
| 2536 | 707.092,379 | 4.647.319,071 | 366,540 | PT |
| 2537 | 707.083,936 | 4.647.318,205 | 366,610 | PT |
| 2538 | 707.082,801 | 4.647.304,078 | 366,800 | PIE |
| 2539 | 707.087,600 | 4.647.296,365 | 366,520 | PIE |
| 2540 | 707.079,109 | 4.647.291,738 | 368,580 | CABE |
| 2541 | 707.085,196 | 4.647.290,117 | 368,740 | CABE |
| 2542 | 707.463,220 | 4.647.565,338 | 361,900 | CABEZA |
| 2543 | 707.076,327 | 4.647.276,530 | 368,600 | PT |
| 2544 | 707.074,220 | 4.647.267,857 | 368,630 | PIE |
| 2545 | 707.095,614 | 4.647.492,857 | 363,070 | CABEZA |
| 2546 | 707.078,758 | 4.647.259,237 | 369,910 | CABE |
| 2547 | 707.104,725 | 4.647.494,148 | 363,050 | CABEZA |
| 2548 | 707.069,139 | 4.647.243,635 | 369,860 | PIE |
| 2549 | 707.073,470 | 4.647.235,454 | 369,770 | PIE |
| 2550 | 707.067,410 | 4.647.232,965 | 371,170 | CABE |
| 2551 | 707.073,367 | 4.647.231,294 | 371,330 | CABE |
| 2552 | 707.071,081 | 4.647.224,477 | 371,030 | PT |
| 2553 | 707.067,695 | 4.647.224,137 | 371,290 | CABE |
| 2554 | 706.985,485 | 4.647.653,682 | 367,330 | CABEZA |
| 2555 | 707.064,678 | 4.647.233,517 | 370,150 | ACEQ |
| 2556 | 707.223,707 | 4.647.021,393 | 369,410 | CABEZA |
| 2557 | 707.062,173 | 4.647.221,502 | 371,850 | PISTA |
| 2558 | 707.057,715 | 4.647.216,222 | 372,260 | PISTA |
| 2559 | 707.356,558 | 4.646.545,194 | 376,040 | CABEZA |
| 2560 | 707.060,573 | 4.647.227,474 | 371,690 | PISTA |
| 2561 | 707.049,731 | 4.647.214,412 | 373,430 | PT |
| 2562 | 707.044,345 | 4.647.218,225 | 373,950 | PT |
| 2563 | 707.039,572 | 4.647.216,295 | 374,380 | PT |
| 2564 | 707.041,563 | 4.647.209,307 | 374,470 | PT |
| 2565 | 707.049,726 | 4.647.198,417 | 373,500 | PT |
| 2566 | 707.046,190 | 4.647.193,131 | 375,910 | PT |
| 2567 | 707.054,303 | 4.647.187,876 | 375,930 | PT |
| 2568 | 707.060,633 | 4.647.191,542 | 375,900 | PT |
| 2569 | 707.069,053 | 4.647.186,394 | 375,940 | PT |
| 2570 | 707.063,968 | 4.647.180,933 | 375,920 | PT |
| 2571 | 707.139,298 | 4.647.130,887 | 375,910 | PT |
| 2572 | 707.502,630 | 4.646.243,433 | 373,230 | CABEZA |
| 2573 | 707.142,831 | 4.647.119,631 | 376,400 | CANALETA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2574 | 707.488,945 | 4.646.239,204 | 373,260 | CABEZA |
| 2575 | 707.506,845 | 4.646.211,189 | 371,780 | CABEZA |
| 2576 | 707.157,218 | 4.647.120,058 | 373,870 | PIE |
| 2577 | 707.162,948 | 4.647.115,003 | 373,150 | ASPERSOR |
| 2578 | 707.157,575 | 4.647.112,360 | 373,190 | PT |
| 2579 | 707.164,572 | 4.647.094,270 | 371,900 | PT |
| 2580 | 707.170,735 | 4.647.095,648 | 371,720 | ASPERSOR |
| 2581 | 707.168,062 | 4.647.083,291 | 368,970 | PT |
| 2582 | 707.177,504 | 4.647.079,256 | 368,770 | ASPERSOR |
| 2583 | 707.544,097 | 4.646.133,344 | 368,400 | CABEZA |
| 2584 | 707.237,614 | 4.646.995,138 | 369,070 | PT |
| 2585 | 707.248,022 | 4.646.972,484 | 369,180 | PIE |
| 2586 | 707.249,465 | 4.646.970,139 | 369,990 | CABE |
| 2587 | 707.558,640 | 4.646.099,990 | 367,500 | CABEZA |
| 2588 | 707.237,964 | 4.646.966,958 | 369,190 | PIE |
| 2589 | 707.242,459 | 4.646.952,874 | 370,000 | PT |
| 2590 | 707.564,187 | 4.646.105,955 | 367,570 | CABEZA |
| 2591 | 707.255,953 | 4.646.946,167 | 369,930 | PIE |
| 2592 | 707.256,883 | 4.646.944,208 | 370,550 | CABE |
| 2593 | 707.572,912 | 4.646.070,856 | 367,040 | CABEZA |
| 2594 | 707.247,017 | 4.646.940,173 | 370,110 | PIE |
| 2595 | 707.253,230 | 4.646.919,373 | 370,580 | PT |
| 2596 | 707.591,419 | 4.646.047,107 | 366,290 | CABEZA |
| 2597 | 707.263,011 | 4.646.907,677 | 370,580 | PT |
| 2598 | 707.254,895 | 4.646.907,726 | 371,140 | PT |
| 2599 | 707.269,752 | 4.646.856,935 | 372,020 | PT |
| 2600 | 707.266,985 | 4.646.854,441 | 372,470 | PT |
| 2601 | 707.267,559 | 4.646.845,744 | 372,610 | PT |
| 2602 | 707.272,147 | 4.646.846,390 | 372,450 | PT |
| 2603 | 708.009,936 | 4.646.142,368 | 367,280 | CABEZA |
| 2604 | 707.270,829 | 4.646.825,753 | 372,980 | PT |
| 2605 | 708.002,946 | 4.646.148,312 | 367,320 | CABEZA |
| 2606 | 707.280,961 | 4.646.808,920 | 373,210 | PT |
| 2607 | 707.285,289 | 4.646.783,082 | 373,730 | PT |
| 2608 | 707.278,798 | 4.646.781,783 | 373,940 | PT |
| 2609 | 707.282,804 | 4.646.756,609 | 374,290 | PT |
| 2610 | 707.289,644 | 4.646.756,573 | 374,320 | PT |
| 2611 | 707.290,762 | 4.646.754,852 | 373,610 | PISTA |
| 2612 | 707.294,081 | 4.646.752,320 | 373,450 | PISTA |
| 2613 | 707.289,264 | 4.646.741,310 | 373,950 | PISTA |
| 2614 | 708.136,565 | 4.646.311,005 | 370,400 | CABEZA |
| 2615 | 707.287,941 | 4.646.732,478 | 373,030 | ACEQ |
| 2616 | 708.141,251 | 4.646.313,501 | 370,720 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2617 | 707.290,913 | 4.646.733,917 | 373,800 | CABE |
| 2618 | 707.294,763 | 4.646.743,558 | 373,440 | CABE |
| 2619 | 707.293,789 | 4.646.743,780 | 372,810 | ACEQ |
| 2620 | 707.297,056 | 4.646.734,057 | 373,070 | PT |
| 2621 | 707.292,842 | 4.646.718,959 | 373,460 | ASPERSOR |
| 2622 | 708.368,579 | 4.646.555,894 | 371,220 | CABEZA |
| 2623 | 707.311,102 | 4.646.711,181 | 373,250 | ASPERSOR |
| 2624 | 707.298,390 | 4.646.699,411 | 373,580 | ASPERSOR |
| 2625 | 707.304,149 | 4.646.680,030 | 373,820 | ASPERSOR |
| 2626 | 707.317,087 | 4.646.692,127 | 373,430 | ASPERSOR |
| 2627 | 708.386,663 | 4.646.596,553 | 368,870 | CABEZA |
| 2628 | 707.309,802 | 4.646.660,623 | 374,140 | ASPERSOR |
| 2629 | 707.328,377 | 4.646.653,732 | 373,830 | ASPERSOR |
| 2630 | 708.842,446 | 4.647.050,426 | 367,250 | CABEZA |
| 2631 | 707.320,752 | 4.646.621,948 | 374,130 | ASPERSOR |
| 2632 | 707.330,426 | 4.646.611,410 | 374,070 | PT |
| 2633 | 707.339,708 | 4.646.614,940 | 374,090 | ASPERSOR |
| 2634 | 708.859,957 | 4.647.085,968 | 367,290 | CABEZA |
| 2635 | 707.334,271 | 4.646.634,239 | 374,020 | ASPERSOR |
| 2636 | 708.880,633 | 4.647.126,432 | 367,150 | CABEZA |
| 2637 | 707.185,732 | 4.646.501,507 | 378,250 | PT |
| 2638 | 709.033,924 | 4.647.256,702 | 363,860 | CABEZA |
| 2639 | 709.038,839 | 4.647.263,608 | 363,930 | CABEZA |
| 2640 | 707.207,332 | 4.646.496,010 | 377,680 | PT |
| 2641 | 707.219,188 | 4.646.491,305 | 376,550 | PT |
| 2642 | 707.220,932 | 4.646.497,102 | 376,450 | PT |
| 2643 | 707.238,536 | 4.646.487,957 | 377,100 | PT |
| 2644 | 707.240,789 | 4.646.493,484 | 377,030 | PT |
| 2645 | 707.262,809 | 4.646.489,495 | 377,360 | PT |
| 2646 | 707.261,121 | 4.646.482,613 | 377,520 | PT |
| 2647 | 707.284,005 | 4.646.477,681 | 377,870 | PT |
| 2648 | 707.288,719 | 4.646.486,192 | 377,680 | PT |
| 2649 | 707.312,848 | 4.646.480,216 | 378,130 | PT |
| 2650 | 709.209,487 | 4.647.765,717 | 355,600 | CABEZA |
| 2651 | 707.334,704 | 4.646.470,439 | 378,630 | PT |
| 2652 | 707.338,655 | 4.646.476,744 | 378,340 | PT |
| 2653 | 707.363,129 | 4.646.471,127 | 378,570 | PT |
| 2654 | 707.359,410 | 4.646.465,461 | 378,830 | PT |
| 2655 | 707.382,149 | 4.646.460,358 | 379,060 | PT |
| 2656 | 709.840,927 | 4.648.804,951 | 343,680 | CABEZA |
| 2657 | 709.838,740 | 4.648.807,515 | 343,450 | CABEZA |
| 2658 | 707.396,731 | 4.646.458,238 | 379,120 | PT |
| 2659 | 707.212,022 | 4.646.493,555 | 376,730 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2660 | 710.226,015 | 4.648.759,737 | 342,980 | CABEZA |
| 2661 | 707.204,271 | 4.646.504,485 | 376,920 | PT |
| 2662 | 707.200,247 | 4.646.501,920 | 377,950 | PT |
| 2663 | 707.193,241 | 4.646.495,156 | 378,120 | PT |
| 2664 | 707.120,889 | 4.647.485,184 | 362,500 | PISTA |
| 2665 | 709.555,532 | 4.648.336,788 | 346,930 | CABEZA |
| 2666 | 707.127,753 | 4.647.481,368 | 362,640 | PISTA |
| 2667 | 705.637,602 | 4.647.477,524 | 378,560 | CABEZA |
| 2668 | 707.127,766 | 4.647.488,731 | 361,490 | DESAGUE |
| 2669 | 707.119,735 | 4.647.488,472 | 361,460 | DESAGUE |
| 2670 | 707.119,717 | 4.647.496,704 | 363,060 | CABE |
| 2671 | 707.126,329 | 4.647.496,824 | 363,080 | CABE |
| 2672 | 707.120,565 | 4.647.504,749 | 363,190 | ASPERSOR |
| 2673 | 707.104,336 | 4.647.504,343 | 363,100 | ASPERSOR |
| 2674 | 707.115,220 | 4.647.528,399 | 363,280 | ASPERSOR |
| 2675 | 705.420,705 | 4.647.336,341 | 381,450 | CABEZA |
| 2676 | 707.106,252 | 4.647.546,487 | 363,450 | ASPERSOR |
| 2677 | 705.425,783 | 4.647.331,881 | 381,360 | CABEZA |
| 2678 | 707.099,161 | 4.647.562,134 | 363,970 | ASPERSOR |
| 2679 | 707.081,334 | 4.647.562,515 | 363,940 | ASPERSOR |
| 2680 | 707.072,478 | 4.647.570,591 | 364,180 | PT |
| 2681 | 707.072,444 | 4.647.580,371 | 364,420 | ASPERSOR |
| 2682 | 707.090,212 | 4.647.580,410 | 364,390 | ASPERSOR |
| 2683 | 707.081,718 | 4.647.598,333 | 364,910 | ASPERSOR |
| 2684 | 707.063,710 | 4.647.598,525 | 364,880 | ASPERSOR |
| 2685 | 707.053,276 | 4.647.601,053 | 364,900 | PT |
| 2686 | 707.054,549 | 4.647.616,452 | 365,090 | ASPERSOR |
| 2687 | 707.036,681 | 4.647.616,793 | 365,070 | ASPERSOR |
| 2688 | 707.036,672 | 4.647.616,787 | 365,080 | ASPERSOR |
| 2689 | 707.045,869 | 4.647.634,480 | 365,580 | ASPERSOR |
| 2690 | 705.943,877 | 4.647.253,368 | 376,600 | CABEZA |
| 2691 | 707.036,174 | 4.647.649,816 | 365,770 | PIE |
| 2692 | 707.024,780 | 4.647.649,523 | 365,700 | PIE |
| 2693 | 705.949,208 | 4.647.243,689 | 377,440 | CABEZA |
| 2694 | 707.027,737 | 4.647.634,801 | 365,640 | ASPERSOR |
| 2695 | 705.957,608 | 4.647.208,837 | 378,510 | CABEZA |
| 2696 | 707.023,584 | 4.647.653,410 | 367,330 | CABE |
| 2697 | 707.017,313 | 4.647.659,456 | 367,020 | PT |
| 2698 | 705.964,561 | 4.647.210,405 | 378,330 | CABEZA |
| 2699 | 705.974,775 | 4.647.177,281 | 379,430 | CABEZA |
| 2700 | 707.007,203 | 4.647.668,930 | 367,030 | PT |
| 2701 | 706.992,418 | 4.647.680,172 | 367,020 | PT |
| 2702 | 706.997,009 | 4.647.683,555 | 367,040 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2703 | 705.991,680 | 4.647.145,730 | 380,150 | CABEZA |
| 2704 | 706.971,744 | 4.647.695,646 | 367,050 | PT |
| 2705 | 706.952,307 | 4.647.710,018 | 366,960 | PT |
| 2706 | 705.998,763 | 4.647.147,754 | 380,110 | CABEZA |
| 2707 | 706.020,643 | 4.647.116,148 | 381,520 | CABEZA |
| 2708 | 706.934,377 | 4.647.724,809 | 367,000 | PT |
| 2709 | 706.013,026 | 4.647.113,065 | 381,320 | CABEZA |
| 2710 | 706.124,978 | 4.646.772,806 | 384,640 | CABEZA |
| 2711 | 706.120,146 | 4.646.768,945 | 384,620 | CABEZA |
| 2712 | 706.170,070 | 4.646.688,611 | 383,690 | CABEZA |
| 2713 | 706.168,511 | 4.646.700,348 | 383,600 | CABEZA |
| 2714 | 706.202,321 | 4.646.701,882 | 382,260 | CABEZA |
| 2715 | 706.201,328 | 4.646.708,643 | 382,250 | CABEZA |
| 2716 | 706.240,634 | 4.646.717,782 | 381,320 | CABEZA |
| 2717 | 706.239,771 | 4.646.725,367 | 381,450 | CABEZA |
| 2718 | 706.283,443 | 4.646.734,421 | 379,570 | CABEZA |
| 2719 | 706.285,039 | 4.646.744,066 | 379,500 | CABEZA |
| 2720 | 706.438,056 | 4.646.826,039 | 378,200 | CABEZA |
| 2721 | 706.446,354 | 4.646.827,149 | 378,030 | CABEZA |
| 2722 | 706.444,302 | 4.646.845,831 | 379,210 | CABEZA |
| 2723 | 706.438,745 | 4.646.845,335 | 379,140 | CABEZA |
| 2724 | 706.444,061 | 4.646.878,123 | 380,370 | CABEZA |
| 2725 | 706.438,758 | 4.646.877,257 | 380,390 | CABEZA |
| 2726 | 706.443,180 | 4.646.900,080 | 381,430 | CABEZA |
| 2727 | 706.438,006 | 4.646.899,353 | 381,530 | CABEZA |
| 2728 | 706.441,304 | 4.646.923,846 | 383,360 | CABEZA |
| 2729 | 706.435,124 | 4.646.923,882 | 383,520 | CABEZA |
| 2730 | 706.440,832 | 4.646.968,652 | 383,480 | CABEZA |
| 2731 | 706.433,567 | 4.646.980,486 | 383,680 | CABEZA |
| 2732 | 706.435,068 | 4.647.036,002 | 381,600 | CABEZA |
| 2733 | 706.429,565 | 4.647.044,688 | 381,490 | CABEZA |
| 2734 | 706.427,729 | 4.647.095,410 | 381,110 | CABEZA |
| 2735 | 706.436,238 | 4.647.100,919 | 381,070 | CABEZA |
| 2736 | 706.548,999 | 4.647.459,408 | 369,440 | CABEZA |
| 2737 | 706.558,152 | 4.647.454,324 | 369,350 | CABEZA |
| 2738 | 706.646,212 | 4.646.775,676 | 375,790 | CABEZA |
| 2739 | 706.647,805 | 4.646.733,181 | 377,810 | CABEZA |
| 2740 | 706.650,439 | 4.646.669,244 | 379,220 | CABEZA |
| 2741 | 706.650,775 | 4.646.669,311 | 379,270 | CABEZA |
| 2742 | 706.674,866 | 4.646.627,040 | 380,840 | CABEZA |
| 2743 | 706.669,457 | 4.646.611,118 | 380,890 | CABEZA |
| 2744 | 706.182,796 | 4.646.491,100 | 387,900 | CABEZA |
| 2745 | 706.192,831 | 4.646.515,215 | 389,390 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2746 | 706.200,547 | 4.646.447,658 | 387,200 | CABEZA |
| 2747 | 706.207,260 | 4.646.445,458 | 387,140 | CABEZA |
| 2748 | 706.213,501 | 4.646.394,345 | 387,960 | CABEZA |
| 2749 | 706.219,459 | 4.646.391,519 | 388,040 | CABEZA |
| 2750 | 706.299,431 | 4.645.998,124 | 388,350 | CABEZA |
| 2751 | 706.313,966 | 4.645.898,163 | 384,420 | CABEZA |
| 2752 | 706.306,908 | 4.645.898,402 | 384,510 | CABEZA |
| 2753 | 706.295,374 | 4.645.826,255 | 383,860 | CABEZA |
| 2754 | 706.296,172 | 4.645.821,236 | 384,000 | CABEZA |
| 2755 | 706.274,625 | 4.645.764,637 | 385,360 | CABEZA |
| 2756 | 706.267,746 | 4.645.768,530 | 385,420 | CABEZA |
| 2757 | 706.268,191 | 4.645.735,027 | 387,300 | CABEZA |
| 2758 | 706.261,360 | 4.645.738,570 | 387,250 | CABEZA |
| 2759 | 706.250,240 | 4.645.700,127 | 391,120 | CABEZA |
| 2760 | 706.246,809 | 4.645.704,792 | 391,360 | CABEZA |
| 2761 | 706.215,421 | 4.645.678,864 | 393,990 | CABEZA |
| 2762 | 706.220,378 | 4.645.675,904 | 393,220 | CABEZA |
| 2763 | 706.182,309 | 4.645.645,349 | 390,890 | CABEZA |
| 2764 | 706.175,682 | 4.645.645,699 | 390,750 | CABEZA |
| 2765 | 706.150,166 | 4.645.621,566 | 388,050 | CABEZA |
| 2766 | 706.123,167 | 4.645.590,749 | 387,260 | CABEZA |
| 2767 | 710.361,114 | 4.647.735,962 | 344,713 | CABEZA |
| 2768 | 710.362,794 | 4.647.731,321 | 344,999 | CABEZA |
| 2769 | 710.570,144 | 4.647.810,566 | 343,052 | CABEZA |
| 2770 | 710.585,568 | 4.647.810,483 | 343,231 | CABEZA |
| 2771 | 710.570,117 | 4.647.840,994 | 342,670 | CABEZA |
| 2772 | 710.566,387 | 4.647.840,699 | 342,697 | CABEZA |
| 2773 | 710.557,165 | 4.647.879,676 | 342,522 | CABEZA |
| 2774 | 710.552,924 | 4.647.879,211 | 342,543 | CABEZA |
| 2775 | 710.549,467 | 4.647.908,219 | 342,379 | CABEZA |
| 2776 | 710.544,871 | 4.647.907,336 | 342,494 | CABEZA |
| 2777 | 710.529,030 | 4.647.957,094 | 342,628 | CABEZA |
| 2778 | 710.533,370 | 4.647.958,034 | 342,761 | CABEZA |
| 2779 | 710.527,043 | 4.647.962,893 | 342,545 | CABEZA |
| 2780 | 710.531,592 | 4.647.963,885 | 342,546 | CABEZA |
| 2781 | 710.517,701 | 4.647.991,032 | 342,745 | CABEZA |
| 2782 | 710.522,891 | 4.647.991,848 | 342,767 | CABEZA |
| 2783 | 710.720,774 | 4.647.864,766 | 342,443 | CABEZA |
| 2784 | 710.721,896 | 4.647.861,296 | 342,504 | CABEZA |
| 2785 | 710.940,979 | 4.647.923,904 | 340,980 | CABEZA |
| 2786 | 710.942,123 | 4.647.920,294 | 341,154 | CABEZA |
| 2787 | 711.019,078 | 4.647.942,298 | 340,259 | CABEZA |
| 2788 | 711.019,284 | 4.647.938,961 | 340,264 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2789 | 710.264,114 | 4.647.182,098 | 354,285 | CABEZA |
| 2790 | 710.265,882 | 4.647.178,023 | 354,035 | CABEZA |
| 2791 | 710.420,931 | 4.647.131,723 | 354,099 | CABEZA |
| 2792 | 710.418,338 | 4.647.127,759 | 353,964 | CABEZA |
| 2793 | 710.493,928 | 4.647.108,448 | 353,232 | CABEZA |
| 2794 | 710.491,077 | 4.647.105,854 | 353,327 | CABEZA |
| 2795 | 706.426,015 | 4.647.172,143 | 382,021 | CABEZA |
| 2796 | 706.428,699 | 4.647.175,546 | 382,018 | CABEZA |
| 2797 | 706.424,469 | 4.647.200,546 | 382,004 | CABEZA |
| 2798 | 706.428,701 | 4.647.204,516 | 382,036 | CABEZA |
| 2799 | 706.430,621 | 4.647.254,374 | 381,616 | CABEZA |
| 2800 | 706.434,756 | 4.647.251,292 | 381,450 | CABEZA |
| 2801 | 706.446,842 | 4.647.289,334 | 378,595 | CABEZA |
| 2802 | 706.451,306 | 4.647.286,842 | 378,561 | CABEZA |
| 2803 | 706.464,311 | 4.647.317,576 | 376,184 | CABEZA |
| 2804 | 706.468,906 | 4.647.315,084 | 376,002 | CABEZA |
| 2805 | 706.484,608 | 4.647.350,484 | 373,921 | CABEZA |
| 2806 | 706.489,203 | 4.647.349,304 | 373,294 | CABEZA |
| 2807 | 706.515,287 | 4.647.400,806 | 370,339 | CABEZA |
| 2808 | 706.519,750 | 4.647.400,085 | 370,050 | CABEZA |
| 2809 | 706.147,459 | 4.646.671,844 | 384,664 | CABEZA |
| 2810 | 706.151,308 | 4.646.672,825 | 385,170 | CABEZA |
| 2811 | 706.118,194 | 4.645.596,264 | 386,554 | CABEZA |
| 2812 | 706.073,087 | 4.645.552,622 | 384,950 | CABEZA |
| 2813 | 706.077,534 | 4.645.551,482 | 384,573 | CABEZA |
| 2814 | 706.041,307 | 4.645.522,686 | 383,768 | CABEZA |
| 2815 | 706.038,000 | 4.645.512,808 | 383,936 | CABEZA |
| 2816 | 706.018,204 | 4.645.494,724 | 383,766 | CABEZA |
| 2817 | 706.019,744 | 4.645.490,736 | 383,763 | CABEZA |
| 2818 | 706.006,722 | 4.645.372,377 | 382,686 | CABEZA |
| 2819 | 706.009,551 | 4.645.370,997 | 382,656 | CABEZA |
| 2820 | 706.109,835 | 4.645.206,392 | 382,179 | CABEZA |
| 2821 | 706.108,795 | 4.645.202,796 | 382,193 | CABEZA |
| 2822 | 706.043,133 | 4.645.017,665 | 384,009 | CABEZA |
| 2823 | 706.039,187 | 4.645.007,534 | 384,161 | CABEZA |
| 2824 | 706.008,209 | 4.645.057,139 | 383,954 | CABEZA |
| 2825 | 705.999,518 | 4.645.055,511 | 384,510 | CABEZA |
| 2826 | 706.199,385 | 4.644.923,023 | 382,004 | CABEZA |
| 2827 | 706.266,140 | 4.644.901,121 | 381,853 | CABEZA |
| 2828 | 706.270,592 | 4.644.896,542 | 381,960 | CABEZA |
| 2829 | 706.357,423 | 4.644.872,521 | 380,165 | CABEZA |
| 2830 | 706.357,103 | 4.644.870,259 | 380,139 | CABEZA |
| 2831 | 706.391,094 | 4.644.862,521 | 379,920 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2832 | 706.391,680 | 4.644.859,538 | 379,912 | CABEZA |
| 2833 | 706.855,424 | 4.644.936,192 | 374,891 | CABEZA |
| 2834 | 706.859,582 | 4.644.937,984 | 374,670 | CABEZA |
| 2835 | 706.778,191 | 4.645.039,183 | 376,454 | CABEZA |
| 2836 | 706.780,057 | 4.645.041,336 | 376,424 | CABEZA |
| 2837 | 706.710,182 | 4.645.134,896 | 376,680 | CABEZA |
| 2838 | 706.713,621 | 4.645.137,410 | 376,643 | CABEZA |
| 2839 | 706.699,732 | 4.645.139,017 | 376,655 | CABEZA |
| 2840 | 706.691,387 | 4.645.124,165 | 377,442 | CABEZA |
| 2841 | 706.717,700 | 4.645.174,393 | 376,198 | CABEZA |
| 2842 | 706.720,499 | 4.645.170,513 | 376,280 | CABEZA |
| 2843 | 706.840,441 | 4.645.492,734 | 375,267 | CABEZA |
| 2844 | 706.836,682 | 4.645.493,094 | 375,111 | CABEZA |
| 2845 | 706.864,061 | 4.645.612,862 | 373,387 | CABEZA |
| 2846 | 706.861,129 | 4.645.613,168 | 373,412 | CABEZA |
| 2847 | 706.860,729 | 4.645.663,527 | 372,266 | CABEZA |
| 2848 | 706.865,128 | 4.645.662,204 | 372,296 | CABEZA |
| 2849 | 706.860,142 | 4.645.734,771 | 371,923 | CABEZA |
| 2850 | 706.866,781 | 4.645.734,203 | 371,696 | CABEZA |
| 2851 | 706.856,063 | 4.645.748,836 | 371,521 | CABEZA |
| 2852 | 706.855,530 | 4.645.744,486 | 371,496 | CABEZA |
| 2853 | 706.781,496 | 4.645.828,211 | 375,111 | CABEZA |
| 2854 | 706.778,884 | 4.645.823,468 | 375,241 | CABEZA |
| 2855 | 706.756,676 | 4.644.357,114 | 384,647 | CABEZA |
| 2856 | 706.761,049 | 4.644.353,541 | 384,435 | CABEZA |
| 2857 | 706.784,349 | 4.644.207,938 | 386,577 | CABEZA |
| 2858 | 706.781,177 | 4.644.204,769 | 386,573 | CABEZA |
| 2859 | 706.798,745 | 4.644.102,433 | 386,376 | CABEZA |
| 2860 | 706.793,920 | 4.644.100,673 | 386,439 | CABEZA |
| 2861 | 706.791,174 | 4.644.078,281 | 386,085 | CABEZA |
| 2862 | 706.787,388 | 4.644.076,160 | 386,044 | CABEZA |
| 2863 | 706.783,443 | 4.644.051,221 | 385,880 | CABEZA |
| 2864 | 706.779,924 | 4.644.050,511 | 385,867 | CABEZA |
| 2865 | 706.776,644 | 4.644.022,665 | 385,992 | CABEZA |
| 2866 | 706.769,766 | 4.644.021,255 | 385,722 | CABEZA |
| 2867 | 706.656,300 | 4.646.777,623 | 375,700 | CABEZA |
| 2868 | 706.659,355 | 4.646.735,076 | 377,800 | CABEZA |
| 2869 | 708.328,154 | 4.646.505,950 | 373,300 | CABEZA |
| 2870 | 713.738,931 | 4.644.953,177 | 326,590 | CABEZA |
| 2871 | 713.672,322 | 4.645.001,344 | 326,980 | CABEZA |
| 2872 | 713.677,541 | 4.645.012,406 | 327,210 | CABEZA |
| 2873 | 713.668,833 | 4.645.005,529 | 326,970 | CABEZA |
| 2874 | 713.516,054 | 4.645.115,649 | 327,730 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2875 | 713.493,776 | 4.645.095,227 | 327,850 | CABEZA |
| 2876 | 713.487,029 | 4.645.089,045 | 327,320 | CABEZA |
| 2877 | 712.865,905 | 4.645.075,412 | 331,190 | CABEZA |
| 2878 | 712.837,763 | 4.645.084,978 | 331,300 | CABEZA |
| 2879 | 712.819,304 | 4.645.095,726 | 331,310 | CABEZA |
| 2880 | 712.587,825 | 4.644.781,829 | 339,930 | CABEZA |
| 2881 | 712.609,289 | 4.644.813,169 | 338,640 | CABEZA |
| 2882 | 712.958,393 | 4.644.571,414 | 338,710 | CABEZA |
| 2883 | 712.974,721 | 4.644.568,339 | 338,700 | CABEZA |
| 2884 | 713.369,347 | 4.644.428,955 | 337,570 | CABEZA |
| 2885 | 713.368,444 | 4.644.418,564 | 338,750 | CABEZA |
| 2886 | 713.362,002 | 4.644.416,466 | 338,510 | CABEZA |
| 2887 | 713.334,868 | 4.644.228,345 | 339,900 | CABEZA |
| 2888 | 713.291,438 | 4.644.200,809 | 340,490 | CABEZA |
| 2889 | 713.258,947 | 4.644.193,028 | 341,510 | CABEZA |
| 2890 | 713.200,152 | 4.644.150,313 | 342,360 | CABEZA |
| 2891 | 713.206,665 | 4.644.158,736 | 342,370 | CABEZA |
| 2892 | 713.147,259 | 4.644.120,584 | 343,240 | CABEZA |
| 2893 | 713.722,133 | 4.644.240,464 | 339,390 | CABEZA |
| 2894 | 713.744,566 | 4.644.239,912 | 338,450 | CABEZA |
| 2895 | 713.770,068 | 4.644.223,880 | 337,740 | CABEZA |
| 2896 | 713.768,881 | 4.644.233,625 | 337,770 | CABEZA |
| 2897 | 713.794,041 | 4.644.216,645 | 337,050 | CABEZA |
| 2898 | 713.793,103 | 4.644.223,324 | 337,060 | CABEZA |
| 2899 | 713.816,356 | 4.644.216,803 | 336,460 | CABEZA |
| 2900 | 714.073,816 | 4.644.705,252 | 325,430 | CABEZA |
| 2901 | 713.896,941 | 4.644.803,059 | 325,160 | CABEZA |
| 2902 | 713.886,240 | 4.644.795,801 | 325,460 | CABEZA |
| 2903 | 713.889,591 | 4.644.806,201 | 325,270 | CABEZA |
| 2904 | 713.809,535 | 4.644.867,704 | 325,970 | CABEZA |
| 2905 | 712.504,315 | 4.644.997,356 | 341,550 | CABEZA |
| 2906 | 712.502,071 | 4.644.999,710 | 341,330 | CABEZA |
| 2907 | 710.837,940 | 4.646.731,482 | 340,800 | CABEZA |
| 2908 | 710.827,675 | 4.646.723,291 | 340,830 | CABEZA |
| 2909 | 710.896,803 | 4.646.662,012 | 340,850 | CABEZA |
| 2910 | 710.906,250 | 4.646.664,474 | 340,800 | CABEZA |
| 2911 | 710.912,399 | 4.646.659,864 | 339,920 | CABEZA |
| 2912 | 710.898,960 | 4.646.657,332 | 339,900 | CABEZA |
| 2913 | 710.991,495 | 4.646.616,085 | 340,960 | CABEZA |
| 2914 | 711.011,199 | 4.646.603,562 | 340,720 | CABEZA |
| 2915 | 711.080,211 | 4.646.596,590 | 342,130 | CABEZA |
| 2916 | 711.065,768 | 4.646.605,250 | 341,960 | CABEZA |
| 2917 | 711.086,967 | 4.646.593,883 | 342,090 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2918 | 711.217,901 | 4.646.567,491 | 343,220 | CABEZA |
| 2919 | 711.193,081 | 4.646.575,733 | 343,270 | CABEZA |
| 2920 | 711.390,712 | 4.646.545,231 | 343,070 | CABEZA |
| 2921 | 711.358,133 | 4.646.540,295 | 343,090 | CABEZA |
| 2922 | 711.543,789 | 4.646.510,152 | 339,440 | CABEZA |
| 2923 | 711.548,088 | 4.646.539,545 | 340,790 | CABEZA |
| 2924 | 711.562,737 | 4.646.617,356 | 344,350 | CABEZA |
| 2925 | 711.594,374 | 4.646.502,414 | 338,310 | CABEZA |
| 2926 | 711.651,209 | 4.646.489,144 | 338,510 | CABEZA |
| 2927 | 711.644,765 | 4.646.485,311 | 338,150 | CABEZA |
| 2928 | 711.643,250 | 4.646.481,802 | 337,040 | CABEZA |
| 2929 | 711.710,669 | 4.646.488,972 | 336,620 | CABEZA |
| 2930 | 711.700,333 | 4.646.392,139 | 334,170 | CABEZA |
| 2931 | 711.681,311 | 4.646.328,096 | 335,270 | CABEZA |
| 2932 | 711.681,296 | 4.646.328,096 | 335,270 | CABEZA |
| 2933 | 711.689,688 | 4.646.331,009 | 335,690 | CABEZA |
| 2934 | 711.887,183 | 4.646.470,012 | 335,110 | CABEZA |
| 2935 | 711.229,681 | 4.646.960,386 | 350,700 | CABEZA |
| 2936 | 711.115,698 | 4.646.842,947 | 351,620 | CABEZA |
| 2937 | 711.046,597 | 4.646.786,823 | 349,860 | CABEZA |
| 2938 | 711.022,662 | 4.646.733,596 | 346,460 | CABEZA |
| 2939 | 711.022,653 | 4.646.734,000 | 346,410 | CABEZA |
| 2940 | 711.022,644 | 4.646.733,925 | 346,430 | CABEZA |
| 2941 | 711.022,884 | 4.646.733,714 | 346,350 | CABEZA |
| 2942 | 711.000,333 | 4.646.718,958 | 345,050 | CABEZA |
| 2943 | 710.989,401 | 4.646.690,056 | 343,590 | CABEZA |
| 2944 | 710.968,290 | 4.646.677,751 | 342,170 | CABEZA |
| 2945 | 710.971,400 | 4.646.656,920 | 342,260 | CABEZA |
| 2946 | 710.954,065 | 4.646.640,305 | 340,880 | CABEZA |
| 2947 | 709.841,856 | 4.646.890,080 | 346,740 | CABEZA |
| 2948 | 709.734,134 | 4.646.839,184 | 348,850 | CABEZA |
| 2949 | 709.737,167 | 4.646.847,097 | 348,830 | CABEZA |
| 2950 | 709.671,401 | 4.646.813,809 | 351,870 | CABEZA |
| 2951 | 709.671,426 | 4.646.822,468 | 351,840 | CABEZA |
| 2952 | 709.671,791 | 4.646.821,197 | 351,940 | CABEZA |
| 2953 | 709.671,782 | 4.646.820,513 | 351,930 | CABEZA |
| 2954 | 709.671,770 | 4.646.820,486 | 351,910 | CABEZA |
| 2955 | 709.671,725 | 4.646.820,500 | 351,920 | CABEZA |
| 2956 | 709.580,422 | 4.646.778,390 | 353,040 | CABEZA |
| 2957 | 709.563,298 | 4.646.716,518 | 351,400 | CABEZA |
| 2958 | 709.562,644 | 4.646.669,523 | 351,060 | CABEZA |
| 2959 | 709.549,119 | 4.646.667,583 | 350,470 | CABEZA |
| 2960 | 709.490,818 | 4.646.501,681 | 350,770 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 2961 | 709.481,980 | 4.646.511,545 | 350,800 | CABEZA |
| 2962 | 709.482,326 | 4.646.511,686 | 350,720 | CABEZA |
| 2963 | 709.481,931 | 4.646.511,273 | 350,670 | CABEZA |
| 2964 | 709.481,973 | 4.646.511,317 | 350,660 | CABEZA |
| 2965 | 709.482,006 | 4.646.511,357 | 350,650 | CABEZA |
| 2966 | 709.482,026 | 4.646.511,351 | 350,650 | CABEZA |
| 2967 | 709.464,435 | 4.646.488,789 | 351,010 | CABEZA |
| 2968 | 709.335,234 | 4.646.412,632 | 352,080 | CABEZA |
| 2969 | 709.327,815 | 4.646.410,860 | 352,120 | CABEZA |
| 2970 | 709.289,379 | 4.646.305,782 | 351,890 | CABEZA |
| 2971 | 709.299,264 | 4.646.293,217 | 351,880 | CABEZA |
| 2972 | 709.285,130 | 4.646.243,998 | 352,300 | CABEZA |
| 2973 | 709.654,199 | 4.646.359,581 | 350,240 | CABEZA |
| 2974 | 710.379,590 | 4.646.225,932 | 344,430 | CABEZA |
| 2975 | 710.381,788 | 4.646.233,687 | 344,350 | CABEZA |
| 2976 | 710.416,754 | 4.646.207,484 | 343,470 | CABEZA |
| 2977 | 710.442,620 | 4.646.162,243 | 343,320 | CABEZA |
| 2978 | 710.429,759 | 4.646.159,620 | 343,370 | CABEZA |
| 2979 | 710.429,798 | 4.646.159,671 | 343,310 | CABEZA |
| 2980 | 710.429,902 | 4.646.159,637 | 343,300 | CABEZA |
| 2981 | 710.427,468 | 4.646.147,653 | 343,740 | CABEZA |
| 2982 | 710.448,562 | 4.646.153,208 | 343,490 | CABEZA |
| 2983 | 710.836,054 | 4.646.187,648 | 339,750 | CABEZA |
| 2984 | 710.881,948 | 4.646.169,667 | 339,430 | CABEZA |
| 2985 | 710.885,551 | 4.646.185,128 | 339,310 | CABEZA |
| 2986 | 710.933,485 | 4.646.171,218 | 339,100 | CABEZA |
| 2987 | 710.935,676 | 4.646.179,214 | 339,050 | CABEZA |
| 2988 | 709.196,279 | 4.646.136,869 | 352,660 | CABEZA |
| 2989 | 709.195,440 | 4.646.116,551 | 352,570 | CABEZA |
| 2990 | 709.148,668 | 4.646.112,844 | 352,930 | CABEZA |
| 2991 | 709.146,669 | 4.646.124,927 | 352,970 | CABEZA |
| 2992 | 709.102,006 | 4.646.117,649 | 353,220 | CABEZA |
| 2993 | 708.972,903 | 4.646.092,875 | 353,740 | CABEZA |
| 2994 | 708.971,120 | 4.646.105,396 | 353,780 | CABEZA |
| 2995 | 708.756,079 | 4.646.059,735 | 355,540 | CABEZA |
| 2996 | 708.765,771 | 4.646.081,430 | 355,050 | CABEZA |
| 2997 | 708.738,257 | 4.646.052,385 | 355,130 | CABEZA |
| 2998 | 708.677,068 | 4.646.072,327 | 355,430 | CABEZA |
| 2999 | 708.684,784 | 4.646.051,614 | 355,260 | CABEZA |
| 3000 | 708.513,140 | 4.646.058,582 | 356,490 | CABEZA |
| 3001 | 708.481,710 | 4.646.044,580 | 356,420 | CABEZA |
| 3002 | 708.435,537 | 4.646.046,992 | 357,280 | CABEZA |
| 3003 | 708.450,566 | 4.646.054,172 | 357,200 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3004 | 708.293,171 | 4.646.042,455 | 358,970 | CABEZA |
| 3005 | 708.262,039 | 4.646.055,347 | 360,020 | CABEZA |
| 3006 | 708.238,428 | 4.646.043,769 | 359,830 | CABEZA |
| 3007 | 707.939,841 | 4.646.048,163 | 365,570 | CABEZA |
| 3008 | 707.794,661 | 4.646.051,973 | 365,300 | CABEZA |
| 3009 | 707.788,495 | 4.646.028,078 | 364,670 | CABEZA |
| 3010 | 707.721,707 | 4.646.028,576 | 364,670 | CABEZA |
| 3011 | 707.660,667 | 4.646.042,439 | 364,640 | CABEZA |
| 3012 | 707.642,443 | 4.646.026,525 | 364,680 | CABEZA |
| 3013 | 707.612,096 | 4.646.026,626 | 365,330 | CABEZA |
| 3014 | 707.619,763 | 4.645.810,692 | 364,220 | CABEZA |
| 3015 | 707.612,975 | 4.645.771,889 | 365,260 | CABEZA |
| 3016 | 707.603,124 | 4.645.769,308 | 365,260 | CABEZA |
| 3017 | 707.610,692 | 4.645.631,892 | 366,370 | CABEZA |
| 3018 | 707.628,367 | 4.645.498,865 | 367,380 | CABEZA |
| 3019 | 707.618,783 | 4.645.472,536 | 367,570 | CABEZA |
| 3020 | 707.615,605 | 4.645.473,866 | 367,890 | CABEZA |
| 3021 | 707.624,245 | 4.645.262,144 | 367,500 | CABEZA |
| 3022 | 707.634,390 | 4.645.250,198 | 367,720 | CABEZA |
| 3023 | 707.625,373 | 4.645.218,388 | 369,450 | CABEZA |
| 3024 | 707.641,503 | 4.645.122,597 | 369,720 | CABEZA |
| 3025 | 707.632,831 | 4.645.056,856 | 369,940 | CABEZA |
| 3026 | 707.642,995 | 4.645.051,593 | 370,270 | CABEZA |
| 3027 | 707.633,952 | 4.645.050,574 | 370,330 | CABEZA |
| 3028 | 707.635,971 | 4.645.009,580 | 371,300 | CABEZA |
| 3029 | 707.674,626 | 4.644.955,014 | 371,400 | CABEZA |
| 3030 | 707.691,549 | 4.644.970,706 | 370,190 | CABEZA |
| 3031 | 707.681,307 | 4.644.981,875 | 370,110 | CABEZA |
| 3032 | 707.722,649 | 4.644.984,312 | 369,240 | CABEZA |
| 3033 | 707.851,528 | 4.645.007,256 | 368,400 | CABEZA |
| 3034 | 707.881,895 | 4.645.002,724 | 368,380 | CABEZA |
| 3035 | 708.051,531 | 4.644.988,567 | 370,670 | CABEZA |
| 3036 | 708.058,334 | 4.644.993,688 | 370,670 | CABEZA |
| 3037 | 708.262,490 | 4.645.072,060 | 370,630 | CABEZA |
| 3038 | 708.271,835 | 4.645.076,294 | 369,410 | CABEZA |
| 3039 | 708.360,522 | 4.645.083,087 | 369,420 | CABEZA |
| 3040 | 708.412,828 | 4.645.103,852 | 367,690 | CABEZA |
| 3041 | 708.561,765 | 4.645.121,400 | 363,500 | CABEZA |
| 3042 | 708.563,767 | 4.645.129,774 | 363,460 | CABEZA |
| 3043 | 708.589,539 | 4.645.127,744 | 362,790 | CABEZA |
| 3044 | 708.739,497 | 4.645.157,496 | 360,080 | CABEZA |
| 3045 | 708.741,247 | 4.645.165,431 | 360,100 | CABEZA |
| 3046 | 708.878,134 | 4.645.501,447 | 357,340 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3047 | 708.887,170 | 4.645.498,364 | 357,130 | CABEZA |
| 3048 | 708.662,516 | 4.645.520,836 | 357,610 | CABEZA |
| 3049 | 708.586,872 | 4.645.537,048 | 358,680 | CABEZA |
| 3050 | 708.432,721 | 4.645.739,687 | 360,750 | CABEZA |
| 3051 | 709.464,018 | 4.645.268,267 | 358,380 | CABEZA |
| 3052 | 709.499,439 | 4.645.272,220 | 358,150 | CABEZA |
| 3053 | 709.497,009 | 4.645.282,155 | 358,130 | CABEZA |
| 3054 | 709.548,730 | 4.645.283,680 | 357,340 | CABEZA |
| 3055 | 709.572,794 | 4.645.294,674 | 356,810 | CABEZA |
| 3056 | 709.574,733 | 4.645.284,836 | 356,720 | CABEZA |
| 3057 | 709.635,443 | 4.645.297,100 | 355,740 | CABEZA |
| 3058 | 709.647,669 | 4.645.310,171 | 355,650 | CABEZA |
| 3059 | 709.723,229 | 4.645.324,083 | 358,270 | CABEZA |
| 3060 | 709.719,194 | 4.645.312,854 | 358,310 | CABEZA |
| 3061 | 709.762,689 | 4.645.329,159 | 357,830 | CABEZA |
| 3062 | 709.789,560 | 4.645.325,187 | 357,800 | CABEZA |
| 3063 | 709.868,950 | 4.645.340,467 | 357,460 | CABEZA |
| 3064 | 709.864,315 | 4.645.349,533 | 357,400 | CABEZA |
| 3065 | 709.989,002 | 4.645.364,441 | 356,750 | CABEZA |
| 3066 | 710.040,418 | 4.645.377,778 | 356,390 | CABEZA |
| 3067 | 710.051,393 | 4.645.372,655 | 356,350 | CABEZA |
| 3068 | 710.101,961 | 4.645.385,662 | 356,070 | CABEZA |
| 3069 | 710.091,022 | 4.645.391,102 | 356,090 | CABEZA |
| 3070 | 710.157,467 | 4.645.399,700 | 355,690 | CABEZA |
| 3071 | 710.172,779 | 4.645.402,074 | 355,800 | CABEZA |
| 3072 | 710.411,638 | 4.645.448,467 | 354,690 | CABEZA |
| 3073 | 710.451,226 | 4.645.453,786 | 354,410 | CABEZA |
| 3074 | 710.454,394 | 4.645.463,864 | 354,120 | CABEZA |
| 3075 | 710.548,962 | 4.645.471,906 | 353,600 | CABEZA |
| 3076 | 710.550,894 | 4.645.483,832 | 353,510 | CABEZA |
| 3077 | 710.579,373 | 4.645.485,892 | 353,300 | CABEZA |
| 3078 | 710.578,207 | 4.645.477,050 | 353,370 | CABEZA |
| 3079 | 710.640,584 | 4.645.466,592 | 352,990 | CABEZA |
| 3080 | 710.674,481 | 4.645.483,113 | 352,830 | CABEZA |
| 3081 | 710.748,991 | 4.645.488,317 | 352,420 | CABEZA |
| 3082 | 711.135,177 | 4.645.557,558 | 350,020 | CABEZA |
| 3083 | 707.233,363 | 4.644.292,510 | 384,930 | CANAL |
| 3084 | 707.254,118 | 4.644.286,994 | 383,950 | CANAL |
| 3085 | 707.281,859 | 4.644.286,733 | 383,690 | CANAL |
| 3086 | 707.313,989 | 4.644.309,683 | 383,590 | CANAL |
| 3087 | 707.323,504 | 4.644.317,667 | 383,600 | CANAL |
| 3088 | 707.209,071 | 4.644.428,763 | 382,470 | CANAL |
| 3089 | 707.203,153 | 4.644.437,254 | 382,450 | CANAL |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3090 | 707.724,345 | 4.644.828,781 | 374,800 | CANAL |
| 3091 | 707.717,502 | 4.644.825,912 | 374,690 | CANAL |
| 3092 | 707.713,720 | 4.644.822,982 | 374,820 | CANAL |
| 3093 | 712.809,837 | 4.645.109,035 | 331,280 | CARRETERA |
| 3094 | 712.799,012 | 4.645.104,408 | 331,590 | CARRETERA |
| 3095 | 712.610,976 | 4.644.830,091 | 338,410 | CARRETERA |
| 3096 | 710.823,750 | 4.646.726,201 | 341,520 | CARRETERA |
| 3097 | 710.321,767 | 4.646.290,589 | 345,540 | CARRETERA |
| 3098 | 710.324,849 | 4.646.286,074 | 345,310 | CARRETERA |
| 3099 | 710.314,142 | 4.646.273,864 | 345,430 | CARRETERA |
| 3100 | 710.301,134 | 4.646.264,721 | 345,810 | CARRETERA |
| 3101 | 707.598,090 | 4.645.812,280 | 363,330 | CARRETERA |
| 3102 | 707.600,317 | 4.645.807,211 | 363,330 | CARRETERA |
| 3103 | 708.970,579 | 4.645.858,512 | 356,610 | CARRETERA |
| 3104 | 708.430,383 | 4.645.806,912 | 362,080 | CARRETERA |
| 3105 | 708.429,686 | 4.645.811,840 | 362,010 | CARRETERA |
| 3106 | 708.442,174 | 4.645.816,427 | 362,070 | CARRETERA |
| 3107 | 708.444,273 | 4.645.811,638 | 361,990 | CARRETERA |
| 3108 | 709.361,535 | 4.645.249,843 | 359,830 | CARRETERA |
| 3109 | 709.357,843 | 4.645.253,132 | 359,690 | CARRETERA |
| 3110 | 709.362,079 | 4.645.259,437 | 359,660 | CARRETERA |
| 3111 | 709.366,106 | 4.645.256,846 | 359,720 | CARRETERA |
| 3112 | 709.359,639 | 4.645.246,881 | 359,870 | CARRETERA |
| 3113 | 709.355,518 | 4.645.249,465 | 359,780 | CARRETERA |
| 3114 | 709.096,055 | 4.644.529,813 | 364,780 | CARRETERA |
| 3115 | 709.102,068 | 4.644.527,390 | 364,920 | CARRETERA |
| 3116 | 709.104,390 | 4.644.537,380 | 364,780 | CARRETERA |
| 3117 | 709.097,544 | 4.644.538,583 | 364,710 | CARRETERA |
| 3118 | 709.098,939 | 4.644.518,348 | 365,080 | CARRETERA |
| 3119 | 709.093,427 | 4.644.518,797 | 364,900 | CARRETERA |
| 3120 | 709.118,404 | 4.644.764,889 | 363,650 | CARRETERA |
| 3121 | 709.123,427 | 4.644.765,404 | 363,650 | CARRETERA |
| 3122 | 709.124,563 | 4.644.775,143 | 363,490 | CARRETERA |
| 3123 | 709.119,173 | 4.644.775,874 | 363,560 | CARRETERA |
| 3124 | 709.979,977 | 4.645.825,179 | 350,680 | CARRETERA |
| 3125 | 709.977,418 | 4.645.830,217 | 350,540 | CARRETERA |
| 3126 | 709.987,383 | 4.645.834,718 | 350,380 | CARRETERA |
| 3127 | 709.990,127 | 4.645.830,194 | 350,240 | CARRETERA |
| 3128 | 709.643,012 | 4.645.661,612 | 353,160 | CARRETERA |
| 3129 | 709.621,659 | 4.645.646,615 | 353,240 | CARRETERA |
| 3130 | 709.610,764 | 4.645.635,030 | 353,510 | CARRETERA |
| 3131 | 709.610,684 | 4.645.634,895 | 353,510 | CARRETERA |
| 3132 | 709.602,934 | 4.645.624,414 | 353,710 | CARRETERA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3133 | 707.475,457 | 4.644.928,978 | 374,810 | CARRETERA |
| 3134 | 707.472,025 | 4.644.924,801 | 374,830 | CARRETERA |
| 3135 | 707.448,987 | 4.644.935,209 | 374,520 | CARRETERA |
| 3136 | 707.451,212 | 4.644.940,090 | 374,490 | CARRETERA |
| 3137 | 706.897,594 | 4.644.854,610 | 377,830 | CARRETERA |
| 3138 | 706.892,909 | 4.644.851,980 | 377,870 | CARRETERA |
| 3139 | 706.901,514 | 4.644.839,981 | 377,980 | CARRETERA |
| 3140 | 706.906,277 | 4.644.842,129 | 377,940 | CARRETERA |
| 3141 | 706.371,950 | 4.645.163,956 | 381,380 | CARRETERA |
| 3142 | 706.375,494 | 4.645.152,671 | 380,790 | CARRETERA |
| 3143 | 706.371,874 | 4.645.179,151 | 380,790 | CARRETERA |
| 3144 | 706.372,303 | 4.645.204,937 | 380,850 | CARRETERA |
| 3145 | 707.203,407 | 4.644.427,113 | 382,220 | CARRETERA |
| 3146 | 707.199,838 | 4.644.431,919 | 382,230 | CARRETERA |
| 3147 | 707.195,467 | 4.644.428,838 | 382,210 | CARRETERA |
| 3148 | 707.201,235 | 4.644.421,006 | 382,280 | CARRETERA |
| 3149 | 707.205,753 | 4.644.423,799 | 382,220 | CARRETERA |
| 3150 | 707.872,213 | 4.644.729,245 | 374,170 | CARRETERA |
| 3151 | 707.869,933 | 4.644.725,061 | 374,180 | CARRETERA |
| 3152 | 707.858,322 | 4.644.730,846 | 374,220 | CARRETERA |
| 3153 | 707.861,406 | 4.644.735,889 | 374,210 | CARRETERA |
| 3154 | 709.194,976 | 4.647.904,968 | 351,980 | CARRETERA |
| 3155 | 709.199,878 | 4.647.905,054 | 351,940 | CARRETERA |
| 3156 | 709.200,360 | 4.647.892,713 | 352,180 | CARRETERA |
| 3157 | 709.195,505 | 4.647.892,142 | 352,190 | CARRETERA |
| 3158 | 710.166,182 | 4.647.578,352 | 346,930 | CARRETERA |
| 3159 | 710.171,046 | 4.647.575,829 | 346,970 | CARRETERA |
| 3160 | 710.174,297 | 4.647.582,986 | 346,900 | CARRETERA |
| 3161 | 710.168,606 | 4.647.585,300 | 346,860 | CARRETERA |
| 3162 | 711.372,363 | 4.647.354,289 | 341,120 | CARRETERA |
| 3163 | 711.368,514 | 4.647.351,780 | 341,200 | CARRETERA |
| 3164 | 711.374,697 | 4.647.345,397 | 341,140 | CARRETERA |
| 3165 | 711.379,308 | 4.647.348,552 | 341,090 | CARRETERA |
| 3166 | 710.199,185 | 4.647.631,166 | 347,220 | CARRETERA |
| 3167 | 710.208,073 | 4.647.628,328 | 347,230 | CARRETERA |
| 3168 | 710.202,209 | 4.647.613,503 | 346,980 | CARRETERA |
| 3169 | 710.194,469 | 4.647.613,330 | 346,960 | CARRETERA |
| 3170 | 707.354,264 | 4.646.565,123 | 375,640 | CARRETERA |
| 3171 | 707.354,750 | 4.646.559,892 | 375,570 | CARRETERA |
| 3172 | 707.366,819 | 4.646.560,710 | 375,680 | CARRETERA |
| 3173 | 707.365,861 | 4.646.565,959 | 375,600 | CARRETERA |
| 3174 | 709.426,379 | 4.647.362,307 | 361,300 | CARRETERA |
| 3175 | 709.426,409 | 4.647.367,220 | 360,870 | CARRETERA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3176 | 709.433,812 | 4.647.367,530 | 360,640 | CARRETERA |
| 3177 | 709.434,514 | 4.647.362,496 | 360,570 | CARRETERA |
| 3178 | 709.069,981 | 4.647.326,469 | 363,590 | CARRETERA |
| 3179 | 709.069,874 | 4.647.321,585 | 363,720 | CARRETERA |
| 3180 | 709.064,068 | 4.647.321,005 | 363,860 | CARRETERA |
| 3181 | 709.062,891 | 4.647.326,160 | 363,720 | CARRETERA |
| 3182 | 709.205,841 | 4.647.691,737 | 355,470 | CARRETERA |
| 3183 | 709.211,241 | 4.647.694,328 | 355,350 | CARRETERA |
| 3184 | 709.208,508 | 4.647.703,754 | 355,260 | CARRETERA |
| 3185 | 709.203,182 | 4.647.704,515 | 355,340 | CARRETERA |
| 3186 | 705.759,298 | 4.647.569,215 | 375,470 | CARRETERA |
| 3187 | 705.765,172 | 4.647.570,499 | 375,500 | CARRETERA |
| 3188 | 705.768,800 | 4.647.563,378 | 375,480 | CARRETERA |
| 3189 | 705.763,000 | 4.647.561,133 | 375,530 | CARRETERA |
| 3190 | 706.291,013 | 4.646.031,110 | 388,530 | CARRETERA |
| 3191 | 706.287,236 | 4.646.027,886 | 388,250 | CARRETERA |
| 3192 | 706.289,516 | 4.646.025,162 | 388,320 | CARRETERA |
| 3193 | 706.293,939 | 4.646.029,065 | 388,550 | CARRETERA |
| 3194 | 706.306,332 | 4.645.828,108 | 384,250 | CARRETERA |
| 3195 | 706.300,134 | 4.645.828,538 | 384,360 | CARRETERA |
| 3196 | 706.301,976 | 4.645.819,304 | 384,230 | CARRETERA |
| 3197 | 706.307,798 | 4.645.820,139 | 384,200 | CARRETERA |
| 3198 | 706.695,413 | 4.645.135,126 | 376,907 | CARRETERA |
| 3199 | 706.699,545 | 4.645.129,826 | 376,938 | CARRETERA |
| 3200 | 706.692,907 | 4.645.131,815 | 376,972 | CARRETERA |
| 3201 | 706.694,853 | 4.645.129,235 | 376,975 | CARRETERA |
| 3202 | 706.746,892 | 4.645.261,439 | 376,136 | CARRETERA |
| 3203 | 706.749,825 | 4.645.259,155 | 376,047 | CARRETERA |
| 3204 | 706.748,199 | 4.645.265,538 | 375,953 | CARRETERA |
| 3205 | 706.751,105 | 4.645.263,702 | 375,853 | CARRETERA |
| 3206 | 706.736,815 | 4.645.280,794 | 376,457 | CARRETERA |
| 3207 | 706.737,615 | 4.645.275,931 | 376,421 | CARRETERA |
| 3208 | 706.728,284 | 4.645.281,559 | 376,629 | CARRETERA |
| 3209 | 706.728,017 | 4.645.278,521 | 376,629 | CARRETERA |
| 3210 | 706.717,700 | 4.645.283,384 | 376,719 | CARRETERA |
| 3211 | 706.714,981 | 4.645.280,619 | 376,666 | CARRETERA |
| 3212 | 706.708,956 | 4.645.559,825 | 376,544 | CARRETERA |
| 3213 | 706.709,702 | 4.645.557,836 | 376,535 | CARRETERA |
| 3214 | 706.704,477 | 4.645.558,644 | 376,781 | CARRETERA |
| 3215 | 706.705,410 | 4.645.556,153 | 376,761 | CARRETERA |
| 3216 | 712.833,766 | 4.645.141,590 | 330,255 | CARRETERA |
| 3217 | 712.804,639 | 4.645.100,347 | 331,500 | CARRETERA |
| 3218 | 712.803,835 | 4.645.111,260 | 331,360 | CARRETERA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3219 | 712.829,671 | 4.645.147,797 | 330,280 | CARRETERA |
| 3220 | 712.837,661 | 4.645.145,992 | 330,230 | CARRETERA |
| 3221 | 712.827,262 | 4.645.144,710 | 330,340 | CARRETERA |
| 3222 | 712.608,610 | 4.644.837,835 | 338,430 | CARRETERA |
| 3223 | 712.600,018 | 4.644.824,376 | 338,800 | CARRETERA |
| 3224 | 712.604,553 | 4.644.821,082 | 338,710 | CARRETERA |
| 3225 | 710.819,536 | 4.646.728,815 | 341,390 | CARRETERA |
| 3226 | 710.828,666 | 4.646.736,813 | 341,720 | CARRETERA |
| 3227 | 710.832,553 | 4.646.733,964 | 341,770 | CARRETERA |
| 3228 | 710.309,001 | 4.646.275,970 | 345,600 | CARRETERA |
| 3229 | 710.304,373 | 4.646.260,389 | 345,590 | CARRETERA |
| 3230 | 707.614,783 | 4.645.813,117 | 363,270 | CARRETERA |
| 3231 | 707.613,327 | 4.645.818,898 | 363,180 | CARRETERA |
| 3232 | 708.970,468 | 4.645.853,025 | 356,600 | CARRETERA |
| 3233 | 708.960,072 | 4.645.858,660 | 356,550 | CARRETERA |
| 3234 | 708.959,309 | 4.645.853,119 | 356,600 | CARRETERA |
| 3235 | 713.281,362 | 4.644.355,754 | 343,239 | CR |
| 3236 | 710.819,293 | 4.646.730,275 | 340,880 | CUNETA |
| 3237 | 710.819,928 | 4.646.730,855 | 340,850 | CUNETA |
| 3238 | 710.827,339 | 4.646.737,356 | 341,080 | CUNETA |
| 3239 | 709.370,467 | 4.645.260,124 | 359,110 | CUNETA |
| 3240 | 709.362,501 | 4.645.247,843 | 359,230 | CUNETA |
| 3241 | 709.351,864 | 4.645.247,947 | 359,040 | CUNETA |
| 3242 | 709.360,208 | 4.645.260,305 | 359,060 | CUNETA |
| 3243 | 709.116,334 | 4.644.765,232 | 362,980 | CUNETA |
| 3244 | 709.117,811 | 4.644.776,172 | 362,890 | CUNETA |
| 3245 | 707.478,772 | 4.644.931,242 | 373,640 | CUNETA |
| 3246 | 707.454,109 | 4.644.941,582 | 373,540 | CUNETA |
| 3247 | 707.194,367 | 4.644.426,583 | 381,290 | CUNETA |
| 3248 | 707.200,681 | 4.644.417,193 | 381,400 | CUNETA |
| 3249 | 709.202,452 | 4.647.892,357 | 351,470 | CUNETA |
| 3250 | 709.201,845 | 4.647.900,755 | 351,250 | CUNETA |
| 3251 | 710.167,741 | 4.647.587,114 | 346,360 | CUNETA |
| 3252 | 710.165,279 | 4.647.579,030 | 346,530 | CUNETA |
| 3253 | 710.175,245 | 4.647.582,981 | 346,380 | CUNETA |
| 3254 | 710.171,750 | 4.647.574,904 | 346,610 | CUNETA |
| 3255 | 711.379,914 | 4.647.347,769 | 340,870 | CUNETA |
| 3256 | 711.373,824 | 4.647.343,570 | 340,870 | CUNETA |
| 3257 | 709.209,931 | 4.647.706,210 | 354,800 | CUNETA |
| 3258 | 709.211,502 | 4.647.700,271 | 354,540 | CUNETA |
| 3259 | 705.770,511 | 4.647.565,126 | 374,570 | CUNETA |
| 3260 | 705.767,012 | 4.647.572,356 | 375,030 | CUNETA |
| 3261 | 710.525,215 | 4.647.775,471 | 343,427 | CUNETA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3262 | 710.517,789 | 4.647.772,629 | 343,548 | CUNETA |
| 3263 | 711.146,977 | 4.647.956,467 | 339,565 | CUNETA |
| 3264 | 711.153,432 | 4.647.958,049 | 339,499 | CUNETA |
| 3265 | 706.005,087 | 4.645.226,498 | 381,399 | CUNETA |
| 3266 | 706.011,042 | 4.645.228,306 | 381,713 | CUNETA |
| 3267 | 706.006,897 | 4.645.221,657 | 380,152 | CUNETA |
| 3268 | 706.012,735 | 4.645.224,282 | 380,293 | CUNETA |
| 3269 | 706.693,173 | 4.645.142,251 | 376,834 | CUNETA |
| 3270 | 706.700,505 | 4.645.131,345 | 376,976 | CUNETA |
| 3271 | 706.746,013 | 4.645.257,757 | 375,972 | CUNETA |
| 3272 | 706.748,225 | 4.645.254,904 | 375,954 | CUNETA |
| 3273 | 706.861,689 | 4.645.728,716 | 371,745 | CUNETA |
| 3274 | 706.866,727 | 4.645.728,323 | 371,798 | CUNETA |
| 3275 | 710.824,770 | 4.646.724,463 | 340,610 | CUNETA |
| 3276 | 710.827,197 | 4.646.737,405 | 341,080 | CUNETA |
| 3277 | 710.834,157 | 4.646.732,222 | 340,790 | CUNETA |
| 3278 | 707.602,018 | 4.645.981,531 | 364,825 | CUNETA |
| 3279 | 705.844,296 | 4.645.209,041 | 383,878 | DESAGUE |
| 3280 | 709.483,429 | 4.646.484,680 | 346,930 | DESAGUE |
| 3281 | 710.430,225 | 4.646.158,771 | 340,220 | DESAGUE |
| 3282 | 710.449,426 | 4.646.156,353 | 339,760 | DESAGUE |
| 3283 | 710.427,247 | 4.646.149,643 | 341,490 | DESAGUE |
| 3284 | 707.622,079 | 4.645.250,517 | 363,720 | DESAGUE |
| 3285 | 706.117,906 | 4.645.194,687 | 380,770 | DESAGUE |
| 3286 | 706.119,511 | 4.645.209,476 | 380,360 | DESAGUE |
| 3287 | 706.344,292 | 4.645.151,018 | 377,630 | DESAGUE |
| 3288 | 706.367,286 | 4.645.125,161 | 377,830 | DESAGUE |
| 3289 | 708.848,215 | 4.647.996,761 | 348,050 | DESAGUE |
| 3290 | 708.868,204 | 4.648.000,830 | 348,050 | DESAGUE |
| 3291 | 708.892,328 | 4.647.997,735 | 348,590 | DESAGUE |
| 3292 | 708.873,822 | 4.647.993,240 | 348,740 | DESAGUE |
| 3293 | 708.919,732 | 4.648.045,059 | 347,380 | DESAGUE |
| 3294 | 708.916,106 | 4.648.032,858 | 347,590 | DESAGUE |
| 3295 | 708.910,474 | 4.648.036,193 | 347,740 | DESAGUE |
| 3296 | 708.912,578 | 4.648.045,194 | 348,040 | DESAGUE |
| 3297 | 707.820,030 | 4.648.509,668 | 352,560 | DESAGUE |
| 3298 | 707.809,568 | 4.648.512,626 | 352,200 | DESAGUE |
| 3299 | 707.811,410 | 4.648.522,410 | 352,550 | DESAGUE |
| 3300 | 707.819,375 | 4.648.520,576 | 352,380 | DESAGUE |
| 3301 | 706.898,826 | 4.648.379,714 | 359,090 | DESAGUE |
| 3302 | 706.883,925 | 4.648.393,934 | 359,130 | DESAGUE |
| 3303 | 708.206,747 | 4.647.837,160 | 352,780 | DESAGUE |
| 3304 | 708.216,098 | 4.647.840,079 | 352,680 | DESAGUE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3305 | 707.678,202 | 4.647.544,456 | 357,460 | DESAGUE |
| 3306 | 707.670,309 | 4.647.532,454 | 357,400 | DESAGUE |
| 3307 | 707.672,964 | 4.647.554,879 | 356,350 | DESAGUE |
| 3308 | 707.667,727 | 4.647.547,963 | 356,280 | DESAGUE |
| 3309 | 707.095,701 | 4.647.491,734 | 360,970 | DESAGUE |
| 3310 | 707.104,779 | 4.647.492,669 | 360,940 | DESAGUE |
| 3311 | 707.104,521 | 4.647.485,770 | 361,090 | DESAGUE |
| 3312 | 707.095,601 | 4.647.484,766 | 361,260 | DESAGUE |
| 3313 | 707.224,647 | 4.647.032,080 | 366,330 | DESAGUE |
| 3314 | 707.213,674 | 4.647.027,085 | 366,570 | DESAGUE |
| 3315 | 707.214,733 | 4.647.019,949 | 366,920 | DESAGUE |
| 3316 | 707.223,363 | 4.647.022,819 | 367,280 | DESAGUE |
| 3317 | 706.551,815 | 4.647.446,753 | 365,940 | DESAGUE |
| 3318 | 706.539,500 | 4.647.452,215 | 365,720 | DESAGUE |
| 3319 | 706.644,597 | 4.646.789,332 | 372,430 | DESAGUE |
| 3320 | 706.654,430 | 4.646.791,993 | 372,170 | DESAGUE |
| 3321 | 706.114,634 | 4.645.199,518 | 380,490 | DESAGUE |
| 3322 | 706.043,879 | 4.645.003,479 | 380,950 | DESAGUE |
| 3323 | 706.047,212 | 4.645.012,004 | 380,900 | DESAGUE |
| 3324 | 707.637,801 | 4.645.255,172 | 363,500 | DESAGUE |
| 3325 | 709.500,100 | 4.646.491,537 | 346,970 | DESAGUE |
| 3326 | 709.492,200 | 4.646.478,779 | 347,910 | DESAGUE |
| 3327 | 709.508,014 | 4.646.486,211 | 348,010 | DESAGUE |
| 3328 | 710.446,686 | 4.646.162,591 | 339,910 | DESAGUE |
| 3329 | 707.811,368 | 4.645.278,569 | 361,910 | DESAGUE |
| 3330 | 712.558,092 | 4.644.749,873 | 341,601 | DESAGUE |
| 3331 | 712.561,201 | 4.644.747,266 | 341,505 | DESAGUE |
| 3332 | 712.562,931 | 4.644.751,294 | 339,838 | DESAGUE |
| 3333 | 712.564,905 | 4.644.751,230 | 341,353 | DESAGUE |
| 3334 | 709.081,830 | 4.644.315,009 | 362,962 | EDI |
| 3335 | 709.073,564 | 4.644.298,028 | 362,946 | EDI |
| 3336 | 704.878,923 | 4.644.715,700 | 430,145 | FINCA |
| 3337 | 704.870,355 | 4.644.713,831 | 430,161 | FINCA |
| 3338 | 704.831,910 | 4.644.702,050 | 430,303 | FINCA |
| 3339 | 704.813,939 | 4.644.695,813 | 430,414 | FINCA |
| 3340 | 704.805,909 | 4.644.692,905 | 430,363 | FINCA |
| 3341 | 704.860,024 | 4.644.586,655 | 427,066 | FINCA |
| 3342 | 704.863,672 | 4.644.591,556 | 426,833 | FINCA |
| 3343 | 704.875,102 | 4.644.599,822 | 426,801 | FINCA |
| 3344 | 704.880,653 | 4.644.607,573 | 427,041 | FINCA |
| 3345 | 704.881,019 | 4.644.612,595 | 427,171 | FINCA |
| 3346 | 704.880,845 | 4.644.619,025 | 427,395 | FINCA |
| 3347 | 704.881,744 | 4.644.625,448 | 427,817 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3348 | 705.844,785 | 4.645.200,109 | 385,843 | FINCA |
| 3349 | 704.888,703 | 4.644.635,687 | 428,177 | FINCA |
| 3350 | 704.894,297 | 4.644.638,966 | 428,075 | FINCA |
| 3351 | 705.824,971 | 4.645.197,768 | 386,985 | FINCA |
| 3352 | 704.909,111 | 4.644.641,017 | 427,629 | FINCA |
| 3353 | 704.920,957 | 4.644.639,215 | 427,299 | FINCA |
| 3354 | 704.931,326 | 4.644.635,645 | 427,005 | FINCA |
| 3355 | 705.778,171 | 4.645.189,256 | 387,922 | FINCA |
| 3356 | 705.764,380 | 4.645.186,086 | 387,945 | FINCA |
| 3357 | 705.752,491 | 4.645.184,401 | 387,999 | FINCA |
| 3358 | 704.960,826 | 4.644.611,184 | 425,878 | FINCA |
| 3359 | 705.730,737 | 4.645.183,636 | 388,127 | FINCA |
| 3360 | 705.716,960 | 4.645.187,524 | 388,245 | FINCA |
| 3361 | 705.704,121 | 4.645.190,507 | 388,300 | FINCA |
| 3362 | 705.691,019 | 4.645.191,509 | 388,411 | FINCA |
| 3363 | 704.998,856 | 4.644.577,097 | 425,090 | FINCA |
| 3364 | 704.980,431 | 4.644.587,117 | 425,703 | FINCA |
| 3365 | 704.946,653 | 4.644.623,521 | 426,703 | FINCA |
| 3366 | 704.937,443 | 4.644.630,435 | 427,244 | FINCA |
| 3367 | 704.928,731 | 4.644.634,900 | 427,562 | FINCA |
| 3368 | 704.921,235 | 4.644.637,306 | 427,673 | FINCA |
| 3369 | 704.914,417 | 4.644.638,522 | 427,897 | FINCA |
| 3370 | 704.904,762 | 4.644.639,152 | 428,342 | FINCA |
| 3371 | 704.892,364 | 4.644.635,557 | 428,803 | FINCA |
| 3372 | 705.616,191 | 4.645.069,865 | 389,845 | FINCA |
| 3373 | 704.885,679 | 4.644.628,356 | 428,893 | FINCA |
| 3374 | 704.884,455 | 4.644.624,743 | 428,813 | FINCA |
| 3375 | 705.653,343 | 4.645.070,118 | 388,980 | FINCA |
| 3376 | 705.672,440 | 4.645.069,099 | 388,592 | FINCA |
| 3377 | 705.695,492 | 4.645.069,179 | 388,304 | FINCA |
| 3378 | 704.895,587 | 4.644.605,189 | 427,993 | FINCA |
| 3379 | 704.901,999 | 4.644.599,957 | 427,640 | FINCA |
| 3380 | 704.906,609 | 4.644.593,609 | 427,615 | FINCA |
| 3381 | 704.910,323 | 4.644.586,681 | 427,457 | FINCA |
| 3382 | 704.914,407 | 4.644.576,009 | 426,812 | FINCA |
| 3383 | 705.790,179 | 4.645.098,022 | 386,505 | FINCA |
| 3384 | 704.917,575 | 4.644.560,440 | 426,003 | FINCA |
| 3385 | 705.819,275 | 4.645.107,211 | 385,947 | FINCA |
| 3386 | 705.837,896 | 4.645.114,035 | 385,606 | FINCA |
| 3387 | 705.851,242 | 4.645.119,373 | 385,458 | FINCA |
| 3388 | 704.923,254 | 4.644.526,134 | 426,246 | FINCA |
| 3389 | 704.927,051 | 4.644.521,350 | 426,418 | FINCA |
| 3390 | 705.877,880 | 4.645.133,208 | 385,012 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3391 | 705.881,825 | 4.645.138,081 | 384,703 | FINCA |
| 3392 | 704.950,206 | 4.644.524,132 | 426,588 | FINCA |
| 3393 | 704.962,018 | 4.644.529,070 | 426,425 | FINCA |
| 3394 | 704.973,175 | 4.644.533,722 | 426,427 | FINCA |
| 3395 | 704.979,989 | 4.644.536,394 | 426,334 | FINCA |
| 3396 | 705.879,315 | 4.645.153,402 | 384,823 | FINCA |
| 3397 | 705.874,429 | 4.645.163,631 | 384,743 | FINCA |
| 3398 | 705.002,084 | 4.644.580,082 | 424,805 | FINCA |
| 3399 | 705.007,181 | 4.644.586,537 | 424,325 | FINCA |
| 3400 | 705.854,320 | 4.645.196,868 | 385,172 | FINCA |
| 3401 | 705.018,112 | 4.644.600,345 | 424,184 | FINCA |
| 3402 | 705.028,630 | 4.644.621,214 | 425,976 | FINCA |
| 3403 | 705.862,889 | 4.645.094,653 | 385,843 | FINCA |
| 3404 | 704.978,274 | 4.644.669,488 | 427,827 | FINCA |
| 3405 | 705.839,701 | 4.645.089,777 | 386,130 | FINCA |
| 3406 | 705.822,283 | 4.645.082,449 | 386,322 | FINCA |
| 3407 | 705.816,025 | 4.645.078,906 | 386,413 | FINCA |
| 3408 | 705.811,151 | 4.645.075,937 | 386,605 | FINCA |
| 3409 | 704.889,398 | 4.644.717,555 | 430,290 | FINCA |
| 3410 | 705.720,991 | 4.645.028,585 | 388,173 | FINCA |
| 3411 | 705.711,802 | 4.645.019,572 | 388,152 | FINCA |
| 3412 | 705.698,990 | 4.645.001,568 | 388,249 | FINCA |
| 3413 | 705.659,794 | 4.644.944,689 | 388,900 | FINCA |
| 3414 | 705.687,448 | 4.644.902,633 | 388,900 | FINCA |
| 3415 | 705.717,873 | 4.644.872,476 | 388,991 | FINCA |
| 3416 | 705.766,247 | 4.644.844,153 | 389,387 | FINCA |
| 3417 | 705.818,503 | 4.644.867,609 | 388,731 | FINCA |
| 3418 | 704.173,086 | 4.644.484,569 | 442,539 | FINCA |
| 3419 | 705.870,560 | 4.644.945,859 | 386,868 | FINCA |
| 3420 | 704.099,381 | 4.644.429,124 | 448,979 | FINCA |
| 3421 | 704.068,061 | 4.644.414,848 | 452,682 | FINCA |
| 3422 | 705.887,071 | 4.645.077,419 | 385,890 | FINCA |
| 3423 | 705.887,914 | 4.645.089,741 | 385,951 | FINCA |
| 3424 | 704.117,094 | 4.644.458,593 | 447,300 | FINCA |
| 3425 | 705.881,186 | 4.645.097,289 | 385,636 | FINCA |
| 3426 | 704.103,979 | 4.644.469,562 | 448,750 | FINCA |
| 3427 | 704.103,120 | 4.644.476,787 | 448,314 | FINCA |
| 3428 | 705.911,432 | 4.645.085,798 | 385,002 | FINCA |
| 3429 | 704.135,797 | 4.644.507,103 | 445,664 | FINCA |
| 3430 | 704.154,705 | 4.644.509,291 | 444,080 | FINCA |
| 3431 | 704.173,085 | 4.644.525,906 | 442,206 | FINCA |
| 3432 | 704.172,030 | 4.644.478,735 | 442,067 | FINCA |
| 3433 | 704.111,618 | 4.644.432,246 | 447,575 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3434 | 705.874,888 | 4.645.203,974 | 384,558 | FINCA |
| 3435 | 704.118,007 | 4.644.395,361 | 447,327 | FINCA |
| 3436 | 704.123,522 | 4.644.394,504 | 446,736 | FINCA |
| 3437 | 705.591,024 | 4.645.228,857 | 390,349 | FINCA |
| 3438 | 704.159,966 | 4.644.375,208 | 445,935 | FINCA |
| 3439 | 704.166,759 | 4.644.378,968 | 445,201 | FINCA |
| 3440 | 705.650,944 | 4.645.273,265 | 389,014 | FINCA |
| 3441 | 705.652,011 | 4.645.286,400 | 388,851 | FINCA |
| 3442 | 704.211,487 | 4.644.405,150 | 440,293 | FINCA |
| 3443 | 704.222,846 | 4.644.413,880 | 439,752 | FINCA |
| 3444 | 705.699,493 | 4.645.453,010 | 389,071 | FINCA |
| 3445 | 704.268,117 | 4.644.420,579 | 436,969 | FINCA |
| 3446 | 704.261,310 | 4.644.413,618 | 437,424 | FINCA |
| 3447 | 705.699,764 | 4.645.415,331 | 388,518 | FINCA |
| 3448 | 705.700,628 | 4.645.397,815 | 388,463 | FINCA |
| 3449 | 704.245,080 | 4.644.392,019 | 438,187 | FINCA |
| 3450 | 705.702,586 | 4.645.368,057 | 388,487 | FINCA |
| 3451 | 704.238,538 | 4.644.367,939 | 438,473 | FINCA |
| 3452 | 705.711,884 | 4.645.313,802 | 387,596 | FINCA |
| 3453 | 705.714,458 | 4.645.309,815 | 387,638 | FINCA |
| 3454 | 704.197,327 | 4.644.334,689 | 441,708 | FINCA |
| 3455 | 705.752,846 | 4.645.335,156 | 387,449 | FINCA |
| 3456 | 704.167,790 | 4.644.322,325 | 441,052 | FINCA |
| 3457 | 705.762,497 | 4.645.352,555 | 387,482 | FINCA |
| 3458 | 705.778,617 | 4.645.361,511 | 387,470 | FINCA |
| 3459 | 704.180,905 | 4.644.270,428 | 444,970 | FINCA |
| 3460 | 704.189,869 | 4.644.274,156 | 444,543 | FINCA |
| 3461 | 704.222,017 | 4.644.275,932 | 444,416 | FINCA |
| 3462 | 705.830,925 | 4.645.414,332 | 387,354 | FINCA |
| 3463 | 705.848,355 | 4.645.426,298 | 387,410 | FINCA |
| 3464 | 705.859,770 | 4.645.432,425 | 387,462 | FINCA |
| 3465 | 705.855,904 | 4.645.449,421 | 387,402 | FINCA |
| 3466 | 704.352,687 | 4.644.288,668 | 443,467 | FINCA |
| 3467 | 705.781,489 | 4.645.472,794 | 387,430 | FINCA |
| 3468 | 705.759,227 | 4.645.464,413 | 387,608 | FINCA |
| 3469 | 705.737,607 | 4.645.458,072 | 387,502 | FINCA |
| 3470 | 705.724,342 | 4.645.455,008 | 387,572 | FINCA |
| 3471 | 705.711,663 | 4.645.444,429 | 387,490 | FINCA |
| 3472 | 704.392,918 | 4.644.310,042 | 436,404 | FINCA |
| 3473 | 705.704,398 | 4.645.406,891 | 387,424 | FINCA |
| 3474 | 705.704,504 | 4.645.396,787 | 387,410 | FINCA |
| 3475 | 704.405,397 | 4.644.344,011 | 437,328 | FINCA |
| 3476 | 705.707,153 | 4.645.351,239 | 387,590 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3477 | 705.711,396 | 4.645.315,517 | 387,580 | FINCA |
| 3478 | 704.410,127 | 4.644.362,302 | 436,066 | FINCA |
| 3479 | 704.416,397 | 4.644.367,610 | 435,059 | FINCA |
| 3480 | 704.445,524 | 4.644.418,717 | 429,960 | FINCA |
| 3481 | 704.435,575 | 4.644.447,109 | 430,528 | FINCA |
| 3482 | 704.396,739 | 4.644.493,701 | 432,467 | FINCA |
| 3483 | 704.342,518 | 4.644.467,522 | 434,138 | FINCA |
| 3484 | 704.334,032 | 4.644.463,003 | 434,492 | FINCA |
| 3485 | 705.185,400 | 4.644.671,057 | 423,854 | FINCA |
| 3486 | 705.122,023 | 4.644.716,624 | 426,549 | FINCA |
| 3487 | 705.017,851 | 4.644.757,062 | 428,977 | FINCA |
| 3488 | 704.933,062 | 4.644.724,745 | 430,566 | FINCA |
| 3489 | 704.983,653 | 4.644.668,440 | 428,891 | FINCA |
| 3490 | 705.005,490 | 4.644.650,826 | 428,203 | FINCA |
| 3491 | 705.030,140 | 4.644.611,258 | 425,454 | FINCA |
| 3492 | 705.023,102 | 4.644.593,678 | 423,040 | FINCA |
| 3493 | 705.889,518 | 4.645.467,525 | 387,683 | FINCA |
| 3494 | 705.881,444 | 4.645.465,280 | 387,674 | FINCA |
| 3495 | 705.057,623 | 4.644.576,760 | 424,027 | FINCA |
| 3496 | 705.114,116 | 4.644.555,727 | 424,833 | FINCA |
| 3497 | 705.147,301 | 4.644.561,000 | 424,477 | FINCA |
| 3498 | 705.209,444 | 4.644.642,810 | 424,287 | FINCA |
| 3499 | 705.189,614 | 4.644.661,627 | 424,341 | FINCA |
| 3500 | 705.164,994 | 4.644.678,459 | 424,747 | FINCA |
| 3501 | 705.942,707 | 4.645.186,561 | 382,806 | FINCA |
| 3502 | 705.921,418 | 4.645.165,975 | 383,218 | FINCA |
| 3503 | 705.896,852 | 4.645.206,851 | 383,972 | FINCA |
| 3504 | 704.852,796 | 4.644.709,109 | 430,236 | FINCA |
| 3505 | 704.844,928 | 4.644.706,690 | 430,215 | FINCA |
| 3506 | 704.870,363 | 4.644.596,624 | 426,847 | FINCA |
| 3507 | 704.884,361 | 4.644.631,077 | 428,077 | FINCA |
| 3508 | 704.948,165 | 4.644.624,289 | 426,349 | FINCA |
| 3509 | 704.994,620 | 4.644.575,884 | 425,354 | FINCA |
| 3510 | 704.887,916 | 4.644.631,972 | 428,983 | FINCA |
| 3511 | 705.622,107 | 4.645.072,286 | 389,601 | FINCA |
| 3512 | 705.713,672 | 4.645.072,067 | 388,321 | FINCA |
| 3513 | 705.743,731 | 4.645.080,476 | 387,464 | FINCA |
| 3514 | 705.762,329 | 4.645.087,656 | 387,233 | FINCA |
| 3515 | 704.916,761 | 4.644.566,211 | 426,252 | FINCA |
| 3516 | 705.803,025 | 4.645.101,832 | 386,186 | FINCA |
| 3517 | 704.918,362 | 4.644.541,940 | 425,912 | FINCA |
| 3518 | 704.920,041 | 4.644.532,954 | 426,027 | FINCA |
| 3519 | 705.860,895 | 4.645.123,288 | 385,362 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3520 | 704.940,536 | 4.644.520,529 | 426,655 | FINCA |
| 3521 | 705.884,443 | 4.645.140,101 | 384,542 | FINCA |
| 3522 | 705.010,152 | 4.644.550,731 | 426,013 | FINCA |
| 3523 | 705.864,560 | 4.645.183,035 | 384,977 | FINCA |
| 3524 | 705.857,124 | 4.645.194,175 | 385,045 | FINCA |
| 3525 | 705.013,306 | 4.644.594,273 | 423,987 | FINCA |
| 3526 | 705.026,750 | 4.644.611,221 | 425,195 | FINCA |
| 3527 | 705.846,196 | 4.645.091,887 | 386,011 | FINCA |
| 3528 | 704.227,897 | 4.644.457,074 | 440,018 | FINCA |
| 3529 | 704.224,273 | 4.644.461,137 | 440,166 | FINCA |
| 3530 | 705.660,802 | 4.644.962,569 | 388,871 | FINCA |
| 3531 | 705.683,397 | 4.644.908,091 | 388,926 | FINCA |
| 3532 | 704.234,858 | 4.644.515,260 | 439,337 | FINCA |
| 3533 | 705.692,009 | 4.644.897,185 | 388,904 | FINCA |
| 3534 | 704.189,282 | 4.644.499,219 | 442,697 | FINCA |
| 3535 | 704.129,607 | 4.644.449,262 | 446,141 | FINCA |
| 3536 | 704.089,061 | 4.644.423,701 | 449,895 | FINCA |
| 3537 | 705.898,335 | 4.645.033,012 | 385,881 | FINCA |
| 3538 | 704.063,637 | 4.644.432,950 | 452,077 | FINCA |
| 3539 | 704.099,670 | 4.644.441,899 | 448,969 | FINCA |
| 3540 | 704.115,693 | 4.644.450,715 | 447,440 | FINCA |
| 3541 | 704.150,151 | 4.644.462,201 | 443,338 | FINCA |
| 3542 | 704.092,820 | 4.644.395,794 | 450,141 | FINCA |
| 3543 | 705.800,105 | 4.645.521,297 | 388,903 | FINCA |
| 3544 | 704.231,336 | 4.644.420,731 | 439,412 | FINCA |
| 3545 | 705.652,781 | 4.645.328,648 | 388,557 | FINCA |
| 3546 | 705.763,942 | 4.645.534,169 | 389,587 | FINCA |
| 3547 | 704.231,938 | 4.644.355,923 | 439,402 | FINCA |
| 3548 | 705.719,589 | 4.645.307,432 | 387,499 | FINCA |
| 3549 | 705.764,588 | 4.645.358,296 | 387,611 | FINCA |
| 3550 | 705.813,952 | 4.645.370,221 | 387,405 | FINCA |
| 3551 | 704.233,462 | 4.644.272,795 | 444,255 | FINCA |
| 3552 | 704.255,266 | 4.644.240,542 | 443,637 | FINCA |
| 3553 | 704.282,688 | 4.644.242,223 | 439,967 | FINCA |
| 3554 | 704.314,754 | 4.644.253,260 | 440,244 | FINCA |
| 3555 | 704.344,385 | 4.644.266,340 | 440,983 | FINCA |
| 3556 | 704.362,815 | 4.644.279,717 | 441,609 | FINCA |
| 3557 | 705.814,475 | 4.645.477,696 | 387,572 | FINCA |
| 3558 | 704.349,255 | 4.644.292,672 | 444,265 | FINCA |
| 3559 | 704.344,625 | 4.644.304,659 | 445,414 | FINCA |
| 3560 | 704.344,980 | 4.644.308,035 | 445,175 | FINCA |
| 3561 | 704.362,713 | 4.644.307,100 | 440,869 | FINCA |
| 3562 | 705.706,444 | 4.645.437,288 | 387,594 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3563 | 704.410,421 | 4.644.331,422 | 435,762 | FINCA |
| 3564 | 705.705,395 | 4.645.385,292 | 387,390 | FINCA |
| 3565 | 705.709,487 | 4.645.324,156 | 387,560 | FINCA |
| 3566 | 704.404,740 | 4.644.356,063 | 437,118 | FINCA |
| 3567 | 705.709,908 | 4.645.301,171 | 388,580 | FINCA |
| 3568 | 704.442,061 | 4.644.377,415 | 432,154 | FINCA |
| 3569 | 705.703,990 | 4.645.260,492 | 388,620 | FINCA |
| 3570 | 705.696,033 | 4.645.252,875 | 388,934 | FINCA |
| 3571 | 704.456,539 | 4.644.389,880 | 430,152 | FINCA |
| 3572 | 705.674,294 | 4.645.242,021 | 389,201 | FINCA |
| 3573 | 704.438,715 | 4.644.434,137 | 430,189 | FINCA |
| 3574 | 705.628,698 | 4.645.227,244 | 389,592 | FINCA |
| 3575 | 704.421,947 | 4.644.472,840 | 431,566 | FINCA |
| 3576 | 704.408,940 | 4.644.495,874 | 432,236 | FINCA |
| 3577 | 704.375,899 | 4.644.478,514 | 432,925 | FINCA |
| 3578 | 704.359,298 | 4.644.475,278 | 433,622 | FINCA |
| 3579 | 704.350,038 | 4.644.471,535 | 433,872 | FINCA |
| 3580 | 704.303,317 | 4.644.446,396 | 435,263 | FINCA |
| 3581 | 705.179,998 | 4.644.674,380 | 424,062 | FINCA |
| 3582 | 705.136,198 | 4.644.704,534 | 426,172 | FINCA |
| 3583 | 705.111,838 | 4.644.725,930 | 427,010 | FINCA |
| 3584 | 705.060,727 | 4.644.773,250 | 428,671 | FINCA |
| 3585 | 705.085,500 | 4.644.782,806 | 427,610 | FINCA |
| 3586 | 705.105,862 | 4.644.791,680 | 427,242 | FINCA |
| 3587 | 705.039,234 | 4.644.765,198 | 428,872 | FINCA |
| 3588 | 704.915,048 | 4.644.712,756 | 431,186 | FINCA |
| 3589 | 704.921,219 | 4.644.708,525 | 430,948 | FINCA |
| 3590 | 704.931,205 | 4.644.701,938 | 430,563 | FINCA |
| 3591 | 704.947,679 | 4.644.691,216 | 429,975 | FINCA |
| 3592 | 704.958,541 | 4.644.684,303 | 429,682 | FINCA |
| 3593 | 705.031,358 | 4.644.617,590 | 426,277 | FINCA |
| 3594 | 705.024,918 | 4.644.605,157 | 424,316 | FINCA |
| 3595 | 705.020,031 | 4.644.599,490 | 423,389 | FINCA |
| 3596 | 705.894,848 | 4.645.469,697 | 387,759 | FINCA |
| 3597 | 705.049,730 | 4.644.574,118 | 422,789 | FINCA |
| 3598 | 705.878,802 | 4.645.465,338 | 387,667 | FINCA |
| 3599 | 705.084,259 | 4.644.577,344 | 425,688 | FINCA |
| 3600 | 705.093,498 | 4.644.572,282 | 425,441 | FINCA |
| 3601 | 705.139,575 | 4.644.549,700 | 424,491 | FINCA |
| 3602 | 705.166,514 | 4.644.587,038 | 424,208 | FINCA |
| 3603 | 705.178,780 | 4.644.602,334 | 424,150 | FINCA |
| 3604 | 705.198,909 | 4.644.626,955 | 424,122 | FINCA |
| 3605 | 705.200,708 | 4.644.654,542 | 424,154 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3606 | 705.177,422 | 4.644.669,912 | 424,435 | FINCA |
| 3607 | 705.154,177 | 4.644.686,078 | 425,263 | FINCA |
| 3608 | 705.940,903 | 4.645.203,888 | 383,486 | FINCA |
| 3609 | 705.957,022 | 4.645.202,743 | 382,871 | FINCA |
| 3610 | 705.914,471 | 4.645.208,320 | 383,700 | FINCA |
| 3611 | 704.906,667 | 4.644.712,781 | 430,248 | FINCA |
| 3612 | 705.795,386 | 4.645.066,054 | 386,990 | FINCA |
| 3613 | 705.767,211 | 4.645.052,485 | 387,473 | FINCA |
| 3614 | 705.701,637 | 4.645.006,584 | 388,257 | FINCA |
| 3615 | 704.235,064 | 4.644.450,461 | 439,214 | FINCA |
| 3616 | 705.692,068 | 4.644.994,274 | 388,467 | FINCA |
| 3617 | 704.229,390 | 4.644.483,745 | 439,768 | FINCA |
| 3618 | 705.672,568 | 4.644.932,423 | 388,883 | FINCA |
| 3619 | 705.680,095 | 4.644.915,265 | 388,920 | FINCA |
| 3620 | 704.233,240 | 4.644.520,570 | 439,176 | FINCA |
| 3621 | 704.233,232 | 4.644.531,265 | 438,937 | FINCA |
| 3622 | 704.182,976 | 4.644.492,926 | 442,435 | FINCA |
| 3623 | 705.844,824 | 4.644.898,351 | 387,999 | FINCA |
| 3624 | 705.898,602 | 4.645.017,883 | 385,977 | FINCA |
| 3625 | 705.891,172 | 4.645.042,096 | 385,926 | FINCA |
| 3626 | 705.883,186 | 4.645.053,214 | 385,930 | FINCA |
| 3627 | 704.078,008 | 4.644.442,920 | 450,730 | FINCA |
| 3628 | 704.091,063 | 4.644.441,342 | 449,630 | FINCA |
| 3629 | 704.114,442 | 4.644.463,245 | 447,524 | FINCA |
| 3630 | 704.113,316 | 4.644.504,940 | 447,639 | FINCA |
| 3631 | 704.215,344 | 4.644.504,603 | 439,773 | FINCA |
| 3632 | 704.214,464 | 4.644.496,848 | 440,154 | FINCA |
| 3633 | 704.123,313 | 4.644.440,354 | 446,542 | FINCA |
| 3634 | 704.076,704 | 4.644.412,459 | 451,155 | FINCA |
| 3635 | 704.079,821 | 4.644.408,582 | 451,028 | FINCA |
| 3636 | 704.105,241 | 4.644.395,344 | 448,823 | FINCA |
| 3637 | 704.128,707 | 4.644.391,221 | 446,438 | FINCA |
| 3638 | 704.139,406 | 4.644.380,051 | 446,288 | FINCA |
| 3639 | 704.149,102 | 4.644.374,487 | 446,380 | FINCA |
| 3640 | 705.637,965 | 4.645.244,576 | 389,230 | FINCA |
| 3641 | 705.651,438 | 4.645.310,187 | 388,646 | FINCA |
| 3642 | 704.247,211 | 4.644.430,689 | 438,315 | FINCA |
| 3643 | 705.658,235 | 4.645.350,498 | 388,446 | FINCA |
| 3644 | 704.260,119 | 4.644.435,877 | 437,195 | FINCA |
| 3645 | 705.654,366 | 4.645.411,578 | 388,701 | FINCA |
| 3646 | 705.654,365 | 4.645.425,792 | 389,013 | FINCA |
| 3647 | 705.666,876 | 4.645.433,346 | 388,932 | FINCA |
| 3648 | 705.700,326 | 4.645.430,341 | 388,669 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3649 | 704.242,453 | 4.644.386,381 | 438,219 | FINCA |
| 3650 | 704.240,806 | 4.644.378,671 | 438,195 | FINCA |
| 3651 | 705.704,839 | 4.645.340,334 | 388,575 | FINCA |
| 3652 | 705.706,491 | 4.645.326,833 | 388,579 | FINCA |
| 3653 | 704.204,863 | 4.644.338,824 | 441,523 | FINCA |
| 3654 | 704.184,830 | 4.644.329,012 | 440,991 | FINCA |
| 3655 | 705.758,336 | 4.645.343,741 | 387,482 | FINCA |
| 3656 | 704.161,126 | 4.644.320,192 | 441,070 | FINCA |
| 3657 | 704.172,284 | 4.644.285,622 | 443,276 | FINCA |
| 3658 | 705.787,528 | 4.645.360,213 | 387,431 | FINCA |
| 3659 | 705.797,890 | 4.645.358,979 | 387,506 | FINCA |
| 3660 | 705.804,821 | 4.645.359,393 | 387,543 | FINCA |
| 3661 | 705.826,940 | 4.645.409,909 | 387,303 | FINCA |
| 3662 | 704.262,949 | 4.644.239,317 | 442,381 | FINCA |
| 3663 | 704.328,713 | 4.644.259,444 | 441,164 | FINCA |
| 3664 | 704.357,860 | 4.644.284,208 | 442,500 | FINCA |
| 3665 | 704.373,067 | 4.644.302,030 | 439,433 | FINCA |
| 3666 | 704.382,861 | 4.644.297,708 | 438,308 | FINCA |
| 3667 | 704.388,377 | 4.644.303,432 | 437,253 | FINCA |
| 3668 | 704.397,654 | 4.644.316,637 | 436,082 | FINCA |
| 3669 | 705.705,282 | 4.645.422,267 | 387,429 | FINCA |
| 3670 | 705.706,361 | 4.645.368,143 | 387,459 | FINCA |
| 3671 | 704.431,272 | 4.644.374,591 | 433,174 | FINCA |
| 3672 | 705.688,044 | 4.645.248,177 | 389,053 | FINCA |
| 3673 | 704.427,034 | 4.644.461,997 | 431,206 | FINCA |
| 3674 | 705.607,244 | 4.645.227,350 | 389,944 | FINCA |
| 3675 | 704.294,460 | 4.644.441,760 | 435,488 | FINCA |
| 3676 | 705.206,421 | 4.644.657,322 | 423,490 | FINCA |
| 3677 | 705.089,171 | 4.644.746,086 | 428,266 | FINCA |
| 3678 | 705.119,806 | 4.644.798,838 | 427,275 | FINCA |
| 3679 | 704.997,787 | 4.644.749,202 | 428,981 | FINCA |
| 3680 | 704.922,296 | 4.644.721,774 | 430,959 | FINCA |
| 3681 | 704.912,274 | 4.644.720,523 | 431,384 | FINCA |
| 3682 | 704.886,078 | 4.644.717,211 | 430,250 | FINCA |
| 3683 | 704.862,242 | 4.644.711,554 | 430,102 | FINCA |
| 3684 | 704.821,790 | 4.644.698,605 | 430,356 | FINCA |
| 3685 | 705.837,379 | 4.645.199,506 | 386,296 | FINCA |
| 3686 | 704.900,957 | 4.644.640,718 | 427,902 | FINCA |
| 3687 | 705.809,296 | 4.645.195,108 | 387,580 | FINCA |
| 3688 | 704.939,557 | 4.644.631,739 | 426,695 | FINCA |
| 3689 | 704.954,035 | 4.644.617,607 | 426,167 | FINCA |
| 3690 | 705.740,825 | 4.645.183,648 | 388,096 | FINCA |
| 3691 | 705.681,447 | 4.645.190,778 | 388,427 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3692 | 704.971,824 | 4.644.596,050 | 426,160 | FINCA |
| 3693 | 704.962,846 | 4.644.605,908 | 426,286 | FINCA |
| 3694 | 704.954,029 | 4.644.615,614 | 426,443 | FINCA |
| 3695 | 704.897,579 | 4.644.637,940 | 428,617 | FINCA |
| 3696 | 705.633,857 | 4.645.071,514 | 389,331 | FINCA |
| 3697 | 704.885,497 | 4.644.614,976 | 428,349 | FINCA |
| 3698 | 705.776,936 | 4.645.093,500 | 387,065 | FINCA |
| 3699 | 705.881,574 | 4.645.147,503 | 384,821 | FINCA |
| 3700 | 704.992,364 | 4.644.541,776 | 426,414 | FINCA |
| 3701 | 705.016,291 | 4.644.554,583 | 425,341 | FINCA |
| 3702 | 705.869,409 | 4.645.173,710 | 384,858 | FINCA |
| 3703 | 705.860,677 | 4.645.189,891 | 384,991 | FINCA |
| 3704 | 705.852,533 | 4.645.197,875 | 385,274 | FINCA |
| 3705 | 705.028,876 | 4.644.616,511 | 425,654 | FINCA |
| 3706 | 705.021,365 | 4.644.629,982 | 426,150 | FINCA |
| 3707 | 705.008,651 | 4.644.644,381 | 426,693 | FINCA |
| 3708 | 704.958,163 | 4.644.681,659 | 428,395 | FINCA |
| 3709 | 705.830,599 | 4.645.085,984 | 386,240 | FINCA |
| 3710 | 704.936,365 | 4.644.695,104 | 429,029 | FINCA |
| 3711 | 704.926,240 | 4.644.701,350 | 429,387 | FINCA |
| 3712 | 704.917,787 | 4.644.706,415 | 429,747 | FINCA |
| 3713 | 704.267,709 | 4.644.443,548 | 435,963 | FINCA |
| 3714 | 705.786,564 | 4.645.061,784 | 387,176 | FINCA |
| 3715 | 705.729,094 | 4.645.036,995 | 388,034 | FINCA |
| 3716 | 704.245,880 | 4.644.446,537 | 438,478 | FINCA |
| 3717 | 704.240,038 | 4.644.448,344 | 438,864 | FINCA |
| 3718 | 704.231,716 | 4.644.452,264 | 439,425 | FINCA |
| 3719 | 704.223,857 | 4.644.469,319 | 440,163 | FINCA |
| 3720 | 704.236,107 | 4.644.493,557 | 439,850 | FINCA |
| 3721 | 704.206,136 | 4.644.513,418 | 440,428 | FINCA |
| 3722 | 704.198,750 | 4.644.508,212 | 442,042 | FINCA |
| 3723 | 705.854,355 | 4.644.913,420 | 387,679 | FINCA |
| 3724 | 704.150,591 | 4.644.466,902 | 443,639 | FINCA |
| 3725 | 705.882,047 | 4.644.975,396 | 386,413 | FINCA |
| 3726 | 704.079,579 | 4.644.419,431 | 451,009 | FINCA |
| 3727 | 705.878,213 | 4.645.059,753 | 385,986 | FINCA |
| 3728 | 704.106,520 | 4.644.444,092 | 448,472 | FINCA |
| 3729 | 705.892,556 | 4.645.081,522 | 385,917 | FINCA |
| 3730 | 704.116,984 | 4.644.453,326 | 447,320 | FINCA |
| 3731 | 705.883,098 | 4.645.094,938 | 385,683 | FINCA |
| 3732 | 705.882,379 | 4.645.099,247 | 385,388 | FINCA |
| 3733 | 704.145,387 | 4.644.507,192 | 444,579 | FINCA |
| 3734 | 704.214,032 | 4.644.511,440 | 439,723 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3735 | 704.205,859 | 4.644.485,664 | 440,804 | FINCA |
| 3736 | 704.199,862 | 4.644.485,852 | 441,126 | FINCA |
| 3737 | 704.132,945 | 4.644.447,865 | 445,448 | FINCA |
| 3738 | 704.103,518 | 4.644.427,835 | 448,164 | FINCA |
| 3739 | 704.094,170 | 4.644.423,238 | 449,184 | FINCA |
| 3740 | 704.081,207 | 4.644.412,229 | 450,743 | FINCA |
| 3741 | 704.111,369 | 4.644.395,496 | 448,197 | FINCA |
| 3742 | 705.597,011 | 4.645.237,216 | 389,916 | FINCA |
| 3743 | 704.189,768 | 4.644.393,319 | 442,747 | FINCA |
| 3744 | 705.802,186 | 4.645.517,133 | 389,097 | FINCA |
| 3745 | 705.792,682 | 4.645.523,252 | 389,112 | FINCA |
| 3746 | 705.786,871 | 4.645.525,127 | 389,324 | FINCA |
| 3747 | 705.780,542 | 4.645.527,061 | 389,324 | FINCA |
| 3748 | 705.772,706 | 4.645.530,670 | 389,517 | FINCA |
| 3749 | 705.660,413 | 4.645.363,313 | 388,407 | FINCA |
| 3750 | 705.660,143 | 4.645.379,037 | 388,360 | FINCA |
| 3751 | 705.745,852 | 4.645.540,214 | 389,768 | FINCA |
| 3752 | 705.737,002 | 4.645.542,872 | 389,940 | FINCA |
| 3753 | 705.729,470 | 4.645.543,935 | 390,076 | FINCA |
| 3754 | 704.278,591 | 4.644.429,925 | 435,949 | FINCA |
| 3755 | 704.272,732 | 4.644.424,939 | 436,488 | FINCA |
| 3756 | 705.701,001 | 4.645.441,524 | 388,799 | FINCA |
| 3757 | 705.703,828 | 4.645.353,305 | 388,591 | FINCA |
| 3758 | 704.223,493 | 4.644.349,904 | 440,106 | FINCA |
| 3759 | 705.746,905 | 4.645.326,017 | 387,485 | FINCA |
| 3760 | 705.770,878 | 4.645.362,224 | 387,407 | FINCA |
| 3761 | 705.809,512 | 4.645.363,014 | 387,418 | FINCA |
| 3762 | 704.249,336 | 4.644.261,615 | 443,829 | FINCA |
| 3763 | 705.836,835 | 4.645.419,531 | 387,387 | FINCA |
| 3764 | 705.875,506 | 4.645.096,702 | 385,911 | FINCA |
| 3765 | 704.968,786 | 4.644.675,054 | 428,075 | FINCA |
| 3766 | 704.946,704 | 4.644.688,849 | 428,678 | FINCA |
| 3767 | 705.802,836 | 4.645.069,448 | 386,802 | FINCA |
| 3768 | 704.265,549 | 4.644.442,899 | 436,279 | FINCA |
| 3769 | 704.258,071 | 4.644.442,164 | 437,666 | FINCA |
| 3770 | 704.255,497 | 4.644.442,203 | 437,963 | FINCA |
| 3771 | 705.681,130 | 4.644.983,605 | 388,530 | FINCA |
| 3772 | 705.655,876 | 4.644.955,269 | 388,929 | FINCA |
| 3773 | 704.237,125 | 4.644.503,674 | 439,683 | FINCA |
| 3774 | 705.700,634 | 4.644.888,051 | 389,027 | FINCA |
| 3775 | 705.711,100 | 4.644.878,078 | 388,998 | FINCA |
| 3776 | 705.734,757 | 4.644.859,620 | 389,094 | FINCA |
| 3777 | 705.818,503 | 4.644.867,602 | 388,728 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3778 | 705.825,964 | 4.644.875,425 | 388,584 | FINCA |
| 3779 | 705.835,402 | 4.644.886,781 | 388,268 | FINCA |
| 3780 | 704.161,033 | 4.644.474,706 | 443,070 | FINCA |
| 3781 | 705.876,442 | 4.644.961,431 | 386,589 | FINCA |
| 3782 | 704.120,899 | 4.644.442,261 | 447,337 | FINCA |
| 3783 | 705.895,348 | 4.645.010,621 | 386,044 | FINCA |
| 3784 | 704.064,232 | 4.644.423,149 | 452,476 | FINCA |
| 3785 | 705.876,920 | 4.645.064,751 | 385,940 | FINCA |
| 3786 | 704.111,359 | 4.644.446,556 | 448,068 | FINCA |
| 3787 | 705.893,067 | 4.645.084,272 | 385,949 | FINCA |
| 3788 | 705.907,544 | 4.645.093,824 | 385,047 | FINCA |
| 3789 | 705.901,805 | 4.645.105,056 | 385,023 | FINCA |
| 3790 | 704.161,396 | 4.644.512,950 | 443,547 | FINCA |
| 3791 | 704.210,342 | 4.644.489,381 | 440,663 | FINCA |
| 3792 | 705.868,186 | 4.645.203,386 | 384,788 | FINCA |
| 3793 | 704.082,966 | 4.644.403,775 | 450,902 | FINCA |
| 3794 | 705.591,499 | 4.645.232,750 | 390,091 | FINCA |
| 3795 | 705.605,129 | 4.645.239,338 | 389,726 | FINCA |
| 3796 | 705.615,300 | 4.645.239,421 | 389,537 | FINCA |
| 3797 | 705.622,772 | 4.645.239,558 | 389,373 | FINCA |
| 3798 | 705.648,854 | 4.645.263,756 | 389,028 | FINCA |
| 3799 | 705.651,461 | 4.645.318,752 | 388,634 | FINCA |
| 3800 | 704.238,021 | 4.644.425,490 | 439,139 | FINCA |
| 3801 | 705.654,862 | 4.645.338,190 | 388,460 | FINCA |
| 3802 | 705.657,579 | 4.645.398,944 | 388,591 | FINCA |
| 3803 | 705.688,629 | 4.645.446,678 | 388,945 | FINCA |
| 3804 | 704.239,265 | 4.644.371,349 | 438,337 | FINCA |
| 3805 | 704.216,485 | 4.644.345,142 | 440,614 | FINCA |
| 3806 | 705.740,578 | 4.645.318,070 | 387,477 | FINCA |
| 3807 | 704.162,375 | 4.644.311,328 | 441,109 | FINCA |
| 3808 | 704.199,538 | 4.644.277,019 | 444,171 | FINCA |
| 3809 | 705.817,402 | 4.645.379,080 | 387,510 | FINCA |
| 3810 | 704.243,605 | 4.644.268,269 | 443,963 | FINCA |
| 3811 | 704.253,087 | 4.644.252,420 | 443,815 | FINCA |
| 3812 | 704.271,301 | 4.644.240,873 | 441,069 | FINCA |
| 3813 | 705.866,944 | 4.645.439,489 | 387,455 | FINCA |
| 3814 | 705.794,815 | 4.645.477,358 | 387,439 | FINCA |
| 3815 | 705.767,980 | 4.645.468,364 | 387,567 | FINCA |
| 3816 | 705.746,411 | 4.645.459,611 | 387,451 | FINCA |
| 3817 | 705.704,783 | 4.645.431,016 | 387,473 | FINCA |
| 3818 | 704.400,855 | 4.644.348,593 | 437,892 | FINCA |
| 3819 | 704.404,763 | 4.644.356,059 | 437,123 | FINCA |
| 3820 | 705.710,165 | 4.645.289,103 | 388,593 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3821 | 705.706,831 | 4.645.267,056 | 388,587 | FINCA |
| 3822 | 704.452,064 | 4.644.378,773 | 431,254 | FINCA |
| 3823 | 704.450,483 | 4.644.404,250 | 430,006 | FINCA |
| 3824 | 705.646,662 | 4.645.230,520 | 389,554 | FINCA |
| 3825 | 704.386,022 | 4.644.486,260 | 432,561 | FINCA |
| 3826 | 704.367,762 | 4.644.476,584 | 433,378 | FINCA |
| 3827 | 705.192,370 | 4.644.666,409 | 423,706 | FINCA |
| 3828 | 705.166,652 | 4.644.682,496 | 424,880 | FINCA |
| 3829 | 705.148,218 | 4.644.695,333 | 425,792 | FINCA |
| 3830 | 705.076,872 | 4.644.756,916 | 428,316 | FINCA |
| 3831 | 704.909,679 | 4.644.716,881 | 431,456 | FINCA |
| 3832 | 704.969,803 | 4.644.677,244 | 429,251 | FINCA |
| 3833 | 704.996,046 | 4.644.659,858 | 428,628 | FINCA |
| 3834 | 705.028,910 | 4.644.624,373 | 426,944 | FINCA |
| 3835 | 705.886,679 | 4.645.475,745 | 387,874 | FINCA |
| 3836 | 705.031,600 | 4.644.584,776 | 422,648 | FINCA |
| 3837 | 705.038,234 | 4.644.577,171 | 422,248 | FINCA |
| 3838 | 705.069,705 | 4.644.581,035 | 425,653 | FINCA |
| 3839 | 705.104,025 | 4.644.565,597 | 425,148 | FINCA |
| 3840 | 705.132,616 | 4.644.544,268 | 424,584 | FINCA |
| 3841 | 705.158,415 | 4.644.576,235 | 424,352 | FINCA |
| 3842 | 705.188,292 | 4.644.615,039 | 424,124 | FINCA |
| 3843 | 705.205,653 | 4.644.635,962 | 424,151 | FINCA |
| 3844 | 705.138,651 | 4.644.697,719 | 425,889 | FINCA |
| 3845 | 705.109,830 | 4.644.722,106 | 426,863 | FINCA |
| 3846 | 705.099,306 | 4.644.731,625 | 427,440 | FINCA |
| 3847 | 705.935,472 | 4.645.207,503 | 383,841 | FINCA |
| 3848 | 705.065,198 | 4.644.760,649 | 428,538 | FINCA |
| 3849 | 705.944,571 | 4.645.202,132 | 383,100 | FINCA |
| 3850 | 705.940,296 | 4.645.189,189 | 383,027 | FINCA |
| 3851 | 705.935,789 | 4.645.186,766 | 383,450 | FINCA |
| 3852 | 705.928,028 | 4.645.178,565 | 383,304 | FINCA |
| 3853 | 705.926,280 | 4.645.172,214 | 383,410 | FINCA |
| 3854 | 705.881,016 | 4.645.204,966 | 384,118 | FINCA |
| 3855 | 704.878,176 | 4.644.603,273 | 426,886 | FINCA |
| 3856 | 705.792,782 | 4.645.192,232 | 387,861 | FINCA |
| 3857 | 704.970,264 | 4.644.601,335 | 425,580 | FINCA |
| 3858 | 704.978,388 | 4.644.592,530 | 425,418 | FINCA |
| 3859 | 704.987,447 | 4.644.582,705 | 425,271 | FINCA |
| 3860 | 704.992,581 | 4.644.579,406 | 425,131 | FINCA |
| 3861 | 704.988,992 | 4.644.578,897 | 425,463 | FINCA |
| 3862 | 704.884,257 | 4.644.619,712 | 428,578 | FINCA |
| 3863 | 704.888,273 | 4.644.610,831 | 428,269 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3864 | 705.728,967 | 4.645.075,561 | 387,757 | FINCA |
| 3865 | 704.917,760 | 4.644.550,488 | 425,860 | FINCA |
| 3866 | 705.871,527 | 4.645.128,708 | 385,125 | FINCA |
| 3867 | 704.933,798 | 4.644.518,832 | 426,553 | FINCA |
| 3868 | 705.002,481 | 4.644.546,557 | 426,355 | FINCA |
| 3869 | 705.022,523 | 4.644.606,215 | 424,639 | FINCA |
| 3870 | 705.015,934 | 4.644.635,672 | 426,401 | FINCA |
| 3871 | 705.002,833 | 4.644.650,414 | 427,031 | FINCA |
| 3872 | 704.995,813 | 4.644.656,925 | 427,222 | FINCA |
| 3873 | 704.987,928 | 4.644.663,193 | 427,502 | FINCA |
| 3874 | 705.854,082 | 4.645.093,551 | 385,998 | FINCA |
| 3875 | 704.898,608 | 4.644.716,300 | 430,336 | FINCA |
| 3876 | 704.250,348 | 4.644.444,794 | 438,232 | FINCA |
| 3877 | 705.652,673 | 4.644.951,235 | 389,073 | FINCA |
| 3878 | 705.667,696 | 4.644.937,854 | 388,869 | FINCA |
| 3879 | 704.237,662 | 4.644.498,410 | 439,835 | FINCA |
| 3880 | 704.202,402 | 4.644.510,933 | 441,172 | FINCA |
| 3881 | 705.886,029 | 4.644.985,397 | 386,299 | FINCA |
| 3882 | 704.066,417 | 4.644.445,859 | 451,935 | FINCA |
| 3883 | 704.103,454 | 4.644.485,198 | 448,178 | FINCA |
| 3884 | 704.167,802 | 4.644.518,724 | 443,089 | FINCA |
| 3885 | 704.140,275 | 4.644.454,265 | 444,627 | FINCA |
| 3886 | 704.084,562 | 4.644.417,240 | 450,323 | FINCA |
| 3887 | 704.087,794 | 4.644.399,105 | 450,649 | FINCA |
| 3888 | 705.641,615 | 4.645.247,883 | 389,102 | FINCA |
| 3889 | 705.644,362 | 4.645.253,693 | 389,066 | FINCA |
| 3890 | 704.203,981 | 4.644.400,467 | 440,941 | FINCA |
| 3891 | 704.254,334 | 4.644.432,362 | 437,749 | FINCA |
| 3892 | 705.752,919 | 4.645.537,464 | 389,706 | FINCA |
| 3893 | 704.269,998 | 4.644.439,804 | 435,997 | FINCA |
| 3894 | 705.652,314 | 4.645.421,524 | 389,021 | FINCA |
| 3895 | 704.283,186 | 4.644.434,279 | 435,707 | FINCA |
| 3896 | 704.253,551 | 4.644.404,294 | 437,877 | FINCA |
| 3897 | 704.249,384 | 4.644.398,675 | 438,073 | FINCA |
| 3898 | 704.236,225 | 4.644.360,200 | 438,911 | FINCA |
| 3899 | 705.727,920 | 4.645.308,919 | 387,517 | FINCA |
| 3900 | 705.734,438 | 4.645.312,554 | 387,486 | FINCA |
| 3901 | 704.178,116 | 4.644.326,239 | 441,000 | FINCA |
| 3902 | 704.167,881 | 4.644.297,174 | 441,893 | FINCA |
| 3903 | 705.843,324 | 4.645.458,184 | 387,500 | FINCA |
| 3904 | 705.820,189 | 4.645.473,252 | 387,553 | FINCA |
| 3905 | 704.351,584 | 4.644.312,568 | 442,941 | FINCA |
| 3906 | 704.356,603 | 4.644.310,067 | 441,906 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3907 | 705.716,659 | 4.645.450,086 | 387,545 | FINCA |
| 3908 | 704.404,132 | 4.644.323,638 | 435,784 | FINCA |
| 3909 | 705.708,154 | 4.645.336,985 | 387,437 | FINCA |
| 3910 | 705.709,362 | 4.645.310,644 | 388,614 | FINCA |
| 3911 | 704.421,495 | 4.644.370,504 | 434,366 | FINCA |
| 3912 | 705.708,025 | 4.645.275,417 | 388,567 | FINCA |
| 3913 | 705.655,516 | 4.645.234,405 | 389,375 | FINCA |
| 3914 | 704.416,398 | 4.644.483,391 | 431,930 | FINCA |
| 3915 | 704.406,916 | 4.644.499,372 | 432,351 | FINCA |
| 3916 | 704.322,997 | 4.644.456,551 | 434,971 | FINCA |
| 3917 | 705.175,421 | 4.644.677,412 | 424,347 | FINCA |
| 3918 | 704.982,551 | 4.644.743,310 | 429,113 | FINCA |
| 3919 | 704.908,560 | 4.644.719,768 | 431,475 | FINCA |
| 3920 | 705.015,813 | 4.644.639,959 | 427,764 | FINCA |
| 3921 | 705.890,090 | 4.645.474,033 | 387,740 | FINCA |
| 3922 | 705.896,006 | 4.645.471,153 | 387,837 | FINCA |
| 3923 | 705.042,202 | 4.644.571,232 | 422,117 | FINCA |
| 3924 | 705.077,590 | 4.644.583,599 | 425,956 | FINCA |
| 3925 | 705.122,619 | 4.644.548,036 | 424,630 | FINCA |
| 3926 | 705.211,137 | 4.644.648,347 | 424,049 | FINCA |
| 3927 | 705.124,567 | 4.644.709,187 | 426,355 | FINCA |
| 3928 | 705.086,601 | 4.644.742,621 | 428,235 | FINCA |
| 3929 | 705.076,245 | 4.644.751,866 | 428,400 | FINCA |
| 3930 | 705.053,830 | 4.644.765,896 | 428,763 | FINCA |
| 3931 | 705.950,562 | 4.645.202,101 | 382,906 | FINCA |
| 3932 | 704.262,285 | 4.644.442,278 | 436,831 | FINCA |
| 3933 | 705.671,632 | 4.644.973,190 | 388,650 | FINCA |
| 3934 | 704.222,608 | 4.644.463,486 | 440,145 | FINCA |
| 3935 | 704.226,664 | 4.644.477,704 | 439,940 | FINCA |
| 3936 | 704.233,500 | 4.644.488,965 | 439,722 | FINCA |
| 3937 | 705.676,576 | 4.644.923,069 | 388,980 | FINCA |
| 3938 | 704.236,185 | 4.644.508,585 | 439,540 | FINCA |
| 3939 | 704.231,762 | 4.644.525,685 | 439,197 | FINCA |
| 3940 | 704.238,348 | 4.644.535,638 | 439,162 | FINCA |
| 3941 | 704.193,540 | 4.644.503,724 | 442,806 | FINCA |
| 3942 | 705.861,815 | 4.644.928,148 | 387,246 | FINCA |
| 3943 | 704.140,931 | 4.644.459,188 | 444,520 | FINCA |
| 3944 | 704.111,945 | 4.644.436,108 | 448,270 | FINCA |
| 3945 | 705.890,845 | 4.644.998,457 | 386,174 | FINCA |
| 3946 | 705.900,220 | 4.645.023,594 | 385,921 | FINCA |
| 3947 | 705.882,224 | 4.645.073,193 | 385,843 | FINCA |
| 3948 | 704.108,962 | 4.644.467,594 | 448,142 | FINCA |
| 3949 | 704.104,005 | 4.644.494,014 | 448,530 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3950 | 704.103,167 | 4.644.504,412 | 448,845 | FINCA |
| 3951 | 704.124,991 | 4.644.506,276 | 446,742 | FINCA |
| 3952 | 705.899,059 | 4.645.110,552 | 385,117 | FINCA |
| 3953 | 704.174,070 | 4.644.529,339 | 441,878 | FINCA |
| 3954 | 704.192,216 | 4.644.486,804 | 441,402 | FINCA |
| 3955 | 704.185,014 | 4.644.485,911 | 441,631 | FINCA |
| 3956 | 704.160,665 | 4.644.469,916 | 442,641 | FINCA |
| 3957 | 705.862,477 | 4.645.204,326 | 384,377 | FINCA |
| 3958 | 704.099,106 | 4.644.394,914 | 449,414 | FINCA |
| 3959 | 704.133,958 | 4.644.385,673 | 446,262 | FINCA |
| 3960 | 704.143,823 | 4.644.376,363 | 446,372 | FINCA |
| 3961 | 704.154,958 | 4.644.374,484 | 446,180 | FINCA |
| 3962 | 705.631,407 | 4.645.241,844 | 389,200 | FINCA |
| 3963 | 704.174,792 | 4.644.383,794 | 444,207 | FINCA |
| 3964 | 704.182,894 | 4.644.389,475 | 443,360 | FINCA |
| 3965 | 704.196,881 | 4.644.396,741 | 441,985 | FINCA |
| 3966 | 705.652,089 | 4.645.297,918 | 388,737 | FINCA |
| 3967 | 704.265,855 | 4.644.437,742 | 436,576 | FINCA |
| 3968 | 705.678,532 | 4.645.440,034 | 388,920 | FINCA |
| 3969 | 705.702,360 | 4.645.380,422 | 388,532 | FINCA |
| 3970 | 705.708,612 | 4.645.314,389 | 388,563 | FINCA |
| 3971 | 704.191,015 | 4.644.331,689 | 441,326 | FINCA |
| 3972 | 705.767,794 | 4.645.361,359 | 387,520 | FINCA |
| 3973 | 704.176,578 | 4.644.277,858 | 444,095 | FINCA |
| 3974 | 704.209,530 | 4.644.277,901 | 444,161 | FINCA |
| 3975 | 705.819,736 | 4.645.387,174 | 387,388 | FINCA |
| 3976 | 705.822,453 | 4.645.396,800 | 387,421 | FINCA |
| 3977 | 705.825,299 | 4.645.406,750 | 387,440 | FINCA |
| 3978 | 704.296,243 | 4.644.247,027 | 439,649 | FINCA |
| 3979 | 705.865,302 | 4.645.436,031 | 387,610 | FINCA |
| 3980 | 705.865,444 | 4.645.443,556 | 387,531 | FINCA |
| 3981 | 704.353,923 | 4.644.271,787 | 441,051 | FINCA |
| 3982 | 704.367,232 | 4.644.276,093 | 440,932 | FINCA |
| 3983 | 705.827,021 | 4.645.468,567 | 387,448 | FINCA |
| 3984 | 705.807,914 | 4.645.478,577 | 387,506 | FINCA |
| 3985 | 704.346,266 | 4.644.298,842 | 444,986 | FINCA |
| 3986 | 704.348,285 | 4.644.311,901 | 443,940 | FINCA |
| 3987 | 705.753,807 | 4.645.462,222 | 387,477 | FINCA |
| 3988 | 704.415,593 | 4.644.341,283 | 436,530 | FINCA |
| 3989 | 704.409,953 | 4.644.342,122 | 436,849 | FINCA |
| 3990 | 704.401,415 | 4.644.345,895 | 437,720 | FINCA |
| 3991 | 704.458,220 | 4.644.378,393 | 430,922 | FINCA |
| 3992 | 705.637,569 | 4.645.228,215 | 389,660 | FINCA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 3993 | 705.618,967 | 4.645.226,708 | 389,780 | FINCA |
| 3994 | 704.313,298 | 4.644.451,431 | 435,144 | FINCA |
| 3995 | 705.211,809 | 4.644.654,827 | 423,412 | FINCA |
| 3996 | 705.199,687 | 4.644.661,722 | 423,555 | FINCA |
| 3997 | 705.158,328 | 4.644.687,898 | 425,318 | FINCA |
| 3998 | 705.099,846 | 4.644.736,303 | 427,754 | FINCA |
| 3999 | 705.062,543 | 4.644.767,387 | 428,665 | FINCA |
| 4000 | 705.072,402 | 4.644.777,593 | 428,082 | FINCA |
| 4001 | 705.128,855 | 4.644.803,190 | 427,291 | FINCA |
| 4002 | 705.048,667 | 4.644.766,748 | 428,885 | FINCA |
| 4003 | 705.029,966 | 4.644.762,001 | 429,055 | FINCA |
| 4004 | 704.960,707 | 4.644.735,019 | 429,667 | FINCA |
| 4005 | 704.948,548 | 4.644.730,495 | 430,009 | FINCA |
| 4006 | 705.844,108 | 4.645.210,520 | 382,696 | FONDO |
| 4007 | 713.683,035 | 4.645.006,208 | 326,630 | PIE |
| 4008 | 713.341,383 | 4.644.233,231 | 339,190 | PIE |
| 4009 | 713.334,024 | 4.644.221,781 | 339,190 | PIE |
| 4010 | 713.294,082 | 4.644.200,876 | 339,790 | PIE |
| 4011 | 713.213,154 | 4.644.163,183 | 341,340 | PIE |
| 4012 | 713.157,187 | 4.644.128,845 | 342,340 | PIE |
| 4013 | 713.113,901 | 4.644.106,658 | 343,260 | PIE |
| 4014 | 713.111,059 | 4.644.103,010 | 343,340 | PIE |
| 4015 | 713.722,905 | 4.644.250,249 | 338,420 | PIE |
| 4016 | 713.724,435 | 4.644.238,565 | 338,370 | PIE |
| 4017 | 713.771,674 | 4.644.223,103 | 336,970 | PIE |
| 4018 | 713.795,184 | 4.644.223,133 | 336,440 | PIE |
| 4019 | 713.796,253 | 4.644.213,235 | 336,460 | PIE |
| 4020 | 713.820,028 | 4.644.205,821 | 335,280 | PIE |
| 4021 | 714.267,024 | 4.644.614,399 | 322,980 | PIE |
| 4022 | 714.277,394 | 4.644.620,247 | 322,960 | PIE |
| 4023 | 714.154,606 | 4.644.669,562 | 324,050 | PIE |
| 4024 | 714.085,860 | 4.644.707,289 | 325,160 | PIE |
| 4025 | 713.820,125 | 4.644.873,568 | 325,460 | PIE |
| 4026 | 713.811,130 | 4.644.866,645 | 325,490 | PIE |
| 4027 | 713.746,769 | 4.644.941,209 | 326,100 | PIE |
| 4028 | 710.898,671 | 4.646.658,558 | 340,210 | PIE |
| 4029 | 711.010,460 | 4.646.601,423 | 339,750 | PIE |
| 4030 | 711.054,691 | 4.646.606,643 | 340,650 | PIE |
| 4031 | 711.360,387 | 4.646.536,169 | 341,380 | PIE |
| 4032 | 711.460,916 | 4.646.515,845 | 339,880 | PIE |
| 4033 | 711.550,033 | 4.646.565,892 | 340,800 | PIE |
| 4034 | 711.561,290 | 4.646.567,844 | 340,860 | PIE |
| 4035 | 711.560,940 | 4.646.592,183 | 341,630 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4036 | 711.554,904 | 4.646.613,144 | 343,250 | PIE |
| 4037 | 711.562,673 | 4.646.614,096 | 343,200 | PIE |
| 4038 | 711.553,388 | 4.646.632,333 | 344,490 | PIE |
| 4039 | 711.582,033 | 4.646.494,356 | 337,310 | PIE |
| 4040 | 711.604,696 | 4.646.502,178 | 337,390 | PIE |
| 4041 | 711.643,838 | 4.646.481,444 | 336,660 | PIE |
| 4042 | 711.666,726 | 4.646.493,859 | 336,630 | PIE |
| 4043 | 711.712,793 | 4.646.487,249 | 335,740 | PIE |
| 4044 | 711.703,226 | 4.646.434,336 | 334,010 | PIE |
| 4045 | 711.684,607 | 4.646.382,143 | 333,620 | PIE |
| 4046 | 711.697,284 | 4.646.387,629 | 334,200 | PIE |
| 4047 | 711.680,432 | 4.646.330,287 | 334,760 | PIE |
| 4048 | 711.888,734 | 4.646.467,979 | 334,700 | PIE |
| 4049 | 711.860,597 | 4.646.456,864 | 334,680 | PIE |
| 4050 | 711.066,841 | 4.646.809,687 | 349,870 | PIE |
| 4051 | 711.073,186 | 4.646.800,534 | 349,880 | PIE |
| 4052 | 711.006,789 | 4.646.739,746 | 345,070 | PIE |
| 4053 | 711.019,413 | 4.646.731,465 | 345,000 | PIE |
| 4054 | 710.988,079 | 4.646.688,012 | 342,160 | PIE |
| 4055 | 710.956,156 | 4.646.662,785 | 340,670 | PIE |
| 4056 | 710.951,441 | 4.646.638,304 | 339,780 | PIE |
| 4057 | 710.038,463 | 4.646.913,480 | 344,260 | PIE |
| 4058 | 710.035,315 | 4.646.904,736 | 344,270 | PIE |
| 4059 | 709.794,856 | 4.646.868,467 | 346,480 | PIE |
| 4060 | 709.789,348 | 4.646.858,526 | 346,550 | PIE |
| 4061 | 709.694,099 | 4.646.830,822 | 348,840 | PIE |
| 4062 | 709.593,322 | 4.646.771,598 | 352,240 | PIE |
| 4063 | 709.562,765 | 4.646.714,886 | 350,780 | PIE |
| 4064 | 709.325,380 | 4.646.400,275 | 350,250 | PIE |
| 4065 | 709.301,523 | 4.646.296,402 | 351,150 | PIE |
| 4066 | 709.658,312 | 4.646.358,573 | 349,600 | PIE |
| 4067 | 710.322,998 | 4.646.277,080 | 344,400 | PIE |
| 4068 | 710.384,251 | 4.646.232,382 | 343,470 | PIE |
| 4069 | 710.416,363 | 4.646.196,981 | 342,940 | PIE |
| 4070 | 710.430,476 | 4.646.188,292 | 342,860 | PIE |
| 4071 | 710.433,259 | 4.646.193,204 | 342,900 | PIE |
| 4072 | 710.423,175 | 4.646.191,039 | 342,860 | PIE |
| 4073 | 710.455,287 | 4.646.173,907 | 342,480 | PIE |
| 4074 | 710.460,002 | 4.646.188,677 | 342,310 | PIE |
| 4075 | 710.505,305 | 4.646.181,089 | 342,080 | PIE |
| 4076 | 710.504,053 | 4.646.173,708 | 342,060 | PIE |
| 4077 | 710.558,054 | 4.646.189,202 | 341,360 | PIE |
| 4078 | 710.683,947 | 4.646.186,505 | 340,820 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4079 | 710.683,370 | 4.646.180,607 | 341,100 | PIE |
| 4080 | 710.837,711 | 4.646.187,071 | 339,280 | PIE |
| 4081 | 709.198,584 | 4.646.135,611 | 352,140 | PIE |
| 4082 | 709.200,270 | 4.646.117,032 | 352,110 | PIE |
| 4083 | 709.153,396 | 4.646.113,379 | 352,530 | PIE |
| 4084 | 709.104,195 | 4.646.117,570 | 352,910 | PIE |
| 4085 | 708.769,784 | 4.646.078,962 | 353,840 | PIE |
| 4086 | 708.759,771 | 4.646.060,481 | 354,260 | PIE |
| 4087 | 708.679,058 | 4.646.074,787 | 354,840 | PIE |
| 4088 | 708.686,845 | 4.646.052,845 | 354,880 | PIE |
| 4089 | 708.240,142 | 4.646.041,918 | 358,990 | PIE |
| 4090 | 707.856,454 | 4.646.038,235 | 364,650 | PIE |
| 4091 | 707.822,341 | 4.646.040,737 | 364,660 | PIE |
| 4092 | 707.622,713 | 4.646.034,924 | 364,540 | PIE |
| 4093 | 707.612,566 | 4.645.774,494 | 364,120 | PIE |
| 4094 | 707.618,107 | 4.645.704,985 | 365,340 | PIE |
| 4095 | 707.605,411 | 4.645.704,306 | 365,370 | PIE |
| 4096 | 707.609,208 | 4.645.670,200 | 365,620 | PIE |
| 4097 | 707.624,139 | 4.645.630,950 | 365,900 | PIE |
| 4098 | 707.611,613 | 4.645.633,534 | 365,910 | PIE |
| 4099 | 707.615,354 | 4.645.592,281 | 366,260 | PIE |
| 4100 | 707.615,471 | 4.645.545,840 | 366,660 | PIE |
| 4101 | 707.636,406 | 4.645.423,188 | 367,500 | PIE |
| 4102 | 707.644,903 | 4.645.010,126 | 370,120 | PIE |
| 4103 | 707.638,489 | 4.645.012,747 | 370,150 | PIE |
| 4104 | 707.676,859 | 4.644.956,934 | 370,170 | PIE |
| 4105 | 707.669,514 | 4.644.964,273 | 370,080 | PIE |
| 4106 | 707.661,483 | 4.644.972,242 | 370,130 | PIE |
| 4107 | 707.683,006 | 4.644.982,972 | 369,040 | PIE |
| 4108 | 707.851,803 | 4.645.009,248 | 367,630 | PIE |
| 4109 | 707.881,595 | 4.645.005,119 | 367,590 | PIE |
| 4110 | 707.971,898 | 4.645.031,815 | 366,980 | PIE |
| 4111 | 708.021,875 | 4.645.030,119 | 368,530 | PIE |
| 4112 | 708.034,577 | 4.645.035,583 | 368,510 | PIE |
| 4113 | 708.359,493 | 4.645.084,599 | 368,800 | PIE |
| 4114 | 708.379,267 | 4.645.094,971 | 368,890 | PIE |
| 4115 | 708.417,465 | 4.645.103,530 | 366,280 | PIE |
| 4116 | 708.482,098 | 4.645.103,377 | 364,550 | PIE |
| 4117 | 708.488,327 | 4.645.115,454 | 364,400 | PIE |
| 4118 | 708.529,174 | 4.645.123,231 | 363,410 | PIE |
| 4119 | 708.566,930 | 4.645.129,017 | 362,660 | PIE |
| 4120 | 708.564,826 | 4.645.121,453 | 362,660 | PIE |
| 4121 | 708.597,696 | 4.645.139,052 | 362,000 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4122 | 708.594,624 | 4.645.129,090 | 361,990 | PIE |
| 4123 | 708.614,755 | 4.645.133,559 | 361,450 | PIE |
| 4124 | 708.667,727 | 4.645.152,738 | 359,850 | PIE |
| 4125 | 708.828,215 | 4.645.223,046 | 358,020 | PIE |
| 4126 | 708.837,541 | 4.645.276,716 | 357,810 | PIE |
| 4127 | 708.850,685 | 4.645.469,189 | 356,760 | PIE |
| 4128 | 708.851,966 | 4.645.476,092 | 356,690 | PIE |
| 4129 | 708.666,236 | 4.645.519,718 | 356,970 | PIE |
| 4130 | 708.663,184 | 4.645.530,083 | 357,030 | PIE |
| 4131 | 708.427,548 | 4.645.733,249 | 358,390 | PIE |
| 4132 | 708.431,363 | 4.645.818,046 | 361,070 | PIE |
| 4133 | 708.442,845 | 4.645.822,010 | 360,850 | PIE |
| 4134 | 709.100,116 | 4.645.212,546 | 359,800 | PIE |
| 4135 | 709.086,006 | 4.645.213,053 | 359,920 | PIE |
| 4136 | 709.034,555 | 4.645.197,147 | 359,810 | PIE |
| 4137 | 709.034,349 | 4.645.205,549 | 359,830 | PIE |
| 4138 | 708.884,999 | 4.645.184,120 | 358,210 | PIE |
| 4139 | 708.891,983 | 4.645.178,993 | 358,070 | PIE |
| 4140 | 708.859,229 | 4.645.030,355 | 360,100 | PIE |
| 4141 | 708.854,918 | 4.645.018,564 | 360,040 | PIE |
| 4142 | 708.903,740 | 4.644.926,985 | 361,240 | PIE |
| 4143 | 708.917,475 | 4.644.925,099 | 361,320 | PIE |
| 4144 | 708.978,254 | 4.644.767,372 | 363,720 | PIE |
| 4145 | 708.990,045 | 4.644.751,083 | 363,740 | PIE |
| 4146 | 709.010,143 | 4.644.723,910 | 363,750 | PIE |
| 4147 | 709.023,438 | 4.644.704,882 | 363,920 | PIE |
| 4148 | 709.051,838 | 4.644.640,056 | 363,920 | PIE |
| 4149 | 709.042,662 | 4.644.632,519 | 364,280 | PIE |
| 4150 | 709.075,293 | 4.644.323,100 | 363,140 | PIE |
| 4151 | 709.065,880 | 4.644.327,067 | 363,100 | PIE |
| 4152 | 709.503,594 | 4.645.457,089 | 357,130 | PIE |
| 4153 | 709.506,578 | 4.645.446,370 | 356,900 | PIE |
| 4154 | 709.487,648 | 4.645.418,611 | 357,460 | PIE |
| 4155 | 709.466,062 | 4.645.399,838 | 357,950 | PIE |
| 4156 | 709.468,290 | 4.645.388,510 | 357,840 | PIE |
| 4157 | 709.420,294 | 4.645.332,015 | 358,390 | PIE |
| 4158 | 709.423,981 | 4.645.321,971 | 358,260 | PIE |
| 4159 | 709.395,607 | 4.645.294,604 | 358,860 | PIE |
| 4160 | 709.400,777 | 4.645.284,708 | 358,740 | PIE |
| 4161 | 709.378,519 | 4.645.255,739 | 359,100 | PIE |
| 4162 | 709.380,431 | 4.645.249,283 | 359,060 | PIE |
| 4163 | 709.465,658 | 4.645.268,353 | 358,110 | PIE |
| 4164 | 709.461,705 | 4.645.277,165 | 358,220 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4165 | 709.523,686 | 4.645.285,461 | 357,190 | PIE |
| 4166 | 709.550,261 | 4.645.283,979 | 356,760 | PIE |
| 4167 | 709.574,487 | 4.645.294,806 | 356,340 | PIE |
| 4168 | 709.623,632 | 4.645.303,700 | 355,630 | PIE |
| 4169 | 709.625,406 | 4.645.295,714 | 355,750 | PIE |
| 4170 | 709.692,563 | 4.645.308,566 | 355,710 | PIE |
| 4171 | 709.743,599 | 4.645.319,239 | 357,860 | PIE |
| 4172 | 709.791,098 | 4.645.325,430 | 357,630 | PIE |
| 4173 | 709.870,374 | 4.645.340,830 | 357,190 | PIE |
| 4174 | 709.933,186 | 4.645.353,565 | 356,830 | PIE |
| 4175 | 710.041,115 | 4.645.378,559 | 356,140 | PIE |
| 4176 | 710.051,855 | 4.645.373,620 | 356,120 | PIE |
| 4177 | 710.102,962 | 4.645.386,435 | 355,810 | PIE |
| 4178 | 710.091,693 | 4.645.391,675 | 355,880 | PIE |
| 4179 | 710.157,737 | 4.645.401,576 | 355,540 | PIE |
| 4180 | 710.365,087 | 4.645.445,851 | 354,480 | PIE |
| 4181 | 710.412,568 | 4.645.449,092 | 354,190 | PIE |
| 4182 | 710.405,811 | 4.645.455,250 | 354,180 | PIE |
| 4183 | 710.580,785 | 4.645.485,700 | 353,090 | PIE |
| 4184 | 710.579,562 | 4.645.476,932 | 353,140 | PIE |
| 4185 | 710.674,539 | 4.645.474,982 | 352,590 | PIE |
| 4186 | 710.675,590 | 4.645.482,981 | 352,610 | PIE |
| 4187 | 710.707,588 | 4.645.486,566 | 352,400 | PIE |
| 4188 | 710.706,433 | 4.645.477,988 | 352,420 | PIE |
| 4189 | 710.748,775 | 4.645.496,823 | 351,890 | PIE |
| 4190 | 711.109,670 | 4.645.548,229 | 350,020 | PIE |
| 4191 | 711.105,309 | 4.645.555,791 | 350,050 | PIE |
| 4192 | 711.136,567 | 4.645.558,193 | 349,610 | PIE |
| 4193 | 711.689,763 | 4.645.503,141 | 342,050 | PIE |
| 4194 | 711.697,015 | 4.645.500,156 | 341,930 | PIE |
| 4195 | 711.310,495 | 4.645.650,840 | 348,710 | PIE |
| 4196 | 711.320,313 | 4.645.655,720 | 348,800 | PIE |
| 4197 | 711.329,734 | 4.645.705,507 | 345,020 | PIE |
| 4198 | 711.339,402 | 4.645.706,693 | 345,130 | PIE |
| 4199 | 711.360,649 | 4.645.768,003 | 343,620 | PIE |
| 4200 | 711.361,645 | 4.645.760,130 | 343,840 | PIE |
| 4201 | 711.359,280 | 4.645.775,878 | 343,260 | PIE |
| 4202 | 711.403,809 | 4.645.775,052 | 342,500 | PIE |
| 4203 | 711.417,194 | 4.645.772,572 | 341,960 | PIE |
| 4204 | 711.426,404 | 4.645.770,131 | 342,010 | PIE |
| 4205 | 711.478,799 | 4.645.783,401 | 341,260 | PIE |
| 4206 | 711.491,859 | 4.645.780,697 | 340,930 | PIE |
| 4207 | 711.555,886 | 4.645.792,499 | 340,110 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4208 | 711.571,711 | 4.645.788,628 | 339,950 | PIE |
| 4209 | 710.436,191 | 4.645.945,003 | 348,100 | PIE |
| 4210 | 710.452,134 | 4.645.633,760 | 352,860 | PIE |
| 4211 | 710.443,874 | 4.645.640,840 | 352,810 | PIE |
| 4212 | 710.445,692 | 4.645.595,957 | 353,200 | PIE |
| 4213 | 710.453,590 | 4.645.596,894 | 353,210 | PIE |
| 4214 | 710.446,951 | 4.645.553,350 | 353,260 | PIE |
| 4215 | 710.459,009 | 4.645.542,926 | 353,220 | PIE |
| 4216 | 710.026,667 | 4.645.757,605 | 350,560 | PIE |
| 4217 | 710.018,921 | 4.645.752,114 | 350,470 | PIE |
| 4218 | 709.562,676 | 4.645.547,683 | 356,130 | PIE |
| 4219 | 709.565,017 | 4.645.532,202 | 356,030 | PIE |
| 4220 | 709.506,199 | 4.645.451,245 | 356,980 | PIE |
| 4221 | 709.504,047 | 4.645.457,803 | 357,110 | PIE |
| 4222 | 707.372,975 | 4.644.913,587 | 372,890 | PIE |
| 4223 | 707.377,548 | 4.644.921,882 | 372,810 | PIE |
| 4224 | 707.366,104 | 4.644.912,757 | 372,850 | PIE |
| 4225 | 707.347,767 | 4.644.920,210 | 372,940 | PIE |
| 4226 | 707.277,331 | 4.644.899,011 | 373,680 | PIE |
| 4227 | 707.260,099 | 4.644.907,838 | 373,770 | PIE |
| 4228 | 707.160,961 | 4.644.884,668 | 374,900 | PIE |
| 4229 | 707.169,818 | 4.644.896,102 | 374,780 | PIE |
| 4230 | 707.136,831 | 4.644.884,049 | 374,730 | PIE |
| 4231 | 707.125,492 | 4.644.890,634 | 374,860 | PIE |
| 4232 | 707.012,812 | 4.644.865,164 | 375,970 | PIE |
| 4233 | 707.004,240 | 4.644.872,332 | 375,730 | PIE |
| 4234 | 706.904,942 | 4.644.856,349 | 376,550 | PIE |
| 4235 | 706.910,872 | 4.644.847,638 | 376,410 | PIE |
| 4236 | 706.898,562 | 4.644.837,471 | 377,400 | PIE |
| 4237 | 706.889,031 | 4.644.850,528 | 377,320 | PIE |
| 4238 | 706.398,997 | 4.644.839,397 | 379,570 | PIE |
| 4239 | 706.396,407 | 4.644.851,336 | 379,610 | PIE |
| 4240 | 706.358,263 | 4.644.861,500 | 379,950 | PIE |
| 4241 | 706.361,829 | 4.644.846,264 | 380,020 | PIE |
| 4242 | 706.241,349 | 4.644.879,652 | 381,740 | PIE |
| 4243 | 706.215,849 | 4.644.908,846 | 381,730 | PIE |
| 4244 | 706.191,656 | 4.644.896,067 | 382,280 | PIE |
| 4245 | 706.172,340 | 4.644.917,941 | 382,270 | PIE |
| 4246 | 706.153,518 | 4.644.938,085 | 382,410 | PIE |
| 4247 | 706.172,275 | 4.645.190,588 | 382,270 | PIE |
| 4248 | 706.164,373 | 4.645.181,123 | 382,220 | PIE |
| 4249 | 706.206,098 | 4.645.169,390 | 381,960 | PIE |
| 4250 | 706.214,098 | 4.645.178,008 | 381,760 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4251 | 706.253,084 | 4.645.165,162 | 381,020 | PIE |
| 4252 | 706.245,700 | 4.645.156,930 | 381,030 | PIE |
| 4253 | 706.281,075 | 4.645.146,327 | 380,820 | PIE |
| 4254 | 706.289,262 | 4.645.156,154 | 380,750 | PIE |
| 4255 | 706.430,955 | 4.644.700,445 | 380,820 | PIE |
| 4256 | 706.472,021 | 4.644.687,674 | 380,770 | PIE |
| 4257 | 706.511,278 | 4.644.639,925 | 381,450 | PIE |
| 4258 | 706.546,544 | 4.644.629,393 | 381,480 | PIE |
| 4259 | 706.594,513 | 4.644.579,234 | 381,800 | PIE |
| 4260 | 706.626,389 | 4.644.569,230 | 381,800 | PIE |
| 4261 | 706.683,438 | 4.644.515,237 | 381,970 | PIE |
| 4262 | 706.716,775 | 4.644.504,606 | 382,070 | PIE |
| 4263 | 706.877,708 | 4.644.464,794 | 382,100 | PIE |
| 4264 | 706.872,892 | 4.644.460,786 | 382,070 | PIE |
| 4265 | 707.006,562 | 4.644.439,290 | 382,520 | PIE |
| 4266 | 707.029,575 | 4.644.446,114 | 382,700 | PIE |
| 4267 | 707.065,016 | 4.644.438,173 | 382,420 | PIE |
| 4268 | 707.071,485 | 4.644.428,662 | 382,440 | PIE |
| 4269 | 707.158,239 | 4.644.421,335 | 381,990 | PIE |
| 4270 | 707.164,771 | 4.644.412,060 | 381,960 | PIE |
| 4271 | 707.177,173 | 4.644.323,061 | 382,250 | PIE |
| 4272 | 707.170,500 | 4.644.326,437 | 382,280 | PIE |
| 4273 | 707.246,128 | 4.644.309,587 | 381,930 | PIE |
| 4274 | 707.260,153 | 4.644.306,379 | 381,950 | PIE |
| 4275 | 707.319,468 | 4.644.157,087 | 381,820 | PIE |
| 4276 | 707.299,517 | 4.644.154,070 | 381,860 | PIE |
| 4277 | 707.378,960 | 4.644.170,365 | 380,950 | PIE |
| 4278 | 707.361,628 | 4.644.166,910 | 381,000 | PIE |
| 4279 | 707.299,028 | 4.644.326,127 | 381,670 | PIE |
| 4280 | 707.306,462 | 4.644.335,354 | 381,730 | PIE |
| 4281 | 707.869,967 | 4.644.759,690 | 373,140 | PIE |
| 4282 | 707.864,968 | 4.644.750,363 | 373,150 | PIE |
| 4283 | 707.862,571 | 4.644.764,746 | 373,890 | PIE |
| 4284 | 707.855,255 | 4.644.754,835 | 373,950 | PIE |
| 4285 | 707.777,475 | 4.644.800,436 | 374,010 | PIE |
| 4286 | 707.776,149 | 4.644.792,063 | 374,070 | PIE |
| 4287 | 709.796,123 | 4.647.724,298 | 348,290 | PIE |
| 4288 | 709.804,775 | 4.647.712,522 | 348,280 | PIE |
| 4289 | 709.916,013 | 4.647.681,483 | 347,300 | PIE |
| 4290 | 709.948,167 | 4.647.665,064 | 347,240 | PIE |
| 4291 | 710.255,160 | 4.647.557,765 | 346,510 | PIE |
| 4292 | 710.253,185 | 4.647.550,509 | 346,440 | PIE |
| 4293 | 710.429,212 | 4.647.507,185 | 345,880 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4294 | 710.427,337 | 4.647.501,140 | 345,940 | PIE |
| 4295 | 710.518,187 | 4.647.478,293 | 345,570 | PIE |
| 4296 | 710.517,850 | 4.647.471,564 | 345,490 | PIE |
| 4297 | 711.059,354 | 4.647.401,283 | 342,420 | PIE |
| 4298 | 711.059,342 | 4.647.401,268 | 342,440 | PIE |
| 4299 | 711.057,211 | 4.647.393,923 | 342,660 | PIE |
| 4300 | 710.958,936 | 4.647.424,378 | 343,510 | PIE |
| 4301 | 710.957,934 | 4.647.419,221 | 343,460 | PIE |
| 4302 | 710.728,415 | 4.647.493,206 | 344,290 | PIE |
| 4303 | 710.726,478 | 4.647.488,317 | 344,240 | PIE |
| 4304 | 710.622,553 | 4.647.523,405 | 344,750 | PIE |
| 4305 | 710.621,903 | 4.647.517,967 | 344,740 | PIE |
| 4306 | 710.356,733 | 4.647.610,552 | 345,610 | PIE |
| 4307 | 710.345,907 | 4.647.605,471 | 345,690 | PIE |
| 4308 | 710.229,128 | 4.647.649,214 | 346,150 | PIE |
| 4309 | 710.231,612 | 4.647.643,298 | 346,160 | PIE |
| 4310 | 710.171,187 | 4.647.550,355 | 346,730 | PIE |
| 4311 | 710.167,654 | 4.647.554,638 | 346,800 | PIE |
| 4312 | 710.156,050 | 4.647.523,578 | 347,240 | PIE |
| 4313 | 710.150,474 | 4.647.527,974 | 347,170 | PIE |
| 4314 | 710.138,320 | 4.647.495,928 | 348,440 | PIE |
| 4315 | 710.132,623 | 4.647.500,241 | 348,380 | PIE |
| 4316 | 710.124,443 | 4.647.468,962 | 350,780 | PIE |
| 4317 | 710.116,966 | 4.647.470,777 | 350,660 | PIE |
| 4318 | 710.149,334 | 4.647.666,208 | 344,510 | PIE |
| 4319 | 710.149,107 | 4.647.675,910 | 344,550 | PIE |
| 4320 | 709.979,473 | 4.647.718,805 | 344,640 | PIE |
| 4321 | 709.978,874 | 4.647.729,856 | 344,530 | PIE |
| 4322 | 709.794,830 | 4.647.785,510 | 345,320 | PIE |
| 4323 | 709.789,234 | 4.647.777,708 | 345,380 | PIE |
| 4324 | 709.523,395 | 4.647.857,539 | 346,780 | PIE |
| 4325 | 709.523,290 | 4.647.865,542 | 346,720 | PIE |
| 4326 | 709.203,057 | 4.647.959,943 | 350,240 | PIE |
| 4327 | 709.201,834 | 4.647.951,780 | 350,360 | PIE |
| 4328 | 708.647,672 | 4.648.126,948 | 350,950 | PIE |
| 4329 | 708.635,280 | 4.648.123,090 | 351,090 | PIE |
| 4330 | 708.272,905 | 4.648.244,389 | 353,540 | PIE |
| 4331 | 708.269,330 | 4.648.235,815 | 353,540 | PIE |
| 4332 | 707.868,296 | 4.648.332,935 | 354,240 | PIE |
| 4333 | 707.866,540 | 4.648.341,591 | 354,360 | PIE |
| 4334 | 707.757,398 | 4.648.362,407 | 354,790 | PIE |
| 4335 | 707.753,858 | 4.648.353,323 | 354,800 | PIE |
| 4336 | 707.704,706 | 4.648.375,912 | 355,200 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4337 | 707.708,988 | 4.648.383,567 | 355,220 | PIE |
| 4338 | 707.801,083 | 4.648.397,692 | 354,800 | PIE |
| 4339 | 707.790,352 | 4.648.400,284 | 354,830 | PIE |
| 4340 | 707.801,287 | 4.648.450,870 | 354,740 | PIE |
| 4341 | 707.811,170 | 4.648.468,368 | 354,730 | PIE |
| 4342 | 707.054,886 | 4.648.208,516 | 360,980 | PIE |
| 4343 | 707.049,088 | 4.648.204,309 | 360,910 | PIE |
| 4344 | 707.205,020 | 4.648.072,151 | 361,470 | PIE |
| 4345 | 707.196,456 | 4.648.063,715 | 361,470 | PIE |
| 4346 | 708.192,409 | 4.647.851,558 | 355,520 | PIE |
| 4347 | 708.192,833 | 4.647.858,650 | 355,680 | PIE |
| 4348 | 708.042,951 | 4.647.826,767 | 355,880 | PIE |
| 4349 | 708.031,643 | 4.647.817,561 | 356,250 | PIE |
| 4350 | 707.671,225 | 4.647.561,798 | 359,090 | PIE |
| 4351 | 707.658,434 | 4.647.564,920 | 359,050 | PIE |
| 4352 | 707.578,626 | 4.647.556,660 | 359,770 | PIE |
| 4353 | 707.578,579 | 4.647.556,627 | 359,720 | PIE |
| 4354 | 707.581,810 | 4.647.565,433 | 359,680 | PIE |
| 4355 | 707.380,735 | 4.647.563,548 | 361,320 | PIE |
| 4356 | 706.992,551 | 4.647.648,854 | 365,720 | PIE |
| 4357 | 706.995,396 | 4.647.650,314 | 366,140 | PIE |
| 4358 | 707.365,069 | 4.646.569,591 | 374,230 | PIE |
| 4359 | 707.356,330 | 4.646.568,810 | 374,320 | PIE |
| 4360 | 707.415,987 | 4.646.427,056 | 380,410 | PIE |
| 4361 | 707.411,914 | 4.646.428,645 | 380,420 | PIE |
| 4362 | 707.483,552 | 4.646.263,699 | 373,190 | PIE |
| 4363 | 707.493,722 | 4.646.263,263 | 373,230 | PIE |
| 4364 | 707.502,994 | 4.646.239,624 | 371,950 | PIE |
| 4365 | 707.495,361 | 4.646.236,602 | 371,870 | PIE |
| 4366 | 707.507,187 | 4.646.208,785 | 371,060 | PIE |
| 4367 | 707.520,576 | 4.646.209,800 | 370,990 | PIE |
| 4368 | 707.524,228 | 4.646.189,130 | 370,400 | PIE |
| 4369 | 707.515,347 | 4.646.187,965 | 370,380 | PIE |
| 4370 | 707.553,192 | 4.646.137,270 | 367,330 | PIE |
| 4371 | 707.544,501 | 4.646.128,351 | 367,310 | PIE |
| 4372 | 707.560,225 | 4.646.098,289 | 366,810 | PIE |
| 4373 | 707.566,032 | 4.646.104,989 | 366,860 | PIE |
| 4374 | 707.579,812 | 4.646.076,264 | 366,270 | PIE |
| 4375 | 707.574,257 | 4.646.069,162 | 366,130 | PIE |
| 4376 | 707.592,594 | 4.646.045,940 | 365,560 | PIE |
| 4377 | 707.587,020 | 4.646.038,635 | 365,350 | PIE |
| 4378 | 707.986,113 | 4.646.122,108 | 364,690 | PIE |
| 4379 | 707.994,225 | 4.646.117,980 | 365,000 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4380 | 708.008,574 | 4.646.140,152 | 365,950 | PIE |
| 4381 | 708.002,108 | 4.646.146,824 | 366,180 | PIE |
| 4382 | 708.078,599 | 4.646.245,608 | 367,230 | PIE |
| 4383 | 708.084,998 | 4.646.239,019 | 367,180 | PIE |
| 4384 | 708.317,750 | 4.646.510,485 | 372,780 | PIE |
| 4385 | 708.372,577 | 4.646.575,117 | 368,670 | PIE |
| 4386 | 708.379,751 | 4.646.573,486 | 368,820 | PIE |
| 4387 | 708.388,350 | 4.646.599,362 | 367,640 | PIE |
| 4388 | 708.396,141 | 4.646.598,361 | 367,680 | PIE |
| 4389 | 708.839,968 | 4.647.035,000 | 365,090 | PIE |
| 4390 | 708.837,609 | 4.647.030,289 | 365,140 | PIE |
| 4391 | 708.846,489 | 4.647.046,453 | 365,040 | PIE |
| 4392 | 708.884,237 | 4.647.123,997 | 364,570 | PIE |
| 4393 | 709.042,916 | 4.647.260,825 | 362,490 | PIE |
| 4394 | 709.045,013 | 4.647.265,159 | 362,500 | PIE |
| 4395 | 709.062,406 | 4.647.329,017 | 362,590 | PIE |
| 4396 | 709.069,715 | 4.647.329,075 | 362,540 | PIE |
| 4397 | 709.558,747 | 4.648.336,225 | 345,800 | PIE |
| 4398 | 709.557,631 | 4.648.330,419 | 345,530 | PIE |
| 4399 | 709.185,708 | 4.648.441,737 | 346,890 | PIE |
| 4400 | 709.184,115 | 4.648.447,351 | 347,030 | PIE |
| 4401 | 705.647,264 | 4.647.486,432 | 376,660 | PIE |
| 4402 | 705.640,296 | 4.647.490,178 | 376,610 | PIE |
| 4403 | 705.591,023 | 4.647.449,487 | 378,720 | PIE |
| 4404 | 705.582,217 | 4.647.451,155 | 378,760 | PIE |
| 4405 | 705.430,118 | 4.647.335,403 | 380,470 | PIE |
| 4406 | 705.424,671 | 4.647.339,801 | 380,420 | PIE |
| 4407 | 705.331,009 | 4.647.280,059 | 381,230 | PIE |
| 4408 | 705.339,875 | 4.647.273,114 | 381,320 | PIE |
| 4409 | 705.392,005 | 4.647.305,542 | 381,510 | PIE |
| 4410 | 705.398,466 | 4.647.308,756 | 381,470 | PIE |
| 4411 | 705.925,167 | 4.647.249,332 | 376,650 | PIE |
| 4412 | 705.948,591 | 4.647.246,967 | 376,320 | PIE |
| 4413 | 705.941,359 | 4.647.244,358 | 376,880 | PIE |
| 4414 | 705.956,381 | 4.647.210,985 | 377,410 | PIE |
| 4415 | 705.964,258 | 4.647.212,780 | 377,440 | PIE |
| 4416 | 705.974,210 | 4.647.179,081 | 378,390 | PIE |
| 4417 | 705.981,705 | 4.647.180,788 | 378,400 | PIE |
| 4418 | 705.991,119 | 4.647.147,975 | 379,160 | PIE |
| 4419 | 705.998,283 | 4.647.149,494 | 379,370 | PIE |
| 4420 | 706.009,295 | 4.647.115,651 | 380,010 | PIE |
| 4421 | 706.017,738 | 4.647.118,396 | 380,020 | PIE |
| 4422 | 706.034,648 | 4.647.088,212 | 381,330 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4423 | 706.027,122 | 4.647.085,952 | 381,340 | PIE |
| 4424 | 706.120,760 | 4.646.762,915 | 383,710 | PIE |
| 4425 | 706.127,206 | 4.646.767,903 | 383,610 | PIE |
| 4426 | 706.173,549 | 4.646.700,879 | 382,200 | PIE |
| 4427 | 706.179,300 | 4.646.692,623 | 382,230 | PIE |
| 4428 | 706.212,017 | 4.646.713,576 | 380,960 | PIE |
| 4429 | 706.216,201 | 4.646.707,075 | 380,930 | PIE |
| 4430 | 706.248,220 | 4.646.728,066 | 379,580 | PIE |
| 4431 | 706.252,557 | 4.646.718,972 | 379,400 | PIE |
| 4432 | 706.291,380 | 4.646.747,361 | 378,510 | PIE |
| 4433 | 706.290,298 | 4.646.737,006 | 378,620 | PIE |
| 4434 | 706.445,222 | 4.646.840,684 | 378,220 | PIE |
| 4435 | 706.439,425 | 4.646.839,987 | 378,210 | PIE |
| 4436 | 706.439,883 | 4.646.872,045 | 379,160 | PIE |
| 4437 | 706.445,869 | 4.646.872,661 | 379,160 | PIE |
| 4438 | 706.438,236 | 4.646.895,582 | 380,480 | PIE |
| 4439 | 706.444,273 | 4.646.896,086 | 380,520 | PIE |
| 4440 | 706.437,143 | 4.646.915,714 | 381,600 | PIE |
| 4441 | 706.442,006 | 4.646.916,174 | 381,660 | PIE |
| 4442 | 706.434,844 | 4.646.982,452 | 383,570 | PIE |
| 4443 | 706.441,040 | 4.646.972,130 | 383,510 | PIE |
| 4444 | 706.437,122 | 4.647.036,818 | 380,900 | PIE |
| 4445 | 706.432,361 | 4.647.045,090 | 380,930 | PIE |
| 4446 | 706.544,720 | 4.647.397,459 | 367,010 | PIE |
| 4447 | 706.531,177 | 4.647.426,304 | 366,740 | PIE |
| 4448 | 706.544,932 | 4.647.435,633 | 367,100 | PIE |
| 4449 | 706.537,945 | 4.647.438,585 | 367,670 | PIE |
| 4450 | 706.647,246 | 4.646.740,062 | 376,190 | PIE |
| 4451 | 706.649,540 | 4.646.676,382 | 377,710 | PIE |
| 4452 | 706.664,308 | 4.646.626,360 | 379,350 | PIE |
| 4453 | 706.672,171 | 4.646.630,171 | 379,450 | PIE |
| 4454 | 706.184,527 | 4.646.483,083 | 386,960 | PIE |
| 4455 | 706.191,832 | 4.646.501,406 | 386,360 | PIE |
| 4456 | 706.205,681 | 4.646.448,909 | 386,750 | PIE |
| 4457 | 706.200,305 | 4.646.450,415 | 386,810 | PIE |
| 4458 | 706.211,735 | 4.646.399,657 | 387,120 | PIE |
| 4459 | 706.217,587 | 4.646.396,626 | 387,110 | PIE |
| 4460 | 706.241,410 | 4.646.300,733 | 388,020 | PIE |
| 4461 | 706.238,336 | 4.646.294,067 | 388,020 | PIE |
| 4462 | 706.306,243 | 4.645.895,000 | 383,860 | PIE |
| 4463 | 706.313,248 | 4.645.894,332 | 383,840 | PIE |
| 4464 | 706.269,591 | 4.645.771,406 | 383,740 | PIE |
| 4465 | 706.273,593 | 4.645.768,821 | 383,840 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4466 | 706.263,027 | 4.645.742,123 | 385,320 | PIE |
| 4467 | 706.269,478 | 4.645.738,453 | 385,300 | PIE |
| 4468 | 706.256,586 | 4.645.716,351 | 387,090 | PIE |
| 4469 | 706.261,776 | 4.645.710,817 | 387,180 | PIE |
| 4470 | 706.219,374 | 4.645.673,515 | 391,940 | PIE |
| 4471 | 706.211,390 | 4.645.674,896 | 391,960 | PIE |
| 4472 | 706.174,344 | 4.645.639,778 | 387,050 | PIE |
| 4473 | 706.166,232 | 4.645.640,926 | 386,980 | PIE |
| 4474 | 710.364,476 | 4.647.736,992 | 343,859 | PIE |
| 4475 | 710.368,462 | 4.647.732,967 | 343,692 | PIE |
| 4476 | 710.574,385 | 4.647.813,805 | 342,831 | PIE |
| 4477 | 710.582,574 | 4.647.813,681 | 342,903 | PIE |
| 4478 | 710.571,853 | 4.647.837,230 | 342,884 | PIE |
| 4479 | 710.566,571 | 4.647.836,898 | 342,921 | PIE |
| 4480 | 710.552,645 | 4.647.882,190 | 342,478 | PIE |
| 4481 | 710.559,961 | 4.647.882,330 | 342,438 | PIE |
| 4482 | 710.542,809 | 4.647.910,691 | 342,339 | PIE |
| 4483 | 710.548,878 | 4.647.911,044 | 342,262 | PIE |
| 4484 | 710.515,602 | 4.647.995,110 | 343,398 | PIE |
| 4485 | 710.520,500 | 4.647.995,343 | 343,347 | PIE |
| 4486 | 710.498,001 | 4.648.046,745 | 344,062 | PIE |
| 4487 | 710.507,032 | 4.648.050,382 | 343,812 | PIE |
| 4488 | 710.728,409 | 4.647.866,972 | 342,451 | PIE |
| 4489 | 710.729,277 | 4.647.864,043 | 342,472 | PIE |
| 4490 | 710.944,867 | 4.647.924,544 | 340,734 | PIE |
| 4491 | 710.946,880 | 4.647.920,888 | 340,784 | PIE |
| 4492 | 711.024,371 | 4.647.943,581 | 340,070 | PIE |
| 4493 | 711.024,422 | 4.647.939,782 | 340,101 | PIE |
| 4494 | 710.211,408 | 4.647.198,744 | 354,617 | PIE |
| 4495 | 710.212,184 | 4.647.194,483 | 354,603 | PIE |
| 4496 | 710.410,364 | 4.647.133,976 | 354,422 | PIE |
| 4497 | 710.410,751 | 4.647.131,273 | 354,336 | PIE |
| 4498 | 710.486,851 | 4.647.110,584 | 354,350 | PIE |
| 4499 | 710.485,273 | 4.647.107,075 | 354,643 | PIE |
| 4500 | 706.425,964 | 4.647.168,174 | 382,131 | PIE |
| 4501 | 706.430,401 | 4.647.172,040 | 382,117 | PIE |
| 4502 | 706.423,850 | 4.647.207,712 | 381,433 | PIE |
| 4503 | 706.429,114 | 4.647.213,125 | 381,426 | PIE |
| 4504 | 706.434,034 | 4.647.262,506 | 378,783 | PIE |
| 4505 | 706.438,826 | 4.647.259,751 | 378,484 | PIE |
| 4506 | 706.451,700 | 4.647.296,154 | 376,155 | PIE |
| 4507 | 706.454,391 | 4.647.293,465 | 376,143 | PIE |
| 4508 | 706.467,790 | 4.647.322,101 | 373,802 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4509 | 706.471,795 | 4.647.321,249 | 373,370 | PIE |
| 4510 | 706.490,450 | 4.647.359,534 | 370,522 | PIE |
| 4511 | 706.493,010 | 4.647.356,911 | 370,365 | PIE |
| 4512 | 706.520,082 | 4.647.407,639 | 369,109 | PIE |
| 4513 | 706.523,233 | 4.647.405,934 | 369,072 | PIE |
| 4514 | 705.490,731 | 4.647.076,204 | 386,595 | PIE |
| 4515 | 705.492,416 | 4.647.071,665 | 386,585 | PIE |
| 4516 | 705.477,687 | 4.647.069,030 | 388,621 | PIE |
| 4517 | 705.479,299 | 4.647.066,028 | 388,538 | PIE |
| 4518 | 706.105,529 | 4.645.583,577 | 384,321 | PIE |
| 4519 | 706.112,042 | 4.645.583,541 | 384,225 | PIE |
| 4520 | 706.068,810 | 4.645.548,122 | 384,128 | PIE |
| 4521 | 706.072,060 | 4.645.546,982 | 384,254 | PIE |
| 4522 | 706.053,281 | 4.645.533,224 | 383,171 | PIE |
| 4523 | 706.049,917 | 4.645.523,711 | 383,162 | PIE |
| 4524 | 706.021,568 | 4.645.500,534 | 383,799 | PIE |
| 4525 | 706.023,564 | 4.645.494,496 | 383,998 | PIE |
| 4526 | 705.996,052 | 4.645.060,964 | 384,410 | PIE |
| 4527 | 706.003,783 | 4.645.061,631 | 384,214 | PIE |
| 4528 | 706.209,862 | 4.644.920,848 | 381,711 | PIE |
| 4529 | 706.394,159 | 4.644.862,434 | 379,699 | PIE |
| 4530 | 706.395,173 | 4.644.859,079 | 379,614 | PIE |
| 4531 | 706.863,181 | 4.644.932,039 | 376,365 | PIE |
| 4532 | 706.859,369 | 4.644.930,312 | 376,295 | PIE |
| 4533 | 706.783,789 | 4.645.031,730 | 376,282 | PIE |
| 4534 | 706.784,722 | 4.645.034,233 | 376,288 | PIE |
| 4535 | 706.719,886 | 4.645.178,021 | 375,768 | PIE |
| 4536 | 706.721,592 | 4.645.175,660 | 375,761 | PIE |
| 4537 | 706.712,395 | 4.645.284,772 | 376,630 | PIE |
| 4538 | 706.709,889 | 4.645.280,630 | 376,552 | PIE |
| 4539 | 706.793,307 | 4.645.384,715 | 375,971 | PIE |
| 4540 | 706.800,718 | 4.645.384,332 | 375,329 | PIE |
| 4541 | 706.838,868 | 4.645.498,559 | 376,016 | PIE |
| 4542 | 706.842,920 | 4.645.497,848 | 376,029 | PIE |
| 4543 | 706.860,436 | 4.645.619,003 | 372,480 | PIE |
| 4544 | 706.864,754 | 4.645.619,309 | 372,392 | PIE |
| 4545 | 706.861,422 | 4.645.667,232 | 371,935 | PIE |
| 4546 | 706.864,674 | 4.645.666,663 | 371,976 | PIE |
| 4547 | 706.861,475 | 4.645.717,963 | 372,036 | PIE |
| 4548 | 706.865,234 | 4.645.717,831 | 372,046 | PIE |
| 4549 | 706.851,398 | 4.645.755,688 | 372,502 | PIE |
| 4550 | 706.849,398 | 4.645.748,355 | 372,656 | PIE |
| 4551 | 706.785,442 | 4.645.822,681 | 372,695 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4552 | 706.784,962 | 4.645.819,206 | 372,688 | PIE |
| 4553 | 706.711,942 | 4.645.561,158 | 376,007 | PIE |
| 4554 | 706.713,008 | 4.645.558,590 | 376,031 | PIE |
| 4555 | 706.701,811 | 4.645.558,207 | 376,741 | PIE |
| 4556 | 706.702,797 | 4.645.555,650 | 376,755 | PIE |
| 4557 | 706.760,489 | 4.644.364,491 | 383,569 | PIE |
| 4558 | 706.763,954 | 4.644.361,136 | 383,569 | PIE |
| 4559 | 706.778,004 | 4.644.217,064 | 386,113 | PIE |
| 4560 | 706.773,125 | 4.644.213,993 | 385,727 | PIE |
| 4561 | 706.803,411 | 4.644.179,917 | 386,595 | PIE |
| 4562 | 706.801,331 | 4.644.176,551 | 386,603 | PIE |
| 4563 | 706.800,345 | 4.644.110,007 | 386,745 | PIE |
| 4564 | 706.796,026 | 4.644.107,974 | 386,764 | PIE |
| 4565 | 706.793,307 | 4.644.083,209 | 386,347 | PIE |
| 4566 | 706.788,721 | 4.644.082,149 | 386,338 | PIE |
| 4567 | 706.785,389 | 4.644.057,472 | 386,006 | PIE |
| 4568 | 706.781,070 | 4.644.055,975 | 386,011 | PIE |
| 4569 | 706.779,097 | 4.644.031,910 | 385,771 | PIE |
| 4570 | 706.772,672 | 4.644.030,238 | 385,782 | PIE |
| 4571 | 706.659,166 | 4.646.740,937 | 376,100 | PIE |
| 4572 | 713.673,914 | 4.645.000,656 | 326,580 | PIE |
| 4573 | 713.667,778 | 4.645.006,400 | 326,820 | PIE |
| 4574 | 713.676,408 | 4.645.013,709 | 326,840 | PIE |
| 4575 | 713.301,606 | 4.644.213,101 | 339,780 | PIE |
| 4576 | 713.253,502 | 4.644.178,579 | 340,440 | PIE |
| 4577 | 713.261,270 | 4.644.191,543 | 340,500 | PIE |
| 4578 | 713.206,035 | 4.644.153,411 | 341,340 | PIE |
| 4579 | 713.164,248 | 4.644.137,637 | 342,340 | PIE |
| 4580 | 713.124,380 | 4.644.120,923 | 343,260 | PIE |
| 4581 | 713.746,139 | 4.644.239,913 | 337,690 | PIE |
| 4582 | 713.747,585 | 4.644.230,347 | 337,750 | PIE |
| 4583 | 713.770,170 | 4.644.233,705 | 337,030 | PIE |
| 4584 | 713.818,780 | 4.644.216,528 | 335,260 | PIE |
| 4585 | 714.149,981 | 4.644.679,526 | 324,000 | PIE |
| 4586 | 714.077,211 | 4.644.703,447 | 325,040 | PIE |
| 4587 | 713.739,497 | 4.644.936,782 | 326,100 | PIE |
| 4588 | 710.911,546 | 4.646.660,897 | 340,350 | PIE |
| 4589 | 710.991,499 | 4.646.613,217 | 339,860 | PIE |
| 4590 | 711.076,938 | 4.646.594,879 | 340,610 | PIE |
| 4591 | 711.194,515 | 4.646.572,170 | 341,830 | PIE |
| 4592 | 711.216,310 | 4.646.564,665 | 341,830 | PIE |
| 4593 | 711.386,616 | 4.646.540,089 | 341,330 | PIE |
| 4594 | 711.480,342 | 4.646.520,823 | 339,950 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4595 | 711.548,788 | 4.646.507,727 | 338,270 | PIE |
| 4596 | 711.539,700 | 4.646.505,083 | 338,280 | PIE |
| 4597 | 711.559,002 | 4.646.510,956 | 338,340 | PIE |
| 4598 | 711.542,803 | 4.646.534,446 | 339,510 | PIE |
| 4599 | 711.556,583 | 4.646.536,849 | 339,410 | PIE |
| 4600 | 711.553,487 | 4.646.590,977 | 341,680 | PIE |
| 4601 | 711.564,144 | 4.646.632,267 | 344,460 | PIE |
| 4602 | 711.703,871 | 4.646.481,083 | 335,680 | PIE |
| 4603 | 711.688,611 | 4.646.427,138 | 336,460 | PIE |
| 4604 | 711.692,312 | 4.646.335,124 | 334,750 | PIE |
| 4605 | 711.795,912 | 4.646.481,857 | 335,030 | PIE |
| 4606 | 711.773,998 | 4.646.470,555 | 334,990 | PIE |
| 4607 | 711.161,790 | 4.646.872,867 | 350,580 | PIE |
| 4608 | 711.142,796 | 4.646.884,332 | 350,640 | PIE |
| 4609 | 711.041,922 | 4.646.787,231 | 348,380 | PIE |
| 4610 | 711.053,438 | 4.646.773,872 | 348,360 | PIE |
| 4611 | 711.025,892 | 4.646.757,846 | 346,180 | PIE |
| 4612 | 711.033,360 | 4.646.748,746 | 346,070 | PIE |
| 4613 | 710.997,369 | 4.646.716,647 | 343,490 | PIE |
| 4614 | 711.005,965 | 4.646.711,039 | 343,530 | PIE |
| 4615 | 710.979,196 | 4.646.693,344 | 342,150 | PIE |
| 4616 | 710.970,309 | 4.646.653,486 | 340,820 | PIE |
| 4617 | 710.942,489 | 4.646.644,263 | 339,770 | PIE |
| 4618 | 709.842,523 | 4.646.877,589 | 345,270 | PIE |
| 4619 | 709.843,977 | 4.646.886,609 | 345,200 | PIE |
| 4620 | 709.744,368 | 4.646.847,844 | 347,500 | PIE |
| 4621 | 709.746,253 | 4.646.842,653 | 347,870 | PIE |
| 4622 | 709.697,025 | 4.646.825,337 | 349,140 | PIE |
| 4623 | 709.580,031 | 4.646.776,572 | 352,170 | PIE |
| 4624 | 709.583,503 | 4.646.740,212 | 351,590 | PIE |
| 4625 | 709.571,894 | 4.646.744,578 | 351,310 | PIE |
| 4626 | 709.573,126 | 4.646.711,620 | 350,990 | PIE |
| 4627 | 709.332,986 | 4.646.400,937 | 350,290 | PIE |
| 4628 | 709.290,866 | 4.646.306,848 | 351,110 | PIE |
| 4629 | 709.690,219 | 4.646.322,865 | 349,890 | PIE |
| 4630 | 710.326,118 | 4.646.281,337 | 344,390 | PIE |
| 4631 | 710.320,072 | 4.646.269,132 | 344,270 | PIE |
| 4632 | 710.382,389 | 4.646.220,799 | 343,430 | PIE |
| 4633 | 710.418,157 | 4.646.205,319 | 342,880 | PIE |
| 4634 | 710.555,399 | 4.646.177,702 | 341,660 | PIE |
| 4635 | 710.734,820 | 4.646.181,900 | 340,310 | PIE |
| 4636 | 710.736,504 | 4.646.192,353 | 340,170 | PIE |
| 4637 | 710.786,783 | 4.646.186,656 | 339,660 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4638 | 710.786,072 | 4.646.177,670 | 339,750 | PIE |
| 4639 | 710.834,977 | 4.646.174,423 | 339,300 | PIE |
| 4640 | 710.884,910 | 4.646.169,932 | 339,010 | PIE |
| 4641 | 710.887,214 | 4.646.184,255 | 338,970 | PIE |
| 4642 | 709.275,221 | 4.646.414,372 | 352,090 | PIE |
| 4643 | 709.275,402 | 4.646.402,775 | 352,140 | PIE |
| 4644 | 709.149,026 | 4.646.125,195 | 352,540 | PIE |
| 4645 | 709.107,180 | 4.646.107,531 | 352,920 | PIE |
| 4646 | 709.017,260 | 4.646.111,011 | 353,090 | PIE |
| 4647 | 709.020,837 | 4.646.098,330 | 353,190 | PIE |
| 4648 | 708.976,451 | 4.646.093,606 | 353,510 | PIE |
| 4649 | 708.972,963 | 4.646.105,960 | 353,450 | PIE |
| 4650 | 708.513,935 | 4.646.055,413 | 355,680 | PIE |
| 4651 | 708.483,336 | 4.646.041,672 | 355,720 | PIE |
| 4652 | 708.439,449 | 4.646.044,736 | 356,600 | PIE |
| 4653 | 708.452,702 | 4.646.051,934 | 356,490 | PIE |
| 4654 | 708.424,464 | 4.646.055,816 | 357,360 | PIE |
| 4655 | 708.432,916 | 4.646.040,978 | 357,320 | PIE |
| 4656 | 708.322,973 | 4.646.055,303 | 357,940 | PIE |
| 4657 | 708.294,091 | 4.646.040,490 | 358,050 | PIE |
| 4658 | 708.263,123 | 4.646.053,270 | 358,900 | PIE |
| 4659 | 708.211,801 | 4.646.054,325 | 359,820 | PIE |
| 4660 | 708.188,660 | 4.646.039,823 | 359,960 | PIE |
| 4661 | 707.710,443 | 4.646.037,346 | 363,960 | PIE |
| 4662 | 707.717,539 | 4.646.028,424 | 363,880 | PIE |
| 4663 | 707.662,684 | 4.646.040,881 | 363,960 | PIE |
| 4664 | 707.644,472 | 4.646.024,630 | 363,820 | PIE |
| 4665 | 707.614,967 | 4.646.025,497 | 364,450 | PIE |
| 4666 | 707.602,909 | 4.645.771,459 | 364,240 | PIE |
| 4667 | 707.607,078 | 4.645.735,560 | 364,920 | PIE |
| 4668 | 707.619,509 | 4.645.737,313 | 364,900 | PIE |
| 4669 | 707.624,627 | 4.645.668,895 | 365,600 | PIE |
| 4670 | 707.629,425 | 4.645.587,381 | 366,270 | PIE |
| 4671 | 707.629,884 | 4.645.538,403 | 366,670 | PIE |
| 4672 | 707.628,359 | 4.645.405,502 | 367,450 | PIE |
| 4673 | 707.634,604 | 4.645.222,255 | 367,500 | PIE |
| 4674 | 707.625,626 | 4.645.222,397 | 367,430 | PIE |
| 4675 | 707.639,924 | 4.645.131,276 | 369,320 | PIE |
| 4676 | 707.630,949 | 4.645.132,687 | 369,390 | PIE |
| 4677 | 707.655,876 | 4.644.977,933 | 370,100 | PIE |
| 4678 | 707.693,575 | 4.644.973,069 | 369,070 | PIE |
| 4679 | 707.939,298 | 4.645.024,965 | 366,970 | PIE |
| 4680 | 707.966,943 | 4.645.020,094 | 367,050 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4681 | 707.983,573 | 4.645.018,911 | 367,730 | PIE |
| 4682 | 708.069,915 | 4.645.049,519 | 368,430 | PIE |
| 4683 | 708.418,231 | 4.645.093,029 | 366,230 | PIE |
| 4684 | 708.446,021 | 4.645.098,170 | 366,330 | PIE |
| 4685 | 708.447,423 | 4.645.102,591 | 366,350 | PIE |
| 4686 | 708.526,964 | 4.645.115,676 | 363,350 | PIE |
| 4687 | 708.615,890 | 4.645.141,593 | 361,460 | PIE |
| 4688 | 708.664,066 | 4.645.138,801 | 359,880 | PIE |
| 4689 | 708.743,093 | 4.645.164,576 | 359,310 | PIE |
| 4690 | 708.741,691 | 4.645.157,141 | 359,260 | PIE |
| 4691 | 708.745,471 | 4.645.170,764 | 359,250 | PIE |
| 4692 | 708.820,377 | 4.645.232,853 | 358,100 | PIE |
| 4693 | 708.867,759 | 4.645.547,233 | 356,620 | PIE |
| 4694 | 708.869,326 | 4.645.555,821 | 356,540 | PIE |
| 4695 | 708.721,426 | 4.645.504,828 | 356,770 | PIE |
| 4696 | 708.721,718 | 4.645.514,122 | 356,810 | PIE |
| 4697 | 708.608,883 | 4.645.524,675 | 357,350 | PIE |
| 4698 | 708.599,616 | 4.645.538,986 | 357,390 | PIE |
| 4699 | 708.434,144 | 4.645.735,846 | 358,440 | PIE |
| 4700 | 709.448,204 | 4.645.263,432 | 358,440 | PIE |
| 4701 | 709.444,064 | 4.645.272,691 | 358,430 | PIE |
| 4702 | 709.501,337 | 4.645.272,087 | 357,690 | PIE |
| 4703 | 709.498,556 | 4.645.281,872 | 357,720 | PIE |
| 4704 | 709.526,065 | 4.645.276,498 | 357,200 | PIE |
| 4705 | 709.548,412 | 4.645.291,195 | 356,740 | PIE |
| 4706 | 709.576,265 | 4.645.285,399 | 356,390 | PIE |
| 4707 | 709.695,704 | 4.645.316,077 | 355,780 | PIE |
| 4708 | 709.701,781 | 4.645.328,890 | 355,710 | PIE |
| 4709 | 709.713,915 | 4.645.313,603 | 356,840 | PIE |
| 4710 | 709.716,747 | 4.645.321,412 | 356,720 | PIE |
| 4711 | 709.739,292 | 4.645.329,688 | 357,880 | PIE |
| 4712 | 709.764,589 | 4.645.329,497 | 357,700 | PIE |
| 4713 | 709.767,909 | 4.645.322,113 | 357,720 | PIE |
| 4714 | 709.786,769 | 4.645.334,198 | 357,610 | PIE |
| 4715 | 709.865,932 | 4.645.349,715 | 357,210 | PIE |
| 4716 | 709.948,323 | 4.645.346,533 | 356,830 | PIE |
| 4717 | 709.999,823 | 4.645.360,595 | 356,400 | PIE |
| 4718 | 709.989,802 | 4.645.365,129 | 356,430 | PIE |
| 4719 | 710.149,382 | 4.645.404,986 | 355,530 | PIE |
| 4720 | 710.371,113 | 4.645.440,222 | 354,520 | PIE |
| 4721 | 710.643,340 | 4.645.477,891 | 352,830 | PIE |
| 4722 | 710.641,820 | 4.645.466,506 | 352,830 | PIE |
| 4723 | 710.750,890 | 4.645.488,261 | 351,920 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4724 | 711.139,675 | 4.645.552,908 | 349,690 | PIE |
| 4725 | 713.747,734 | 4.644.947,720 | 327,110 | PISTA |
| 4726 | 713.739,947 | 4.644.950,428 | 326,940 | PISTA |
| 4727 | 713.190,565 | 4.645.050,650 | 329,220 | PISTA |
| 4728 | 713.266,013 | 4.644.540,114 | 338,850 | PISTA |
| 4729 | 713.261,316 | 4.644.532,110 | 339,090 | PISTA |
| 4730 | 713.257,684 | 4.644.533,026 | 339,130 | PISTA |
| 4731 | 713.360,784 | 4.644.243,261 | 341,050 | PISTA |
| 4732 | 713.370,184 | 4.644.237,310 | 341,250 | PISTA |
| 4733 | 713.111,213 | 4.644.114,288 | 345,720 | PISTA |
| 4734 | 713.100,913 | 4.644.101,050 | 345,750 | PISTA |
| 4735 | 713.096,374 | 4.644.094,770 | 345,720 | PISTA |
| 4736 | 713.088,188 | 4.644.079,497 | 345,820 | PISTA |
| 4737 | 713.065,735 | 4.644.055,906 | 345,690 | PISTA |
| 4738 | 713.068,644 | 4.644.054,488 | 345,490 | PISTA |
| 4739 | 713.066,251 | 4.644.048,810 | 344,940 | PISTA |
| 4740 | 713.062,369 | 4.644.051,745 | 345,090 | PISTA |
| 4741 | 713.058,632 | 4.644.051,857 | 345,030 | PISTA |
| 4742 | 713.059,919 | 4.644.054,540 | 345,250 | PISTA |
| 4743 | 713.036,981 | 4.644.073,892 | 344,930 | PISTA |
| 4744 | 713.695,110 | 4.644.259,435 | 340,330 | PISTA |
| 4745 | 713.696,593 | 4.644.255,933 | 340,360 | PISTA |
| 4746 | 713.687,267 | 4.644.246,662 | 340,830 | PISTA |
| 4747 | 713.681,944 | 4.644.250,010 | 341,000 | PISTA |
| 4748 | 711.678,000 | 4.645.459,300 | 344,490 | PISTA |
| 4749 | 711.680,180 | 4.645.456,361 | 344,410 | PISTA |
| 4750 | 711.668,650 | 4.645.450,078 | 344,630 | PISTA |
| 4751 | 711.323,376 | 4.646.552,977 | 343,710 | PISTA |
| 4752 | 711.317,965 | 4.646.544,866 | 343,310 | PISTA |
| 4753 | 711.669,842 | 4.646.318,662 | 334,780 | PISTA |
| 4754 | 711.670,943 | 4.646.315,394 | 334,810 | PISTA |
| 4755 | 711.694,737 | 4.646.318,078 | 334,790 | PISTA |
| 4756 | 711.946,947 | 4.646.450,900 | 335,100 | PISTA |
| 4757 | 711.231,611 | 4.646.970,192 | 350,480 | PISTA |
| 4758 | 711.231,843 | 4.646.963,936 | 350,520 | PISTA |
| 4759 | 710.489,526 | 4.646.828,329 | 342,270 | PISTA |
| 4760 | 709.970,385 | 4.646.931,854 | 344,900 | PISTA |
| 4761 | 709.967,193 | 4.646.930,673 | 344,930 | PISTA |
| 4762 | 709.974,405 | 4.646.921,337 | 344,930 | PISTA |
| 4763 | 709.977,312 | 4.646.923,361 | 344,750 | PISTA |
| 4764 | 709.570,280 | 4.646.681,494 | 350,730 | PISTA |
| 4765 | 709.518,768 | 4.646.516,058 | 350,140 | PISTA |
| 4766 | 709.511,021 | 4.646.508,057 | 350,130 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4767 | 709.501,889 | 4.646.504,522 | 350,160 | PISTA |
| 4768 | 709.497,192 | 4.646.506,782 | 350,250 | PISTA |
| 4769 | 709.493,108 | 4.646.510,390 | 350,310 | PISTA |
| 4770 | 709.488,513 | 4.646.515,659 | 350,390 | PISTA |
| 4771 | 709.490,055 | 4.646.490,622 | 350,030 | PISTA |
| 4772 | 709.488,063 | 4.646.494,550 | 350,090 | PISTA |
| 4773 | 709.478,851 | 4.646.488,975 | 350,130 | PISTA |
| 4774 | 709.480,174 | 4.646.485,443 | 349,930 | PISTA |
| 4775 | 710.423,732 | 4.646.188,056 | 343,550 | PISTA |
| 4776 | 710.438,669 | 4.646.174,239 | 343,460 | PISTA |
| 4777 | 710.440,543 | 4.646.177,233 | 343,340 | PISTA |
| 4778 | 707.933,661 | 4.646.035,721 | 364,630 | PISTA |
| 4779 | 707.937,992 | 4.646.031,781 | 364,590 | PISTA |
| 4780 | 707.799,905 | 4.646.031,623 | 364,900 | PISTA |
| 4781 | 707.796,085 | 4.646.031,889 | 364,930 | PISTA |
| 4782 | 707.803,289 | 4.646.049,651 | 365,270 | PISTA |
| 4783 | 707.586,732 | 4.646.003,165 | 365,430 | PISTA |
| 4784 | 707.605,689 | 4.646.003,739 | 365,340 | PISTA |
| 4785 | 707.606,385 | 4.646.010,577 | 365,350 | PISTA |
| 4786 | 707.624,103 | 4.645.372,871 | 367,270 | PISTA |
| 4787 | 707.622,070 | 4.645.368,999 | 367,320 | PISTA |
| 4788 | 707.634,626 | 4.645.367,414 | 367,060 | PISTA |
| 4789 | 708.446,463 | 4.645.110,245 | 365,680 | PISTA |
| 4790 | 708.799,718 | 4.645.180,075 | 359,400 | PISTA |
| 4791 | 708.795,180 | 4.645.182,126 | 359,360 | PISTA |
| 4792 | 708.851,285 | 4.645.332,327 | 357,740 | PISTA |
| 4793 | 708.885,017 | 4.645.481,184 | 356,890 | PISTA |
| 4794 | 708.878,044 | 4.645.553,774 | 357,070 | PISTA |
| 4795 | 708.869,799 | 4.645.545,536 | 357,220 | PISTA |
| 4796 | 708.859,020 | 4.645.472,103 | 357,360 | PISTA |
| 4797 | 709.903,797 | 4.645.348,982 | 357,310 | PISTA |
| 4798 | 709.908,205 | 4.645.347,490 | 357,220 | PISTA |
| 4799 | 709.900,553 | 4.645.339,441 | 357,400 | PISTA |
| 4800 | 710.852,931 | 4.645.511,580 | 351,480 | PISTA |
| 4801 | 710.850,992 | 4.645.515,138 | 351,490 | PISTA |
| 4802 | 711.361,111 | 4.645.776,327 | 343,400 | PISTA |
| 4803 | 711.360,455 | 4.645.780,064 | 343,420 | PISTA |
| 4804 | 711.353,958 | 4.645.778,921 | 343,560 | PISTA |
| 4805 | 711.353,346 | 4.645.775,127 | 343,480 | PISTA |
| 4806 | 711.573,829 | 4.645.799,760 | 340,260 | PISTA |
| 4807 | 711.573,818 | 4.645.803,139 | 340,220 | PISTA |
| 4808 | 711.564,775 | 4.645.802,597 | 340,380 | PISTA |
| 4809 | 711.564,630 | 4.645.798,814 | 340,370 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4810 | 711.628,058 | 4.645.936,256 | 340,640 | PISTA |
| 4811 | 711.627,943 | 4.645.940,129 | 340,690 | PISTA |
| 4812 | 711.643,525 | 4.645.940,160 | 340,690 | PISTA |
| 4813 | 711.644,368 | 4.645.936,589 | 340,730 | PISTA |
| 4814 | 710.439,372 | 4.645.746,052 | 351,940 | PISTA |
| 4815 | 710.440,087 | 4.645.742,473 | 351,910 | PISTA |
| 4816 | 710.448,989 | 4.645.744,991 | 351,830 | PISTA |
| 4817 | 710.449,406 | 4.645.748,197 | 351,830 | PISTA |
| 4818 | 707.224,269 | 4.644.893,498 | 374,590 | PISTA |
| 4819 | 707.221,321 | 4.644.890,711 | 374,700 | PISTA |
| 4820 | 707.210,206 | 4.644.903,171 | 374,570 | PISTA |
| 4821 | 707.212,404 | 4.644.905,457 | 374,460 | PISTA |
| 4822 | 706.310,242 | 4.644.877,679 | 380,800 | PISTA |
| 4823 | 706.306,214 | 4.644.876,615 | 380,910 | PISTA |
| 4824 | 706.307,663 | 4.644.860,146 | 381,260 | PISTA |
| 4825 | 706.311,688 | 4.644.860,495 | 381,100 | PISTA |
| 4826 | 706.055,246 | 4.645.001,684 | 383,970 | PISTA |
| 4827 | 706.049,216 | 4.645.003,180 | 383,760 | PISTA |
| 4828 | 706.042,596 | 4.644.990,420 | 383,780 | PISTA |
| 4829 | 706.047,073 | 4.644.987,318 | 383,890 | PISTA |
| 4830 | 706.125,615 | 4.645.212,340 | 382,600 | PISTA |
| 4831 | 706.121,650 | 4.645.207,263 | 382,050 | PISTA |
| 4832 | 706.120,666 | 4.645.194,942 | 382,520 | PISTA |
| 4833 | 706.129,625 | 4.645.192,919 | 382,570 | PISTA |
| 4834 | 706.344,704 | 4.645.132,230 | 381,250 | PISTA |
| 4835 | 706.351,929 | 4.645.136,694 | 381,020 | PISTA |
| 4836 | 706.344,374 | 4.645.147,712 | 381,100 | PISTA |
| 4837 | 706.337,063 | 4.645.144,678 | 381,360 | PISTA |
| 4838 | 706.360,348 | 4.645.142,452 | 380,420 | PISTA |
| 4839 | 706.363,098 | 4.645.144,987 | 380,550 | PISTA |
| 4840 | 706.357,257 | 4.645.159,036 | 381,340 | PISTA |
| 4841 | 706.352,132 | 4.645.157,046 | 380,750 | PISTA |
| 4842 | 706.395,454 | 4.644.726,383 | 381,720 | PISTA |
| 4843 | 706.398,464 | 4.644.728,153 | 381,630 | PISTA |
| 4844 | 706.386,715 | 4.644.744,747 | 381,650 | PISTA |
| 4845 | 706.390,160 | 4.644.744,953 | 381,580 | PISTA |
| 4846 | 707.258,593 | 4.644.283,600 | 384,030 | PISTA |
| 4847 | 707.258,541 | 4.644.280,438 | 384,220 | PISTA |
| 4848 | 707.280,657 | 4.644.279,664 | 384,160 | PISTA |
| 4849 | 707.282,134 | 4.644.284,573 | 383,860 | PISTA |
| 4850 | 707.314,081 | 4.644.302,098 | 383,650 | PISTA |
| 4851 | 707.310,921 | 4.644.305,736 | 383,710 | PISTA |
| 4852 | 707.326,596 | 4.644.313,211 | 383,470 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4853 | 707.323,231 | 4.644.315,844 | 383,680 | PISTA |
| 4854 | 707.863,005 | 4.644.752,899 | 374,280 | PISTA |
| 4855 | 707.858,423 | 4.644.755,708 | 374,230 | PISTA |
| 4856 | 707.863,456 | 4.644.763,135 | 374,410 | PISTA |
| 4857 | 707.868,312 | 4.644.761,364 | 374,380 | PISTA |
| 4858 | 707.513,021 | 4.644.926,261 | 374,580 | PISTA |
| 4859 | 707.508,096 | 4.644.930,352 | 374,660 | PISTA |
| 4860 | 707.502,214 | 4.644.922,611 | 374,620 | PISTA |
| 4861 | 707.497,377 | 4.644.924,710 | 374,770 | PISTA |
| 4862 | 708.832,069 | 4.648.003,204 | 350,420 | PISTA |
| 4863 | 708.836,547 | 4.648.000,147 | 350,470 | PISTA |
| 4864 | 708.848,692 | 4.648.007,434 | 350,360 | PISTA |
| 4865 | 708.847,341 | 4.648.010,713 | 350,410 | PISTA |
| 4866 | 710.702,385 | 4.647.422,990 | 344,940 | PISTA |
| 4867 | 710.705,397 | 4.647.422,131 | 344,880 | PISTA |
| 4868 | 710.703,518 | 4.647.417,736 | 345,230 | PISTA |
| 4869 | 710.700,849 | 4.647.418,075 | 345,210 | PISTA |
| 4870 | 710.957,392 | 4.647.424,448 | 343,920 | PISTA |
| 4871 | 710.954,310 | 4.647.425,251 | 344,050 | PISTA |
| 4872 | 710.953,335 | 4.647.420,815 | 344,010 | PISTA |
| 4873 | 710.956,820 | 4.647.419,493 | 343,890 | PISTA |
| 4874 | 710.228,253 | 4.647.641,470 | 348,640 | PISTA |
| 4875 | 710.221,356 | 4.647.641,048 | 348,740 | PISTA |
| 4876 | 710.218,092 | 4.647.653,789 | 348,500 | PISTA |
| 4877 | 710.224,581 | 4.647.652,910 | 348,430 | PISTA |
| 4878 | 710.198,087 | 4.647.603,406 | 346,780 | PISTA |
| 4879 | 710.197,781 | 4.647.597,902 | 346,780 | PISTA |
| 4880 | 710.185,137 | 4.647.594,292 | 346,500 | PISTA |
| 4881 | 710.185,069 | 4.647.599,625 | 346,810 | PISTA |
| 4882 | 709.199,080 | 4.647.960,404 | 350,890 | PISTA |
| 4883 | 709.192,577 | 4.647.960,119 | 351,050 | PISTA |
| 4884 | 709.192,573 | 4.647.953,776 | 351,150 | PISTA |
| 4885 | 709.198,724 | 4.647.951,397 | 351,020 | PISTA |
| 4886 | 708.276,068 | 4.648.234,546 | 354,000 | PISTA |
| 4887 | 708.272,304 | 4.648.236,080 | 354,130 | PISTA |
| 4888 | 708.278,803 | 4.648.241,809 | 354,000 | PISTA |
| 4889 | 708.275,214 | 4.648.243,472 | 353,980 | PISTA |
| 4890 | 707.701,665 | 4.648.377,227 | 355,660 | PISTA |
| 4891 | 707.697,300 | 4.648.379,943 | 355,680 | PISTA |
| 4892 | 707.702,895 | 4.648.386,864 | 355,640 | PISTA |
| 4893 | 707.707,545 | 4.648.384,347 | 355,700 | PISTA |
| 4894 | 706.889,499 | 4.648.379,874 | 360,680 | PISTA |
| 4895 | 706.886,695 | 4.648.376,789 | 360,690 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4896 | 706.879,419 | 4.648.383,431 | 360,680 | PISTA |
| 4897 | 706.882,248 | 4.648.387,390 | 360,610 | PISTA |
| 4898 | 706.948,919 | 4.648.294,769 | 361,380 | PISTA |
| 4899 | 706.950,195 | 4.648.291,461 | 361,220 | PISTA |
| 4900 | 706.964,355 | 4.648.294,641 | 361,150 | PISTA |
| 4901 | 706.962,977 | 4.648.299,691 | 361,360 | PISTA |
| 4902 | 707.416,661 | 4.647.839,404 | 362,470 | PISTA |
| 4903 | 707.420,240 | 4.647.841,990 | 362,610 | PISTA |
| 4904 | 707.414,452 | 4.647.851,457 | 362,580 | PISTA |
| 4905 | 707.410,408 | 4.647.849,543 | 362,450 | PISTA |
| 4906 | 707.412,988 | 4.647.776,406 | 362,380 | PISTA |
| 4907 | 707.415,340 | 4.647.773,335 | 362,440 | PISTA |
| 4908 | 707.422,337 | 4.647.777,395 | 362,500 | PISTA |
| 4909 | 707.421,874 | 4.647.782,213 | 362,640 | PISTA |
| 4910 | 708.215,287 | 4.647.847,049 | 355,160 | PISTA |
| 4911 | 708.214,248 | 4.647.850,440 | 355,070 | PISTA |
| 4912 | 708.203,855 | 4.647.848,303 | 355,070 | PISTA |
| 4913 | 708.204,450 | 4.647.844,312 | 355,040 | PISTA |
| 4914 | 707.985,445 | 4.647.806,477 | 358,270 | PISTA |
| 4915 | 707.981,081 | 4.647.805,482 | 358,280 | PISTA |
| 4916 | 707.981,821 | 4.647.811,698 | 358,230 | PISTA |
| 4917 | 707.985,771 | 4.647.812,331 | 358,200 | PISTA |
| 4918 | 707.685,151 | 4.647.542,234 | 362,180 | PISTA |
| 4919 | 707.677,986 | 4.647.513,247 | 362,390 | PISTA |
| 4920 | 707.683,038 | 4.647.510,757 | 362,390 | PISTA |
| 4921 | 707.677,777 | 4.647.513,026 | 362,670 | PISTA |
| 4922 | 707.682,675 | 4.647.535,423 | 361,810 | PISTA |
| 4923 | 707.377,774 | 4.647.564,011 | 361,860 | PISTA |
| 4924 | 707.373,601 | 4.647.565,529 | 361,880 | PISTA |
| 4925 | 707.367,060 | 4.647.555,991 | 361,830 | PISTA |
| 4926 | 707.371,013 | 4.647.552,437 | 361,940 | PISTA |
| 4927 | 707.095,994 | 4.647.483,281 | 363,420 | PISTA |
| 4928 | 707.096,050 | 4.647.479,282 | 363,390 | PISTA |
| 4929 | 707.102,366 | 4.647.479,625 | 363,320 | PISTA |
| 4930 | 707.103,148 | 4.647.484,458 | 363,360 | PISTA |
| 4931 | 707.137,648 | 4.647.111,860 | 374,520 | PISTA |
| 4932 | 707.139,012 | 4.647.108,177 | 374,960 | PISTA |
| 4933 | 707.151,805 | 4.647.113,009 | 374,420 | PISTA |
| 4934 | 707.151,672 | 4.647.117,382 | 374,290 | PISTA |
| 4935 | 707.180,995 | 4.647.077,969 | 371,050 | PISTA |
| 4936 | 707.184,511 | 4.647.081,005 | 371,140 | PISTA |
| 4937 | 707.188,313 | 4.647.071,747 | 370,550 | PISTA |
| 4938 | 707.184,719 | 4.647.069,457 | 370,660 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4939 | 707.209,341 | 4.647.038,257 | 369,030 | PISTA |
| 4940 | 707.217,446 | 4.647.039,514 | 368,530 | PISTA |
| 4941 | 707.221,229 | 4.647.032,929 | 368,780 | PISTA |
| 4942 | 707.213,168 | 4.647.030,046 | 368,950 | PISTA |
| 4943 | 708.516,623 | 4.646.763,522 | 362,500 | PISTA |
| 4944 | 708.519,539 | 4.646.761,447 | 362,440 | PISTA |
| 4945 | 708.525,286 | 4.646.770,344 | 362,610 | PISTA |
| 4946 | 708.523,109 | 4.646.772,996 | 362,690 | PISTA |
| 4947 | 708.618,109 | 4.646.913,543 | 365,570 | PISTA |
| 4948 | 708.621,760 | 4.646.910,965 | 365,370 | PISTA |
| 4949 | 708.819,970 | 4.646.984,603 | 364,210 | PISTA |
| 4950 | 708.820,561 | 4.646.988,139 | 364,440 | PISTA |
| 4951 | 708.815,333 | 4.646.989,142 | 364,620 | PISTA |
| 4952 | 708.813,567 | 4.646.985,186 | 364,530 | PISTA |
| 4953 | 708.833,311 | 4.647.014,122 | 364,990 | PISTA |
| 4954 | 708.828,826 | 4.647.019,393 | 365,710 | PISTA |
| 4955 | 708.832,302 | 4.647.022,176 | 365,690 | PISTA |
| 4956 | 708.835,222 | 4.647.018,923 | 365,200 | PISTA |
| 4957 | 709.229,622 | 4.647.283,361 | 360,960 | PISTA |
| 4958 | 709.233,395 | 4.647.284,034 | 361,010 | PISTA |
| 4959 | 709.232,119 | 4.647.291,718 | 361,190 | PISTA |
| 4960 | 709.227,654 | 4.647.291,636 | 361,100 | PISTA |
| 4961 | 709.227,484 | 4.647.294,748 | 361,030 | PISTA |
| 4962 | 709.208,573 | 4.647.767,811 | 354,100 | PISTA |
| 4963 | 709.209,252 | 4.647.772,852 | 354,140 | PISTA |
| 4964 | 709.215,855 | 4.647.771,716 | 354,620 | PISTA |
| 4965 | 709.215,953 | 4.647.767,538 | 354,880 | PISTA |
| 4966 | 709.177,563 | 4.648.127,872 | 348,830 | PISTA |
| 4967 | 709.176,511 | 4.648.141,354 | 348,880 | PISTA |
| 4968 | 709.170,784 | 4.648.148,864 | 348,850 | PISTA |
| 4969 | 709.167,936 | 4.648.142,376 | 348,790 | PISTA |
| 4970 | 710.183,327 | 4.648.723,847 | 342,930 | PISTA |
| 4971 | 710.178,330 | 4.648.720,445 | 342,900 | PISTA |
| 4972 | 710.181,656 | 4.648.716,170 | 342,960 | PISTA |
| 4973 | 710.186,341 | 4.648.719,233 | 342,950 | PISTA |
| 4974 | 709.897,751 | 4.648.229,504 | 344,430 | PISTA |
| 4975 | 709.897,331 | 4.648.226,601 | 344,590 | PISTA |
| 4976 | 709.903,818 | 4.648.224,620 | 344,470 | PISTA |
| 4977 | 709.905,219 | 4.648.227,846 | 344,320 | PISTA |
| 4978 | 709.179,677 | 4.648.448,187 | 348,060 | PISTA |
| 4979 | 709.173,257 | 4.648.448,278 | 348,440 | PISTA |
| 4980 | 709.173,273 | 4.648.443,181 | 348,430 | PISTA |
| 4981 | 709.179,157 | 4.648.441,935 | 348,330 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 4982 | 705.337,679 | 4.647.268,812 | 381,620 | PISTA |
| 4983 | 705.334,206 | 4.647.265,526 | 381,740 | PISTA |
| 4984 | 705.328,822 | 4.647.273,232 | 381,630 | PISTA |
| 4985 | 705.331,904 | 4.647.276,265 | 381,630 | PISTA |
| 4986 | 706.028,070 | 4.647.082,726 | 382,830 | PISTA |
| 4987 | 706.029,945 | 4.647.077,181 | 382,860 | PISTA |
| 4988 | 706.038,866 | 4.647.079,732 | 382,770 | PISTA |
| 4989 | 706.038,881 | 4.647.086,051 | 382,640 | PISTA |
| 4990 | 706.539,530 | 4.647.444,282 | 368,760 | PISTA |
| 4991 | 706.541,146 | 4.647.449,129 | 368,800 | PISTA |
| 4992 | 706.550,585 | 4.647.444,543 | 368,810 | PISTA |
| 4993 | 706.548,194 | 4.647.441,423 | 368,820 | PISTA |
| 4994 | 706.683,887 | 4.647.671,068 | 372,700 | PISTA |
| 4995 | 706.692,532 | 4.647.677,757 | 372,970 | PISTA |
| 4996 | 706.675,145 | 4.647.674,022 | 373,250 | PISTA |
| 4997 | 706.670,263 | 4.647.667,395 | 372,900 | PISTA |
| 4998 | 706.655,494 | 4.646.803,080 | 375,140 | PISTA |
| 4999 | 706.657,243 | 4.646.798,213 | 374,990 | PISTA |
| 5000 | 706.644,560 | 4.646.794,436 | 375,370 | PISTA |
| 5001 | 706.641,422 | 4.646.800,070 | 375,830 | PISTA |
| 5002 | 706.643,108 | 4.646.674,671 | 379,040 | PISTA |
| 5003 | 706.642,818 | 4.646.682,219 | 378,590 | PISTA |
| 5004 | 706.638,535 | 4.646.682,352 | 378,650 | PISTA |
| 5005 | 706.638,621 | 4.646.674,468 | 379,110 | PISTA |
| 5006 | 706.256,023 | 4.645.704,500 | 389,060 | PISTA |
| 5007 | 706.253,123 | 4.645.709,355 | 389,180 | PISTA |
| 5008 | 706.248,883 | 4.645.705,968 | 389,330 | PISTA |
| 5009 | 706.252,496 | 4.645.701,015 | 389,190 | PISTA |
| 5010 | 706.147,686 | 4.645.616,860 | 388,040 | PISTA |
| 5011 | 706.144,833 | 4.645.613,730 | 387,520 | PISTA |
| 5012 | 710.514,366 | 4.647.778,101 | 343,610 | PISTA |
| 5013 | 710.516,736 | 4.647.774,892 | 343,613 | PISTA |
| 5014 | 710.523,372 | 4.647.777,575 | 343,495 | PISTA |
| 5015 | 710.522,108 | 4.647.781,416 | 343,416 | PISTA |
| 5016 | 710.497,125 | 4.648.052,131 | 344,640 | PISTA |
| 5017 | 710.502,931 | 4.648.055,768 | 344,602 | PISTA |
| 5018 | 710.494,451 | 4.648.056,464 | 344,486 | PISTA |
| 5019 | 710.501,546 | 4.648.059,042 | 344,492 | PISTA |
| 5020 | 710.651,467 | 4.648.152,632 | 343,892 | PISTA |
| 5021 | 710.658,403 | 4.648.157,143 | 343,856 | PISTA |
| 5022 | 710.655,131 | 4.648.150,083 | 343,907 | PISTA |
| 5023 | 710.660,693 | 4.648.153,547 | 343,941 | PISTA |
| 5024 | 711.142,875 | 4.647.962,928 | 339,646 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5025 | 711.151,280 | 4.647.964,875 | 339,573 | PISTA |
| 5026 | 711.144,662 | 4.647.959,278 | 339,917 | PISTA |
| 5027 | 711.152,620 | 4.647.961,468 | 339,909 | PISTA |
| 5028 | 710.220,844 | 4.647.195,710 | 354,345 | PISTA |
| 5029 | 710.227,760 | 4.647.195,387 | 354,440 | PISTA |
| 5030 | 710.220,586 | 4.647.190,157 | 353,873 | PISTA |
| 5031 | 710.227,049 | 4.647.188,543 | 353,806 | PISTA |
| 5032 | 710.533,786 | 4.647.101,569 | 353,206 | PISTA |
| 5033 | 710.543,510 | 4.647.097,754 | 353,151 | PISTA |
| 5034 | 710.540,862 | 4.647.104,519 | 353,190 | PISTA |
| 5035 | 710.549,721 | 4.647.101,721 | 353,219 | PISTA |
| 5036 | 705.483,842 | 4.647.071,519 | 388,316 | PISTA |
| 5037 | 705.484,868 | 4.647.068,517 | 388,258 | PISTA |
| 5038 | 705.479,812 | 4.647.070,055 | 388,306 | PISTA |
| 5039 | 705.481,131 | 4.647.066,833 | 388,356 | PISTA |
| 5040 | 706.144,367 | 4.645.619,391 | 388,000 | PISTA |
| 5041 | 706.141,470 | 4.645.616,932 | 387,906 | PISTA |
| 5042 | 706.008,846 | 4.645.477,721 | 383,557 | PISTA |
| 5043 | 706.015,924 | 4.645.477,897 | 383,543 | PISTA |
| 5044 | 706.008,670 | 4.645.472,637 | 383,431 | PISTA |
| 5045 | 706.015,690 | 4.645.472,403 | 383,369 | PISTA |
| 5046 | 706.010,633 | 4.645.213,609 | 382,872 | PISTA |
| 5047 | 706.016,705 | 4.645.216,292 | 382,868 | PISTA |
| 5048 | 706.008,262 | 4.645.220,151 | 381,808 | PISTA |
| 5049 | 706.012,981 | 4.645.221,462 | 381,763 | PISTA |
| 5050 | 706.289,707 | 4.644.896,007 | 381,245 | PISTA |
| 5051 | 706.295,279 | 4.644.895,428 | 381,115 | PISTA |
| 5052 | 706.299,465 | 4.644.886,707 | 380,685 | PISTA |
| 5053 | 706.303,810 | 4.644.887,668 | 380,727 | PISTA |
| 5054 | 706.307,702 | 4.644.885,603 | 380,590 | PISTA |
| 5055 | 706.311,062 | 4.644.888,707 | 380,551 | PISTA |
| 5056 | 706.313,381 | 4.644.887,286 | 380,574 | PISTA |
| 5057 | 706.311,835 | 4.644.884,116 | 380,610 | PISTA |
| 5058 | 706.740,761 | 4.645.242,467 | 375,770 | PISTA |
| 5059 | 706.744,013 | 4.645.238,500 | 375,718 | PISTA |
| 5060 | 706.742,973 | 4.645.245,833 | 375,899 | PISTA |
| 5061 | 706.744,440 | 4.645.243,549 | 375,813 | PISTA |
| 5062 | 706.856,410 | 4.645.564,426 | 374,528 | PISTA |
| 5063 | 706.861,129 | 4.645.562,907 | 374,388 | PISTA |
| 5064 | 706.857,983 | 4.645.568,513 | 374,258 | PISTA |
| 5065 | 706.861,449 | 4.645.566,885 | 374,291 | PISTA |
| 5066 | 706.861,395 | 4.645.721,044 | 372,149 | PISTA |
| 5067 | 706.864,701 | 4.645.720,564 | 372,107 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5068 | 706.861,502 | 4.645.724,760 | 372,131 | PISTA |
| 5069 | 706.865,607 | 4.645.724,268 | 372,076 | PISTA |
| 5070 | 706.809,169 | 4.644.171,590 | 386,932 | PISTA |
| 5071 | 706.811,835 | 4.644.169,502 | 386,904 | PISTA |
| 5072 | 706.806,183 | 4.644.167,819 | 386,970 | PISTA |
| 5073 | 706.807,783 | 4.644.165,633 | 386,921 | PISTA |
| 5074 | 713.733,495 | 4.644.937,761 | 326,960 | PISTA |
| 5075 | 713.728,845 | 4.644.941,382 | 327,050 | PISTA |
| 5076 | 713.182,407 | 4.645.040,704 | 328,910 | PISTA |
| 5077 | 713.178,485 | 4.645.044,175 | 329,250 | PISTA |
| 5078 | 713.185,612 | 4.645.052,667 | 329,290 | PISTA |
| 5079 | 713.263,363 | 4.644.542,490 | 338,800 | PISTA |
| 5080 | 713.363,619 | 4.644.245,453 | 341,000 | PISTA |
| 5081 | 713.372,979 | 4.644.240,131 | 340,970 | PISTA |
| 5082 | 713.113,686 | 4.644.113,037 | 345,690 | PISTA |
| 5083 | 713.103,439 | 4.644.099,462 | 345,740 | PISTA |
| 5084 | 713.098,791 | 4.644.093,592 | 345,800 | PISTA |
| 5085 | 713.086,722 | 4.644.082,077 | 345,700 | PISTA |
| 5086 | 713.077,555 | 4.644.066,158 | 345,640 | PISTA |
| 5087 | 713.074,586 | 4.644.067,357 | 345,520 | PISTA |
| 5088 | 713.063,005 | 4.644.047,600 | 344,800 | PISTA |
| 5089 | 713.047,119 | 4.644.067,581 | 345,320 | PISTA |
| 5090 | 713.042,762 | 4.644.064,273 | 344,770 | PISTA |
| 5091 | 714.277,111 | 4.644.623,629 | 323,790 | PISTA |
| 5092 | 714.271,788 | 4.644.625,334 | 323,720 | PISTA |
| 5093 | 714.262,554 | 4.644.619,468 | 323,830 | PISTA |
| 5094 | 714.264,587 | 4.644.616,325 | 323,800 | PISTA |
| 5095 | 711.693,480 | 4.645.471,683 | 344,290 | PISTA |
| 5096 | 711.690,487 | 4.645.473,487 | 344,300 | PISTA |
| 5097 | 711.672,673 | 4.645.448,012 | 344,600 | PISTA |
| 5098 | 711.320,020 | 4.646.552,613 | 343,460 | PISTA |
| 5099 | 711.321,219 | 4.646.544,850 | 343,320 | PISTA |
| 5100 | 711.695,407 | 4.646.321,307 | 334,770 | PISTA |
| 5101 | 711.935,837 | 4.646.457,002 | 335,420 | PISTA |
| 5102 | 711.220,285 | 4.646.975,693 | 350,560 | PISTA |
| 5103 | 711.216,396 | 4.646.971,237 | 350,490 | PISTA |
| 5104 | 710.478,418 | 4.646.835,809 | 342,400 | PISTA |
| 5105 | 710.477,264 | 4.646.831,346 | 342,360 | PISTA |
| 5106 | 710.491,539 | 4.646.832,971 | 342,270 | PISTA |
| 5107 | 709.566,981 | 4.646.669,752 | 350,690 | PISTA |
| 5108 | 709.570,503 | 4.646.669,162 | 350,630 | PISTA |
| 5109 | 709.573,584 | 4.646.679,993 | 350,790 | PISTA |
| 5110 | 709.522,448 | 4.646.512,764 | 350,190 | PISTA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5111 | 709.515,191 | 4.646.505,176 | 350,190 | PISTA |
| 5112 | 709.484,786 | 4.646.512,899 | 350,400 | PISTA |
| 5113 | 709.492,944 | 4.646.504,351 | 350,310 | PISTA |
| 5114 | 710.421,497 | 4.646.185,940 | 343,530 | PISTA |
| 5115 | 708.750,732 | 4.646.058,818 | 354,210 | PISTA |
| 5116 | 708.747,031 | 4.646.060,607 | 354,360 | PISTA |
| 5117 | 708.756,985 | 4.646.081,233 | 354,400 | PISTA |
| 5118 | 708.761,696 | 4.646.080,058 | 354,340 | PISTA |
| 5119 | 707.958,429 | 4.646.053,594 | 364,590 | PISTA |
| 5120 | 707.953,960 | 4.646.055,392 | 364,650 | PISTA |
| 5121 | 707.799,723 | 4.646.050,409 | 365,230 | PISTA |
| 5122 | 707.586,636 | 4.646.010,315 | 365,340 | PISTA |
| 5123 | 707.632,592 | 4.645.363,505 | 367,080 | PISTA |
| 5124 | 708.459,569 | 4.645.096,962 | 365,420 | PISTA |
| 5125 | 708.461,094 | 4.645.100,587 | 365,330 | PISTA |
| 5126 | 708.444,251 | 4.645.107,311 | 365,730 | PISTA |
| 5127 | 708.792,528 | 4.645.165,274 | 359,520 | PISTA |
| 5128 | 708.797,108 | 4.645.164,513 | 359,550 | PISTA |
| 5129 | 708.852,591 | 4.645.336,584 | 357,520 | PISTA |
| 5130 | 708.840,977 | 4.645.340,291 | 357,470 | PISTA |
| 5131 | 708.839,339 | 4.645.335,339 | 357,770 | PISTA |
| 5132 | 708.869,823 | 4.645.475,851 | 357,170 | PISTA |
| 5133 | 708.869,781 | 4.645.481,471 | 356,970 | PISTA |
| 5134 | 708.885,823 | 4.645.477,779 | 357,060 | PISTA |
| 5135 | 708.872,300 | 4.645.554,918 | 357,280 | PISTA |
| 5136 | 708.876,185 | 4.645.543,859 | 357,090 | PISTA |
| 5137 | 708.854,418 | 4.645.473,900 | 357,440 | PISTA |
| 5138 | 708.853,287 | 4.645.469,076 | 357,430 | PISTA |
| 5139 | 708.858,587 | 4.645.466,623 | 357,350 | PISTA |
| 5140 | 709.905,279 | 4.645.338,246 | 357,400 | PISTA |
| 5141 | 710.837,953 | 4.645.504,178 | 351,650 | PISTA |
| 5142 | 710.840,102 | 4.645.501,301 | 351,640 | PISTA |
| 5143 | 709.165,240 | 4.648.264,988 | 351,070 | ROCA |
| 5144 | 709.172,384 | 4.648.263,431 | 351,350 | ROCA |
| 5145 | 709.174,106 | 4.648.265,674 | 351,610 | ROCA |
| 5146 | 709.167,706 | 4.648.267,718 | 350,740 | ROCA |
| 5147 | 707.588,998 | 4.645.976,615 | 366,170 | TREN |
| 5148 | 707.588,915 | 4.645.973,577 | 366,140 | TREN |
| 5149 | 706.422,044 | 4.646.774,079 | 380,490 | TREN |
| 5150 | 706.416,068 | 4.646.787,145 | 380,500 | TREN |
| 5151 | 706.414,254 | 4.646.786,193 | 380,620 | TREN |
| 5152 | 706.411,171 | 4.646.791,677 | 380,830 | TREN |
| 5153 | 706.413,375 | 4.646.793,196 | 380,860 | TREN |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5154 | 707.609,970 | 4.645.974,063 | 365,880 | TREN |
| 5155 | 707.610,513 | 4.645.977,310 | 365,880 | TREN |
| 5156 | 713.018,848 | 4.644.042,605 | 344,143 | VALLA |
| 5157 | 713.311,384 | 4.644.348,328 | 341,043 | VALLA |
| 5158 | 713.321,901 | 4.644.354,158 | 340,551 | VALLA |
| 5159 | 709.081,169 | 4.644.305,404 | 362,914 | |
| 5160 | 709.058,530 | 4.644.308,722 | 363,346 | |
| 5161 | 709.058,596 | 4.644.308,911 | 364,305 | |
| 5162 | 705.877,536 | 4.644.752,441 | 393,492 | |
| 5163 | 704.806,381 | 4.644.682,384 | 429,944 | |
| 5164 | 704.824,018 | 4.644.646,367 | 428,551 | |
| 5165 | 705.668,517 | 4.645.190,540 | 388,744 | |
| 5166 | 705.654,144 | 4.645.189,688 | 388,963 | |
| 5167 | 705.622,075 | 4.645.190,566 | 389,431 | |
| 5168 | 705.609,423 | 4.645.190,838 | 389,530 | |
| 5169 | 705.609,891 | 4.645.179,683 | 389,557 | |
| 5170 | 705.607,961 | 4.645.073,634 | 390,110 | |
| 5171 | 705.009,704 | 4.644.561,994 | 425,101 | |
| 5172 | 705.000,610 | 4.644.572,368 | 425,091 | |
| 5173 | 705.845,498 | 4.645.190,430 | 385,553 | |
| 5174 | 705.857,355 | 4.645.172,043 | 385,447 | |
| 5175 | 705.864,826 | 4.645.157,089 | 385,019 | |
| 5176 | 713.650,743 | 4.645.038,035 | 326,790 | |
| 5177 | 713.640,560 | 4.645.029,510 | 326,800 | |
| 5178 | 713.609,997 | 4.645.055,793 | 326,920 | |
| 5179 | 713.582,383 | 4.645.100,291 | 326,990 | |
| 5180 | 713.573,554 | 4.645.092,048 | 327,010 | |
| 5181 | 713.553,657 | 4.645.123,596 | 327,080 | |
| 5182 | 713.519,863 | 4.645.104,479 | 327,040 | |
| 5183 | 713.512,471 | 4.645.103,964 | 327,060 | |
| 5184 | 713.461,043 | 4.645.099,390 | 327,330 | |
| 5185 | 713.408,835 | 4.645.065,513 | 327,360 | |
| 5186 | 713.378,408 | 4.645.064,786 | 327,410 | |
| 5187 | 713.371,871 | 4.645.075,754 | 327,410 | |
| 5188 | 713.354,636 | 4.645.055,653 | 327,540 | |
| 5189 | 713.325,806 | 4.645.047,639 | 327,520 | |
| 5190 | 713.301,161 | 4.645.062,316 | 327,620 | |
| 5191 | 713.297,293 | 4.645.042,699 | 327,520 | |
| 5192 | 713.275,720 | 4.645.034,852 | 328,350 | |
| 5193 | 713.264,307 | 4.645.041,188 | 328,430 | |
| 5194 | 713.168,580 | 4.645.053,567 | 329,230 | |
| 5195 | 713.126,136 | 4.645.047,962 | 329,280 | |
| 5196 | 713.094,574 | 4.645.052,620 | 329,300 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5197 | 713.038,605 | 4.645.065,433 | 330,110 | |
| 5198 | 713.047,737 | 4.645.056,491 | 329,990 | |
| 5199 | 713.008,196 | 4.645.061,373 | 329,900 | |
| 5200 | 712.975,715 | 4.645.075,265 | 329,830 | |
| 5201 | 712.978,724 | 4.645.064,680 | 329,860 | |
| 5202 | 712.960,791 | 4.645.062,997 | 329,850 | |
| 5203 | 712.942,839 | 4.645.075,486 | 329,840 | |
| 5204 | 712.944,004 | 4.645.068,910 | 330,560 | |
| 5205 | 712.929,734 | 4.645.078,476 | 330,580 | |
| 5206 | 712.867,517 | 4.645.077,187 | 330,480 | |
| 5207 | 712.852,817 | 4.645.086,935 | 330,520 | |
| 5208 | 712.803,044 | 4.645.126,933 | 331,160 | |
| 5209 | 712.810,317 | 4.645.123,161 | 330,890 | |
| 5210 | 712.821,597 | 4.645.139,609 | 330,470 | |
| 5211 | 712.817,058 | 4.645.144,377 | 330,530 | |
| 5212 | 712.820,227 | 4.645.152,128 | 330,450 | |
| 5213 | 705.735,664 | 4.645.188,858 | 387,733 | |
| 5214 | 705.743,743 | 4.645.188,760 | 387,978 | |
| 5215 | 712.850,715 | 4.645.139,487 | 329,710 | |
| 5216 | 712.778,308 | 4.645.101,995 | 332,030 | |
| 5217 | 712.758,034 | 4.645.090,718 | 332,530 | |
| 5218 | 712.759,416 | 4.645.083,210 | 332,530 | |
| 5219 | 705.127,735 | 4.644.693,352 | 425,856 | |
| 5220 | 712.735,274 | 4.645.077,385 | 333,230 | |
| 5221 | 712.709,962 | 4.645.065,633 | 334,150 | |
| 5222 | 712.712,614 | 4.645.056,255 | 333,930 | |
| 5223 | 712.687,940 | 4.645.053,157 | 335,030 | |
| 5224 | 712.665,242 | 4.645.047,036 | 335,990 | |
| 5225 | 712.666,261 | 4.645.036,811 | 335,770 | |
| 5226 | 712.638,507 | 4.645.025,804 | 336,540 | |
| 5227 | 712.632,781 | 4.645.034,798 | 336,880 | |
| 5228 | 712.510,076 | 4.644.984,452 | 340,100 | |
| 5229 | 712.523,836 | 4.644.961,670 | 339,650 | |
| 5230 | 705.793,164 | 4.644.922,417 | 387,919 | |
| 5231 | 712.556,266 | 4.644.915,789 | 338,680 | |
| 5232 | 705.768,614 | 4.644.933,050 | 387,925 | |
| 5233 | 712.592,375 | 4.644.866,099 | 337,760 | |
| 5234 | 705.825,898 | 4.644.970,678 | 386,933 | |
| 5235 | 705.799,392 | 4.644.976,322 | 387,142 | |
| 5236 | 712.624,640 | 4.644.786,040 | 338,850 | |
| 5237 | 712.641,733 | 4.644.755,210 | 339,460 | |
| 5238 | 712.648,539 | 4.644.760,961 | 339,300 | |
| 5239 | 712.666,616 | 4.644.727,008 | 340,100 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5240 | 705.739,030 | 4.644.963,206 | 388,056 | |
| 5241 | 712.683,201 | 4.644.696,509 | 341,220 | |
| 5242 | 712.705,003 | 4.644.633,064 | 342,770 | |
| 5243 | 712.712,355 | 4.644.640,549 | 342,950 | |
| 5244 | 712.723,259 | 4.644.622,229 | 342,450 | |
| 5245 | 712.720,248 | 4.644.610,180 | 343,050 | |
| 5246 | 705.831,541 | 4.645.066,170 | 386,384 | |
| 5247 | 705.817,763 | 4.645.058,300 | 386,689 | |
| 5248 | 712.735,970 | 4.644.599,982 | 340,580 | |
| 5249 | 712.743,594 | 4.644.586,006 | 340,550 | |
| 5250 | 712.748,837 | 4.644.571,177 | 340,550 | |
| 5251 | 705.700,320 | 4.644.980,257 | 388,416 | |
| 5252 | 712.777,783 | 4.644.578,493 | 340,490 | |
| 5253 | 705.771,836 | 4.645.007,802 | 387,481 | |
| 5254 | 712.848,948 | 4.644.563,330 | 339,750 | |
| 5255 | 705.870,244 | 4.645.114,808 | 384,991 | |
| 5256 | 705.841,376 | 4.645.099,068 | 385,979 | |
| 5257 | 712.971,775 | 4.644.560,606 | 339,800 | |
| 5258 | 712.971,958 | 4.644.555,046 | 339,680 | |
| 5259 | 705.856,466 | 4.645.139,729 | 385,271 | |
| 5260 | 712.998,759 | 4.644.569,847 | 338,070 | |
| 5261 | 713.015,049 | 4.644.561,702 | 338,680 | |
| 5262 | 705.807,258 | 4.645.120,054 | 386,215 | |
| 5263 | 705.785,606 | 4.645.112,185 | 386,783 | |
| 5264 | 713.063,781 | 4.644.563,377 | 338,150 | |
| 5265 | 713.091,453 | 4.644.553,122 | 338,290 | |
| 5266 | 713.117,365 | 4.644.555,391 | 338,280 | |
| 5267 | 713.117,213 | 4.644.550,576 | 338,830 | |
| 5268 | 713.139,728 | 4.644.546,240 | 338,950 | |
| 5269 | 713.142,988 | 4.644.554,785 | 338,200 | |
| 5270 | 713.168,475 | 4.644.553,749 | 338,210 | |
| 5271 | 713.190,498 | 4.644.542,802 | 338,210 | |
| 5272 | 713.193,026 | 4.644.550,074 | 338,180 | |
| 5273 | 713.225,203 | 4.644.549,560 | 338,230 | |
| 5274 | 713.227,597 | 4.644.539,509 | 338,130 | |
| 5275 | 713.270,474 | 4.644.532,110 | 340,330 | |
| 5276 | 713.266,429 | 4.644.526,937 | 340,400 | |
| 5277 | 713.277,396 | 4.644.532,947 | 340,210 | |
| 5278 | 713.288,296 | 4.644.522,146 | 340,460 | |
| 5279 | 713.296,049 | 4.644.511,050 | 340,410 | |
| 5280 | 713.282,283 | 4.644.541,742 | 337,790 | |
| 5281 | 713.286,695 | 4.644.532,412 | 337,840 | |
| 5282 | 713.290,855 | 4.644.541,669 | 337,660 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5283 | 705.630,109 | 4.645.181,046 | 389,400 | |
| 5284 | 713.291,287 | 4.644.524,993 | 337,920 | |
| 5285 | 705.704,249 | 4.645.183,013 | 388,236 | |
| 5286 | 705.714,091 | 4.645.160,060 | 388,273 | |
| 5287 | 713.319,540 | 4.644.497,758 | 337,720 | |
| 5288 | 713.312,416 | 4.644.492,519 | 337,830 | |
| 5289 | 713.327,375 | 4.644.470,235 | 337,770 | |
| 5290 | 705.787,575 | 4.645.148,911 | 386,826 | |
| 5291 | 713.364,373 | 4.644.408,828 | 338,450 | |
| 5292 | 705.635,358 | 4.645.143,664 | 389,496 | |
| 5293 | 713.378,552 | 4.644.354,531 | 338,480 | |
| 5294 | 705.903,706 | 4.645.181,046 | 383,371 | |
| 5295 | 713.372,385 | 4.644.327,606 | 338,440 | |
| 5296 | 713.382,233 | 4.644.326,144 | 338,490 | |
| 5297 | 713.384,767 | 4.644.296,060 | 338,500 | |
| 5298 | 713.375,260 | 4.644.261,728 | 338,720 | |
| 5299 | 713.377,838 | 4.644.254,684 | 339,120 | |
| 5300 | 713.388,092 | 4.644.257,781 | 338,690 | |
| 5301 | 713.389,830 | 4.644.258,681 | 338,720 | |
| 5302 | 713.387,475 | 4.644.238,794 | 340,110 | |
| 5303 | 713.389,985 | 4.644.240,712 | 339,530 | |
| 5304 | 713.367,337 | 4.644.248,699 | 339,700 | |
| 5305 | 713.348,677 | 4.644.236,834 | 339,060 | |
| 5306 | 713.348,217 | 4.644.227,827 | 339,080 | |
| 5307 | 713.322,459 | 4.644.215,239 | 339,750 | |
| 5308 | 713.304,320 | 4.644.205,054 | 339,640 | |
| 5309 | 713.276,918 | 4.644.199,109 | 340,360 | |
| 5310 | 713.278,860 | 4.644.190,806 | 340,420 | |
| 5311 | 713.253,678 | 4.644.170,281 | 340,320 | |
| 5312 | 713.179,774 | 4.644.139,259 | 342,290 | |
| 5313 | 713.130,553 | 4.644.121,274 | 343,270 | |
| 5314 | 713.123,657 | 4.644.109,328 | 343,270 | |
| 5315 | 713.015,437 | 4.644.092,759 | 344,950 | |
| 5316 | 704.234,318 | 4.644.311,598 | 440,607 | |
| 5317 | 704.230,439 | 4.644.322,675 | 440,051 | |
| 5318 | 712.964,393 | 4.644.095,534 | 344,180 | |
| 5319 | 712.965,384 | 4.644.103,474 | 344,880 | |
| 5320 | 712.942,402 | 4.644.106,409 | 344,940 | |
| 5321 | 704.251,773 | 4.644.314,921 | 440,589 | |
| 5322 | 712.906,322 | 4.644.096,975 | 344,460 | |
| 5323 | 712.905,381 | 4.644.103,598 | 344,510 | |
| 5324 | 712.883,266 | 4.644.104,256 | 344,430 | |
| 5325 | 704.269,228 | 4.644.258,979 | 441,760 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5326 | 712.854,680 | 4.644.103,717 | 344,460 | |
| 5327 | 704.283,635 | 4.644.266,733 | 441,260 | |
| 5328 | 712.807,458 | 4.644.102,844 | 344,530 | |
| 5329 | 713.418,848 | 4.644.248,612 | 340,240 | |
| 5330 | 713.408,446 | 4.644.255,220 | 340,090 | |
| 5331 | 713.410,722 | 4.644.248,392 | 340,420 | |
| 5332 | 704.259,531 | 4.644.347,877 | 439,081 | |
| 5333 | 713.431,973 | 4.644.250,510 | 340,250 | |
| 5334 | 713.457,405 | 4.644.253,544 | 340,300 | |
| 5335 | 713.457,011 | 4.644.262,890 | 340,300 | |
| 5336 | 713.522,618 | 4.644.265,702 | 340,480 | |
| 5337 | 713.548,237 | 4.644.258,870 | 340,850 | |
| 5338 | 704.283,635 | 4.644.320,183 | 443,213 | |
| 5339 | 713.585,649 | 4.644.271,824 | 341,120 | |
| 5340 | 704.294,717 | 4.644.293,043 | 443,436 | |
| 5341 | 713.619,761 | 4.644.262,299 | 341,240 | |
| 5342 | 713.656,307 | 4.644.256,755 | 341,210 | |
| 5343 | 713.657,517 | 4.644.264,413 | 341,220 | |
| 5344 | 704.316,328 | 4.644.265,902 | 441,458 | |
| 5345 | 713.676,997 | 4.644.256,126 | 341,070 | |
| 5346 | 704.342,372 | 4.644.278,919 | 442,927 | |
| 5347 | 704.819,890 | 4.644.687,084 | 429,918 | |
| 5348 | 704.336,000 | 4.644.301,351 | 445,406 | |
| 5349 | 704.864,835 | 4.644.603,435 | 426,825 | |
| 5350 | 713.702,574 | 4.644.255,311 | 339,370 | |
| 5351 | 713.708,648 | 4.644.252,081 | 339,260 | |
| 5352 | 704.296,941 | 4.644.342,636 | 440,928 | |
| 5353 | 704.290,845 | 4.644.357,037 | 439,702 | |
| 5354 | 704.278,100 | 4.644.413,533 | 436,667 | |
| 5355 | 704.287,244 | 4.644.405,224 | 436,692 | |
| 5356 | 704.294,170 | 4.644.394,424 | 437,204 | |
| 5357 | 704.868,167 | 4.644.641,522 | 427,990 | |
| 5358 | 704.304,698 | 4.644.369,222 | 440,474 | |
| 5359 | 704.881,381 | 4.644.645,367 | 428,032 | |
| 5360 | 704.318,551 | 4.644.330,727 | 444,579 | |
| 5361 | 704.325,478 | 4.644.316,880 | 446,042 | |
| 5362 | 704.329,080 | 4.644.356,483 | 443,907 | |
| 5363 | 704.885,731 | 4.644.663,425 | 428,076 | |
| 5364 | 713.846,356 | 4.644.197,927 | 335,140 | |
| 5365 | 704.899,614 | 4.644.665,264 | 427,821 | |
| 5366 | 713.889,227 | 4.644.190,719 | 335,140 | |
| 5367 | 704.889,076 | 4.644.685,162 | 428,435 | |
| 5368 | 704.309,212 | 4.644.430,488 | 436,251 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5369 | 704.321,680 | 4.644.438,519 | 435,727 | |
| 5370 | 713.952,655 | 4.644.168,311 | 335,070 | |
| 5371 | 704.897,273 | 4.644.699,207 | 429,057 | |
| 5372 | 713.969,964 | 4.644.158,858 | 335,690 | |
| 5373 | 713.978,457 | 4.644.149,838 | 335,840 | |
| 5374 | 704.913,498 | 4.644.651,721 | 427,404 | |
| 5375 | 704.923,200 | 4.644.651,052 | 427,162 | |
| 5376 | 704.389,580 | 4.644.458,749 | 432,698 | |
| 5377 | 714.309,282 | 4.644.581,135 | 323,010 | |
| 5378 | 704.363,536 | 4.644.446,010 | 434,357 | |
| 5379 | 714.301,246 | 4.644.619,906 | 322,940 | |
| 5380 | 714.284,195 | 4.644.609,057 | 322,960 | |
| 5381 | 704.322,808 | 4.644.411,669 | 436,370 | |
| 5382 | 704.945,114 | 4.644.661,084 | 426,928 | |
| 5383 | 704.946,786 | 4.644.670,448 | 427,509 | |
| 5384 | 704.365,752 | 4.644.433,548 | 434,734 | |
| 5385 | 704.960,503 | 4.644.665,766 | 427,388 | |
| 5386 | 704.957,659 | 4.644.657,406 | 426,736 | |
| 5387 | 714.237,997 | 4.644.640,116 | 323,640 | |
| 5388 | 714.233,556 | 4.644.633,093 | 323,630 | |
| 5389 | 704.413,130 | 4.644.437,425 | 431,222 | |
| 5390 | 704.962,721 | 4.644.637,806 | 425,834 | |
| 5391 | 714.186,498 | 4.644.662,469 | 324,040 | |
| 5392 | 714.184,054 | 4.644.655,766 | 323,970 | |
| 5393 | 704.348,574 | 4.644.407,792 | 436,630 | |
| 5394 | 704.985,303 | 4.644.625,767 | 424,798 | |
| 5395 | 704.993,834 | 4.644.638,642 | 426,001 | |
| 5396 | 705.005,543 | 4.644.630,783 | 425,848 | |
| 5397 | 704.996,176 | 4.644.617,741 | 424,392 | |
| 5398 | 704.988,314 | 4.644.603,194 | 424,446 | |
| 5399 | 705.011,565 | 4.644.614,397 | 424,523 | |
| 5400 | 705.016,082 | 4.644.622,757 | 425,537 | |
| 5401 | 714.045,216 | 4.644.727,595 | 325,270 | |
| 5402 | 704.377,943 | 4.644.394,776 | 436,756 | |
| 5403 | 714.003,860 | 4.644.737,627 | 325,350 | |
| 5404 | 704.348,297 | 4.644.372,344 | 440,461 | |
| 5405 | 704.338,600 | 4.644.367,359 | 441,997 | |
| 5406 | 713.971,503 | 4.644.760,091 | 325,220 | |
| 5407 | 704.364,367 | 4.644.366,528 | 440,327 | |
| 5408 | 704.378,220 | 4.644.375,113 | 437,821 | |
| 5409 | 704.922,916 | 4.644.596,438 | 428,540 | |
| 5410 | 713.899,027 | 4.644.783,393 | 325,060 | |
| 5411 | 704.931,781 | 4.644.575,705 | 427,797 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5412 | 704.441,113 | 4.644.400,315 | 430,496 | |
| 5413 | 704.443,884 | 4.644.389,237 | 430,966 | |
| 5414 | 704.938,138 | 4.644.530,727 | 426,673 | |
| 5415 | 704.970,589 | 4.644.541,428 | 426,493 | |
| 5416 | 713.868,647 | 4.644.824,702 | 325,330 | |
| 5417 | 704.997,186 | 4.644.555,306 | 426,133 | |
| 5418 | 704.347,743 | 4.644.341,880 | 444,359 | |
| 5419 | 713.836,973 | 4.644.855,552 | 325,370 | |
| 5420 | 704.964,233 | 4.644.590,419 | 426,919 | |
| 5421 | 713.785,461 | 4.644.905,019 | 325,940 | |
| 5422 | 704.374,341 | 4.644.327,479 | 439,567 | |
| 5423 | 713.752,832 | 4.644.924,093 | 325,990 | |
| 5424 | 704.374,355 | 4.644.315,806 | 438,722 | |
| 5425 | 704.943,825 | 4.644.579,049 | 427,772 | |
| 5426 | 704.392,087 | 4.644.328,546 | 437,341 | |
| 5427 | 712.514,355 | 4.644.998,635 | 340,050 | |
| 5428 | 704.945,498 | 4.644.545,775 | 426,819 | |
| 5429 | 704.963,062 | 4.644.551,627 | 426,743 | |
| 5430 | 704.968,582 | 4.644.564,502 | 426,844 | |
| 5431 | 704.228,675 | 4.644.449,909 | 439,678 | |
| 5432 | 704.217,989 | 4.644.459,167 | 440,412 | |
| 5433 | 712.479,688 | 4.645.008,684 | 341,940 | |
| 5434 | 704.216,921 | 4.644.448,663 | 440,500 | |
| 5435 | 704.226,004 | 4.644.445,281 | 439,838 | |
| 5436 | 712.411,702 | 4.645.047,505 | 344,850 | |
| 5437 | 705.235,853 | 4.644.799,380 | 421,603 | |
| 5438 | 712.376,712 | 4.645.067,036 | 347,230 | |
| 5439 | 712.380,325 | 4.645.075,206 | 347,400 | |
| 5440 | 704.228,853 | 4.644.435,490 | 439,649 | |
| 5441 | 712.344,121 | 4.645.097,288 | 350,510 | |
| 5442 | 712.310,993 | 4.645.112,602 | 351,640 | |
| 5443 | 712.307,166 | 4.645.105,356 | 351,500 | |
| 5444 | 712.265,442 | 4.645.128,397 | 353,300 | |
| 5445 | 704.193,946 | 4.644.437,448 | 441,606 | |
| 5446 | 712.230,409 | 4.645.149,616 | 355,020 | |
| 5447 | 712.234,910 | 4.645.157,747 | 355,150 | |
| 5448 | 704.159,573 | 4.644.417,331 | 443,504 | |
| 5449 | 712.191,759 | 4.645.170,070 | 356,760 | |
| 5450 | 712.154,749 | 4.645.189,062 | 358,660 | |
| 5451 | 705.226,495 | 4.644.787,900 | 422,538 | |
| 5452 | 705.238,405 | 4.644.775,994 | 422,095 | |
| 5453 | 712.123,014 | 4.645.222,209 | 362,170 | |
| 5454 | 712.059,988 | 4.645.242,993 | 363,180 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5455 | 705.219,263 | 4.644.752,396 | 424,077 | |
| 5456 | 704.191,274 | 4.644.423,028 | 441,600 | |
| 5457 | 712.019,464 | 4.645.280,314 | 363,380 | |
| 5458 | 704.211,934 | 4.644.436,024 | 440,946 | |
| 5459 | 704.223,867 | 4.644.430,505 | 439,899 | |
| 5460 | 711.921,619 | 4.645.317,034 | 362,890 | |
| 5461 | 705.232,450 | 4.644.729,010 | 423,257 | |
| 5462 | 705.247,551 | 4.644.733,687 | 422,101 | |
| 5463 | 711.886,047 | 4.645.356,053 | 361,100 | |
| 5464 | 711.842,483 | 4.645.360,043 | 357,070 | |
| 5465 | 711.852,161 | 4.645.378,362 | 357,420 | |
| 5466 | 711.800,306 | 4.645.382,804 | 352,720 | |
| 5467 | 711.809,647 | 4.645.399,340 | 352,170 | |
| 5468 | 711.758,233 | 4.645.406,049 | 349,580 | |
| 5469 | 705.277,129 | 4.644.716,004 | 422,726 | |
| 5470 | 711.716,189 | 4.645.429,199 | 346,960 | |
| 5471 | 705.280,958 | 4.644.696,870 | 422,667 | |
| 5472 | 711.681,982 | 4.645.448,231 | 345,150 | |
| 5473 | 711.696,502 | 4.645.468,356 | 344,430 | |
| 5474 | 705.241,397 | 4.644.698,784 | 423,045 | |
| 5475 | 705.232,039 | 4.644.713,666 | 423,619 | |
| 5476 | 705.201,198 | 4.644.754,485 | 425,452 | |
| 5477 | 705.184,997 | 4.644.778,562 | 425,625 | |
| 5478 | 704.140,474 | 4.644.413,949 | 444,827 | |
| 5479 | 704.128,898 | 4.644.417,509 | 445,860 | |
| 5480 | 705.236,538 | 4.644.653,022 | 422,483 | |
| 5481 | 704.129,432 | 4.644.433,531 | 445,924 | |
| 5482 | 705.262,912 | 4.644.663,227 | 420,602 | |
| 5483 | 704.158,640 | 4.644.425,698 | 443,560 | |
| 5484 | 704.152,051 | 4.644.431,929 | 443,963 | |
| 5485 | 705.276,312 | 4.644.684,487 | 422,025 | |
| 5486 | 710.858,024 | 4.646.697,173 | 340,780 | |
| 5487 | 704.159,887 | 4.644.441,008 | 443,381 | |
| 5488 | 705.292,477 | 4.644.692,353 | 422,448 | |
| 5489 | 705.306,302 | 4.644.685,762 | 422,369 | |
| 5490 | 705.316,511 | 4.644.693,416 | 422,376 | |
| 5491 | 705.309,917 | 4.644.702,770 | 422,181 | |
| 5492 | 704.173,422 | 4.644.466,821 | 441,812 | |
| 5493 | 704.183,396 | 4.644.460,769 | 441,757 | |
| 5494 | 704.190,164 | 4.644.455,428 | 441,478 | |
| 5495 | 704.204,055 | 4.644.455,428 | 440,981 | |
| 5496 | 704.199,069 | 4.644.462,015 | 441,078 | |
| 5497 | 705.603,100 | 4.645.171,790 | 389,681 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5498 | 710.952,940 | 4.646.628,474 | 339,830 | |
| 5499 | 710.941,942 | 4.646.621,351 | 339,790 | |
| 5500 | 705.592,045 | 4.645.189,943 | 390,232 | |
| 5501 | 710.940,230 | 4.646.598,111 | 339,870 | |
| 5502 | 710.929,633 | 4.646.605,717 | 339,830 | |
| 5503 | 704.218,320 | 4.644.477,017 | 440,415 | |
| 5504 | 704.212,621 | 4.644.481,823 | 440,557 | |
| 5505 | 704.224,910 | 4.644.487,520 | 440,073 | |
| 5506 | 704.222,772 | 4.644.492,683 | 439,996 | |
| 5507 | 711.014,407 | 4.646.612,942 | 340,600 | |
| 5508 | 711.050,325 | 4.646.598,095 | 340,620 | |
| 5509 | 704.227,225 | 4.644.519,386 | 439,155 | |
| 5510 | 705.660,079 | 4.645.241,184 | 389,079 | |
| 5511 | 705.668,849 | 4.645.246,444 | 388,945 | |
| 5512 | 705.677,460 | 4.645.250,747 | 388,805 | |
| 5513 | 705.687,505 | 4.645.256,007 | 388,591 | |
| 5514 | 711.108,801 | 4.646.593,285 | 341,930 | |
| 5515 | 711.106,074 | 4.646.588,236 | 341,970 | |
| 5516 | 711.136,129 | 4.646.589,256 | 341,720 | |
| 5517 | 711.135,719 | 4.646.582,192 | 341,740 | |
| 5518 | 711.163,612 | 4.646.576,626 | 341,750 | |
| 5519 | 711.165,864 | 4.646.581,718 | 341,810 | |
| 5520 | 711.193,619 | 4.646.569,706 | 341,820 | |
| 5521 | 705.661,515 | 4.645.261,585 | 388,921 | |
| 5522 | 705.660,877 | 4.645.274,973 | 388,848 | |
| 5523 | 704.185,039 | 4.644.520,527 | 441,491 | |
| 5524 | 711.220,603 | 4.646.574,798 | 343,110 | |
| 5525 | 705.680,011 | 4.645.283,580 | 388,588 | |
| 5526 | 705.698,667 | 4.645.283,739 | 388,395 | |
| 5527 | 711.268,907 | 4.646.565,802 | 343,150 | |
| 5528 | 704.179,124 | 4.644.505,896 | 443,018 | |
| 5529 | 704.177,877 | 4.644.496,817 | 442,563 | |
| 5530 | 705.702,035 | 4.645.307,409 | 388,337 | |
| 5531 | 704.157,930 | 4.644.504,650 | 443,865 | |
| 5532 | 705.681,146 | 4.645.315,060 | 388,410 | |
| 5533 | 704.168,082 | 4.644.493,078 | 442,795 | |
| 5534 | 704.156,506 | 4.644.489,696 | 443,378 | |
| 5535 | 704.154,012 | 4.644.497,529 | 443,817 | |
| 5536 | 704.148,847 | 4.644.502,157 | 444,476 | |
| 5537 | 705.683,538 | 4.645.337,692 | 388,314 | |
| 5538 | 704.156,149 | 4.644.481,507 | 443,239 | |
| 5539 | 711.503,638 | 4.646.507,798 | 339,450 | |
| 5540 | 711.509,188 | 4.646.516,812 | 339,410 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5541 | 705.671,731 | 4.645.368,545 | 388,346 | |
| 5542 | 705.683,849 | 4.645.368,705 | 388,270 | |
| 5543 | 705.696,127 | 4.645.368,705 | 388,312 | |
| 5544 | 705.694,213 | 4.645.377,789 | 388,277 | |
| 5545 | 711.558,465 | 4.646.507,554 | 338,270 | |
| 5546 | 705.671,571 | 4.645.377,630 | 388,341 | |
| 5547 | 704.127,832 | 4.644.475,988 | 445,458 | |
| 5548 | 711.544,759 | 4.646.524,574 | 339,470 | |
| 5549 | 704.145,107 | 4.644.473,674 | 443,697 | |
| 5550 | 704.135,846 | 4.644.469,936 | 444,372 | |
| 5551 | 704.140,120 | 4.644.463,171 | 444,195 | |
| 5552 | 705.679,384 | 4.645.411,419 | 388,318 | |
| 5553 | 704.088,616 | 4.644.432,497 | 449,728 | |
| 5554 | 705.715,932 | 4.645.427,037 | 387,327 | |
| 5555 | 704.935,437 | 4.644.715,999 | 430,464 | |
| 5556 | 711.586,990 | 4.646.491,809 | 337,330 | |
| 5557 | 711.617,400 | 4.646.500,430 | 337,380 | |
| 5558 | 705.718,330 | 4.645.343,799 | 387,402 | |
| 5559 | 705.040,288 | 4.644.755,222 | 428,590 | |
| 5560 | 705.722,795 | 4.645.317,979 | 387,303 | |
| 5561 | 705.067,914 | 4.644.748,946 | 428,349 | |
| 5562 | 705.733,638 | 4.645.337,902 | 387,369 | |
| 5563 | 705.730,927 | 4.645.350,334 | 387,397 | |
| 5564 | 711.681,755 | 4.646.491,089 | 336,580 | |
| 5565 | 705.728,057 | 4.645.405,321 | 387,478 | |
| 5566 | 711.690,639 | 4.646.479,798 | 336,580 | |
| 5567 | 704.981,898 | 4.644.702,820 | 429,207 | |
| 5568 | 705.018,627 | 4.644.715,999 | 428,311 | |
| 5569 | 711.724,896 | 4.646.477,576 | 335,690 | |
| 5570 | 705.051,590 | 4.644.729,805 | 427,935 | |
| 5571 | 705.070,111 | 4.644.738,278 | 428,220 | |
| 5572 | 711.690,689 | 4.646.455,753 | 335,720 | |
| 5573 | 705.051,590 | 4.644.714,116 | 427,713 | |
| 5574 | 705.751,026 | 4.645.347,938 | 387,376 | |
| 5575 | 705.014,232 | 4.644.681,168 | 428,625 | |
| 5576 | 705.748,476 | 4.645.426,106 | 387,399 | |
| 5577 | 705.746,403 | 4.645.438,379 | 387,437 | |
| 5578 | 705.077,331 | 4.644.710,037 | 427,140 | |
| 5579 | 705.758,203 | 4.645.443,957 | 387,405 | |
| 5580 | 705.116,297 | 4.644.709,024 | 426,367 | |
| 5581 | 705.759,957 | 4.645.364,426 | 387,399 | |
| 5582 | 711.697,884 | 4.646.310,035 | 334,810 | |
| 5583 | 705.771,597 | 4.645.396,621 | 387,447 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5584 | 711.677,928 | 4.646.305,002 | 334,980 | |
| 5585 | 711.670,734 | 4.646.310,542 | 335,110 | |
| 5586 | 705.769,524 | 4.645.441,726 | 387,459 | |
| 5587 | 705.089,927 | 4.644.681,410 | 426,993 | |
| 5588 | 711.912,555 | 4.646.446,783 | 334,770 | |
| 5589 | 705.780,048 | 4.645.453,201 | 387,377 | |
| 5590 | 705.780,207 | 4.645.429,613 | 387,397 | |
| 5591 | 711.817,691 | 4.646.461,777 | 334,920 | |
| 5592 | 705.058,849 | 4.644.652,542 | 427,255 | |
| 5593 | 705.042,525 | 4.644.645,325 | 427,666 | |
| 5594 | 705.034,363 | 4.644.639,990 | 427,612 | |
| 5595 | 705.792,804 | 4.645.434,235 | 387,390 | |
| 5596 | 705.792,166 | 4.645.446,667 | 387,351 | |
| 5597 | 705.792,007 | 4.645.467,864 | 387,364 | |
| 5598 | 705.803,646 | 4.645.460,055 | 387,366 | |
| 5599 | 711.204,121 | 4.646.933,816 | 350,650 | |
| 5600 | 711.192,835 | 4.646.919,605 | 350,750 | |
| 5601 | 711.182,867 | 4.646.925,753 | 350,750 | |
| 5602 | 711.163,912 | 4.646.905,338 | 350,720 | |
| 5603 | 711.169,653 | 4.646.903,941 | 350,710 | |
| 5604 | 705.073,917 | 4.644.627,125 | 426,929 | |
| 5605 | 705.063,244 | 4.644.621,163 | 427,102 | |
| 5606 | 705.055,082 | 4.644.614,887 | 426,988 | |
| 5607 | 711.140,469 | 4.646.862,689 | 350,710 | |
| 5608 | 705.814,968 | 4.645.434,394 | 387,257 | |
| 5609 | 711.122,583 | 4.646.858,146 | 350,750 | |
| 5610 | 705.085,532 | 4.644.613,004 | 426,515 | |
| 5611 | 705.825,970 | 4.645.460,692 | 387,343 | |
| 5612 | 705.143,294 | 4.644.651,287 | 425,824 | |
| 5613 | 705.159,305 | 4.644.661,014 | 425,153 | |
| 5614 | 711.094,540 | 4.646.837,378 | 351,440 | |
| 5615 | 711.079,490 | 4.646.820,857 | 351,430 | |
| 5616 | 711.085,243 | 4.646.815,040 | 351,490 | |
| 5617 | 705.073,289 | 4.644.593,550 | 426,255 | |
| 5618 | 705.062,930 | 4.644.587,588 | 425,689 | |
| 5619 | 705.917,579 | 4.645.200,793 | 383,385 | |
| 5620 | 705.128,226 | 4.644.609,239 | 425,482 | |
| 5621 | 705.145,806 | 4.644.618,966 | 425,143 | |
| 5622 | 705.916,959 | 4.645.154,929 | 382,860 | |
| 5623 | 705.185,674 | 4.644.649,718 | 424,557 | |
| 5624 | 705.196,034 | 4.644.648,776 | 424,524 | |
| 5625 | 705.190,069 | 4.644.640,618 | 424,545 | |
| 5626 | 705.132,307 | 4.644.593,550 | 425,041 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5627 | 705.122,575 | 4.644.586,332 | 425,220 | |
| 5628 | 705.110,960 | 4.644.574,722 | 425,220 | |
| 5629 | 705.123,517 | 4.644.568,133 | 424,858 | |
| 5630 | 705.138,900 | 4.644.577,546 | 424,773 | |
| 5631 | 705.150,515 | 4.644.589,470 | 424,573 | |
| 5632 | 705.167,153 | 4.644.598,884 | 424,311 | |
| 5633 | 705.092,849 | 4.644.774,678 | 427,474 | |
| 5634 | 705.106,976 | 4.644.780,954 | 427,084 | |
| 5635 | 705.142,763 | 4.644.798,526 | 427,187 | |
| 5636 | 705.133,659 | 4.644.781,895 | 426,818 | |
| 5637 | 710.804,335 | 4.646.744,245 | 342,250 | |
| 5638 | 710.807,983 | 4.646.751,338 | 342,260 | |
| 5639 | 705.138,368 | 4.644.769,030 | 426,374 | |
| 5640 | 710.781,652 | 4.646.760,041 | 342,270 | |
| 5641 | 710.750,898 | 4.646.776,462 | 342,380 | |
| 5642 | 705.169,133 | 4.644.774,051 | 426,536 | |
| 5643 | 705.155,634 | 4.644.769,344 | 426,318 | |
| 5644 | 710.720,888 | 4.646.786,465 | 342,430 | |
| 5645 | 705.126,753 | 4.644.753,341 | 426,651 | |
| 5646 | 710.685,583 | 4.646.804,451 | 342,580 | |
| 5647 | 705.115,138 | 4.644.734,827 | 427,083 | |
| 5648 | 710.643,935 | 4.646.804,684 | 342,490 | |
| 5649 | 710.606,988 | 4.646.812,481 | 342,460 | |
| 5650 | 710.606,630 | 4.646.825,018 | 342,570 | |
| 5651 | 710.570,151 | 4.646.832,257 | 342,410 | |
| 5652 | 705.132,090 | 4.644.745,810 | 426,544 | |
| 5653 | 705.148,728 | 4.644.752,713 | 426,024 | |
| 5654 | 705.154,692 | 4.644.742,986 | 425,822 | |
| 5655 | 710.493,814 | 4.646.849,950 | 342,530 | |
| 5656 | 710.490,590 | 4.646.836,876 | 342,140 | |
| 5657 | 705.168,191 | 4.644.750,517 | 425,671 | |
| 5658 | 705.164,738 | 4.644.759,616 | 425,923 | |
| 5659 | 705.175,725 | 4.644.766,206 | 426,172 | |
| 5660 | 705.188,282 | 4.644.747,065 | 425,430 | |
| 5661 | 705.193,619 | 4.644.737,965 | 425,085 | |
| 5662 | 705.182,004 | 4.644.728,551 | 425,122 | |
| 5663 | 710.475,780 | 4.646.815,058 | 342,990 | |
| 5664 | 705.165,052 | 4.644.700,310 | 425,478 | |
| 5665 | 705.173,214 | 4.644.693,721 | 425,098 | |
| 5666 | 710.436,272 | 4.646.864,863 | 342,510 | |
| 5667 | 705.194,561 | 4.644.677,404 | 423,590 | |
| 5668 | 710.396,453 | 4.646.858,784 | 342,460 | |
| 5669 | 710.396,416 | 4.646.871,583 | 342,680 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5670 | 710.353,816 | 4.646.882,364 | 343,280 | |
| 5671 | 705.233,487 | 4.644.665,166 | 422,257 | |
| 5672 | 705.226,581 | 4.644.673,638 | 422,961 | |
| 5673 | 710.314,177 | 4.646.889,382 | 343,550 | |
| 5674 | 710.275,059 | 4.646.897,536 | 343,560 | |
| 5675 | 705.198,328 | 4.644.689,955 | 424,494 | |
| 5676 | 705.190,480 | 4.644.697,800 | 424,945 | |
| 5677 | 710.231,819 | 4.646.907,087 | 343,760 | |
| 5678 | 705.172,900 | 4.644.711,921 | 425,383 | |
| 5679 | 710.196,236 | 4.646.900,645 | 343,730 | |
| 5680 | 710.158,197 | 4.646.897,553 | 343,950 | |
| 5681 | 705.206,490 | 4.644.698,741 | 424,463 | |
| 5682 | 710.104,868 | 4.646.915,040 | 344,160 | |
| 5683 | 710.104,835 | 4.646.898,970 | 344,140 | |
| 5684 | 705.225,639 | 4.644.696,545 | 423,828 | |
| 5685 | 705.216,221 | 4.644.708,783 | 424,104 | |
| 5686 | 705.209,001 | 4.644.721,648 | 424,481 | |
| 5687 | 710.114,674 | 4.646.991,978 | 344,210 | |
| 5688 | 710.124,976 | 4.647.022,096 | 344,180 | |
| 5689 | 710.137,076 | 4.647.058,478 | 344,370 | |
| 5690 | 710.148,375 | 4.647.091,268 | 345,720 | |
| 5691 | 710.159,162 | 4.647.123,625 | 347,720 | |
| 5692 | 710.166,258 | 4.647.139,160 | 348,640 | |
| 5693 | 710.174,391 | 4.647.132,490 | 348,490 | |
| 5694 | 710.166,092 | 4.647.119,115 | 347,400 | |
| 5695 | 710.156,071 | 4.647.089,096 | 345,560 | |
| 5696 | 710.145,240 | 4.647.055,960 | 344,300 | |
| 5697 | 710.133,289 | 4.647.021,284 | 344,150 | |
| 5698 | 710.122,853 | 4.646.989,182 | 344,190 | |
| 5699 | 710.113,232 | 4.646.956,291 | 344,160 | |
| 5700 | 710.104,635 | 4.646.924,697 | 344,150 | |
| 5701 | 710.088,200 | 4.646.910,494 | 344,270 | |
| 5702 | 710.071,296 | 4.646.902,884 | 344,270 | |
| 5703 | 710.059,238 | 4.646.902,619 | 344,240 | |
| 5704 | 710.061,037 | 4.646.914,413 | 344,230 | |
| 5705 | 710.012,292 | 4.646.915,782 | 344,490 | |
| 5706 | 710.009,464 | 4.646.904,741 | 344,490 | |
| 5707 | 710.000,360 | 4.646.906,659 | 344,590 | |
| 5708 | 709.992,125 | 4.646.908,184 | 344,780 | |
| 5709 | 709.983,778 | 4.646.917,403 | 344,910 | |
| 5710 | 709.991,454 | 4.646.928,623 | 344,790 | |
| 5711 | 709.980,303 | 4.646.936,683 | 344,690 | |
| 5712 | 709.932,474 | 4.646.920,795 | 345,110 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5713 | 709.935,862 | 4.646.910,986 | 345,130 | |
| 5714 | 709.902,811 | 4.646.898,136 | 345,060 | |
| 5715 | 709.897,943 | 4.646.908,185 | 345,130 | |
| 5716 | 709.865,028 | 4.646.896,188 | 345,090 | |
| 5717 | 709.867,771 | 4.646.886,237 | 345,160 | |
| 5718 | 704.101,858 | 4.644.524,757 | 453,259 | |
| 5719 | 704.113,377 | 4.644.529,749 | 448,978 | |
| 5720 | 704.131,004 | 4.644.513,109 | 446,807 | |
| 5721 | 709.762,513 | 4.646.848,777 | 347,630 | |
| 5722 | 704.818,282 | 4.644.658,651 | 429,007 | |
| 5723 | 704.152,377 | 4.644.530,304 | 444,137 | |
| 5724 | 704.150,851 | 4.644.523,232 | 445,920 | |
| 5725 | 704.844,639 | 4.644.607,939 | 427,279 | |
| 5726 | 704.853,359 | 4.644.596,177 | 427,008 | |
| 5727 | 704.800,423 | 4.644.666,199 | 429,417 | |
| 5728 | 704.817,675 | 4.644.635,215 | 428,359 | |
| 5729 | 704.809,547 | 4.644.626,695 | 428,369 | |
| 5730 | 704.837,268 | 4.644.580,347 | 427,768 | |
| 5731 | 709.631,144 | 4.646.808,663 | 351,700 | |
| 5732 | 704.827,835 | 4.644.530,474 | 427,008 | |
| 5733 | 709.613,756 | 4.646.804,739 | 353,260 | |
| 5734 | 709.586,891 | 4.646.790,951 | 352,880 | |
| 5735 | 709.583,326 | 4.646.785,894 | 352,900 | |
| 5736 | 709.593,765 | 4.646.778,369 | 352,940 | |
| 5737 | 704.886,988 | 4.644.603,450 | 426,868 | |
| 5738 | 704.904,467 | 4.644.587,809 | 425,659 | |
| 5739 | 704.909,389 | 4.644.576,851 | 425,003 | |
| 5740 | 704.912,345 | 4.644.564,038 | 424,319 | |
| 5741 | 704.900,312 | 4.644.521,150 | 421,748 | |
| 5742 | 709.565,072 | 4.646.681,931 | 350,770 | |
| 5743 | 704.903,246 | 4.644.557,679 | 423,551 | |
| 5744 | 704.882,483 | 4.644.522,954 | 422,537 | |
| 5745 | 705.608,130 | 4.645.067,761 | 390,395 | |
| 5746 | 709.576,722 | 4.646.666,381 | 352,330 | |
| 5747 | 704.861,721 | 4.644.566,698 | 426,932 | |
| 5748 | 709.535,426 | 4.646.580,194 | 349,810 | |
| 5749 | 709.520,069 | 4.646.521,250 | 350,040 | |
| 5750 | 705.233,772 | 4.644.645,124 | 423,130 | |
| 5751 | 705.238,436 | 4.644.643,598 | 422,979 | |
| 5752 | 705.231,717 | 4.644.637,160 | 423,451 | |
| 5753 | 705.864,141 | 4.645.236,069 | 385,804 | |
| 5754 | 705.874,660 | 4.645.240,368 | 385,823 | |
| 5755 | 705.862,707 | 4.645.279,780 | 385,935 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5756 | 705.852,427 | 4.645.280,377 | 385,927 | |
| 5757 | 705.854,818 | 4.645.272,375 | 385,930 | |
| 5758 | 709.407,941 | 4.646.470,760 | 351,550 | |
| 5759 | 705.842,379 | 4.645.291,353 | 385,897 | |
| 5760 | 709.374,763 | 4.646.445,948 | 351,620 | |
| 5761 | 705.860,309 | 4.645.300,430 | 385,933 | |
| 5762 | 709.340,614 | 4.646.438,152 | 351,640 | |
| 5763 | 709.335,538 | 4.646.430,684 | 352,110 | |
| 5764 | 705.839,272 | 4.645.312,850 | 385,901 | |
| 5765 | 705.847,280 | 4.645.310,223 | 385,903 | |
| 5766 | 709.336,459 | 4.646.413,365 | 352,170 | |
| 5767 | 709.322,011 | 4.646.369,966 | 350,000 | |
| 5768 | 709.314,393 | 4.646.371,193 | 350,110 | |
| 5769 | 709.307,920 | 4.646.357,299 | 350,760 | |
| 5770 | 709.316,658 | 4.646.350,129 | 351,070 | |
| 5771 | 709.309,138 | 4.646.313,711 | 351,020 | |
| 5772 | 709.296,910 | 4.646.316,513 | 351,110 | |
| 5773 | 705.786,067 | 4.645.338,585 | 387,189 | |
| 5774 | 705.766,491 | 4.645.322,456 | 387,127 | |
| 5775 | 705.760,568 | 4.645.319,703 | 387,053 | |
| 5776 | 709.270,174 | 4.646.237,990 | 351,240 | |
| 5777 | 709.271,692 | 4.646.202,548 | 351,210 | |
| 5778 | 709.264,127 | 4.646.172,577 | 351,160 | |
| 5779 | 705.721,967 | 4.645.282,340 | 386,812 | |
| 5780 | 705.714,391 | 4.645.269,678 | 386,895 | |
| 5781 | 709.368,010 | 4.646.393,108 | 350,600 | |
| 5782 | 709.376,816 | 4.646.403,168 | 350,620 | |
| 5783 | 705.694,091 | 4.645.241,810 | 387,086 | |
| 5784 | 705.693,393 | 4.645.233,444 | 387,279 | |
| 5785 | 709.530,014 | 4.646.448,591 | 349,910 | |
| 5786 | 705.654,457 | 4.645.227,030 | 390,077 | |
| 5787 | 705.659,227 | 4.645.219,522 | 389,894 | |
| 5788 | 709.606,129 | 4.646.383,951 | 349,980 | |
| 5789 | 709.644,182 | 4.646.351,369 | 350,070 | |
| 5790 | 705.573,331 | 4.645.178,589 | 390,489 | |
| 5791 | 705.572,474 | 4.645.159,046 | 391,345 | |
| 5792 | 709.714,612 | 4.646.326,237 | 349,750 | |
| 5793 | 709.744,647 | 4.646.308,028 | 349,800 | |
| 5794 | 709.781,516 | 4.646.302,705 | 349,530 | |
| 5795 | 709.825,324 | 4.646.307,143 | 348,880 | |
| 5796 | 709.825,099 | 4.646.298,331 | 348,850 | |
| 5797 | 709.860,180 | 4.646.292,749 | 348,940 | |
| 5798 | 709.862,809 | 4.646.303,211 | 348,950 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5799 | 709.906,728 | 4.646.287,767 | 348,520 | |
| 5800 | 709.953,490 | 4.646.281,571 | 348,400 | |
| 5801 | 709.954,242 | 4.646.292,357 | 348,260 | |
| 5802 | 709.995,711 | 4.646.285,011 | 348,400 | |
| 5803 | 710.000,001 | 4.646.276,392 | 348,540 | |
| 5804 | 710.039,546 | 4.646.279,168 | 347,980 | |
| 5805 | 705.733,500 | 4.645.514,183 | 392,650 | |
| 5806 | 710.094,506 | 4.646.262,073 | 347,630 | |
| 5807 | 705.729,887 | 4.645.488,738 | 390,731 | |
| 5808 | 705.738,724 | 4.645.486,196 | 390,097 | |
| 5809 | 705.738,992 | 4.645.492,751 | 390,511 | |
| 5810 | 705.739,126 | 4.645.512,820 | 391,607 | |
| 5811 | 710.256,622 | 4.646.285,954 | 345,660 | |
| 5812 | 705.745,687 | 4.645.518,589 | 391,515 | |
| 5813 | 710.302,869 | 4.646.298,031 | 345,050 | |
| 5814 | 705.745,018 | 4.645.505,210 | 390,841 | |
| 5815 | 705.742,607 | 4.645.499,591 | 390,663 | |
| 5816 | 705.761,960 | 4.645.496,517 | 390,182 | |
| 5817 | 705.772,759 | 4.645.516,241 | 390,573 | |
| 5818 | 705.775,452 | 4.645.510,013 | 390,534 | |
| 5819 | 705.775,557 | 4.645.505,225 | 390,084 | |
| 5820 | 705.833,745 | 4.645.495,964 | 387,845 | |
| 5821 | 705.776,702 | 4.645.196,993 | 387,968 | |
| 5822 | 705.681,870 | 4.644.955,136 | 388,643 | |
| 5823 | 710.430,429 | 4.646.141,306 | 344,000 | |
| 5824 | 705.703,966 | 4.644.926,507 | 388,468 | |
| 5825 | 705.714,604 | 4.644.909,329 | 388,453 | |
| 5826 | 710.604,439 | 4.646.187,372 | 341,400 | |
| 5827 | 710.647,867 | 4.646.179,248 | 341,430 | |
| 5828 | 705.855,161 | 4.645.022,230 | 386,127 | |
| 5829 | 705.750,184 | 4.644.942,220 | 387,977 | |
| 5830 | 705.841,345 | 4.645.483,904 | 387,534 | |
| 5831 | 705.726,564 | 4.644.946,810 | 388,150 | |
| 5832 | 705.857,860 | 4.645.483,036 | 387,393 | |
| 5833 | 705.820,388 | 4.645.015,672 | 386,698 | |
| 5834 | 710.986,023 | 4.646.175,617 | 338,720 | |
| 5835 | 705.870,908 | 4.645.084,533 | 385,763 | |
| 5836 | 711.051,903 | 4.646.157,728 | 337,890 | |
| 5837 | 709.311,603 | 4.646.417,172 | 352,030 | |
| 5838 | 709.284,211 | 4.646.414,420 | 352,030 | |
| 5839 | 709.234,502 | 4.646.115,033 | 352,560 | |
| 5840 | 709.221,831 | 4.646.132,947 | 352,120 | |
| 5841 | 705.791,519 | 4.645.018,295 | 387,106 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5842 | 705.852,529 | 4.645.109,561 | 385,339 | |
| 5843 | 705.821,692 | 4.645.093,166 | 386,134 | |
| 5844 | 709.059,014 | 4.646.113,296 | 353,280 | |
| 5845 | 708.937,496 | 4.646.098,977 | 353,840 | |
| 5846 | 708.901,355 | 4.646.077,800 | 353,740 | |
| 5847 | 708.863,632 | 4.646.070,105 | 353,760 | |
| 5848 | 708.817,584 | 4.646.075,335 | 353,800 | |
| 5849 | 705.731,806 | 4.645.116,775 | 387,994 | |
| 5850 | 705.807,914 | 4.645.136,450 | 386,285 | |
| 5851 | 705.840,063 | 4.645.166,618 | 385,850 | |
| 5852 | 708.726,318 | 4.646.070,697 | 354,880 | |
| 5853 | 708.635,625 | 4.646.044,256 | 355,210 | |
| 5854 | 708.592,369 | 4.646.055,417 | 355,240 | |
| 5855 | 705.660,946 | 4.645.168,585 | 388,902 | |
| 5856 | 708.565,164 | 4.646.040,141 | 355,590 | |
| 5857 | 705.629,453 | 4.645.168,585 | 389,512 | |
| 5858 | 708.556,085 | 4.646.054,381 | 355,620 | |
| 5859 | 705.740,335 | 4.645.160,715 | 387,997 | |
| 5860 | 705.815,131 | 4.645.171,864 | 386,460 | |
| 5861 | 705.761,987 | 4.645.143,664 | 387,362 | |
| 5862 | 705.687,846 | 4.645.130,548 | 388,705 | |
| 5863 | 708.396,829 | 4.646.043,783 | 357,840 | |
| 5864 | 705.651,104 | 4.645.158,092 | 389,567 | |
| 5865 | 705.670,131 | 4.645.144,320 | 389,031 | |
| 5866 | 708.361,412 | 4.646.043,525 | 358,000 | |
| 5867 | 708.329,976 | 4.646.041,864 | 357,890 | |
| 5868 | 708.206,178 | 4.646.041,682 | 359,780 | |
| 5869 | 708.175,506 | 4.646.050,273 | 361,120 | |
| 5870 | 708.166,181 | 4.646.032,724 | 364,100 | |
| 5871 | 708.155,932 | 4.646.041,137 | 364,290 | |
| 5872 | 708.141,623 | 4.646.055,193 | 365,540 | |
| 5873 | 708.104,241 | 4.646.061,028 | 368,550 | |
| 5874 | 708.028,343 | 4.646.037,015 | 366,550 | |
| 5875 | 708.008,099 | 4.646.049,704 | 364,200 | |
| 5876 | 707.996,795 | 4.646.046,911 | 363,920 | |
| 5877 | 708.002,456 | 4.646.032,036 | 363,850 | |
| 5878 | 708.012,070 | 4.646.033,444 | 364,180 | |
| 5879 | 707.957,886 | 4.646.039,005 | 363,470 | |
| 5880 | 707.959,592 | 4.646.049,672 | 363,830 | |
| 5881 | 707.865,079 | 4.646.038,839 | 365,570 | |
| 5882 | 707.864,840 | 4.646.045,124 | 365,330 | |
| 5883 | 707.771,015 | 4.646.033,195 | 364,470 | |
| 5884 | 707.731,162 | 4.646.041,757 | 364,500 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5885 | 707.732,224 | 4.646.028,816 | 364,490 | |
| 5886 | 704.176,135 | 4.644.314,921 | 440,986 | |
| 5887 | 704.180,014 | 4.644.305,505 | 441,368 | |
| 5888 | 707.675,416 | 4.646.025,842 | 363,910 | |
| 5889 | 704.189,157 | 4.644.284,458 | 443,337 | |
| 5890 | 704.201,348 | 4.644.298,858 | 442,112 | |
| 5891 | 704.198,577 | 4.644.307,998 | 441,467 | |
| 5892 | 704.195,806 | 4.644.316,583 | 441,289 | |
| 5893 | 704.208,551 | 4.644.326,553 | 441,351 | |
| 5894 | 704.214,369 | 4.644.313,813 | 441,232 | |
| 5895 | 707.597,854 | 4.646.035,126 | 365,210 | |
| 5896 | 707.601,365 | 4.646.020,811 | 365,220 | |
| 5897 | 704.241,799 | 4.644.288,335 | 442,460 | |
| 5898 | 704.238,751 | 4.644.301,351 | 441,430 | |
| 5899 | 704.244,015 | 4.644.339,292 | 439,414 | |
| 5900 | 704.255,929 | 4.644.302,182 | 442,015 | |
| 5901 | 707.590,071 | 4.645.986,252 | 365,110 | |
| 5902 | 704.270,890 | 4.644.249,009 | 441,404 | |
| 5903 | 704.287,237 | 4.644.252,886 | 440,303 | |
| 5904 | 707.595,374 | 4.645.948,789 | 363,280 | |
| 5905 | 707.606,327 | 4.645.948,049 | 362,830 | |
| 5906 | 707.607,994 | 4.645.933,647 | 362,420 | |
| 5907 | 707.594,380 | 4.645.934,491 | 362,490 | |
| 5908 | 707.591,411 | 4.645.900,093 | 362,510 | |
| 5909 | 704.264,795 | 4.644.330,984 | 440,019 | |
| 5910 | 707.611,115 | 4.645.856,395 | 363,330 | |
| 5911 | 707.597,551 | 4.645.859,874 | 363,270 | |
| 5912 | 707.598,526 | 4.645.824,568 | 363,100 | |
| 5913 | 704.253,712 | 4.644.385,541 | 437,661 | |
| 5914 | 707.613,367 | 4.645.828,174 | 362,750 | |
| 5915 | 704.276,985 | 4.644.339,569 | 440,412 | |
| 5916 | 704.280,033 | 4.644.330,984 | 441,671 | |
| 5917 | 707.612,852 | 4.645.794,635 | 364,090 | |
| 5918 | 704.299,704 | 4.644.274,765 | 441,762 | |
| 5919 | 704.826,463 | 4.644.674,183 | 429,406 | |
| 5920 | 704.858,740 | 4.644.637,959 | 427,998 | |
| 5921 | 704.281,979 | 4.644.379,746 | 437,727 | |
| 5922 | 704.863,985 | 4.644.655,065 | 428,377 | |
| 5923 | 704.300,542 | 4.644.382,515 | 438,059 | |
| 5924 | 704.866,828 | 4.644.675,129 | 428,704 | |
| 5925 | 707.620,203 | 4.645.511,681 | 367,340 | |
| 5926 | 707.629,651 | 4.645.507,788 | 367,180 | |
| 5927 | 704.338,777 | 4.644.328,235 | 445,032 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5928 | 704.323,539 | 4.644.368,668 | 442,182 | |
| 5929 | 704.313,010 | 4.644.394,424 | 437,275 | |
| 5930 | 704.308,300 | 4.644.405,778 | 436,918 | |
| 5931 | 704.892,589 | 4.644.676,300 | 428,151 | |
| 5932 | 704.294,480 | 4.644.425,203 | 436,243 | |
| 5933 | 707.624,828 | 4.645.430,012 | 367,870 | |
| 5934 | 704.894,262 | 4.644.708,905 | 429,831 | |
| 5935 | 704.380,991 | 4.644.467,335 | 433,062 | |
| 5936 | 704.907,476 | 4.644.670,113 | 427,768 | |
| 5937 | 704.910,822 | 4.644.661,920 | 427,581 | |
| 5938 | 704.414,515 | 4.644.468,996 | 431,740 | |
| 5939 | 704.402,047 | 4.644.464,011 | 432,328 | |
| 5940 | 707.650,214 | 4.645.375,474 | 367,500 | |
| 5941 | 704.375,726 | 4.644.451,272 | 433,852 | |
| 5942 | 707.665,350 | 4.645.357,068 | 367,380 | |
| 5943 | 704.353,007 | 4.644.441,302 | 434,890 | |
| 5944 | 707.682,142 | 4.645.359,315 | 367,120 | |
| 5945 | 707.693,877 | 4.645.352,392 | 366,780 | |
| 5946 | 707.690,934 | 4.645.345,016 | 366,820 | |
| 5947 | 707.624,435 | 4.645.377,039 | 367,760 | |
| 5948 | 704.946,786 | 4.644.675,798 | 427,902 | |
| 5949 | 704.396,783 | 4.644.447,395 | 432,285 | |
| 5950 | 704.416,177 | 4.644.456,534 | 431,551 | |
| 5951 | 707.630,679 | 4.645.346,139 | 367,530 | |
| 5952 | 704.958,539 | 4.644.631,953 | 425,797 | |
| 5953 | 704.398,446 | 4.644.430,224 | 432,626 | |
| 5954 | 707.622,029 | 4.645.307,863 | 367,460 | |
| 5955 | 704.374,895 | 4.644.419,978 | 435,518 | |
| 5956 | 704.984,299 | 4.644.647,671 | 426,415 | |
| 5957 | 707.636,439 | 4.645.268,988 | 367,500 | |
| 5958 | 704.334,721 | 4.644.384,806 | 438,900 | |
| 5959 | 704.380,159 | 4.644.410,008 | 435,803 | |
| 5960 | 704.395,398 | 4.644.418,316 | 433,336 | |
| 5961 | 704.410,359 | 4.644.422,193 | 431,607 | |
| 5962 | 704.428,368 | 4.644.429,394 | 430,608 | |
| 5963 | 707.635,598 | 4.645.213,989 | 369,330 | |
| 5964 | 704.405,649 | 4.644.407,792 | 432,423 | |
| 5965 | 705.016,959 | 4.644.574,035 | 423,434 | |
| 5966 | 705.023,818 | 4.644.578,717 | 422,605 | |
| 5967 | 705.029,672 | 4.644.571,026 | 422,441 | |
| 5968 | 705.021,810 | 4.644.565,341 | 423,528 | |
| 5969 | 704.900,501 | 4.644.623,023 | 429,042 | |
| 5970 | 704.908,530 | 4.644.613,158 | 428,921 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 5971 | 704.915,556 | 4.644.605,634 | 428,772 | |
| 5972 | 707.636,610 | 4.645.061,586 | 369,810 | |
| 5973 | 707.641,799 | 4.645.063,567 | 369,110 | |
| 5974 | 704.933,621 | 4.644.566,676 | 427,491 | |
| 5975 | 704.415,623 | 4.644.380,652 | 433,462 | |
| 5976 | 704.399,277 | 4.644.372,067 | 435,413 | |
| 5977 | 704.384,870 | 4.644.365,420 | 437,684 | |
| 5978 | 704.374,064 | 4.644.358,497 | 440,087 | |
| 5979 | 704.993,339 | 4.644.567,177 | 425,857 | |
| 5980 | 704.383,484 | 4.644.346,588 | 439,502 | |
| 5981 | 704.397,337 | 4.644.355,727 | 437,497 | |
| 5982 | 704.395,675 | 4.644.343,542 | 437,994 | |
| 5983 | 704.934,960 | 4.644.616,335 | 427,926 | |
| 5984 | 704.393,472 | 4.644.320,237 | 436,738 | |
| 5985 | 707.661,619 | 4.644.979,388 | 370,070 | |
| 5986 | 704.260,377 | 4.644.439,406 | 436,821 | |
| 5987 | 704.253,075 | 4.644.440,296 | 437,951 | |
| 5988 | 704.980,459 | 4.644.558,984 | 426,561 | |
| 5989 | 704.959,382 | 4.644.571,859 | 427,241 | |
| 5990 | 704.956,204 | 4.644.579,049 | 427,397 | |
| 5991 | 704.952,691 | 4.644.591,422 | 427,544 | |
| 5992 | 704.231,347 | 4.644.442,432 | 439,414 | |
| 5993 | 707.751,213 | 4.644.990,004 | 368,180 | |
| 5994 | 707.781,955 | 4.644.993,696 | 368,190 | |
| 5995 | 707.785,536 | 4.644.987,725 | 368,230 | |
| 5996 | 707.827,332 | 4.644.994,614 | 368,210 | |
| 5997 | 707.826,113 | 4.645.003,354 | 368,220 | |
| 5998 | 704.199,467 | 4.644.441,898 | 441,315 | |
| 5999 | 704.169,724 | 4.644.423,740 | 442,860 | |
| 6000 | 705.197,568 | 4.644.783,861 | 424,703 | |
| 6001 | 705.204,375 | 4.644.774,931 | 424,595 | |
| 6002 | 705.217,561 | 4.644.780,034 | 423,516 | |
| 6003 | 704.141,051 | 4.644.394,367 | 445,443 | |
| 6004 | 705.213,520 | 4.644.764,727 | 424,275 | |
| 6005 | 707.968,100 | 4.645.028,625 | 366,930 | |
| 6006 | 705.237,129 | 4.644.746,018 | 422,785 | |
| 6007 | 705.224,793 | 4.644.739,640 | 423,780 | |
| 6008 | 704.206,057 | 4.644.419,468 | 440,572 | |
| 6009 | 708.024,224 | 4.645.040,208 | 368,470 | |
| 6010 | 704.183,616 | 4.644.395,435 | 443,002 | |
| 6011 | 705.286,275 | 4.644.706,437 | 422,796 | |
| 6012 | 705.266,069 | 4.644.689,217 | 422,030 | |
| 6013 | 704.227,607 | 4.644.422,672 | 439,571 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6014 | 708.076,965 | 4.645.036,018 | 370,660 | |
| 6015 | 704.103,786 | 4.644.402,378 | 448,594 | |
| 6016 | 705.210,557 | 4.644.741,729 | 424,938 | |
| 6017 | 704.101,827 | 4.644.416,441 | 448,271 | |
| 6018 | 704.109,841 | 4.644.409,498 | 447,707 | |
| 6019 | 704.123,555 | 4.644.409,498 | 446,422 | |
| 6020 | 708.199,772 | 4.645.066,212 | 370,690 | |
| 6021 | 705.162,239 | 4.644.800,885 | 426,022 | |
| 6022 | 705.250,151 | 4.644.658,762 | 421,073 | |
| 6023 | 708.282,624 | 4.645.072,901 | 368,790 | |
| 6024 | 708.297,187 | 4.645.073,115 | 368,720 | |
| 6025 | 708.300,412 | 4.645.081,542 | 368,690 | |
| 6026 | 704.143,680 | 4.644.439,940 | 444,394 | |
| 6027 | 705.288,436 | 4.644.675,558 | 422,616 | |
| 6028 | 705.292,051 | 4.644.685,762 | 422,435 | |
| 6029 | 708.341,784 | 4.645.090,193 | 368,760 | |
| 6030 | 704.176,984 | 4.644.447,061 | 442,254 | |
| 6031 | 705.580,043 | 4.645.172,421 | 390,489 | |
| 6032 | 705.580,201 | 4.645.180,314 | 390,042 | |
| 6033 | 705.590,940 | 4.645.171,001 | 389,927 | |
| 6034 | 705.602,942 | 4.645.161,214 | 389,885 | |
| 6035 | 704.192,657 | 4.644.467,356 | 441,238 | |
| 6036 | 705.602,784 | 4.645.182,208 | 389,524 | |
| 6037 | 704.194,260 | 4.644.480,351 | 441,249 | |
| 6038 | 704.203,165 | 4.644.474,120 | 440,939 | |
| 6039 | 705.570,406 | 4.645.239,721 | 391,271 | |
| 6040 | 708.460,632 | 4.645.107,605 | 365,390 | |
| 6041 | 704.224,375 | 4.644.501,940 | 439,640 | |
| 6042 | 708.507,945 | 4.645.111,633 | 364,380 | |
| 6043 | 704.228,139 | 4.644.531,208 | 438,608 | |
| 6044 | 704.231,879 | 4.644.540,643 | 438,121 | |
| 6045 | 704.222,796 | 4.644.543,492 | 437,681 | |
| 6046 | 705.698,826 | 4.645.274,973 | 388,391 | |
| 6047 | 704.193,410 | 4.644.520,883 | 440,533 | |
| 6048 | 704.195,369 | 4.644.514,652 | 441,198 | |
| 6049 | 704.189,848 | 4.644.509,312 | 442,353 | |
| 6050 | 705.679,373 | 4.645.293,780 | 388,523 | |
| 6051 | 705.663,607 | 4.645.306,613 | 388,543 | |
| 6052 | 704.172,356 | 4.644.499,843 | 442,990 | |
| 6053 | 704.165,945 | 4.644.506,074 | 443,484 | |
| 6054 | 705.701,078 | 4.645.314,582 | 388,410 | |
| 6055 | 704.162,027 | 4.644.497,707 | 443,381 | |
| 6056 | 705.663,766 | 4.645.316,016 | 388,499 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6057 | 705.663,607 | 4.645.322,551 | 388,455 | |
| 6058 | 705.685,930 | 4.645.324,941 | 388,333 | |
| 6059 | 705.699,962 | 4.645.325,101 | 388,380 | |
| 6060 | 705.698,686 | 4.645.336,736 | 388,377 | |
| 6061 | 704.139,942 | 4.644.501,801 | 445,195 | |
| 6062 | 708.803,537 | 4.645.176,475 | 358,960 | |
| 6063 | 705.682,741 | 4.645.356,499 | 388,320 | |
| 6064 | 708.810,400 | 4.645.183,741 | 358,710 | |
| 6065 | 704.127,297 | 4.644.500,555 | 446,470 | |
| 6066 | 704.116,255 | 4.644.498,775 | 447,566 | |
| 6067 | 704.114,296 | 4.644.482,575 | 447,060 | |
| 6068 | 705.667,266 | 4.645.383,368 | 388,336 | |
| 6069 | 708.848,340 | 4.645.326,795 | 358,050 | |
| 6070 | 705.694,373 | 4.645.395,640 | 388,294 | |
| 6071 | 705.682,095 | 4.645.395,959 | 388,365 | |
| 6072 | 704.126,051 | 4.644.458,186 | 446,098 | |
| 6073 | 708.850,654 | 4.645.391,409 | 357,480 | |
| 6074 | 708.860,776 | 4.645.388,507 | 357,450 | |
| 6075 | 708.856,212 | 4.645.402,243 | 356,990 | |
| 6076 | 705.695,967 | 4.645.408,869 | 388,369 | |
| 6077 | 705.690,865 | 4.645.412,216 | 388,310 | |
| 6078 | 704.094,137 | 4.644.436,769 | 449,375 | |
| 6079 | 704.077,396 | 4.644.437,303 | 450,749 | |
| 6080 | 705.676,993 | 4.645.420,344 | 388,466 | |
| 6081 | 705.693,735 | 4.645.434,848 | 388,565 | |
| 6082 | 705.672,687 | 4.645.428,154 | 388,624 | |
| 6083 | 704.207,436 | 4.644.493,044 | 441,220 | |
| 6084 | 704.208,148 | 4.644.505,505 | 440,979 | |
| 6085 | 708.878,629 | 4.645.505,954 | 356,560 | |
| 6086 | 708.885,471 | 4.645.541,137 | 356,350 | |
| 6087 | 704.964,946 | 4.644.724,471 | 429,756 | |
| 6088 | 708.905,110 | 4.645.573,926 | 356,350 | |
| 6089 | 704.992,572 | 4.644.735,767 | 428,910 | |
| 6090 | 705.008,268 | 4.644.743,612 | 428,762 | |
| 6091 | 705.023,964 | 4.644.751,143 | 428,856 | |
| 6092 | 705.719,765 | 4.645.332,961 | 387,271 | |
| 6093 | 708.911,896 | 4.645.653,254 | 356,360 | |
| 6094 | 708.922,141 | 4.645.697,935 | 356,350 | |
| 6095 | 708.937,728 | 4.645.698,916 | 356,370 | |
| 6096 | 705.036,207 | 4.644.738,905 | 428,362 | |
| 6097 | 708.927,028 | 4.645.712,209 | 356,400 | |
| 6098 | 708.939,158 | 4.645.743,754 | 356,480 | |
| 6099 | 708.943,062 | 4.645.742,838 | 356,450 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6100 | 705.002,303 | 4.644.711,606 | 428,704 | |
| 6101 | 705.736,348 | 4.645.434,870 | 387,366 | |
| 6102 | 705.035,893 | 4.644.722,902 | 428,059 | |
| 6103 | 705.736,507 | 4.645.412,875 | 387,391 | |
| 6104 | 705.737,145 | 4.645.402,197 | 387,396 | |
| 6105 | 705.087,377 | 4.644.732,002 | 427,801 | |
| 6106 | 705.738,899 | 4.645.375,739 | 387,425 | |
| 6107 | 705.740,024 | 4.645.353,357 | 387,375 | |
| 6108 | 705.740,662 | 4.645.336,781 | 387,392 | |
| 6109 | 708.963,886 | 4.645.867,208 | 356,380 | |
| 6110 | 705.000,734 | 4.644.690,896 | 428,992 | |
| 6111 | 704.986,293 | 4.644.686,503 | 429,335 | |
| 6112 | 705.748,317 | 4.645.411,443 | 387,386 | |
| 6113 | 705.047,509 | 4.644.694,975 | 427,733 | |
| 6114 | 705.747,360 | 4.645.450,173 | 387,374 | |
| 6115 | 705.758,203 | 4.645.456,070 | 387,479 | |
| 6116 | 705.095,225 | 4.644.716,312 | 426,868 | |
| 6117 | 705.758,522 | 4.645.432,960 | 387,527 | |
| 6118 | 705.759,478 | 4.645.420,528 | 387,400 | |
| 6119 | 705.094,008 | 4.644.699,924 | 426,733 | |
| 6120 | 705.069,836 | 4.644.689,883 | 427,270 | |
| 6121 | 705.057,907 | 4.644.684,548 | 427,459 | |
| 6122 | 705.044,722 | 4.644.677,645 | 427,618 | |
| 6123 | 708.861,206 | 4.645.465,768 | 356,860 | |
| 6124 | 705.032,793 | 4.644.655,052 | 427,925 | |
| 6125 | 708.830,869 | 4.645.475,159 | 356,700 | |
| 6126 | 708.794,019 | 4.645.486,004 | 356,700 | |
| 6127 | 708.796,220 | 4.645.492,696 | 356,760 | |
| 6128 | 708.754,790 | 4.645.506,845 | 356,720 | |
| 6129 | 705.121,948 | 4.644.697,727 | 426,018 | |
| 6130 | 705.778,932 | 4.645.441,885 | 387,351 | |
| 6131 | 705.089,927 | 4.644.667,604 | 426,856 | |
| 6132 | 705.781,961 | 4.645.393,911 | 387,402 | |
| 6133 | 708.684,963 | 4.645.515,555 | 356,990 | |
| 6134 | 705.061,360 | 4.644.634,028 | 427,260 | |
| 6135 | 705.076,115 | 4.644.642,501 | 426,918 | |
| 6136 | 705.088,044 | 4.644.649,090 | 426,633 | |
| 6137 | 705.101,229 | 4.644.656,307 | 426,484 | |
| 6138 | 705.112,844 | 4.644.662,583 | 426,464 | |
| 6139 | 708.569,919 | 4.645.531,620 | 358,560 | |
| 6140 | 708.565,969 | 4.645.535,397 | 358,320 | |
| 6141 | 708.550,208 | 4.645.546,807 | 358,290 | |
| 6142 | 705.804,603 | 4.645.451,129 | 387,471 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6143 | 708.543,331 | 4.645.535,465 | 358,280 | |
| 6144 | 708.536,749 | 4.645.540,450 | 358,220 | |
| 6145 | 708.540,315 | 4.645.548,604 | 358,200 | |
| 6146 | 708.521,831 | 4.645.560,121 | 358,250 | |
| 6147 | 708.516,714 | 4.645.552,779 | 358,190 | |
| 6148 | 705.804,125 | 4.645.385,305 | 387,351 | |
| 6149 | 705.803,806 | 4.645.370,482 | 387,277 | |
| 6150 | 705.811,141 | 4.645.387,217 | 387,324 | |
| 6151 | 708.474,778 | 4.645.609,037 | 358,240 | |
| 6152 | 708.470,401 | 4.645.604,422 | 358,210 | |
| 6153 | 708.455,682 | 4.645.631,889 | 358,210 | |
| 6154 | 705.814,808 | 4.645.448,261 | 387,357 | |
| 6155 | 705.814,649 | 4.645.460,533 | 387,383 | |
| 6156 | 705.100,601 | 4.644.623,046 | 426,155 | |
| 6157 | 705.117,239 | 4.644.633,401 | 425,904 | |
| 6158 | 708.432,274 | 4.645.665,883 | 358,570 | |
| 6159 | 708.422,726 | 4.645.680,569 | 359,140 | |
| 6160 | 705.825,385 | 4.645.426,737 | 387,337 | |
| 6161 | 705.169,664 | 4.644.666,662 | 424,708 | |
| 6162 | 705.176,884 | 4.644.661,014 | 424,697 | |
| 6163 | 705.838,460 | 4.645.442,675 | 387,408 | |
| 6164 | 705.149,259 | 4.644.639,676 | 425,498 | |
| 6165 | 705.847,229 | 4.645.434,069 | 387,301 | |
| 6166 | 705.101,542 | 4.644.609,239 | 426,013 | |
| 6167 | 708.429,664 | 4.645.760,852 | 360,510 | |
| 6168 | 705.917,992 | 4.645.175,795 | 383,189 | |
| 6169 | 705.053,198 | 4.644.581,939 | 424,296 | |
| 6170 | 708.429,901 | 4.645.783,332 | 360,540 | |
| 6171 | 708.439,116 | 4.645.792,701 | 361,850 | |
| 6172 | 705.971,317 | 4.645.197,280 | 382,634 | |
| 6173 | 705.975,657 | 4.645.200,173 | 382,557 | |
| 6174 | 708.429,257 | 4.645.825,750 | 360,810 | |
| 6175 | 708.439,738 | 4.645.828,209 | 360,780 | |
| 6176 | 709.361,135 | 4.645.266,567 | 359,360 | |
| 6177 | 709.357,637 | 4.645.269,345 | 359,280 | |
| 6178 | 709.352,509 | 4.645.265,585 | 359,300 | |
| 6179 | 709.349,712 | 4.645.257,627 | 359,330 | |
| 6180 | 709.346,818 | 4.645.253,134 | 359,370 | |
| 6181 | 709.347,564 | 4.645.247,994 | 358,770 | |
| 6182 | 709.327,927 | 4.645.243,978 | 359,300 | |
| 6183 | 709.325,312 | 4.645.253,219 | 359,550 | |
| 6184 | 709.295,779 | 4.645.248,177 | 359,690 | |
| 6185 | 709.297,382 | 4.645.238,889 | 359,500 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6186 | 709.297,376 | 4.645.238,876 | 359,490 | |
| 6187 | 709.277,976 | 4.645.236,838 | 359,530 | |
| 6188 | 709.271,897 | 4.645.243,296 | 359,500 | |
| 6189 | 709.234,662 | 4.645.229,295 | 359,210 | |
| 6190 | 709.233,738 | 4.645.237,918 | 359,190 | |
| 6191 | 709.205,298 | 4.645.234,747 | 359,220 | |
| 6192 | 709.209,107 | 4.645.228,195 | 359,450 | |
| 6193 | 709.196,133 | 4.645.225,201 | 359,580 | |
| 6194 | 709.190,591 | 4.645.230,471 | 359,600 | |
| 6195 | 709.160,823 | 4.645.219,020 | 359,590 | |
| 6196 | 709.158,776 | 4.645.227,219 | 359,610 | |
| 6197 | 709.115,328 | 4.645.220,134 | 359,610 | |
| 6198 | 709.117,089 | 4.645.212,398 | 359,640 | |
| 6199 | 709.098,073 | 4.645.209,616 | 359,980 | |
| 6200 | 709.094,855 | 4.645.217,021 | 359,790 | |
| 6201 | 709.085,376 | 4.645.210,962 | 360,070 | |
| 6202 | 709.091,181 | 4.645.210,556 | 360,170 | |
| 6203 | 709.065,853 | 4.645.210,821 | 360,150 | |
| 6204 | 709.067,867 | 4.645.205,783 | 360,130 | |
| 6205 | 709.042,113 | 4.645.202,075 | 360,050 | |
| 6206 | 709.039,894 | 4.645.208,093 | 360,250 | |
| 6207 | 709.023,511 | 4.645.198,026 | 359,640 | |
| 6208 | 709.019,797 | 4.645.204,194 | 359,800 | |
| 6209 | 709.005,776 | 4.645.194,380 | 360,020 | |
| 6210 | 709.001,778 | 4.645.201,345 | 360,050 | |
| 6211 | 708.979,695 | 4.645.192,232 | 360,150 | |
| 6212 | 708.962,504 | 4.645.187,531 | 360,040 | |
| 6213 | 708.927,435 | 4.645.191,496 | 358,490 | |
| 6214 | 708.911,710 | 4.645.187,395 | 358,630 | |
| 6215 | 708.911,709 | 4.645.180,831 | 358,580 | |
| 6216 | 708.908,952 | 4.645.180,771 | 358,020 | |
| 6217 | 708.908,625 | 4.645.188,516 | 357,980 | |
| 6218 | 708.858,942 | 4.645.180,177 | 358,590 | |
| 6219 | 708.859,083 | 4.645.170,166 | 358,600 | |
| 6220 | 708.806,939 | 4.645.172,247 | 359,230 | |
| 6221 | 708.804,462 | 4.645.164,485 | 359,300 | |
| 6222 | 708.803,038 | 4.645.151,531 | 359,200 | |
| 6223 | 708.798,293 | 4.645.152,013 | 359,270 | |
| 6224 | 708.795,791 | 4.645.138,041 | 359,220 | |
| 6225 | 708.807,197 | 4.645.121,637 | 359,900 | |
| 6226 | 708.816,925 | 4.645.119,746 | 359,380 | |
| 6227 | 708.850,346 | 4.645.053,092 | 360,080 | |
| 6228 | 708.834,360 | 4.645.059,965 | 360,020 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6229 | 708.873,983 | 4.644.986,225 | 360,890 | |
| 6230 | 708.881,627 | 4.644.991,490 | 361,040 | |
| 6231 | 708.896,233 | 4.644.962,767 | 361,220 | |
| 6232 | 708.893,029 | 4.644.949,775 | 361,330 | |
| 6233 | 708.919,409 | 4.644.899,948 | 363,800 | |
| 6234 | 708.927,506 | 4.644.902,170 | 363,760 | |
| 6235 | 708.939,419 | 4.644.876,658 | 363,810 | |
| 6236 | 708.930,168 | 4.644.875,891 | 363,790 | |
| 6237 | 708.948,360 | 4.644.836,878 | 363,870 | |
| 6238 | 708.958,030 | 4.644.840,583 | 363,770 | |
| 6239 | 708.976,552 | 4.644.806,226 | 363,850 | |
| 6240 | 708.966,899 | 4.644.802,305 | 363,830 | |
| 6241 | 709.003,449 | 4.644.770,455 | 363,790 | |
| 6242 | 709.007,065 | 4.644.756,503 | 363,830 | |
| 6243 | 709.050,225 | 4.644.759,111 | 363,850 | |
| 6244 | 709.051,085 | 4.644.771,463 | 364,050 | |
| 6245 | 709.054,117 | 4.644.771,499 | 363,480 | |
| 6246 | 709.062,410 | 4.644.759,985 | 363,490 | |
| 6247 | 709.060,285 | 4.644.758,215 | 363,930 | |
| 6248 | 709.003,493 | 4.644.752,389 | 363,810 | |
| 6249 | 709.015,215 | 4.644.730,219 | 363,820 | |
| 6250 | 709.008,496 | 4.644.724,440 | 363,820 | |
| 6251 | 709.012,611 | 4.644.707,941 | 364,250 | |
| 6252 | 709.030,699 | 4.644.687,551 | 364,240 | |
| 6253 | 709.021,336 | 4.644.686,145 | 364,280 | |
| 6254 | 709.032,625 | 4.644.657,500 | 364,260 | |
| 6255 | 709.045,388 | 4.644.655,712 | 364,260 | |
| 6256 | 709.057,570 | 4.644.623,557 | 363,920 | |
| 6257 | 709.050,848 | 4.644.621,775 | 364,110 | |
| 6258 | 709.058,660 | 4.644.602,540 | 364,230 | |
| 6259 | 709.067,807 | 4.644.604,215 | 364,050 | |
| 6260 | 709.064,899 | 4.644.578,822 | 364,250 | |
| 6261 | 709.078,789 | 4.644.581,534 | 364,220 | |
| 6262 | 709.087,346 | 4.644.548,564 | 364,380 | |
| 6263 | 709.092,160 | 4.644.556,857 | 364,400 | |
| 6264 | 709.107,093 | 4.644.525,223 | 365,220 | |
| 6265 | 709.111,229 | 4.644.514,573 | 365,480 | |
| 6266 | 709.111,251 | 4.644.503,485 | 365,150 | |
| 6267 | 709.107,432 | 4.644.487,976 | 365,140 | |
| 6268 | 709.099,027 | 4.644.490,455 | 365,130 | |
| 6269 | 709.093,354 | 4.644.461,585 | 365,100 | |
| 6270 | 709.104,375 | 4.644.457,603 | 365,080 | |
| 6271 | 709.094,158 | 4.644.419,650 | 365,020 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6272 | 709.082,880 | 4.644.416,059 | 365,010 | |
| 6273 | 709.077,525 | 4.644.386,235 | 364,990 | |
| 6274 | 709.088,780 | 4.644.381,623 | 365,100 | |
| 6275 | 709.083,861 | 4.644.352,240 | 365,120 | |
| 6276 | 709.070,730 | 4.644.355,373 | 365,090 | |
| 6277 | 709.062,930 | 4.644.317,330 | 362,940 | |
| 6278 | 709.098,478 | 4.644.764,355 | 363,480 | |
| 6279 | 709.095,380 | 4.644.774,522 | 363,510 | |
| 6280 | 709.115,084 | 4.644.775,798 | 363,580 | |
| 6281 | 709.113,745 | 4.644.765,904 | 363,690 | |
| 6282 | 709.126,762 | 4.644.777,013 | 362,840 | |
| 6283 | 709.125,982 | 4.644.767,023 | 363,000 | |
| 6284 | 709.449,933 | 4.645.363,055 | 358,190 | |
| 6285 | 709.441,673 | 4.645.366,060 | 358,210 | |
| 6286 | 709.432,539 | 4.645.340,417 | 358,350 | |
| 6287 | 709.427,834 | 4.645.343,360 | 358,280 | |
| 6288 | 709.381,980 | 4.645.259,506 | 359,060 | |
| 6289 | 709.396,389 | 4.645.248,756 | 359,100 | |
| 6290 | 709.395,738 | 4.645.263,140 | 359,100 | |
| 6291 | 709.410,150 | 4.645.263,038 | 358,730 | |
| 6292 | 709.412,659 | 4.645.256,122 | 358,730 | |
| 6293 | 709.597,491 | 4.645.301,969 | 356,040 | |
| 6294 | 709.658,732 | 4.645.301,695 | 355,620 | |
| 6295 | 705.893,529 | 4.645.105,090 | 385,094 | |
| 6296 | 709.885,451 | 4.645.342,004 | 357,210 | |
| 6297 | 705.877,941 | 4.645.119,224 | 384,747 | |
| 6298 | 709.917,260 | 4.645.338,301 | 357,130 | |
| 6299 | 705.746,352 | 4.645.190,020 | 387,961 | |
| 6300 | 710.185,125 | 4.645.406,258 | 355,320 | |
| 6301 | 705.765,205 | 4.645.194,466 | 388,029 | |
| 6302 | 710.210,297 | 4.645.416,798 | 355,340 | |
| 6303 | 705.552,247 | 4.645.373,363 | 393,402 | |
| 6304 | 710.248,544 | 4.645.425,583 | 355,390 | |
| 6305 | 710.321,489 | 4.645.436,645 | 355,160 | |
| 6306 | 710.327,504 | 4.645.432,602 | 354,870 | |
| 6307 | 705.770,251 | 4.644.864,340 | 388,858 | |
| 6308 | 710.469,593 | 4.645.466,304 | 353,820 | |
| 6309 | 705.782,526 | 4.644.909,329 | 388,060 | |
| 6310 | 705.772,706 | 4.644.896,241 | 388,297 | |
| 6311 | 710.509,809 | 4.645.474,402 | 353,830 | |
| 6312 | 705.840,628 | 4.644.985,401 | 386,615 | |
| 6313 | 710.605,806 | 4.645.484,153 | 353,110 | |
| 6314 | 710.621,803 | 4.645.468,664 | 352,930 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6315 | 710.613,985 | 4.645.451,950 | 352,980 | |
| 6316 | 705.761,994 | 4.644.952,713 | 387,907 | |
| 6317 | 710.631,615 | 4.645.465,811 | 352,970 | |
| 6318 | 710.630,986 | 4.645.477,455 | 352,960 | |
| 6319 | 705.777,741 | 4.644.983,536 | 387,350 | |
| 6320 | 705.795,456 | 4.645.047,151 | 387,039 | |
| 6321 | 705.812,514 | 4.645.031,411 | 386,836 | |
| 6322 | 710.861,649 | 4.645.513,279 | 351,020 | |
| 6323 | 710.896,256 | 4.645.512,146 | 350,790 | |
| 6324 | 705.805,946 | 4.645.092,510 | 386,173 | |
| 6325 | 705.802,009 | 4.645.080,705 | 387,516 | |
| 6326 | 710.935,774 | 4.645.517,739 | 350,530 | |
| 6327 | 710.961,995 | 4.645.522,702 | 350,760 | |
| 6328 | 710.959,455 | 4.645.531,193 | 350,570 | |
| 6329 | 711.010,546 | 4.645.538,517 | 350,550 | |
| 6330 | 711.028,267 | 4.645.532,220 | 350,510 | |
| 6331 | 705.826,285 | 4.645.125,957 | 385,873 | |
| 6332 | 711.061,141 | 4.645.545,599 | 350,370 | |
| 6333 | 711.156,146 | 4.645.555,053 | 349,390 | |
| 6334 | 711.198,014 | 4.645.566,559 | 349,430 | |
| 6335 | 711.219,723 | 4.645.567,217 | 349,740 | |
| 6336 | 711.289,751 | 4.645.573,523 | 349,610 | |
| 6337 | 705.836,127 | 4.645.177,111 | 386,112 | |
| 6338 | 711.304,022 | 4.645.562,830 | 349,630 | |
| 6339 | 711.333,457 | 4.645.564,556 | 349,630 | |
| 6340 | 711.333,517 | 4.645.554,353 | 349,620 | |
| 6341 | 711.368,658 | 4.645.546,134 | 349,590 | |
| 6342 | 711.371,088 | 4.645.553,999 | 349,580 | |
| 6343 | 711.412,036 | 4.645.542,792 | 348,720 | |
| 6344 | 711.408,685 | 4.645.535,806 | 348,710 | |
| 6345 | 711.447,660 | 4.645.526,222 | 347,060 | |
| 6346 | 711.450,235 | 4.645.534,180 | 347,050 | |
| 6347 | 711.496,619 | 4.645.521,254 | 345,710 | |
| 6348 | 711.494,183 | 4.645.513,671 | 345,710 | |
| 6349 | 711.537,822 | 4.645.512,324 | 344,470 | |
| 6350 | 711.612,853 | 4.645.483,475 | 342,910 | |
| 6351 | 705.788,887 | 4.645.165,962 | 386,938 | |
| 6352 | 711.654,497 | 4.645.479,832 | 342,820 | |
| 6353 | 711.651,243 | 4.645.473,813 | 342,910 | |
| 6354 | 711.669,425 | 4.645.481,418 | 342,780 | |
| 6355 | 711.678,677 | 4.645.490,820 | 342,770 | |
| 6356 | 711.685,097 | 4.645.484,426 | 342,880 | |
| 6357 | 711.701,716 | 4.645.508,569 | 341,910 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6358 | 711.284,536 | 4.645.589,255 | 349,480 | |
| 6359 | 711.291,727 | 4.645.604,939 | 349,600 | |
| 6360 | 711.300,395 | 4.645.600,104 | 349,580 | |
| 6361 | 711.301,680 | 4.645.629,554 | 349,300 | |
| 6362 | 711.349,676 | 4.645.734,675 | 345,000 | |
| 6363 | 711.342,647 | 4.645.737,025 | 345,000 | |
| 6364 | 711.369,036 | 4.645.771,045 | 342,910 | |
| 6365 | 711.368,795 | 4.645.762,681 | 342,900 | |
| 6366 | 711.391,330 | 4.645.768,745 | 342,910 | |
| 6367 | 711.392,053 | 4.645.773,646 | 342,950 | |
| 6368 | 711.425,031 | 4.645.778,523 | 341,980 | |
| 6369 | 711.449,605 | 4.645.779,840 | 341,990 | |
| 6370 | 711.451,626 | 4.645.773,089 | 342,030 | |
| 6371 | 711.518,998 | 4.645.785,482 | 340,900 | |
| 6372 | 711.520,279 | 4.645.781,211 | 340,920 | |
| 6373 | 711.587,822 | 4.645.827,030 | 340,180 | |
| 6374 | 711.590,202 | 4.645.828,203 | 339,720 | |
| 6375 | 711.590,433 | 4.645.846,965 | 340,380 | |
| 6376 | 711.592,306 | 4.645.847,185 | 339,740 | |
| 6377 | 711.608,084 | 4.645.865,790 | 340,150 | |
| 6378 | 711.601,860 | 4.645.871,467 | 340,180 | |
| 6379 | 711.616,825 | 4.645.900,663 | 340,190 | |
| 6380 | 711.621,194 | 4.645.898,160 | 340,200 | |
| 6381 | 711.639,674 | 4.645.927,881 | 340,290 | |
| 6382 | 711.630,066 | 4.645.927,633 | 340,640 | |
| 6383 | 711.646,545 | 4.645.946,429 | 340,510 | |
| 6384 | 711.643,670 | 4.645.951,696 | 340,450 | |
| 6385 | 711.632,628 | 4.645.950,748 | 340,540 | |
| 6386 | 711.622,428 | 4.645.950,895 | 340,510 | |
| 6387 | 711.622,753 | 4.645.942,163 | 340,490 | |
| 6388 | 710.434,438 | 4.645.930,337 | 351,400 | |
| 6389 | 710.426,909 | 4.645.927,769 | 351,430 | |
| 6390 | 710.436,851 | 4.645.905,266 | 351,610 | |
| 6391 | 710.429,236 | 4.645.901,742 | 351,920 | |
| 6392 | 710.431,145 | 4.645.870,134 | 351,810 | |
| 6393 | 710.438,758 | 4.645.871,039 | 351,810 | |
| 6394 | 710.441,134 | 4.645.838,099 | 351,840 | |
| 6395 | 710.433,599 | 4.645.837,655 | 351,790 | |
| 6396 | 710.435,698 | 4.645.801,195 | 351,820 | |
| 6397 | 710.444,775 | 4.645.801,680 | 351,810 | |
| 6398 | 710.446,295 | 4.645.769,445 | 351,800 | |
| 6399 | 710.438,362 | 4.645.769,483 | 351,830 | |
| 6400 | 710.440,300 | 4.645.723,831 | 352,430 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6401 | 710.448,716 | 4.645.722,474 | 352,490 | |
| 6402 | 710.449,330 | 4.645.697,132 | 352,460 | |
| 6403 | 710.441,458 | 4.645.697,881 | 352,460 | |
| 6404 | 710.441,489 | 4.645.682,765 | 352,750 | |
| 6405 | 710.449,358 | 4.645.676,838 | 352,760 | |
| 6406 | 710.446,398 | 4.645.552,378 | 353,780 | |
| 6407 | 710.458,062 | 4.645.541,644 | 353,780 | |
| 6408 | 710.460,318 | 4.645.477,967 | 353,780 | |
| 6409 | 710.450,355 | 4.645.477,624 | 353,650 | |
| 6410 | 710.182,731 | 4.645.404,335 | 355,320 | |
| 6411 | 710.180,491 | 4.645.395,978 | 355,500 | |
| 6412 | 710.172,257 | 4.645.395,842 | 355,540 | |
| 6413 | 710.167,671 | 4.645.371,515 | 355,560 | |
| 6414 | 710.161,087 | 4.645.334,946 | 356,350 | |
| 6415 | 710.155,477 | 4.645.300,235 | 356,770 | |
| 6416 | 710.149,203 | 4.645.266,059 | 356,800 | |
| 6417 | 710.141,791 | 4.645.227,725 | 356,970 | |
| 6418 | 710.135,753 | 4.645.192,402 | 357,140 | |
| 6419 | 710.127,552 | 4.645.146,290 | 357,060 | |
| 6420 | 710.124,058 | 4.645.126,597 | 357,090 | |
| 6421 | 710.132,796 | 4.645.126,258 | 357,010 | |
| 6422 | 710.137,669 | 4.645.148,504 | 356,970 | |
| 6423 | 710.145,213 | 4.645.189,080 | 357,070 | |
| 6424 | 710.152,440 | 4.645.226,239 | 356,820 | |
| 6425 | 710.158,274 | 4.645.261,520 | 356,840 | |
| 6426 | 710.163,720 | 4.645.301,183 | 356,670 | |
| 6427 | 710.163,860 | 4.645.307,142 | 356,350 | |
| 6428 | 710.167,293 | 4.645.335,912 | 356,080 | |
| 6429 | 710.173,898 | 4.645.368,674 | 355,650 | |
| 6430 | 709.898,003 | 4.645.362,764 | 357,000 | |
| 6431 | 709.889,795 | 4.645.366,041 | 356,960 | |
| 6432 | 709.897,847 | 4.645.394,774 | 356,880 | |
| 6433 | 709.906,156 | 4.645.393,216 | 356,840 | |
| 6434 | 709.914,448 | 4.645.420,791 | 356,780 | |
| 6435 | 709.909,082 | 4.645.429,996 | 356,670 | |
| 6436 | 709.942,914 | 4.645.485,190 | 356,250 | |
| 6437 | 709.948,167 | 4.645.486,741 | 356,520 | |
| 6438 | 709.956,410 | 4.645.491,093 | 356,100 | |
| 6439 | 709.963,899 | 4.645.495,246 | 355,840 | |
| 6440 | 709.959,050 | 4.645.507,243 | 355,820 | |
| 6441 | 709.952,783 | 4.645.506,215 | 356,100 | |
| 6442 | 709.944,406 | 4.645.501,397 | 356,180 | |
| 6443 | 709.937,233 | 4.645.497,727 | 356,110 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6444 | 709.926,231 | 4.645.492,600 | 356,110 | |
| 6445 | 709.935,080 | 4.645.515,714 | 356,080 | |
| 6446 | 709.941,298 | 4.645.547,072 | 355,820 | |
| 6447 | 709.950,586 | 4.645.545,017 | 355,840 | |
| 6448 | 709.962,881 | 4.645.580,334 | 355,750 | |
| 6449 | 709.952,558 | 4.645.585,900 | 355,720 | |
| 6450 | 709.972,525 | 4.645.614,986 | 355,500 | |
| 6451 | 709.980,618 | 4.645.634,856 | 355,230 | |
| 6452 | 709.992,983 | 4.645.654,293 | 355,160 | |
| 6453 | 710.009,285 | 4.645.678,592 | 355,170 | |
| 6454 | 710.024,370 | 4.645.703,352 | 355,360 | |
| 6455 | 710.026,992 | 4.645.708,915 | 354,720 | |
| 6456 | 710.016,215 | 4.645.714,125 | 353,180 | |
| 6457 | 710.045,728 | 4.645.731,484 | 355,100 | |
| 6458 | 710.039,410 | 4.645.720,651 | 355,130 | |
| 6459 | 710.043,839 | 4.645.718,158 | 354,980 | |
| 6460 | 710.048,517 | 4.645.726,757 | 355,150 | |
| 6461 | 710.055,666 | 4.645.712,289 | 354,010 | |
| 6462 | 710.061,685 | 4.645.720,757 | 354,730 | |
| 6463 | 710.035,764 | 4.645.738,249 | 352,030 | |
| 6464 | 710.028,668 | 4.645.733,014 | 351,800 | |
| 6465 | 709.991,752 | 4.645.822,082 | 350,560 | |
| 6466 | 709.982,144 | 4.645.817,993 | 350,490 | |
| 6467 | 709.608,995 | 4.645.621,566 | 353,190 | |
| 6468 | 709.617,310 | 4.645.614,474 | 353,170 | |
| 6469 | 709.626,496 | 4.645.623,617 | 352,720 | |
| 6470 | 709.636,514 | 4.645.638,880 | 352,800 | |
| 6471 | 709.636,308 | 4.645.649,184 | 354,660 | |
| 6472 | 709.598,268 | 4.645.602,787 | 355,650 | |
| 6473 | 709.600,471 | 4.645.591,558 | 355,290 | |
| 6474 | 709.584,566 | 4.645.565,701 | 355,720 | |
| 6475 | 709.578,549 | 4.645.572,125 | 356,200 | |
| 6476 | 709.544,930 | 4.645.506,004 | 356,420 | |
| 6477 | 709.540,884 | 4.645.513,659 | 356,770 | |
| 6478 | 709.521,165 | 4.645.485,797 | 357,050 | |
| 6479 | 709.525,379 | 4.645.474,915 | 357,010 | |
| 6480 | 707.514,936 | 4.644.955,537 | 373,890 | |
| 6481 | 707.546,172 | 4.644.963,366 | 373,880 | |
| 6482 | 707.604,746 | 4.644.967,586 | 373,620 | |
| 6483 | 707.627,367 | 4.644.969,699 | 373,030 | |
| 6484 | 707.632,699 | 4.644.958,429 | 373,020 | |
| 6485 | 707.618,229 | 4.644.954,970 | 373,200 | |
| 6486 | 707.612,230 | 4.644.954,993 | 373,920 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6487 | 707.591,685 | 4.644.955,235 | 374,300 | |
| 6488 | 707.584,740 | 4.644.955,680 | 373,970 | |
| 6489 | 707.576,044 | 4.644.955,590 | 374,100 | |
| 6490 | 707.554,054 | 4.644.948,537 | 373,930 | |
| 6491 | 707.517,683 | 4.644.942,348 | 373,910 | |
| 6492 | 707.489,931 | 4.644.938,992 | 373,880 | |
| 6493 | 707.481,184 | 4.644.949,335 | 373,890 | |
| 6494 | 707.480,033 | 4.644.935,050 | 373,900 | |
| 6495 | 707.458,310 | 4.644.944,607 | 373,900 | |
| 6496 | 707.452,169 | 4.644.921,633 | 374,860 | |
| 6497 | 707.443,335 | 4.644.920,022 | 374,650 | |
| 6498 | 707.428,762 | 4.644.921,274 | 374,640 | |
| 6499 | 707.429,800 | 4.644.930,361 | 374,650 | |
| 6500 | 707.364,596 | 4.644.921,797 | 372,760 | |
| 6501 | 707.305,204 | 4.644.914,133 | 373,640 | |
| 6502 | 707.307,018 | 4.644.903,180 | 373,690 | |
| 6503 | 707.188,381 | 4.644.896,689 | 375,500 | |
| 6504 | 707.189,520 | 4.644.888,490 | 375,530 | |
| 6505 | 707.148,644 | 4.644.891,572 | 374,760 | |
| 6506 | 707.146,333 | 4.644.881,243 | 374,780 | |
| 6507 | 707.105,960 | 4.644.887,807 | 375,500 | |
| 6508 | 707.104,650 | 4.644.879,560 | 375,500 | |
| 6509 | 707.066,867 | 4.644.880,044 | 374,620 | |
| 6510 | 707.066,680 | 4.644.872,514 | 374,890 | |
| 6511 | 707.041,677 | 4.644.877,462 | 375,820 | |
| 6512 | 707.039,919 | 4.644.869,346 | 375,830 | |
| 6513 | 706.967,154 | 4.644.860,901 | 376,580 | |
| 6514 | 706.963,962 | 4.644.868,852 | 376,550 | |
| 6515 | 706.944,843 | 4.644.863,927 | 376,490 | |
| 6516 | 706.944,810 | 4.644.857,185 | 376,540 | |
| 6517 | 706.919,325 | 4.644.850,055 | 376,490 | |
| 6518 | 706.921,518 | 4.644.863,108 | 376,480 | |
| 6519 | 706.909,249 | 4.644.860,733 | 376,480 | |
| 6520 | 706.877,876 | 4.644.848,514 | 377,400 | |
| 6521 | 706.879,883 | 4.644.834,761 | 377,350 | |
| 6522 | 706.843,797 | 4.644.830,963 | 377,400 | |
| 6523 | 706.843,327 | 4.644.845,539 | 377,220 | |
| 6524 | 706.804,386 | 4.644.845,536 | 377,340 | |
| 6525 | 706.778,914 | 4.644.827,917 | 377,840 | |
| 6526 | 706.770,293 | 4.644.840,227 | 378,220 | |
| 6527 | 706.756,342 | 4.644.842,112 | 378,230 | |
| 6528 | 706.773,298 | 4.644.826,675 | 378,020 | |
| 6529 | 706.763,740 | 4.644.821,763 | 377,940 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6530 | 706.801,247 | 4.644.788,554 | 377,960 | |
| 6531 | 706.791,750 | 4.644.779,188 | 378,630 | |
| 6532 | 706.835,325 | 4.644.740,183 | 378,560 | |
| 6533 | 706.828,311 | 4.644.734,225 | 378,900 | |
| 6534 | 706.856,654 | 4.644.711,347 | 378,780 | |
| 6535 | 706.847,513 | 4.644.704,466 | 379,390 | |
| 6536 | 706.884,352 | 4.644.672,279 | 379,740 | |
| 6537 | 706.872,888 | 4.644.664,268 | 380,070 | |
| 6538 | 706.877,925 | 4.644.684,138 | 379,120 | |
| 6539 | 706.755,267 | 4.644.828,609 | 378,210 | |
| 6540 | 706.725,025 | 4.644.835,815 | 378,120 | |
| 6541 | 706.697,077 | 4.644.829,730 | 378,240 | |
| 6542 | 706.669,608 | 4.644.830,254 | 378,860 | |
| 6543 | 706.670,381 | 4.644.813,670 | 378,570 | |
| 6544 | 706.591,567 | 4.644.820,565 | 378,720 | |
| 6545 | 706.591,644 | 4.644.835,980 | 378,740 | |
| 6546 | 706.454,393 | 4.644.832,593 | 379,320 | |
| 6547 | 706.451,721 | 4.644.844,838 | 379,170 | |
| 6548 | 706.441,038 | 4.644.843,278 | 379,600 | |
| 6549 | 706.442,228 | 4.644.833,145 | 379,670 | |
| 6550 | 706.412,283 | 4.644.834,113 | 379,660 | |
| 6551 | 706.407,999 | 4.644.848,758 | 379,630 | |
| 6552 | 706.349,956 | 4.644.849,584 | 380,680 | |
| 6553 | 706.338,431 | 4.644.866,857 | 380,520 | |
| 6554 | 706.297,109 | 4.644.844,659 | 381,400 | |
| 6555 | 706.287,106 | 4.644.852,179 | 381,420 | |
| 6556 | 706.270,638 | 4.644.888,780 | 381,650 | |
| 6557 | 706.260,164 | 4.644.872,517 | 381,640 | |
| 6558 | 706.199,936 | 4.644.897,397 | 382,260 | |
| 6559 | 706.127,493 | 4.644.945,620 | 383,190 | |
| 6560 | 706.130,657 | 4.644.957,903 | 383,170 | |
| 6561 | 706.102,789 | 4.644.971,174 | 383,160 | |
| 6562 | 706.098,277 | 4.644.960,760 | 383,180 | |
| 6563 | 706.049,562 | 4.644.981,954 | 383,640 | |
| 6564 | 706.062,102 | 4.644.999,108 | 383,550 | |
| 6565 | 706.138,334 | 4.645.202,320 | 382,200 | |
| 6566 | 706.319,693 | 4.645.147,679 | 380,850 | |
| 6567 | 706.316,344 | 4.645.136,320 | 380,760 | |
| 6568 | 706.331,273 | 4.645.130,820 | 380,720 | |
| 6569 | 706.342,673 | 4.645.130,940 | 381,050 | |
| 6570 | 706.333,164 | 4.645.143,705 | 380,850 | |
| 6571 | 706.383,990 | 4.645.159,092 | 379,680 | |
| 6572 | 706.385,476 | 4.645.204,236 | 379,750 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6573 | 706.309,952 | 4.644.857,344 | 381,040 | |
| 6574 | 706.308,949 | 4.644.848,326 | 381,950 | |
| 6575 | 706.306,306 | 4.644.843,652 | 381,970 | |
| 6576 | 706.329,190 | 4.644.821,683 | 381,950 | |
| 6577 | 706.325,055 | 4.644.815,924 | 381,940 | |
| 6578 | 706.348,725 | 4.644.783,415 | 381,980 | |
| 6579 | 706.353,550 | 4.644.787,869 | 381,960 | |
| 6580 | 706.379,101 | 4.644.753,769 | 382,090 | |
| 6581 | 706.373,014 | 4.644.749,826 | 381,980 | |
| 6582 | 706.396,340 | 4.644.723,705 | 381,790 | |
| 6583 | 706.417,640 | 4.644.721,126 | 380,800 | |
| 6584 | 706.463,217 | 4.644.675,170 | 381,480 | |
| 6585 | 706.490,435 | 4.644.654,297 | 381,440 | |
| 6586 | 706.543,807 | 4.644.614,983 | 381,830 | |
| 6587 | 706.578,545 | 4.644.589,813 | 381,840 | |
| 6588 | 706.588,456 | 4.644.595,604 | 381,830 | |
| 6589 | 706.627,668 | 4.644.553,905 | 382,000 | |
| 6590 | 706.649,160 | 4.644.538,968 | 382,050 | |
| 6591 | 706.665,167 | 4.644.538,589 | 382,010 | |
| 6592 | 706.719,287 | 4.644.484,021 | 382,630 | |
| 6593 | 706.734,260 | 4.644.482,561 | 382,760 | |
| 6594 | 706.742,087 | 4.644.491,046 | 382,610 | |
| 6595 | 706.755,182 | 4.644.479,660 | 383,590 | |
| 6596 | 706.768,797 | 4.644.485,736 | 381,970 | |
| 6597 | 706.785,077 | 4.644.480,653 | 382,000 | |
| 6598 | 706.778,832 | 4.644.475,302 | 382,030 | |
| 6599 | 706.784,712 | 4.644.463,673 | 382,520 | |
| 6600 | 706.788,805 | 4.644.471,258 | 382,470 | |
| 6601 | 706.784,346 | 4.644.450,235 | 382,520 | |
| 6602 | 706.803,038 | 4.644.468,158 | 382,520 | |
| 6603 | 706.803,316 | 4.644.480,468 | 382,460 | |
| 6604 | 706.826,052 | 4.644.474,437 | 382,510 | |
| 6605 | 706.830,778 | 4.644.466,761 | 382,520 | |
| 6606 | 706.834,484 | 4.644.471,490 | 382,020 | |
| 6607 | 706.852,878 | 4.644.463,997 | 382,000 | |
| 6608 | 706.855,606 | 4.644.470,802 | 381,970 | |
| 6609 | 706.897,223 | 4.644.455,798 | 382,620 | |
| 6610 | 706.889,775 | 4.644.464,939 | 382,730 | |
| 6611 | 706.920,564 | 4.644.458,377 | 382,480 | |
| 6612 | 706.938,990 | 4.644.457,525 | 382,480 | |
| 6613 | 706.937,375 | 4.644.449,775 | 382,530 | |
| 6614 | 706.976,817 | 4.644.444,288 | 382,500 | |
| 6615 | 706.984,972 | 4.644.450,890 | 382,490 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6616 | 707.123,515 | 4.644.420,103 | 382,310 | |
| 6617 | 707.125,195 | 4.644.428,848 | 382,330 | |
| 6618 | 707.179,624 | 4.644.409,819 | 381,970 | |
| 6619 | 707.177,785 | 4.644.395,718 | 382,040 | |
| 6620 | 707.190,637 | 4.644.392,731 | 381,950 | |
| 6621 | 707.184,220 | 4.644.369,135 | 382,290 | |
| 6622 | 707.175,254 | 4.644.370,868 | 382,300 | |
| 6623 | 707.168,915 | 4.644.343,617 | 382,340 | |
| 6624 | 707.179,859 | 4.644.340,760 | 382,290 | |
| 6625 | 707.212,838 | 4.644.352,890 | 381,920 | |
| 6626 | 707.222,595 | 4.644.365,734 | 381,920 | |
| 6627 | 707.240,195 | 4.644.339,873 | 381,920 | |
| 6628 | 707.231,568 | 4.644.334,143 | 381,900 | |
| 6629 | 707.286,529 | 4.644.269,443 | 383,950 | |
| 6630 | 707.274,802 | 4.644.265,039 | 384,060 | |
| 6631 | 707.279,005 | 4.644.249,954 | 383,930 | |
| 6632 | 707.292,107 | 4.644.250,861 | 383,830 | |
| 6633 | 707.302,028 | 4.644.225,548 | 383,240 | |
| 6634 | 707.288,569 | 4.644.220,511 | 383,360 | |
| 6635 | 707.296,821 | 4.644.184,097 | 383,100 | |
| 6636 | 707.309,455 | 4.644.188,388 | 382,880 | |
| 6637 | 707.357,271 | 4.644.148,836 | 380,980 | |
| 6638 | 707.381,638 | 4.644.159,464 | 380,990 | |
| 6639 | 707.364,941 | 4.644.197,505 | 382,610 | |
| 6640 | 707.357,560 | 4.644.195,665 | 382,650 | |
| 6641 | 707.347,786 | 4.644.233,029 | 382,640 | |
| 6642 | 707.354,420 | 4.644.234,699 | 382,650 | |
| 6643 | 707.347,360 | 4.644.259,936 | 382,640 | |
| 6644 | 707.349,194 | 4.644.264,027 | 383,190 | |
| 6645 | 707.336,923 | 4.644.270,362 | 382,670 | |
| 6646 | 707.331,164 | 4.644.279,769 | 382,750 | |
| 6647 | 707.336,300 | 4.644.284,780 | 383,280 | |
| 6648 | 707.313,785 | 4.644.296,895 | 383,460 | |
| 6649 | 707.285,781 | 4.644.361,159 | 381,590 | |
| 6650 | 707.277,632 | 4.644.356,676 | 381,590 | |
| 6651 | 707.256,567 | 4.644.384,707 | 381,700 | |
| 6652 | 707.264,643 | 4.644.389,783 | 381,690 | |
| 6653 | 707.240,249 | 4.644.422,768 | 381,870 | |
| 6654 | 707.225,858 | 4.644.420,164 | 381,830 | |
| 6655 | 707.218,343 | 4.644.432,736 | 382,000 | |
| 6656 | 707.221,203 | 4.644.444,867 | 381,940 | |
| 6657 | 707.207,251 | 4.644.437,741 | 382,200 | |
| 6658 | 707.213,801 | 4.644.430,622 | 382,100 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6659 | 707.189,752 | 4.644.412,850 | 381,990 | |
| 6660 | 707.184,259 | 4.644.419,116 | 382,020 | |
| 6661 | 707.196,279 | 4.644.407,099 | 382,010 | |
| 6662 | 708.140,090 | 4.644.598,141 | 374,230 | |
| 6663 | 708.145,075 | 4.644.613,801 | 373,210 | |
| 6664 | 708.142,764 | 4.644.619,679 | 373,000 | |
| 6665 | 708.109,708 | 4.644.634,672 | 373,010 | |
| 6666 | 708.105,551 | 4.644.626,740 | 373,160 | |
| 6667 | 708.072,276 | 4.644.643,915 | 373,150 | |
| 6668 | 708.075,719 | 4.644.651,348 | 373,080 | |
| 6669 | 708.043,874 | 4.644.667,443 | 372,970 | |
| 6670 | 708.039,830 | 4.644.660,364 | 373,100 | |
| 6671 | 708.004,660 | 4.644.680,192 | 373,080 | |
| 6672 | 708.007,759 | 4.644.686,832 | 372,940 | |
| 6673 | 707.972,844 | 4.644.704,722 | 372,910 | |
| 6674 | 707.968,432 | 4.644.697,577 | 373,010 | |
| 6675 | 707.930,062 | 4.644.718,650 | 372,800 | |
| 6676 | 707.933,176 | 4.644.725,368 | 372,730 | |
| 6677 | 707.897,067 | 4.644.743,899 | 373,110 | |
| 6678 | 707.893,297 | 4.644.737,027 | 373,090 | |
| 6679 | 707.878,560 | 4.644.743,985 | 373,090 | |
| 6680 | 707.880,351 | 4.644.753,620 | 373,080 | |
| 6681 | 707.864,093 | 4.644.741,537 | 373,160 | |
| 6682 | 707.872,654 | 4.644.731,172 | 373,070 | |
| 6683 | 707.864,510 | 4.644.714,016 | 373,620 | |
| 6684 | 707.853,454 | 4.644.720,552 | 373,620 | |
| 6685 | 707.857,107 | 4.644.728,924 | 373,650 | |
| 6686 | 707.823,700 | 4.644.772,071 | 373,870 | |
| 6687 | 707.825,925 | 4.644.779,143 | 373,890 | |
| 6688 | 707.741,316 | 4.644.810,770 | 374,470 | |
| 6689 | 707.744,240 | 4.644.816,449 | 374,500 | |
| 6690 | 707.709,138 | 4.644.826,905 | 375,240 | |
| 6691 | 707.714,237 | 4.644.830,936 | 374,910 | |
| 6692 | 707.682,377 | 4.644.846,356 | 374,900 | |
| 6693 | 707.677,500 | 4.644.840,056 | 374,880 | |
| 6694 | 707.637,671 | 4.644.860,451 | 374,810 | |
| 6695 | 707.639,470 | 4.644.866,602 | 374,810 | |
| 6696 | 707.589,018 | 4.644.891,319 | 374,580 | |
| 6697 | 707.581,794 | 4.644.886,275 | 374,730 | |
| 6698 | 707.555,064 | 4.644.898,179 | 374,590 | |
| 6699 | 707.558,450 | 4.644.905,156 | 374,470 | |
| 6700 | 707.525,768 | 4.644.920,299 | 374,450 | |
| 6701 | 707.522,922 | 4.644.913,908 | 374,660 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6702 | 708.832,780 | 4.648.013,966 | 350,280 | |
| 6703 | 708.829,486 | 4.648.004,316 | 350,420 | |
| 6704 | 708.886,517 | 4.647.989,080 | 350,910 | |
| 6705 | 708.894,056 | 4.647.985,477 | 350,980 | |
| 6706 | 708.902,589 | 4.647.992,283 | 350,890 | |
| 6707 | 708.922,197 | 4.647.984,842 | 351,010 | |
| 6708 | 708.922,301 | 4.647.975,612 | 351,600 | |
| 6709 | 708.954,094 | 4.647.965,939 | 352,880 | |
| 6710 | 708.959,176 | 4.647.974,641 | 352,140 | |
| 6711 | 708.988,645 | 4.647.964,828 | 352,900 | |
| 6712 | 708.988,146 | 4.647.956,963 | 353,450 | |
| 6713 | 709.024,600 | 4.647.944,962 | 354,080 | |
| 6714 | 709.026,386 | 4.647.953,201 | 353,690 | |
| 6715 | 709.068,022 | 4.647.940,897 | 354,110 | |
| 6716 | 709.067,212 | 4.647.932,551 | 354,990 | |
| 6717 | 709.110,716 | 4.647.919,998 | 355,530 | |
| 6718 | 709.112,272 | 4.647.928,444 | 355,070 | |
| 6719 | 709.148,044 | 4.647.908,370 | 355,340 | |
| 6720 | 709.152,653 | 4.647.915,744 | 354,600 | |
| 6721 | 709.218,010 | 4.647.895,584 | 351,330 | |
| 6722 | 709.218,154 | 4.647.888,139 | 351,360 | |
| 6723 | 709.249,302 | 4.647.878,777 | 351,500 | |
| 6724 | 709.249,753 | 4.647.886,129 | 351,270 | |
| 6725 | 709.290,743 | 4.647.874,076 | 351,330 | |
| 6726 | 709.290,765 | 4.647.865,753 | 351,460 | |
| 6727 | 709.333,081 | 4.647.861,420 | 351,420 | |
| 6728 | 709.333,504 | 4.647.851,308 | 351,990 | |
| 6729 | 709.371,328 | 4.647.839,147 | 352,850 | |
| 6730 | 709.376,677 | 4.647.849,168 | 352,030 | |
| 6731 | 709.431,393 | 4.647.831,893 | 351,740 | |
| 6732 | 709.430,850 | 4.647.823,220 | 352,530 | |
| 6733 | 709.477,473 | 4.647.808,259 | 352,510 | |
| 6734 | 709.486,413 | 4.647.816,936 | 351,460 | |
| 6735 | 709.533,109 | 4.647.793,714 | 351,710 | |
| 6736 | 709.538,143 | 4.647.801,148 | 350,910 | |
| 6737 | 709.575,599 | 4.647.787,729 | 350,790 | |
| 6738 | 709.572,902 | 4.647.781,865 | 351,300 | |
| 6739 | 709.586,287 | 4.647.778,836 | 348,860 | |
| 6740 | 709.586,461 | 4.647.785,925 | 349,070 | |
| 6741 | 709.617,326 | 4.647.770,684 | 351,330 | |
| 6742 | 709.621,527 | 4.647.774,721 | 351,190 | |
| 6743 | 709.659,991 | 4.647.757,112 | 349,940 | |
| 6744 | 709.664,410 | 4.647.762,762 | 349,500 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6745 | 709.713,915 | 4.647.740,707 | 349,690 | |
| 6746 | 709.715,500 | 4.647.746,790 | 349,650 | |
| 6747 | 709.767,245 | 4.647.725,528 | 349,420 | |
| 6748 | 709.769,476 | 4.647.730,652 | 348,870 | |
| 6749 | 709.787,554 | 4.647.727,508 | 349,170 | |
| 6750 | 709.789,672 | 4.647.720,481 | 349,740 | |
| 6751 | 709.844,106 | 4.647.698,538 | 348,210 | |
| 6752 | 709.848,003 | 4.647.705,319 | 348,250 | |
| 6753 | 709.887,770 | 4.647.688,659 | 348,280 | |
| 6754 | 709.883,897 | 4.647.682,081 | 348,320 | |
| 6755 | 709.973,232 | 4.647.657,229 | 347,200 | |
| 6756 | 709.975,595 | 4.647.649,308 | 347,240 | |
| 6757 | 710.011,343 | 4.647.637,032 | 347,300 | |
| 6758 | 710.014,623 | 4.647.644,033 | 347,270 | |
| 6759 | 710.047,140 | 4.647.628,297 | 347,350 | |
| 6760 | 710.046,076 | 4.647.622,887 | 347,370 | |
| 6761 | 710.077,393 | 4.647.612,918 | 347,470 | |
| 6762 | 710.078,897 | 4.647.618,233 | 347,450 | |
| 6763 | 710.110,277 | 4.647.599,616 | 347,010 | |
| 6764 | 710.114,128 | 4.647.605,314 | 347,040 | |
| 6765 | 710.144,113 | 4.647.592,905 | 347,010 | |
| 6766 | 710.141,964 | 4.647.588,043 | 347,040 | |
| 6767 | 710.175,533 | 4.647.572,791 | 346,720 | |
| 6768 | 710.180,226 | 4.647.581,081 | 346,750 | |
| 6769 | 710.209,497 | 4.647.570,888 | 346,750 | |
| 6770 | 710.207,876 | 4.647.565,431 | 346,750 | |
| 6771 | 710.237,233 | 4.647.557,831 | 346,750 | |
| 6772 | 710.238,103 | 4.647.563,083 | 346,740 | |
| 6773 | 710.255,826 | 4.647.549,793 | 346,370 | |
| 6774 | 710.257,912 | 4.647.557,537 | 346,430 | |
| 6775 | 710.286,689 | 4.647.548,067 | 346,350 | |
| 6776 | 710.285,394 | 4.647.543,434 | 346,330 | |
| 6777 | 710.313,165 | 4.647.535,705 | 346,330 | |
| 6778 | 710.314,437 | 4.647.540,680 | 346,330 | |
| 6779 | 710.354,375 | 4.647.523,125 | 345,960 | |
| 6780 | 710.356,019 | 4.647.528,140 | 345,980 | |
| 6781 | 710.386,258 | 4.647.519,177 | 345,940 | |
| 6782 | 710.385,026 | 4.647.513,970 | 345,950 | |
| 6783 | 710.411,365 | 4.647.506,411 | 345,940 | |
| 6784 | 710.413,228 | 4.647.511,510 | 345,930 | |
| 6785 | 710.446,672 | 4.647.496,977 | 345,670 | |
| 6786 | 710.448,063 | 4.647.500,637 | 345,700 | |
| 6787 | 710.475,739 | 4.647.492,019 | 345,710 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6788 | 710.474,304 | 4.647.487,387 | 345,740 | |
| 6789 | 710.499,957 | 4.647.479,984 | 345,740 | |
| 6790 | 710.501,367 | 4.647.484,484 | 345,720 | |
| 6791 | 710.540,503 | 4.647.467,812 | 345,490 | |
| 6792 | 710.542,079 | 4.647.471,946 | 345,520 | |
| 6793 | 710.557,287 | 4.647.469,887 | 345,420 | |
| 6794 | 710.556,323 | 4.647.461,065 | 345,540 | |
| 6795 | 710.576,665 | 4.647.456,676 | 345,350 | |
| 6796 | 710.578,930 | 4.647.460,541 | 345,340 | |
| 6797 | 710.636,240 | 4.647.442,549 | 345,160 | |
| 6798 | 710.633,791 | 4.647.437,997 | 345,230 | |
| 6799 | 710.653,268 | 4.647.432,440 | 345,240 | |
| 6800 | 710.659,714 | 4.647.436,138 | 345,200 | |
| 6801 | 710.679,765 | 4.647.429,577 | 345,230 | |
| 6802 | 710.680,715 | 4.647.424,304 | 345,280 | |
| 6803 | 710.713,492 | 4.647.416,167 | 344,850 | |
| 6804 | 710.714,043 | 4.647.418,652 | 344,770 | |
| 6805 | 710.726,332 | 4.647.415,806 | 344,790 | |
| 6806 | 710.727,933 | 4.647.411,632 | 344,840 | |
| 6807 | 710.749,073 | 4.647.405,078 | 344,780 | |
| 6808 | 710.750,812 | 4.647.407,207 | 344,750 | |
| 6809 | 710.777,180 | 4.647.399,938 | 344,750 | |
| 6810 | 710.776,980 | 4.647.396,885 | 344,770 | |
| 6811 | 710.804,878 | 4.647.388,402 | 344,690 | |
| 6812 | 710.806,631 | 4.647.391,191 | 344,710 | |
| 6813 | 710.831,588 | 4.647.383,649 | 344,710 | |
| 6814 | 710.831,495 | 4.647.380,378 | 344,730 | |
| 6815 | 710.859,659 | 4.647.371,989 | 344,720 | |
| 6816 | 710.861,330 | 4.647.376,599 | 344,720 | |
| 6817 | 710.888,943 | 4.647.367,188 | 344,690 | |
| 6818 | 710.888,614 | 4.647.363,444 | 344,720 | |
| 6819 | 710.913,154 | 4.647.356,719 | 344,730 | |
| 6820 | 710.913,881 | 4.647.360,041 | 344,640 | |
| 6821 | 710.922,636 | 4.647.359,808 | 345,130 | |
| 6822 | 710.920,037 | 4.647.349,244 | 345,040 | |
| 6823 | 710.927,146 | 4.647.352,468 | 345,120 | |
| 6824 | 710.928,434 | 4.647.357,112 | 345,020 | |
| 6825 | 711.220,702 | 4.647.374,403 | 342,070 | |
| 6826 | 711.250,765 | 4.647.370,904 | 342,010 | |
| 6827 | 711.282,758 | 4.647.366,788 | 342,000 | |
| 6828 | 711.311,542 | 4.647.363,232 | 341,990 | |
| 6829 | 711.342,697 | 4.647.358,401 | 341,980 | |
| 6830 | 711.371,495 | 4.647.361,773 | 342,000 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6831 | 711.388,598 | 4.647.338,959 | 341,080 | |
| 6832 | 711.381,965 | 4.647.335,689 | 341,050 | |
| 6833 | 711.364,784 | 4.647.361,084 | 341,860 | |
| 6834 | 711.343,171 | 4.647.364,740 | 341,930 | |
| 6835 | 711.311,757 | 4.647.368,884 | 341,940 | |
| 6836 | 711.284,675 | 4.647.371,724 | 341,950 | |
| 6837 | 711.252,681 | 4.647.376,456 | 342,000 | |
| 6838 | 711.223,271 | 4.647.378,865 | 341,980 | |
| 6839 | 711.202,496 | 4.647.382,852 | 341,930 | |
| 6840 | 711.197,982 | 4.647.377,576 | 341,950 | |
| 6841 | 711.167,816 | 4.647.386,217 | 342,470 | |
| 6842 | 711.164,132 | 4.647.382,381 | 342,130 | |
| 6843 | 711.130,146 | 4.647.392,356 | 342,040 | |
| 6844 | 711.127,723 | 4.647.386,831 | 341,820 | |
| 6845 | 711.093,409 | 4.647.391,761 | 342,030 | |
| 6846 | 711.093,580 | 4.647.397,512 | 342,190 | |
| 6847 | 711.034,046 | 4.647.403,931 | 343,390 | |
| 6848 | 711.031,882 | 4.647.399,992 | 343,400 | |
| 6849 | 711.004,335 | 4.647.410,357 | 343,420 | |
| 6850 | 711.003,529 | 4.647.402,932 | 343,450 | |
| 6851 | 710.978,488 | 4.647.414,447 | 343,330 | |
| 6852 | 710.979,266 | 4.647.419,217 | 343,310 | |
| 6853 | 710.942,602 | 4.647.425,042 | 343,890 | |
| 6854 | 710.943,859 | 4.647.429,250 | 343,900 | |
| 6855 | 710.917,199 | 4.647.437,193 | 343,910 | |
| 6856 | 710.915,453 | 4.647.432,916 | 343,910 | |
| 6857 | 710.883,710 | 4.647.442,218 | 344,000 | |
| 6858 | 710.884,475 | 4.647.446,672 | 344,020 | |
| 6859 | 710.849,630 | 4.647.457,179 | 344,050 | |
| 6860 | 710.848,333 | 4.647.452,606 | 344,030 | |
| 6861 | 710.819,165 | 4.647.461,531 | 344,090 | |
| 6862 | 710.820,232 | 4.647.466,064 | 344,140 | |
| 6863 | 710.788,683 | 4.647.475,006 | 344,110 | |
| 6864 | 710.787,383 | 4.647.469,573 | 344,130 | |
| 6865 | 710.753,745 | 4.647.480,744 | 344,210 | |
| 6866 | 710.754,608 | 4.647.485,974 | 344,270 | |
| 6867 | 710.596,469 | 4.647.533,056 | 345,110 | |
| 6868 | 710.595,061 | 4.647.528,109 | 345,150 | |
| 6869 | 710.563,028 | 4.647.538,653 | 345,130 | |
| 6870 | 710.563,504 | 4.647.543,656 | 345,190 | |
| 6871 | 710.534,584 | 4.647.551,919 | 345,260 | |
| 6872 | 710.533,447 | 4.647.546,928 | 345,310 | |
| 6873 | 710.511,281 | 4.647.554,758 | 345,480 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6874 | 710.513,099 | 4.647.559,717 | 345,430 | |
| 6875 | 710.461,407 | 4.647.574,892 | 345,380 | |
| 6876 | 710.460,146 | 4.647.571,264 | 345,360 | |
| 6877 | 710.449,743 | 4.647.574,966 | 345,400 | |
| 6878 | 710.449,712 | 4.647.581,882 | 345,640 | |
| 6879 | 710.437,063 | 4.647.581,654 | 345,690 | |
| 6880 | 710.436,599 | 4.647.577,719 | 345,760 | |
| 6881 | 710.415,232 | 4.647.589,282 | 345,650 | |
| 6882 | 710.414,520 | 4.647.585,086 | 345,630 | |
| 6883 | 710.389,499 | 4.647.593,380 | 345,740 | |
| 6884 | 710.390,723 | 4.647.598,034 | 345,770 | |
| 6885 | 710.322,472 | 4.647.614,638 | 346,070 | |
| 6886 | 710.324,911 | 4.647.619,237 | 346,050 | |
| 6887 | 710.324,943 | 4.647.619,251 | 346,040 | |
| 6888 | 710.324,963 | 4.647.619,229 | 346,040 | |
| 6889 | 710.324,935 | 4.647.619,244 | 346,040 | |
| 6890 | 710.292,462 | 4.647.629,352 | 346,080 | |
| 6891 | 710.291,065 | 4.647.624,247 | 346,120 | |
| 6892 | 710.258,679 | 4.647.634,331 | 346,070 | |
| 6893 | 710.259,935 | 4.647.639,573 | 346,110 | |
| 6894 | 710.209,117 | 4.647.657,465 | 348,110 | |
| 6895 | 710.206,264 | 4.647.646,704 | 348,070 | |
| 6896 | 710.213,098 | 4.647.644,934 | 348,240 | |
| 6897 | 710.180,354 | 4.647.589,017 | 346,810 | |
| 6898 | 710.189,479 | 4.647.582,953 | 346,540 | |
| 6899 | 710.184,227 | 4.647.568,857 | 346,730 | |
| 6900 | 710.107,779 | 4.647.440,458 | 354,950 | |
| 6901 | 710.100,439 | 4.647.442,898 | 354,940 | |
| 6902 | 710.170,216 | 4.647.661,477 | 345,080 | |
| 6903 | 710.170,895 | 4.647.669,266 | 345,060 | |
| 6904 | 710.131,545 | 4.647.681,148 | 344,450 | |
| 6905 | 710.128,076 | 4.647.674,814 | 344,440 | |
| 6906 | 710.085,442 | 4.647.696,344 | 344,430 | |
| 6907 | 710.082,525 | 4.647.688,160 | 344,400 | |
| 6908 | 710.045,491 | 4.647.699,156 | 344,600 | |
| 6909 | 710.047,567 | 4.647.708,072 | 344,730 | |
| 6910 | 710.014,481 | 4.647.718,304 | 344,560 | |
| 6911 | 710.012,009 | 4.647.711,121 | 344,560 | |
| 6912 | 709.945,395 | 4.647.739,538 | 344,820 | |
| 6913 | 709.943,717 | 4.647.731,144 | 344,790 | |
| 6914 | 709.903,998 | 4.647.743,868 | 344,970 | |
| 6915 | 709.905,043 | 4.647.750,992 | 344,930 | |
| 6916 | 709.865,144 | 4.647.762,670 | 345,130 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6917 | 709.863,008 | 4.647.755,692 | 345,130 | |
| 6918 | 709.815,260 | 4.647.770,230 | 345,280 | |
| 6919 | 709.817,327 | 4.647.778,642 | 345,310 | |
| 6920 | 709.752,526 | 4.647.796,796 | 345,760 | |
| 6921 | 709.750,183 | 4.647.788,562 | 345,750 | |
| 6922 | 709.714,532 | 4.647.799,333 | 345,740 | |
| 6923 | 709.716,847 | 4.647.806,730 | 345,720 | |
| 6924 | 709.682,491 | 4.647.817,797 | 345,730 | |
| 6925 | 709.679,810 | 4.647.810,509 | 345,730 | |
| 6926 | 709.654,624 | 4.647.827,869 | 346,030 | |
| 6927 | 709.652,668 | 4.647.818,595 | 346,040 | |
| 6928 | 709.618,900 | 4.647.828,292 | 346,320 | |
| 6929 | 709.618,710 | 4.647.838,041 | 346,260 | |
| 6930 | 709.603,345 | 4.647.822,829 | 346,440 | |
| 6931 | 709.580,893 | 4.647.829,289 | 346,640 | |
| 6932 | 709.562,381 | 4.647.840,311 | 346,930 | |
| 6933 | 709.563,382 | 4.647.855,370 | 346,810 | |
| 6934 | 709.457,158 | 4.647.878,177 | 347,500 | |
| 6935 | 709.456,790 | 4.647.885,417 | 347,520 | |
| 6936 | 709.352,513 | 4.647.900,762 | 348,580 | |
| 6937 | 709.322,908 | 4.647.909,924 | 348,840 | |
| 6938 | 709.265,257 | 4.647.943,737 | 350,170 | |
| 6939 | 709.259,578 | 4.647.933,992 | 350,180 | |
| 6940 | 709.235,215 | 4.647.942,165 | 350,110 | |
| 6941 | 709.237,586 | 4.647.949,248 | 350,190 | |
| 6942 | 709.167,591 | 4.647.962,093 | 351,110 | |
| 6943 | 709.170,139 | 4.647.970,193 | 351,100 | |
| 6944 | 709.145,280 | 4.647.977,293 | 351,100 | |
| 6945 | 709.142,478 | 4.647.968,244 | 351,150 | |
| 6946 | 709.090,116 | 4.647.981,805 | 351,140 | |
| 6947 | 709.093,281 | 4.647.992,387 | 351,120 | |
| 6948 | 709.064,008 | 4.648.002,740 | 351,160 | |
| 6949 | 709.058,968 | 4.647.992,022 | 351,240 | |
| 6950 | 709.014,861 | 4.648.007,495 | 349,660 | |
| 6951 | 709.017,618 | 4.648.013,962 | 349,640 | |
| 6952 | 708.981,155 | 4.648.024,008 | 349,640 | |
| 6953 | 708.979,074 | 4.648.016,643 | 349,660 | |
| 6954 | 708.942,194 | 4.648.027,627 | 349,650 | |
| 6955 | 708.943,879 | 4.648.035,642 | 349,590 | |
| 6956 | 708.893,098 | 4.648.050,300 | 350,040 | |
| 6957 | 708.889,564 | 4.648.045,038 | 350,110 | |
| 6958 | 708.865,242 | 4.648.060,546 | 350,040 | |
| 6959 | 708.859,412 | 4.648.055,181 | 350,200 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 6960 | 708.826,726 | 4.648.064,776 | 350,280 | |
| 6961 | 708.827,098 | 4.648.071,244 | 350,130 | |
| 6962 | 708.796,758 | 4.648.081,081 | 350,340 | |
| 6963 | 708.794,461 | 4.648.075,828 | 350,150 | |
| 6964 | 708.759,629 | 4.648.086,068 | 350,620 | |
| 6965 | 708.760,733 | 4.648.092,825 | 350,480 | |
| 6966 | 708.726,358 | 4.648.102,225 | 350,270 | |
| 6967 | 708.724,023 | 4.648.096,309 | 350,760 | |
| 6968 | 708.702,644 | 4.648.103,361 | 351,160 | |
| 6969 | 708.703,416 | 4.648.109,009 | 350,900 | |
| 6970 | 708.658,193 | 4.648.122,860 | 351,000 | |
| 6971 | 708.655,116 | 4.648.116,398 | 351,010 | |
| 6972 | 708.610,340 | 4.648.130,774 | 353,140 | |
| 6973 | 708.613,350 | 4.648.138,713 | 353,080 | |
| 6974 | 708.579,373 | 4.648.148,109 | 353,190 | |
| 6975 | 708.576,240 | 4.648.139,664 | 353,180 | |
| 6976 | 708.541,689 | 4.648.152,269 | 353,240 | |
| 6977 | 708.544,983 | 4.648.159,641 | 353,220 | |
| 6978 | 708.480,717 | 4.648.178,984 | 354,100 | |
| 6979 | 708.478,729 | 4.648.171,868 | 354,110 | |
| 6980 | 708.445,825 | 4.648.182,204 | 354,190 | |
| 6981 | 708.448,435 | 4.648.189,713 | 354,150 | |
| 6982 | 708.417,545 | 4.648.199,831 | 354,190 | |
| 6983 | 708.414,044 | 4.648.191,411 | 354,210 | |
| 6984 | 708.376,309 | 4.648.203,733 | 354,230 | |
| 6985 | 708.378,962 | 4.648.210,237 | 354,210 | |
| 6986 | 708.340,853 | 4.648.215,216 | 353,940 | |
| 6987 | 708.342,980 | 4.648.221,561 | 353,970 | |
| 6988 | 708.305,713 | 4.648.232,396 | 353,890 | |
| 6989 | 708.303,086 | 4.648.224,555 | 353,900 | |
| 6990 | 708.245,302 | 4.648.243,361 | 353,500 | |
| 6991 | 708.247,919 | 4.648.250,249 | 353,460 | |
| 6992 | 708.207,029 | 4.648.262,163 | 353,420 | |
| 6993 | 708.204,226 | 4.648.254,509 | 353,430 | |
| 6994 | 708.171,199 | 4.648.264,234 | 353,430 | |
| 6995 | 708.173,932 | 4.648.272,239 | 353,430 | |
| 6996 | 708.117,047 | 4.648.280,319 | 353,840 | |
| 6997 | 708.119,431 | 4.648.287,908 | 353,790 | |
| 6998 | 708.082,157 | 4.648.300,077 | 353,880 | |
| 6999 | 708.078,413 | 4.648.291,223 | 353,820 | |
| 7000 | 708.032,277 | 4.648.306,144 | 353,870 | |
| 7001 | 708.035,028 | 4.648.313,397 | 353,870 | |
| 7002 | 707.982,354 | 4.648.324,185 | 354,270 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7003 | 707.982,460 | 4.648.316,114 | 354,290 | |
| 7004 | 707.948,754 | 4.648.321,191 | 354,280 | |
| 7005 | 707.950,559 | 4.648.329,445 | 354,290 | |
| 7006 | 707.909,842 | 4.648.335,257 | 354,260 | |
| 7007 | 707.909,029 | 4.648.326,106 | 354,280 | |
| 7008 | 707.837,388 | 4.648.344,391 | 354,780 | |
| 7009 | 707.836,468 | 4.648.336,437 | 354,770 | |
| 7010 | 707.797,448 | 4.648.344,172 | 354,740 | |
| 7011 | 707.797,801 | 4.648.349,845 | 354,730 | |
| 7012 | 707.789,133 | 4.648.351,336 | 354,730 | |
| 7013 | 707.777,744 | 4.648.344,316 | 354,740 | |
| 7014 | 707.775,193 | 4.648.357,095 | 354,810 | |
| 7015 | 707.734,869 | 4.648.360,381 | 355,180 | |
| 7016 | 707.739,461 | 4.648.367,912 | 355,140 | |
| 7017 | 707.718,271 | 4.648.377,410 | 355,120 | |
| 7018 | 707.715,459 | 4.648.368,407 | 355,120 | |
| 7019 | 707.784,488 | 4.648.384,653 | 354,710 | |
| 7020 | 707.796,699 | 4.648.382,620 | 354,730 | |
| 7021 | 707.805,980 | 4.648.427,765 | 354,710 | |
| 7022 | 707.795,723 | 4.648.430,456 | 354,710 | |
| 7023 | 707.802,722 | 4.648.472,288 | 355,090 | |
| 7024 | 707.808,439 | 4.648.496,900 | 355,090 | |
| 7025 | 707.815,336 | 4.648.494,182 | 355,110 | |
| 7026 | 707.823,556 | 4.648.540,568 | 355,160 | |
| 7027 | 707.815,446 | 4.648.542,537 | 355,150 | |
| 7028 | 707.821,149 | 4.648.568,866 | 355,330 | |
| 7029 | 707.829,355 | 4.648.567,406 | 355,280 | |
| 7030 | 707.832,656 | 4.648.582,304 | 355,240 | |
| 7031 | 707.823,259 | 4.648.584,022 | 355,210 | |
| 7032 | 707.823,613 | 4.648.599,569 | 355,230 | |
| 7033 | 707.832,437 | 4.648.599,971 | 355,240 | |
| 7034 | 707.830,926 | 4.648.614,198 | 355,430 | |
| 7035 | 707.820,456 | 4.648.616,889 | 355,420 | |
| 7036 | 707.809,624 | 4.648.658,768 | 355,380 | |
| 7037 | 707.800,698 | 4.648.710,956 | 355,660 | |
| 7038 | 707.808,930 | 4.648.711,689 | 355,660 | |
| 7039 | 707.794,308 | 4.648.740,181 | 355,880 | |
| 7040 | 707.802,609 | 4.648.746,032 | 355,930 | |
| 7041 | 707.802,042 | 4.648.762,219 | 355,930 | |
| 7042 | 707.791,012 | 4.648.761,865 | 355,960 | |
| 7043 | 707.797,142 | 4.648.784,410 | 355,980 | |
| 7044 | 707.805,561 | 4.648.780,735 | 355,980 | |
| 7045 | 707.813,686 | 4.648.803,585 | 355,950 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7046 | 707.803,047 | 4.648.803,312 | 356,040 | |
| 7047 | 707.217,381 | 4.648.514,331 | 364,400 | |
| 7048 | 707.215,424 | 4.648.521,076 | 364,720 | |
| 7049 | 707.183,213 | 4.648.499,830 | 363,590 | |
| 7050 | 707.177,391 | 4.648.505,815 | 363,590 | |
| 7051 | 707.157,877 | 4.648.489,681 | 362,890 | |
| 7052 | 707.147,343 | 4.648.495,393 | 362,400 | |
| 7053 | 707.120,678 | 4.648.476,407 | 362,410 | |
| 7054 | 707.114,209 | 4.648.483,643 | 362,330 | |
| 7055 | 707.082,614 | 4.648.472,533 | 361,950 | |
| 7056 | 707.089,830 | 4.648.465,627 | 362,070 | |
| 7057 | 707.053,235 | 4.648.450,279 | 361,580 | |
| 7058 | 707.044,725 | 4.648.457,998 | 361,520 | |
| 7059 | 707.007,432 | 4.648.444,662 | 361,030 | |
| 7060 | 707.014,742 | 4.648.437,183 | 361,100 | |
| 7061 | 706.976,715 | 4.648.422,243 | 360,600 | |
| 7062 | 706.969,392 | 4.648.431,399 | 360,640 | |
| 7063 | 706.935,136 | 4.648.407,235 | 360,550 | |
| 7064 | 706.929,707 | 4.648.416,594 | 360,560 | |
| 7065 | 706.894,648 | 4.648.405,007 | 360,650 | |
| 7066 | 706.901,954 | 4.648.392,155 | 360,630 | |
| 7067 | 706.879,386 | 4.648.404,782 | 360,650 | |
| 7068 | 706.885,146 | 4.648.410,237 | 360,650 | |
| 7069 | 706.866,820 | 4.648.427,501 | 360,670 | |
| 7070 | 706.860,564 | 4.648.421,042 | 360,660 | |
| 7071 | 706.841,814 | 4.648.438,191 | 360,630 | |
| 7072 | 706.846,352 | 4.648.445,460 | 360,660 | |
| 7073 | 706.870,954 | 4.648.369,330 | 360,650 | |
| 7074 | 706.873,632 | 4.648.364,576 | 360,650 | |
| 7075 | 706.879,018 | 4.648.359,875 | 360,650 | |
| 7076 | 706.887,780 | 4.648.368,299 | 360,720 | |
| 7077 | 706.904,679 | 4.648.350,470 | 360,970 | |
| 7078 | 706.898,183 | 4.648.347,019 | 361,000 | |
| 7079 | 706.920,878 | 4.648.324,261 | 361,020 | |
| 7080 | 706.928,672 | 4.648.328,340 | 361,060 | |
| 7081 | 706.992,135 | 4.648.270,480 | 360,940 | |
| 7082 | 706.985,098 | 4.648.264,873 | 361,020 | |
| 7083 | 707.012,669 | 4.648.240,453 | 360,960 | |
| 7084 | 707.018,765 | 4.648.245,387 | 360,950 | |
| 7085 | 707.078,647 | 4.648.176,464 | 361,360 | |
| 7086 | 707.105,343 | 4.648.152,159 | 361,390 | |
| 7087 | 707.124,238 | 4.648.151,486 | 361,370 | |
| 7088 | 707.160,940 | 4.648.112,771 | 361,320 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7089 | 707.157,931 | 4.648.104,454 | 361,340 | |
| 7090 | 707.187,839 | 4.648.075,422 | 361,410 | |
| 7091 | 707.193,692 | 4.648.082,165 | 361,370 | |
| 7092 | 707.231,058 | 4.648.045,926 | 361,610 | |
| 7093 | 707.226,358 | 4.648.038,786 | 361,590 | |
| 7094 | 707.275,330 | 4.648.003,949 | 360,870 | |
| 7095 | 707.270,867 | 4.647.997,927 | 360,880 | |
| 7096 | 707.300,709 | 4.647.982,519 | 360,980 | |
| 7097 | 707.293,205 | 4.647.975,979 | 361,020 | |
| 7098 | 707.312,922 | 4.647.956,383 | 361,120 | |
| 7099 | 707.325,734 | 4.647.959,358 | 361,940 | |
| 7100 | 707.339,348 | 4.647.938,772 | 362,000 | |
| 7101 | 707.332,179 | 4.647.931,025 | 361,990 | |
| 7102 | 707.348,482 | 4.647.906,935 | 361,970 | |
| 7103 | 707.356,492 | 4.647.913,152 | 361,930 | |
| 7104 | 707.380,595 | 4.647.875,402 | 362,140 | |
| 7105 | 707.377,990 | 4.647.862,013 | 362,310 | |
| 7106 | 707.397,958 | 4.647.835,179 | 362,100 | |
| 7107 | 707.403,920 | 4.647.844,120 | 362,130 | |
| 7108 | 707.410,288 | 4.647.833,868 | 362,120 | |
| 7109 | 707.427,091 | 4.647.852,272 | 363,090 | |
| 7110 | 707.423,471 | 4.647.857,177 | 363,020 | |
| 7111 | 707.410,305 | 4.647.820,581 | 362,130 | |
| 7112 | 707.402,934 | 4.647.817,572 | 362,130 | |
| 7113 | 707.409,969 | 4.647.790,031 | 362,090 | |
| 7114 | 707.416,030 | 4.647.797,746 | 362,190 | |
| 7115 | 707.422,193 | 4.647.766,496 | 362,250 | |
| 7116 | 707.412,722 | 4.647.766,237 | 362,180 | |
| 7117 | 707.406,672 | 4.647.743,293 | 362,050 | |
| 7118 | 707.413,243 | 4.647.741,574 | 362,060 | |
| 7119 | 707.405,808 | 4.647.712,894 | 361,970 | |
| 7120 | 707.397,629 | 4.647.714,076 | 361,980 | |
| 7121 | 707.396,803 | 4.647.680,985 | 361,760 | |
| 7122 | 707.388,155 | 4.647.682,207 | 361,790 | |
| 7123 | 707.386,044 | 4.647.635,726 | 361,710 | |
| 7124 | 707.375,749 | 4.647.640,097 | 361,740 | |
| 7125 | 707.373,366 | 4.647.587,725 | 361,670 | |
| 7126 | 707.359,621 | 4.647.588,299 | 361,770 | |
| 7127 | 707.354,389 | 4.647.567,853 | 361,710 | |
| 7128 | 707.367,425 | 4.647.568,940 | 361,670 | |
| 7129 | 708.209,886 | 4.647.861,329 | 354,800 | |
| 7130 | 708.204,827 | 4.647.860,770 | 354,780 | |
| 7131 | 708.199,948 | 4.647.851,392 | 355,330 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7132 | 708.163,722 | 4.647.844,506 | 356,320 | |
| 7133 | 708.161,211 | 4.647.853,233 | 355,860 | |
| 7134 | 708.122,774 | 4.647.845,392 | 355,860 | |
| 7135 | 708.123,377 | 4.647.835,232 | 355,850 | |
| 7136 | 708.080,805 | 4.647.826,146 | 355,870 | |
| 7137 | 708.078,506 | 4.647.834,282 | 355,870 | |
| 7138 | 708.010,394 | 4.647.819,892 | 357,400 | |
| 7139 | 708.006,296 | 4.647.811,405 | 357,360 | |
| 7140 | 707.956,215 | 4.647.799,921 | 358,230 | |
| 7141 | 707.959,000 | 4.647.793,087 | 358,240 | |
| 7142 | 707.920,145 | 4.647.784,161 | 358,260 | |
| 7143 | 707.923,283 | 4.647.777,479 | 358,230 | |
| 7144 | 707.889,905 | 4.647.762,825 | 358,290 | |
| 7145 | 707.886,224 | 4.647.769,061 | 358,280 | |
| 7146 | 707.848,557 | 4.647.753,436 | 358,330 | |
| 7147 | 707.849,228 | 4.647.745,553 | 358,400 | |
| 7148 | 707.805,496 | 4.647.725,380 | 358,540 | |
| 7149 | 707.800,196 | 4.647.732,573 | 358,490 | |
| 7150 | 707.785,314 | 4.647.723,665 | 358,790 | |
| 7151 | 707.790,316 | 4.647.716,136 | 358,900 | |
| 7152 | 707.779,271 | 4.647.707,283 | 358,750 | |
| 7153 | 707.771,819 | 4.647.711,979 | 358,710 | |
| 7154 | 707.684,664 | 4.647.500,842 | 363,140 | |
| 7155 | 707.691,362 | 4.647.499,091 | 364,050 | |
| 7156 | 707.694,227 | 4.647.510,407 | 364,920 | |
| 7157 | 707.764,109 | 4.647.687,679 | 358,820 | |
| 7158 | 707.757,257 | 4.647.692,007 | 358,650 | |
| 7159 | 707.739,960 | 4.647.677,803 | 358,700 | |
| 7160 | 707.751,163 | 4.647.668,762 | 358,580 | |
| 7161 | 707.713,295 | 4.647.620,159 | 358,990 | |
| 7162 | 707.707,386 | 4.647.624,504 | 359,000 | |
| 7163 | 707.685,678 | 4.647.597,316 | 359,010 | |
| 7164 | 707.692,245 | 4.647.591,224 | 359,000 | |
| 7165 | 707.645,412 | 4.647.557,434 | 359,620 | |
| 7166 | 707.641,943 | 4.647.565,498 | 359,650 | |
| 7167 | 707.608,102 | 4.647.565,126 | 359,640 | |
| 7168 | 707.609,592 | 4.647.556,605 | 359,610 | |
| 7169 | 707.549,487 | 4.647.557,786 | 361,480 | |
| 7170 | 707.548,960 | 4.647.563,935 | 361,490 | |
| 7171 | 707.508,871 | 4.647.564,997 | 361,520 | |
| 7172 | 707.507,219 | 4.647.556,894 | 361,480 | |
| 7173 | 707.429,995 | 4.647.553,831 | 361,530 | |
| 7174 | 707.430,129 | 4.647.563,447 | 361,490 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7175 | 707.406,665 | 4.647.563,833 | 361,610 | |
| 7176 | 707.404,151 | 4.647.556,539 | 361,550 | |
| 7177 | 707.386,419 | 4.647.556,498 | 361,480 | |
| 7178 | 707.386,682 | 4.647.563,123 | 361,510 | |
| 7179 | 707.355,714 | 4.647.552,859 | 361,700 | |
| 7180 | 707.346,210 | 4.647.557,231 | 361,620 | |
| 7181 | 707.329,284 | 4.647.539,857 | 361,730 | |
| 7182 | 707.325,254 | 4.647.548,070 | 361,760 | |
| 7183 | 707.303,600 | 4.647.528,899 | 361,790 | |
| 7184 | 707.301,386 | 4.647.536,961 | 361,850 | |
| 7185 | 707.279,611 | 4.647.518,865 | 362,160 | |
| 7186 | 707.273,298 | 4.647.525,369 | 362,170 | |
| 7187 | 707.255,690 | 4.647.512,428 | 362,340 | |
| 7188 | 707.252,016 | 4.647.521,112 | 362,450 | |
| 7189 | 707.222,576 | 4.647.506,879 | 362,800 | |
| 7190 | 707.220,641 | 4.647.515,919 | 362,900 | |
| 7191 | 707.183,650 | 4.647.511,819 | 363,290 | |
| 7192 | 707.183,913 | 4.647.503,430 | 363,180 | |
| 7193 | 707.140,926 | 4.647.510,688 | 363,440 | |
| 7194 | 707.140,908 | 4.647.502,375 | 363,390 | |
| 7195 | 707.107,708 | 4.647.510,075 | 363,440 | |
| 7196 | 707.108,678 | 4.647.499,808 | 363,360 | |
| 7197 | 707.094,346 | 4.647.500,116 | 363,320 | |
| 7198 | 707.090,248 | 4.647.515,648 | 363,280 | |
| 7199 | 707.095,512 | 4.647.522,987 | 363,360 | |
| 7200 | 707.077,493 | 4.647.545,474 | 363,680 | |
| 7201 | 707.071,897 | 4.647.540,091 | 363,660 | |
| 7202 | 707.049,254 | 4.647.569,949 | 364,230 | |
| 7203 | 707.055,296 | 4.647.575,351 | 364,350 | |
| 7204 | 707.038,364 | 4.647.594,266 | 364,780 | |
| 7205 | 707.033,683 | 4.647.591,222 | 364,660 | |
| 7206 | 707.019,376 | 4.647.612,002 | 365,030 | |
| 7207 | 707.023,837 | 4.647.616,072 | 365,110 | |
| 7208 | 707.004,151 | 4.647.639,998 | 365,720 | |
| 7209 | 706.999,372 | 4.647.636,371 | 365,640 | |
| 7210 | 706.977,559 | 4.647.667,047 | 367,030 | |
| 7211 | 706.981,587 | 4.647.670,325 | 367,090 | |
| 7212 | 706.967,746 | 4.647.688,238 | 367,050 | |
| 7213 | 706.963,604 | 4.647.685,525 | 367,010 | |
| 7214 | 706.946,972 | 4.647.706,631 | 367,030 | |
| 7215 | 706.950,751 | 4.647.710,535 | 367,050 | |
| 7216 | 706.935,987 | 4.647.730,968 | 367,060 | |
| 7217 | 706.930,269 | 4.647.727,992 | 367,030 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7218 | 706.915,018 | 4.647.742,994 | 367,510 | |
| 7219 | 706.922,841 | 4.647.749,977 | 367,340 | |
| 7220 | 707.098,026 | 4.647.461,518 | 363,170 | |
| 7221 | 707.089,831 | 4.647.460,098 | 363,150 | |
| 7222 | 707.083,372 | 4.647.433,022 | 363,250 | |
| 7223 | 707.089,904 | 4.647.432,196 | 363,310 | |
| 7224 | 707.086,369 | 4.647.418,033 | 363,420 | |
| 7225 | 707.080,593 | 4.647.419,291 | 363,290 | |
| 7226 | 707.069,788 | 4.647.377,458 | 364,310 | |
| 7227 | 707.077,315 | 4.647.375,969 | 364,380 | |
| 7228 | 707.065,600 | 4.647.330,310 | 366,350 | |
| 7229 | 707.057,942 | 4.647.331,002 | 366,180 | |
| 7230 | 707.054,026 | 4.647.282,823 | 369,360 | |
| 7231 | 707.045,975 | 4.647.283,720 | 369,540 | |
| 7232 | 707.043,952 | 4.647.245,189 | 372,490 | |
| 7233 | 707.036,664 | 4.647.246,548 | 372,720 | |
| 7234 | 707.027,077 | 4.647.211,056 | 375,200 | |
| 7235 | 707.040,604 | 4.647.213,922 | 374,190 | |
| 7236 | 707.043,801 | 4.647.209,317 | 374,200 | |
| 7237 | 707.041,067 | 4.647.201,249 | 375,310 | |
| 7238 | 707.060,361 | 4.647.188,887 | 375,910 | |
| 7239 | 707.065,181 | 4.647.193,312 | 376,010 | |
| 7240 | 707.080,449 | 4.647.174,691 | 375,870 | |
| 7241 | 707.083,660 | 4.647.179,356 | 375,820 | |
| 7242 | 707.101,316 | 4.647.156,367 | 375,900 | |
| 7243 | 707.109,694 | 4.647.159,701 | 375,900 | |
| 7244 | 707.129,244 | 4.647.140,487 | 375,870 | |
| 7245 | 707.121,758 | 4.647.137,439 | 375,870 | |
| 7246 | 707.135,777 | 4.647.119,009 | 376,050 | |
| 7247 | 707.145,160 | 4.647.122,240 | 376,200 | |
| 7248 | 707.156,289 | 4.647.107,493 | 373,000 | |
| 7249 | 707.150,399 | 4.647.105,458 | 373,010 | |
| 7250 | 707.163,018 | 4.647.088,557 | 371,570 | |
| 7251 | 707.169,693 | 4.647.090,885 | 371,540 | |
| 7252 | 707.172,551 | 4.647.074,006 | 370,300 | |
| 7253 | 707.172,542 | 4.647.068,898 | 370,020 | |
| 7254 | 707.174,566 | 4.647.065,003 | 369,730 | |
| 7255 | 707.181,179 | 4.647.066,690 | 369,730 | |
| 7256 | 707.184,121 | 4.647.070,745 | 370,600 | |
| 7257 | 707.194,477 | 4.647.068,843 | 370,100 | |
| 7258 | 707.208,174 | 4.647.072,262 | 369,810 | |
| 7259 | 707.205,363 | 4.647.089,895 | 370,240 | |
| 7260 | 707.202,516 | 4.647.044,671 | 368,890 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7261 | 707.210,822 | 4.647.051,366 | 369,040 | |
| 7262 | 707.232,707 | 4.646.990,375 | 369,120 | |
| 7263 | 707.226,229 | 4.646.984,290 | 369,290 | |
| 7264 | 707.235,126 | 4.646.951,876 | 370,070 | |
| 7265 | 707.244,518 | 4.646.953,458 | 370,220 | |
| 7266 | 707.247,722 | 4.646.910,946 | 371,760 | |
| 7267 | 707.257,465 | 4.646.912,277 | 371,450 | |
| 7268 | 707.273,537 | 4.646.871,872 | 372,030 | |
| 7269 | 707.265,074 | 4.646.865,912 | 371,710 | |
| 7270 | 707.299,852 | 4.646.796,726 | 371,950 | |
| 7271 | 707.292,894 | 4.646.790,872 | 372,060 | |
| 7272 | 707.293,590 | 4.646.767,007 | 373,400 | |
| 7273 | 707.294,599 | 4.646.755,816 | 373,350 | |
| 7274 | 707.305,958 | 4.646.761,426 | 372,690 | |
| 7275 | 707.318,926 | 4.646.727,833 | 372,830 | |
| 7276 | 707.305,470 | 4.646.725,653 | 373,160 | |
| 7277 | 707.317,489 | 4.646.688,912 | 373,430 | |
| 7278 | 707.326,629 | 4.646.690,974 | 373,370 | |
| 7279 | 707.335,933 | 4.646.656,366 | 373,660 | |
| 7280 | 707.328,858 | 4.646.653,055 | 373,850 | |
| 7281 | 707.341,150 | 4.646.613,267 | 374,080 | |
| 7282 | 707.350,330 | 4.646.616,947 | 374,000 | |
| 7283 | 707.375,831 | 4.646.523,347 | 376,190 | |
| 7284 | 707.371,545 | 4.646.513,486 | 376,620 | |
| 7285 | 707.392,614 | 4.646.485,685 | 377,750 | |
| 7286 | 707.386,164 | 4.646.479,778 | 378,180 | |
| 7287 | 707.399,155 | 4.646.450,800 | 379,470 | |
| 7288 | 707.406,803 | 4.646.451,884 | 379,350 | |
| 7289 | 707.431,362 | 4.646.397,310 | 382,080 | |
| 7290 | 707.423,748 | 4.646.392,524 | 383,080 | |
| 7291 | 707.435,738 | 4.646.367,280 | 383,260 | |
| 7292 | 707.444,639 | 4.646.368,897 | 382,160 | |
| 7293 | 707.445,886 | 4.646.345,545 | 381,290 | |
| 7294 | 707.457,532 | 4.646.344,535 | 380,310 | |
| 7295 | 707.466,409 | 4.646.322,632 | 378,230 | |
| 7296 | 707.459,910 | 4.646.314,377 | 377,730 | |
| 7297 | 707.470,330 | 4.646.297,006 | 376,730 | |
| 7298 | 707.477,769 | 4.646.295,877 | 376,390 | |
| 7299 | 707.479,623 | 4.646.275,529 | 374,720 | |
| 7300 | 707.486,147 | 4.646.276,610 | 374,730 | |
| 7301 | 707.525,519 | 4.646.167,679 | 369,680 | |
| 7302 | 707.535,821 | 4.646.169,703 | 369,840 | |
| 7303 | 707.543,106 | 4.646.151,353 | 369,070 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7304 | 707.536,446 | 4.646.145,905 | 369,080 | |
| 7305 | 707.928,458 | 4.646.049,588 | 365,230 | |
| 7306 | 707.939,485 | 4.646.061,116 | 365,410 | |
| 7307 | 707.940,518 | 4.646.063,236 | 364,630 | |
| 7308 | 707.951,498 | 4.646.063,991 | 364,670 | |
| 7309 | 707.969,379 | 4.646.087,982 | 364,630 | |
| 7310 | 707.963,947 | 4.646.094,086 | 364,620 | |
| 7311 | 708.028,702 | 4.646.178,627 | 367,150 | |
| 7312 | 708.033,785 | 4.646.173,970 | 367,100 | |
| 7313 | 708.065,632 | 4.646.212,768 | 367,150 | |
| 7314 | 708.058,774 | 4.646.218,369 | 367,110 | |
| 7315 | 708.104,166 | 4.646.278,059 | 369,100 | |
| 7316 | 708.111,057 | 4.646.273,991 | 369,110 | |
| 7317 | 708.135,600 | 4.646.304,988 | 369,450 | |
| 7318 | 708.127,899 | 4.646.309,905 | 370,220 | |
| 7319 | 708.150,362 | 4.646.335,518 | 371,840 | |
| 7320 | 708.155,125 | 4.646.332,801 | 372,290 | |
| 7321 | 708.159,582 | 4.646.353,836 | 371,890 | |
| 7322 | 708.164,250 | 4.646.354,011 | 370,220 | |
| 7323 | 708.167,013 | 4.646.348,661 | 370,160 | |
| 7324 | 708.183,734 | 4.646.361,256 | 370,480 | |
| 7325 | 708.189,509 | 4.646.366,077 | 371,680 | |
| 7326 | 708.176,597 | 4.646.372,467 | 372,050 | |
| 7327 | 708.195,269 | 4.646.387,437 | 372,350 | |
| 7328 | 708.190,582 | 4.646.388,195 | 372,390 | |
| 7329 | 708.196,167 | 4.646.396,229 | 373,410 | |
| 7330 | 708.207,754 | 4.646.397,860 | 373,030 | |
| 7331 | 708.209,651 | 4.646.407,151 | 372,740 | |
| 7332 | 708.216,564 | 4.646.405,369 | 372,680 | |
| 7333 | 708.229,502 | 4.646.427,663 | 372,630 | |
| 7334 | 708.237,192 | 4.646.424,731 | 372,910 | |
| 7335 | 708.264,168 | 4.646.449,576 | 372,720 | |
| 7336 | 708.259,964 | 4.646.456,100 | 372,620 | |
| 7337 | 708.275,079 | 4.646.471,309 | 374,510 | |
| 7338 | 708.279,038 | 4.646.466,240 | 374,460 | |
| 7339 | 708.295,127 | 4.646.479,745 | 373,680 | |
| 7340 | 708.290,713 | 4.646.485,697 | 373,540 | |
| 7341 | 708.329,065 | 4.646.507,606 | 372,940 | |
| 7342 | 708.350,670 | 4.646.528,530 | 372,700 | |
| 7343 | 708.343,626 | 4.646.534,334 | 372,060 | |
| 7344 | 708.355,261 | 4.646.548,917 | 371,520 | |
| 7345 | 708.362,284 | 4.646.546,948 | 371,490 | |
| 7346 | 708.689,858 | 4.647.030,567 | 384,870 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7347 | 708.692,475 | 4.647.037,026 | 384,850 | |
| 7348 | 708.685,944 | 4.647.037,347 | 384,870 | |
| 7349 | 708.683,069 | 4.647.021,873 | 380,540 | |
| 7350 | 708.671,336 | 4.647.010,421 | 378,060 | |
| 7351 | 708.653,688 | 4.646.984,603 | 371,080 | |
| 7352 | 708.634,507 | 4.646.947,735 | 369,960 | |
| 7353 | 708.599,936 | 4.646.921,570 | 366,390 | |
| 7354 | 708.610,024 | 4.646.920,314 | 366,410 | |
| 7355 | 708.604,831 | 4.646.909,086 | 365,340 | |
| 7356 | 708.593,632 | 4.646.891,602 | 365,310 | |
| 7357 | 708.594,405 | 4.646.892,682 | 366,560 | |
| 7358 | 708.589,036 | 4.646.884,487 | 365,570 | |
| 7359 | 708.571,515 | 4.646.867,516 | 365,050 | |
| 7360 | 708.564,722 | 4.646.861,271 | 363,810 | |
| 7361 | 708.547,612 | 4.646.833,445 | 363,830 | |
| 7362 | 708.546,337 | 4.646.830,117 | 362,670 | |
| 7363 | 708.520,014 | 4.646.792,972 | 362,740 | |
| 7364 | 708.514,676 | 4.646.784,516 | 361,270 | |
| 7365 | 708.504,818 | 4.646.771,543 | 362,250 | |
| 7366 | 708.532,288 | 4.646.766,884 | 361,950 | |
| 7367 | 708.528,424 | 4.646.760,627 | 361,970 | |
| 7368 | 708.501,280 | 4.646.750,345 | 362,890 | |
| 7369 | 708.496,525 | 4.646.753,148 | 362,890 | |
| 7370 | 708.478,323 | 4.646.727,974 | 362,830 | |
| 7371 | 708.483,421 | 4.646.727,241 | 362,920 | |
| 7372 | 708.472,437 | 4.646.719,295 | 363,530 | |
| 7373 | 708.476,483 | 4.646.714,592 | 363,490 | |
| 7374 | 708.463,193 | 4.646.694,856 | 364,900 | |
| 7375 | 708.455,680 | 4.646.695,226 | 364,700 | |
| 7376 | 708.438,217 | 4.646.669,129 | 364,680 | |
| 7377 | 708.443,170 | 4.646.666,139 | 364,750 | |
| 7378 | 708.430,740 | 4.646.650,453 | 364,660 | |
| 7379 | 708.427,416 | 4.646.652,756 | 364,690 | |
| 7380 | 708.424,191 | 4.646.638,500 | 366,460 | |
| 7381 | 708.420,677 | 4.646.644,243 | 366,520 | |
| 7382 | 708.406,251 | 4.646.624,256 | 366,620 | |
| 7383 | 708.410,450 | 4.646.619,565 | 366,730 | |
| 7384 | 708.407,950 | 4.646.615,220 | 367,570 | |
| 7385 | 708.404,264 | 4.646.620,957 | 367,700 | |
| 7386 | 708.632,719 | 4.646.908,717 | 364,460 | |
| 7387 | 708.640,097 | 4.646.909,893 | 364,750 | |
| 7388 | 708.648,148 | 4.646.910,155 | 365,480 | |
| 7389 | 708.649,649 | 4.646.924,923 | 365,550 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7390 | 708.668,134 | 4.646.926,667 | 365,500 | |
| 7391 | 708.667,594 | 4.646.920,495 | 365,530 | |
| 7392 | 708.692,959 | 4.646.923,974 | 365,660 | |
| 7393 | 708.696,459 | 4.646.932,907 | 365,710 | |
| 7394 | 708.708,467 | 4.646.933,309 | 365,680 | |
| 7395 | 708.709,452 | 4.646.929,634 | 365,580 | |
| 7396 | 708.727,771 | 4.646.931,908 | 365,430 | |
| 7397 | 708.742,557 | 4.646.935,502 | 364,460 | |
| 7398 | 708.762,885 | 4.646.944,346 | 364,560 | |
| 7399 | 708.772,585 | 4.646.957,418 | 364,560 | |
| 7400 | 708.776,451 | 4.646.951,544 | 364,530 | |
| 7401 | 708.804,656 | 4.646.965,205 | 364,650 | |
| 7402 | 708.802,782 | 4.646.973,391 | 364,600 | |
| 7403 | 708.814,380 | 4.646.978,295 | 364,700 | |
| 7404 | 708.830,712 | 4.647.009,619 | 364,970 | |
| 7405 | 708.825,834 | 4.647.012,733 | 365,150 | |
| 7406 | 708.889,795 | 4.647.119,531 | 364,630 | |
| 7407 | 708.906,400 | 4.647.142,110 | 364,990 | |
| 7408 | 708.901,624 | 4.647.146,343 | 365,050 | |
| 7409 | 708.921,280 | 4.647.169,446 | 364,950 | |
| 7410 | 708.924,443 | 4.647.163,915 | 364,970 | |
| 7411 | 708.938,465 | 4.647.174,091 | 365,150 | |
| 7412 | 708.955,546 | 4.647.199,663 | 364,970 | |
| 7413 | 708.953,677 | 4.647.194,430 | 365,100 | |
| 7414 | 708.955,816 | 4.647.191,470 | 363,650 | |
| 7415 | 708.964,774 | 4.647.206,888 | 363,730 | |
| 7416 | 708.980,236 | 4.647.215,495 | 363,760 | |
| 7417 | 708.978,262 | 4.647.220,487 | 363,780 | |
| 7418 | 709.006,278 | 4.647.237,295 | 363,750 | |
| 7419 | 709.004,013 | 4.647.241,682 | 363,790 | |
| 7420 | 709.069,336 | 4.647.304,547 | 363,930 | |
| 7421 | 709.062,390 | 4.647.307,814 | 363,880 | |
| 7422 | 709.055,715 | 4.647.297,056 | 363,820 | |
| 7423 | 709.045,247 | 4.647.281,857 | 363,770 | |
| 7424 | 709.035,326 | 4.647.268,888 | 363,770 | |
| 7425 | 709.029,825 | 4.647.261,303 | 363,720 | |
| 7426 | 709.020,667 | 4.647.254,651 | 363,740 | |
| 7427 | 709.024,261 | 4.647.250,774 | 363,670 | |
| 7428 | 709.060,620 | 4.647.262,535 | 362,520 | |
| 7429 | 709.063,300 | 4.647.266,823 | 362,510 | |
| 7430 | 709.081,942 | 4.647.269,545 | 362,550 | |
| 7431 | 709.077,664 | 4.647.263,198 | 362,510 | |
| 7432 | 709.087,111 | 4.647.266,197 | 361,340 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7433 | 709.090,615 | 4.647.270,627 | 361,410 | |
| 7434 | 709.105,784 | 4.647.269,041 | 360,890 | |
| 7435 | 709.106,350 | 4.647.273,572 | 360,960 | |
| 7436 | 709.133,727 | 4.647.276,166 | 360,910 | |
| 7437 | 709.131,179 | 4.647.271,960 | 360,920 | |
| 7438 | 709.155,236 | 4.647.274,818 | 360,880 | |
| 7439 | 709.166,372 | 4.647.279,062 | 360,730 | |
| 7440 | 709.174,915 | 4.647.276,471 | 360,030 | |
| 7441 | 709.196,530 | 4.647.280,267 | 359,730 | |
| 7442 | 709.195,282 | 4.647.286,017 | 359,690 | |
| 7443 | 709.216,040 | 4.647.286,187 | 359,810 | |
| 7444 | 709.214,498 | 4.647.282,916 | 359,730 | |
| 7445 | 709.242,530 | 4.647.300,231 | 362,740 | |
| 7446 | 709.258,895 | 4.647.303,368 | 363,610 | |
| 7447 | 709.267,059 | 4.647.309,755 | 363,600 | |
| 7448 | 709.264,129 | 4.647.312,179 | 363,750 | |
| 7449 | 709.295,327 | 4.647.326,942 | 364,140 | |
| 7450 | 709.308,507 | 4.647.340,354 | 364,710 | |
| 7451 | 709.334,130 | 4.647.344,020 | 363,320 | |
| 7452 | 709.335,039 | 4.647.330,263 | 369,130 | |
| 7453 | 709.400,781 | 4.647.340,704 | 362,470 | |
| 7454 | 709.403,743 | 4.647.351,271 | 361,030 | |
| 7455 | 709.422,861 | 4.647.354,447 | 361,340 | |
| 7456 | 709.423,724 | 4.647.347,211 | 361,600 | |
| 7457 | 709.436,201 | 4.647.350,834 | 361,680 | |
| 7458 | 709.068,054 | 4.647.341,241 | 362,360 | |
| 7459 | 709.063,497 | 4.647.341,560 | 362,400 | |
| 7460 | 709.062,995 | 4.647.347,713 | 362,260 | |
| 7461 | 709.069,039 | 4.647.346,947 | 362,230 | |
| 7462 | 709.079,192 | 4.647.362,272 | 361,940 | |
| 7463 | 709.074,881 | 4.647.366,851 | 361,880 | |
| 7464 | 709.089,157 | 4.647.387,334 | 361,320 | |
| 7465 | 709.092,096 | 4.647.384,610 | 361,380 | |
| 7466 | 709.103,385 | 4.647.402,961 | 360,950 | |
| 7467 | 709.099,790 | 4.647.404,962 | 360,920 | |
| 7468 | 709.112,107 | 4.647.424,038 | 360,330 | |
| 7469 | 709.116,968 | 4.647.422,574 | 360,420 | |
| 7470 | 709.130,349 | 4.647.444,142 | 359,760 | |
| 7471 | 709.125,284 | 4.647.447,574 | 359,690 | |
| 7472 | 709.141,935 | 4.647.470,914 | 359,090 | |
| 7473 | 709.146,058 | 4.647.468,000 | 359,070 | |
| 7474 | 709.161,972 | 4.647.493,367 | 358,450 | |
| 7475 | 709.157,763 | 4.647.496,994 | 358,350 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7476 | 709.177,888 | 4.647.520,419 | 358,150 | |
| 7477 | 709.173,441 | 4.647.524,101 | 358,070 | |
| 7478 | 709.190,833 | 4.647.548,644 | 357,580 | |
| 7479 | 709.192,792 | 4.647.544,731 | 357,570 | |
| 7480 | 709.201,741 | 4.647.557,996 | 357,230 | |
| 7481 | 709.193,987 | 4.647.558,992 | 357,150 | |
| 7482 | 709.194,963 | 4.647.573,827 | 357,240 | |
| 7483 | 709.199,607 | 4.647.573,284 | 357,210 | |
| 7484 | 709.199,173 | 4.647.577,264 | 356,870 | |
| 7485 | 709.193,873 | 4.647.577,549 | 356,750 | |
| 7486 | 709.194,237 | 4.647.604,648 | 356,800 | |
| 7487 | 709.194,206 | 4.647.607,027 | 356,370 | |
| 7488 | 709.198,849 | 4.647.604,158 | 356,780 | |
| 7489 | 709.198,613 | 4.647.607,062 | 356,490 | |
| 7490 | 709.198,611 | 4.647.634,375 | 356,320 | |
| 7491 | 709.198,006 | 4.647.637,754 | 355,780 | |
| 7492 | 709.192,537 | 4.647.636,189 | 356,290 | |
| 7493 | 709.192,893 | 4.647.637,603 | 355,690 | |
| 7494 | 709.194,518 | 4.647.669,794 | 355,760 | |
| 7495 | 709.194,319 | 4.647.671,868 | 355,220 | |
| 7496 | 709.199,057 | 4.647.667,849 | 355,790 | |
| 7497 | 709.198,319 | 4.647.672,152 | 355,220 | |
| 7498 | 709.198,716 | 4.647.685,429 | 355,060 | |
| 7499 | 709.193,642 | 4.647.686,180 | 355,060 | |
| 7500 | 709.193,992 | 4.647.694,523 | 355,120 | |
| 7501 | 709.205,216 | 4.647.685,292 | 355,340 | |
| 7502 | 709.210,968 | 4.647.678,760 | 355,450 | |
| 7503 | 709.214,767 | 4.647.674,985 | 355,480 | |
| 7504 | 709.213,992 | 4.647.668,877 | 355,410 | |
| 7505 | 709.206,912 | 4.647.675,146 | 355,410 | |
| 7506 | 709.201,244 | 4.647.680,614 | 355,460 | |
| 7507 | 709.200,836 | 4.647.700,488 | 355,410 | |
| 7508 | 709.211,528 | 4.647.709,337 | 355,420 | |
| 7509 | 709.215,491 | 4.647.709,444 | 355,270 | |
| 7510 | 709.211,033 | 4.647.733,294 | 355,490 | |
| 7511 | 709.215,217 | 4.647.733,474 | 355,260 | |
| 7512 | 709.212,760 | 4.647.783,983 | 354,390 | |
| 7513 | 709.208,166 | 4.647.785,540 | 354,490 | |
| 7514 | 709.211,496 | 4.647.807,588 | 354,060 | |
| 7515 | 709.207,335 | 4.647.808,585 | 354,040 | |
| 7516 | 709.205,721 | 4.647.838,594 | 353,070 | |
| 7517 | 709.210,446 | 4.647.840,353 | 352,900 | |
| 7518 | 709.210,585 | 4.647.864,188 | 352,390 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7519 | 709.205,059 | 4.647.864,822 | 352,490 | |
| 7520 | 709.209,944 | 4.647.884,139 | 351,650 | |
| 7521 | 709.203,970 | 4.647.884,028 | 351,700 | |
| 7522 | 709.175,568 | 4.647.979,069 | 350,890 | |
| 7523 | 709.182,211 | 4.647.978,558 | 350,950 | |
| 7524 | 709.181,279 | 4.647.995,526 | 351,260 | |
| 7525 | 709.175,067 | 4.647.997,418 | 351,310 | |
| 7526 | 709.175,310 | 4.647.999,855 | 350,460 | |
| 7527 | 709.183,089 | 4.648.000,793 | 350,460 | |
| 7528 | 709.180,281 | 4.648.040,375 | 350,400 | |
| 7529 | 709.174,206 | 4.648.042,883 | 350,330 | |
| 7530 | 709.179,139 | 4.648.047,829 | 348,540 | |
| 7531 | 709.173,412 | 4.648.047,875 | 348,480 | |
| 7532 | 709.173,925 | 4.648.083,057 | 348,230 | |
| 7533 | 709.179,029 | 4.648.083,396 | 348,240 | |
| 7534 | 709.171,816 | 4.648.115,045 | 348,640 | |
| 7535 | 709.177,902 | 4.648.116,342 | 348,730 | |
| 7536 | 709.170,578 | 4.648.185,774 | 348,550 | |
| 7537 | 709.175,071 | 4.648.185,931 | 348,630 | |
| 7538 | 709.174,424 | 4.648.219,978 | 348,690 | |
| 7539 | 709.168,495 | 4.648.220,519 | 348,510 | |
| 7540 | 709.173,236 | 4.648.253,294 | 348,620 | |
| 7541 | 709.167,330 | 4.648.255,111 | 348,590 | |
| 7542 | 709.166,592 | 4.648.275,877 | 348,840 | |
| 7543 | 709.171,853 | 4.648.274,438 | 348,730 | |
| 7544 | 709.164,367 | 4.648.300,265 | 348,900 | |
| 7545 | 709.171,808 | 4.648.303,168 | 348,670 | |
| 7546 | 709.171,889 | 4.648.326,388 | 348,650 | |
| 7547 | 709.165,262 | 4.648.326,573 | 348,480 | |
| 7548 | 709.164,458 | 4.648.362,417 | 348,770 | |
| 7549 | 709.164,648 | 4.648.365,095 | 348,460 | |
| 7550 | 709.170,070 | 4.648.362,606 | 348,520 | |
| 7551 | 709.170,859 | 4.648.359,041 | 348,770 | |
| 7552 | 709.168,229 | 4.648.391,244 | 348,340 | |
| 7553 | 709.162,835 | 4.648.392,816 | 348,230 | |
| 7554 | 709.162,426 | 4.648.425,474 | 348,400 | |
| 7555 | 709.162,519 | 4.648.428,428 | 348,050 | |
| 7556 | 709.167,134 | 4.648.426,826 | 347,960 | |
| 7557 | 709.168,114 | 4.648.422,474 | 348,430 | |
| 7558 | 709.166,797 | 4.648.444,823 | 348,100 | |
| 7559 | 709.161,377 | 4.648.444,902 | 347,960 | |
| 7560 | 709.160,734 | 4.648.454,472 | 348,000 | |
| 7561 | 709.160,466 | 4.648.469,994 | 347,730 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7562 | 709.168,792 | 4.648.468,600 | 347,620 | |
| 7563 | 709.182,357 | 4.648.482,594 | 347,670 | |
| 7564 | 709.179,808 | 4.648.487,045 | 347,580 | |
| 7565 | 709.208,598 | 4.648.511,986 | 347,630 | |
| 7566 | 709.212,327 | 4.648.508,617 | 347,510 | |
| 7567 | 709.239,222 | 4.648.535,659 | 346,960 | |
| 7568 | 709.241,774 | 4.648.531,979 | 347,190 | |
| 7569 | 709.244,217 | 4.648.534,113 | 346,700 | |
| 7570 | 709.241,029 | 4.648.538,477 | 346,770 | |
| 7571 | 709.270,941 | 4.648.560,765 | 346,330 | |
| 7572 | 709.273,551 | 4.648.557,475 | 346,530 | |
| 7573 | 709.304,019 | 4.648.583,433 | 346,350 | |
| 7574 | 709.305,996 | 4.648.585,043 | 345,940 | |
| 7575 | 709.300,671 | 4.648.588,254 | 346,200 | |
| 7576 | 709.301,856 | 4.648.589,685 | 345,750 | |
| 7577 | 709.331,667 | 4.648.612,442 | 345,870 | |
| 7578 | 709.333,042 | 4.648.613,461 | 345,580 | |
| 7579 | 709.337,002 | 4.648.609,766 | 345,610 | |
| 7580 | 709.335,123 | 4.648.607,841 | 345,800 | |
| 7581 | 709.365,890 | 4.648.635,237 | 345,660 | |
| 7582 | 709.367,900 | 4.648.636,554 | 345,430 | |
| 7583 | 709.364,383 | 4.648.639,453 | 345,520 | |
| 7584 | 709.362,824 | 4.648.638,516 | 345,790 | |
| 7585 | 709.394,157 | 4.648.663,008 | 345,630 | |
| 7586 | 709.395,618 | 4.648.664,003 | 345,350 | |
| 7587 | 709.398,758 | 4.648.660,771 | 345,400 | |
| 7588 | 709.396,971 | 4.648.659,330 | 345,670 | |
| 7589 | 709.419,376 | 4.648.677,047 | 345,490 | |
| 7590 | 709.417,576 | 4.648.685,026 | 345,380 | |
| 7591 | 709.450,998 | 4.648.695,993 | 345,180 | |
| 7592 | 709.448,457 | 4.648.701,555 | 345,180 | |
| 7593 | 709.481,155 | 4.648.716,232 | 345,090 | |
| 7594 | 709.483,733 | 4.648.712,115 | 345,010 | |
| 7595 | 709.513,915 | 4.648.732,935 | 344,940 | |
| 7596 | 709.516,247 | 4.648.728,968 | 344,900 | |
| 7597 | 709.547,909 | 4.648.746,473 | 344,700 | |
| 7598 | 709.546,223 | 4.648.752,062 | 344,710 | |
| 7599 | 709.580,675 | 4.648.768,644 | 344,450 | |
| 7600 | 709.583,401 | 4.648.764,024 | 344,450 | |
| 7601 | 709.620,447 | 4.648.785,590 | 344,250 | |
| 7602 | 709.619,147 | 4.648.792,287 | 344,250 | |
| 7603 | 709.655,460 | 4.648.808,370 | 343,500 | |
| 7604 | 709.658,892 | 4.648.803,552 | 343,530 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7605 | 709.692,550 | 4.648.821,455 | 343,450 | |
| 7606 | 709.691,131 | 4.648.826,077 | 343,430 | |
| 7607 | 709.715,111 | 4.648.831,897 | 343,350 | |
| 7608 | 709.718,063 | 4.648.828,020 | 343,380 | |
| 7609 | 709.741,415 | 4.648.835,173 | 343,340 | |
| 7610 | 709.742,277 | 4.648.831,173 | 343,410 | |
| 7611 | 709.766,672 | 4.648.828,486 | 343,320 | |
| 7612 | 709.769,443 | 4.648.833,616 | 343,210 | |
| 7613 | 709.798,126 | 4.648.824,870 | 343,220 | |
| 7614 | 709.796,240 | 4.648.818,358 | 343,270 | |
| 7615 | 709.857,228 | 4.648.801,589 | 343,160 | |
| 7616 | 709.859,049 | 4.648.795,687 | 343,270 | |
| 7617 | 709.871,472 | 4.648.790,679 | 343,830 | |
| 7618 | 709.872,190 | 4.648.797,160 | 343,600 | |
| 7619 | 709.892,281 | 4.648.788,106 | 343,070 | |
| 7620 | 709.891,222 | 4.648.784,738 | 343,130 | |
| 7621 | 709.924,067 | 4.648.768,143 | 343,200 | |
| 7622 | 709.925,836 | 4.648.777,434 | 343,160 | |
| 7623 | 710.018,366 | 4.648.733,676 | 343,150 | |
| 7624 | 710.018,099 | 4.648.743,040 | 343,180 | |
| 7625 | 710.020,980 | 4.648.741,916 | 342,870 | |
| 7626 | 710.023,752 | 4.648.731,767 | 342,980 | |
| 7627 | 710.066,062 | 4.648.717,519 | 342,880 | |
| 7628 | 710.069,672 | 4.648.722,864 | 342,850 | |
| 7629 | 710.114,420 | 4.648.705,597 | 343,030 | |
| 7630 | 710.114,873 | 4.648.699,491 | 343,070 | |
| 7631 | 710.122,877 | 4.648.696,934 | 342,830 | |
| 7632 | 710.128,264 | 4.648.697,688 | 342,880 | |
| 7633 | 710.126,568 | 4.648.702,850 | 342,620 | |
| 7634 | 710.141,449 | 4.648.710,125 | 342,620 | |
| 7635 | 710.143,978 | 4.648.706,100 | 342,680 | |
| 7636 | 710.154,412 | 4.648.714,418 | 342,910 | |
| 7637 | 710.153,749 | 4.648.718,575 | 342,850 | |
| 7638 | 710.158,846 | 4.648.721,167 | 342,490 | |
| 7639 | 710.161,081 | 4.648.717,947 | 342,560 | |
| 7640 | 710.186,711 | 4.648.734,191 | 342,580 | |
| 7641 | 710.180,040 | 4.648.730,653 | 342,490 | |
| 7642 | 710.190,024 | 4.648.737,567 | 342,390 | |
| 7643 | 710.186,233 | 4.648.741,570 | 342,600 | |
| 7644 | 710.208,913 | 4.648.749,830 | 342,470 | |
| 7645 | 710.207,251 | 4.648.753,325 | 342,290 | |
| 7646 | 710.219,632 | 4.648.757,619 | 342,300 | |
| 7647 | 710.218,835 | 4.648.760,847 | 342,330 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7648 | 710.187,611 | 4.648.706,290 | 342,860 | |
| 7649 | 709.903,573 | 4.648.230,796 | 344,040 | |
| 7650 | 709.906,347 | 4.648.237,166 | 344,070 | |
| 7651 | 709.892,778 | 4.648.241,673 | 344,170 | |
| 7652 | 709.889,948 | 4.648.235,608 | 344,340 | |
| 7653 | 709.872,158 | 4.648.241,227 | 344,290 | |
| 7654 | 709.873,103 | 4.648.245,634 | 344,300 | |
| 7655 | 709.850,366 | 4.648.253,076 | 344,280 | |
| 7656 | 709.848,381 | 4.648.247,459 | 344,300 | |
| 7657 | 709.843,192 | 4.648.249,357 | 344,640 | |
| 7658 | 709.843,896 | 4.648.253,724 | 344,620 | |
| 7659 | 709.802,783 | 4.648.264,577 | 344,490 | |
| 7660 | 709.801,131 | 4.648.261,181 | 344,510 | |
| 7661 | 709.797,138 | 4.648.262,447 | 344,860 | |
| 7662 | 709.797,995 | 4.648.266,191 | 344,860 | |
| 7663 | 709.757,521 | 4.648.277,154 | 344,810 | |
| 7664 | 709.756,431 | 4.648.274,518 | 344,940 | |
| 7665 | 709.736,613 | 4.648.280,481 | 345,080 | |
| 7666 | 709.737,391 | 4.648.283,889 | 345,070 | |
| 7667 | 709.705,019 | 4.648.292,401 | 345,100 | |
| 7668 | 709.703,189 | 4.648.287,733 | 345,110 | |
| 7669 | 709.664,254 | 4.648.300,632 | 345,340 | |
| 7670 | 709.665,541 | 4.648.305,215 | 345,370 | |
| 7671 | 709.626,833 | 4.648.316,170 | 345,780 | |
| 7672 | 709.624,707 | 4.648.311,464 | 345,760 | |
| 7673 | 709.588,664 | 4.648.322,910 | 345,970 | |
| 7674 | 709.589,362 | 4.648.327,972 | 345,950 | |
| 7675 | 709.511,423 | 4.648.349,402 | 346,400 | |
| 7676 | 709.509,135 | 4.648.344,196 | 346,530 | |
| 7677 | 709.457,595 | 4.648.361,686 | 346,790 | |
| 7678 | 709.457,820 | 4.648.367,529 | 346,860 | |
| 7679 | 709.409,581 | 4.648.379,493 | 347,210 | |
| 7680 | 709.405,825 | 4.648.374,711 | 347,330 | |
| 7681 | 709.367,302 | 4.648.388,390 | 347,550 | |
| 7682 | 709.368,516 | 4.648.392,436 | 347,500 | |
| 7683 | 709.324,691 | 4.648.404,819 | 347,480 | |
| 7684 | 709.322,467 | 4.648.400,209 | 347,540 | |
| 7685 | 709.290,092 | 4.648.410,741 | 346,880 | |
| 7686 | 709.290,906 | 4.648.414,939 | 346,940 | |
| 7687 | 709.254,237 | 4.648.426,171 | 346,890 | |
| 7688 | 709.252,432 | 4.648.421,282 | 346,820 | |
| 7689 | 709.213,802 | 4.648.432,827 | 346,810 | |
| 7690 | 709.215,105 | 4.648.438,350 | 346,920 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7691 | 705.753,022 | 4.647.565,346 | 375,120 | |
| 7692 | 705.754,451 | 4.647.560,416 | 375,350 | |
| 7693 | 705.738,324 | 4.647.549,151 | 375,160 | |
| 7694 | 705.718,148 | 4.647.535,533 | 375,610 | |
| 7695 | 705.699,185 | 4.647.522,830 | 375,720 | |
| 7696 | 705.675,378 | 4.647.506,129 | 375,890 | |
| 7697 | 705.613,222 | 4.647.464,354 | 378,500 | |
| 7698 | 705.548,848 | 4.647.420,298 | 380,390 | |
| 7699 | 705.524,124 | 4.647.402,214 | 380,370 | |
| 7700 | 705.502,264 | 4.647.386,348 | 380,470 | |
| 7701 | 705.468,249 | 4.647.361,413 | 380,430 | |
| 7702 | 705.446,556 | 4.647.345,785 | 380,520 | |
| 7703 | 705.406,931 | 4.647.320,203 | 381,200 | |
| 7704 | 705.401,670 | 4.647.324,468 | 381,200 | |
| 7705 | 705.382,035 | 4.647.311,411 | 381,160 | |
| 7706 | 705.364,414 | 4.647.300,130 | 381,180 | |
| 7707 | 705.345,955 | 4.647.288,314 | 381,180 | |
| 7708 | 705.315,205 | 4.647.265,663 | 382,420 | |
| 7709 | 705.320,073 | 4.647.259,441 | 382,330 | |
| 7710 | 705.346,282 | 4.647.276,177 | 381,220 | |
| 7711 | 705.366,740 | 4.647.288,596 | 381,340 | |
| 7712 | 705.384,335 | 4.647.301,980 | 381,410 | |
| 7713 | 705.441,163 | 4.647.353,702 | 380,430 | |
| 7714 | 705.465,574 | 4.647.371,474 | 380,460 | |
| 7715 | 705.502,430 | 4.647.398,487 | 380,450 | |
| 7716 | 705.551,509 | 4.647.433,051 | 380,450 | |
| 7717 | 705.606,747 | 4.647.469,747 | 378,530 | |
| 7718 | 705.665,890 | 4.647.511,470 | 376,060 | |
| 7719 | 705.692,613 | 4.647.528,280 | 375,820 | |
| 7720 | 705.714,308 | 4.647.541,012 | 375,560 | |
| 7721 | 705.732,796 | 4.647.555,363 | 375,370 | |
| 7722 | 705.743,048 | 4.647.563,097 | 374,890 | |
| 7723 | 705.746,558 | 4.647.556,917 | 374,940 | |
| 7724 | 705.771,917 | 4.647.572,369 | 375,740 | |
| 7725 | 705.780,019 | 4.647.554,562 | 375,630 | |
| 7726 | 705.786,767 | 4.647.540,175 | 375,700 | |
| 7727 | 705.793,401 | 4.647.525,583 | 375,750 | |
| 7728 | 705.801,776 | 4.647.507,504 | 375,780 | |
| 7729 | 705.809,136 | 4.647.492,329 | 375,770 | |
| 7730 | 705.814,087 | 4.647.481,784 | 375,600 | |
| 7731 | 705.823,158 | 4.647.466,199 | 375,610 | |
| 7732 | 705.833,259 | 4.647.444,492 | 375,620 | |
| 7733 | 705.840,364 | 4.647.429,513 | 375,760 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7734 | 705.846,580 | 4.647.416,040 | 376,200 | |
| 7735 | 705.855,425 | 4.647.395,881 | 376,590 | |
| 7736 | 705.863,913 | 4.647.377,916 | 376,630 | |
| 7737 | 705.873,683 | 4.647.357,182 | 376,660 | |
| 7738 | 705.885,342 | 4.647.331,797 | 376,630 | |
| 7739 | 705.895,167 | 4.647.310,939 | 376,670 | |
| 7740 | 705.904,199 | 4.647.291,511 | 376,630 | |
| 7741 | 705.915,668 | 4.647.267,511 | 376,650 | |
| 7742 | 705.956,427 | 4.647.226,964 | 377,330 | |
| 7743 | 705.950,351 | 4.647.224,011 | 377,330 | |
| 7744 | 705.972,465 | 4.647.197,310 | 378,340 | |
| 7745 | 705.965,501 | 4.647.194,169 | 378,290 | |
| 7746 | 705.992,078 | 4.647.163,177 | 379,140 | |
| 7747 | 705.984,839 | 4.647.159,471 | 379,170 | |
| 7748 | 706.011,144 | 4.647.130,675 | 379,990 | |
| 7749 | 706.004,675 | 4.647.126,940 | 379,970 | |
| 7750 | 706.020,862 | 4.647.098,963 | 381,280 | |
| 7751 | 706.026,597 | 4.647.101,823 | 381,280 | |
| 7752 | 706.044,610 | 4.647.073,231 | 385,120 | |
| 7753 | 706.036,955 | 4.647.072,117 | 385,130 | |
| 7754 | 706.038,135 | 4.647.063,802 | 386,370 | |
| 7755 | 706.047,852 | 4.647.059,390 | 386,800 | |
| 7756 | 706.050,184 | 4.647.044,309 | 385,860 | |
| 7757 | 706.043,785 | 4.647.043,962 | 385,740 | |
| 7758 | 706.052,112 | 4.647.038,026 | 386,110 | |
| 7759 | 706.046,445 | 4.647.034,810 | 386,190 | |
| 7760 | 706.050,030 | 4.647.026,476 | 384,770 | |
| 7761 | 706.055,844 | 4.647.027,769 | 384,820 | |
| 7762 | 706.061,947 | 4.647.007,136 | 385,000 | |
| 7763 | 706.054,493 | 4.647.004,511 | 385,080 | |
| 7764 | 706.058,506 | 4.646.990,728 | 386,510 | |
| 7765 | 706.061,042 | 4.646.982,070 | 386,060 | |
| 7766 | 706.069,445 | 4.646.981,603 | 386,040 | |
| 7767 | 706.073,669 | 4.646.964,500 | 386,650 | |
| 7768 | 706.066,966 | 4.646.962,913 | 387,010 | |
| 7769 | 706.079,888 | 4.646.946,111 | 387,550 | |
| 7770 | 706.082,864 | 4.646.936,583 | 387,970 | |
| 7771 | 706.072,219 | 4.646.937,322 | 388,160 | |
| 7772 | 706.078,905 | 4.646.913,395 | 388,300 | |
| 7773 | 706.086,783 | 4.646.914,689 | 388,050 | |
| 7774 | 706.088,317 | 4.646.881,744 | 388,160 | |
| 7775 | 706.094,345 | 4.646.881,247 | 388,020 | |
| 7776 | 706.096,140 | 4.646.856,718 | 387,280 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7777 | 706.102,098 | 4.646.855,741 | 387,260 | |
| 7778 | 706.109,163 | 4.646.829,406 | 386,280 | |
| 7779 | 706.104,025 | 4.646.826,515 | 386,040 | |
| 7780 | 706.111,673 | 4.646.791,529 | 385,240 | |
| 7781 | 706.112,697 | 4.646.771,338 | 385,150 | |
| 7782 | 706.122,175 | 4.646.778,810 | 384,440 | |
| 7783 | 706.117,333 | 4.646.784,436 | 384,580 | |
| 7784 | 706.117,846 | 4.646.797,931 | 384,500 | |
| 7785 | 706.132,453 | 4.646.747,287 | 383,520 | |
| 7786 | 706.125,500 | 4.646.744,005 | 383,550 | |
| 7787 | 706.139,592 | 4.646.722,341 | 383,580 | |
| 7788 | 706.131,785 | 4.646.718,454 | 383,570 | |
| 7789 | 706.149,989 | 4.646.693,008 | 383,600 | |
| 7790 | 706.139,710 | 4.646.690,719 | 383,600 | |
| 7791 | 706.144,919 | 4.646.677,986 | 383,890 | |
| 7792 | 706.156,810 | 4.646.682,540 | 383,640 | |
| 7793 | 706.311,760 | 4.646.745,459 | 378,600 | |
| 7794 | 706.309,752 | 4.646.750,835 | 378,660 | |
| 7795 | 706.335,005 | 4.646.760,203 | 378,660 | |
| 7796 | 706.337,928 | 4.646.754,370 | 378,640 | |
| 7797 | 706.374,048 | 4.646.768,855 | 378,560 | |
| 7798 | 706.370,848 | 4.646.775,465 | 378,800 | |
| 7799 | 706.428,935 | 4.647.099,906 | 381,000 | |
| 7800 | 706.435,328 | 4.647.106,514 | 380,750 | |
| 7801 | 706.570,107 | 4.647.480,266 | 369,790 | |
| 7802 | 706.584,352 | 4.647.503,357 | 370,320 | |
| 7803 | 706.601,414 | 4.647.530,775 | 370,730 | |
| 7804 | 706.619,884 | 4.647.561,590 | 370,590 | |
| 7805 | 706.641,456 | 4.647.596,311 | 370,640 | |
| 7806 | 706.659,151 | 4.647.627,451 | 370,840 | |
| 7807 | 706.677,204 | 4.647.653,276 | 371,500 | |
| 7808 | 706.700,898 | 4.647.695,400 | 373,970 | |
| 7809 | 706.711,089 | 4.647.712,872 | 374,760 | |
| 7810 | 706.726,042 | 4.647.739,635 | 375,750 | |
| 7811 | 706.740,665 | 4.647.764,470 | 375,470 | |
| 7812 | 706.749,227 | 4.647.776,168 | 374,800 | |
| 7813 | 706.758,487 | 4.647.791,299 | 373,740 | |
| 7814 | 706.770,839 | 4.647.805,781 | 372,520 | |
| 7815 | 706.780,397 | 4.647.813,886 | 372,330 | |
| 7816 | 706.795,950 | 4.647.819,249 | 371,440 | |
| 7817 | 706.803,499 | 4.647.819,494 | 370,680 | |
| 7818 | 706.789,946 | 4.647.831,008 | 371,900 | |
| 7819 | 706.778,291 | 4.647.826,294 | 372,010 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7820 | 706.768,527 | 4.647.816,200 | 372,630 | |
| 7821 | 706.757,173 | 4.647.804,553 | 373,570 | |
| 7822 | 706.745,589 | 4.647.790,215 | 374,530 | |
| 7823 | 706.733,745 | 4.647.768,808 | 375,780 | |
| 7824 | 706.715,154 | 4.647.743,838 | 376,220 | |
| 7825 | 706.701,883 | 4.647.717,244 | 375,150 | |
| 7826 | 706.691,064 | 4.647.695,970 | 374,300 | |
| 7827 | 706.671,619 | 4.647.662,735 | 372,730 | |
| 7828 | 706.660,749 | 4.647.645,495 | 371,980 | |
| 7829 | 706.646,575 | 4.647.623,738 | 371,170 | |
| 7830 | 706.633,237 | 4.647.599,984 | 370,950 | |
| 7831 | 706.615,538 | 4.647.573,185 | 370,870 | |
| 7832 | 706.594,378 | 4.647.537,744 | 370,940 | |
| 7833 | 706.577,112 | 4.647.508,227 | 370,620 | |
| 7834 | 706.563,253 | 4.647.482,918 | 370,050 | |
| 7835 | 706.649,332 | 4.646.809,236 | 376,010 | |
| 7836 | 706.641,953 | 4.646.809,414 | 376,050 | |
| 7837 | 706.636,833 | 4.646.804,426 | 377,270 | |
| 7838 | 706.633,503 | 4.646.809,602 | 377,240 | |
| 7839 | 706.617,978 | 4.646.809,837 | 377,250 | |
| 7840 | 706.618,201 | 4.646.801,944 | 377,200 | |
| 7841 | 706.583,419 | 4.646.802,519 | 377,000 | |
| 7842 | 706.549,945 | 4.646.800,864 | 377,250 | |
| 7843 | 706.539,601 | 4.646.800,481 | 377,770 | |
| 7844 | 706.501,527 | 4.646.798,521 | 377,520 | |
| 7845 | 706.467,087 | 4.646.797,031 | 377,390 | |
| 7846 | 706.445,215 | 4.646.796,487 | 377,280 | |
| 7847 | 706.437,950 | 4.646.799,737 | 377,260 | |
| 7848 | 706.438,055 | 4.646.809,100 | 377,260 | |
| 7849 | 706.451,000 | 4.646.808,181 | 377,230 | |
| 7850 | 706.485,341 | 4.646.807,406 | 377,090 | |
| 7851 | 706.514,797 | 4.646.807,108 | 377,070 | |
| 7852 | 706.541,300 | 4.646.808,362 | 377,700 | |
| 7853 | 706.547,553 | 4.646.808,668 | 376,990 | |
| 7854 | 706.582,470 | 4.646.808,671 | 376,940 | |
| 7855 | 706.642,970 | 4.646.763,842 | 375,990 | |
| 7856 | 706.648,228 | 4.646.707,122 | 377,540 | |
| 7857 | 706.629,590 | 4.646.675,656 | 378,860 | |
| 7858 | 706.628,835 | 4.646.682,130 | 378,700 | |
| 7859 | 706.655,470 | 4.646.640,156 | 379,260 | |
| 7860 | 706.671,686 | 4.646.603,570 | 381,260 | |
| 7861 | 706.679,200 | 4.646.608,914 | 380,960 | |
| 7862 | 706.695,015 | 4.646.587,901 | 382,490 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7863 | 706.688,805 | 4.646.583,814 | 382,460 | |
| 7864 | 706.707,176 | 4.646.565,597 | 382,420 | |
| 7865 | 706.702,008 | 4.646.558,352 | 382,090 | |
| 7866 | 706.718,410 | 4.646.547,905 | 382,420 | |
| 7867 | 706.724,035 | 4.646.551,452 | 383,120 | |
| 7868 | 706.739,441 | 4.646.542,767 | 384,880 | |
| 7869 | 706.758,114 | 4.646.536,894 | 383,460 | |
| 7870 | 706.781,409 | 4.646.533,088 | 382,390 | |
| 7871 | 706.802,759 | 4.646.526,109 | 382,190 | |
| 7872 | 706.821,908 | 4.646.522,134 | 382,310 | |
| 7873 | 706.821,885 | 4.646.522,129 | 382,310 | |
| 7874 | 706.844,578 | 4.646.518,691 | 381,980 | |
| 7875 | 706.820,857 | 4.646.517,083 | 382,510 | |
| 7876 | 706.794,464 | 4.646.522,291 | 382,260 | |
| 7877 | 706.766,836 | 4.646.527,903 | 382,430 | |
| 7878 | 706.742,721 | 4.646.533,610 | 382,950 | |
| 7879 | 706.730,518 | 4.646.537,387 | 382,920 | |
| 7880 | 706.186,470 | 4.646.535,732 | 389,660 | |
| 7881 | 706.178,933 | 4.646.532,187 | 389,190 | |
| 7882 | 706.177,404 | 4.646.552,532 | 389,810 | |
| 7883 | 706.180,864 | 4.646.553,435 | 389,790 | |
| 7884 | 706.172,364 | 4.646.567,863 | 391,060 | |
| 7885 | 706.196,497 | 4.646.487,804 | 386,290 | |
| 7886 | 706.190,907 | 4.646.489,127 | 386,670 | |
| 7887 | 706.191,595 | 4.646.484,888 | 386,990 | |
| 7888 | 706.198,391 | 4.646.482,496 | 386,840 | |
| 7889 | 706.213,621 | 4.646.414,911 | 387,150 | |
| 7890 | 706.208,215 | 4.646.415,342 | 387,140 | |
| 7891 | 706.225,181 | 4.646.366,114 | 387,940 | |
| 7892 | 706.219,847 | 4.646.365,245 | 387,950 | |
| 7893 | 706.227,910 | 4.646.333,799 | 387,900 | |
| 7894 | 706.233,909 | 4.646.334,965 | 387,970 | |
| 7895 | 706.246,221 | 4.646.259,192 | 389,250 | |
| 7896 | 706.249,711 | 4.646.263,643 | 389,150 | |
| 7897 | 706.249,033 | 4.646.278,626 | 389,090 | |
| 7898 | 706.255,080 | 4.646.244,185 | 389,750 | |
| 7899 | 706.250,326 | 4.646.241,326 | 389,790 | |
| 7900 | 706.257,274 | 4.646.213,151 | 390,150 | |
| 7901 | 706.261,174 | 4.646.217,327 | 390,240 | |
| 7902 | 706.264,589 | 4.646.209,592 | 390,710 | |
| 7903 | 706.260,216 | 4.646.197,930 | 390,680 | |
| 7904 | 706.267,560 | 4.646.190,087 | 390,820 | |
| 7905 | 706.269,423 | 4.646.174,741 | 391,090 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7906 | 706.264,373 | 4.646.173,665 | 390,920 | |
| 7907 | 706.275,533 | 4.646.146,666 | 391,140 | |
| 7908 | 706.269,917 | 4.646.143,087 | 391,080 | |
| 7909 | 706.281,778 | 4.646.117,554 | 391,370 | |
| 7910 | 706.273,570 | 4.646.115,820 | 391,250 | |
| 7911 | 706.274,761 | 4.646.105,360 | 390,980 | |
| 7912 | 706.284,050 | 4.646.107,611 | 391,370 | |
| 7913 | 706.299,261 | 4.646.112,687 | 391,770 | |
| 7914 | 706.300,287 | 4.646.118,990 | 391,740 | |
| 7915 | 706.326,745 | 4.646.120,594 | 392,420 | |
| 7916 | 706.326,328 | 4.646.114,422 | 392,520 | |
| 7917 | 706.345,851 | 4.646.115,718 | 393,000 | |
| 7918 | 706.359,688 | 4.646.114,953 | 393,360 | |
| 7919 | 706.371,976 | 4.646.114,139 | 393,500 | |
| 7920 | 706.386,119 | 4.646.111,538 | 393,670 | |
| 7921 | 706.402,133 | 4.646.107,903 | 393,060 | |
| 7922 | 706.414,428 | 4.646.103,035 | 392,600 | |
| 7923 | 706.418,449 | 4.646.098,606 | 392,440 | |
| 7924 | 706.412,921 | 4.646.094,998 | 392,560 | |
| 7925 | 706.408,141 | 4.646.097,557 | 393,880 | |
| 7926 | 706.401,674 | 4.646.102,745 | 395,330 | |
| 7927 | 706.287,280 | 4.646.076,223 | 390,430 | |
| 7928 | 706.278,581 | 4.646.074,454 | 390,090 | |
| 7929 | 706.299,438 | 4.645.998,146 | 388,360 | |
| 7930 | 706.288,975 | 4.645.976,584 | 386,140 | |
| 7931 | 706.297,208 | 4.645.960,218 | 385,600 | |
| 7932 | 706.290,780 | 4.645.958,524 | 386,020 | |
| 7933 | 706.294,988 | 4.645.948,102 | 385,230 | |
| 7934 | 706.300,681 | 4.645.949,530 | 385,220 | |
| 7935 | 706.304,185 | 4.645.932,678 | 385,410 | |
| 7936 | 706.300,982 | 4.645.930,813 | 385,400 | |
| 7937 | 706.303,166 | 4.645.926,093 | 384,240 | |
| 7938 | 706.307,782 | 4.645.925,604 | 384,400 | |
| 7939 | 706.312,289 | 4.645.859,975 | 383,790 | |
| 7940 | 706.319,939 | 4.645.859,511 | 383,110 | |
| 7941 | 706.321,261 | 4.645.841,025 | 382,160 | |
| 7942 | 706.315,881 | 4.645.839,130 | 382,310 | |
| 7943 | 706.323,233 | 4.645.826,538 | 382,150 | |
| 7944 | 706.320,534 | 4.645.822,485 | 382,230 | |
| 7945 | 706.318,274 | 4.645.830,666 | 382,210 | |
| 7946 | 706.284,545 | 4.645.817,677 | 383,780 | |
| 7947 | 706.278,955 | 4.645.823,203 | 383,750 | |
| 7948 | 706.275,939 | 4.645.820,989 | 383,780 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7949 | 706.276,022 | 4.645.809,989 | 383,760 | |
| 7950 | 706.281,822 | 4.645.808,317 | 383,780 | |
| 7951 | 706.276,998 | 4.645.789,362 | 383,750 | |
| 7952 | 706.272,612 | 4.645.790,703 | 383,840 | |
| 7953 | 706.240,794 | 4.645.693,369 | 393,930 | |
| 7954 | 706.235,799 | 4.645.695,633 | 396,310 | |
| 7955 | 706.231,556 | 4.645.691,761 | 396,010 | |
| 7956 | 706.223,278 | 4.645.688,878 | 395,650 | |
| 7957 | 706.231,540 | 4.645.685,642 | 393,160 | |
| 7958 | 706.223,411 | 4.645.681,021 | 392,910 | |
| 7959 | 706.218,784 | 4.645.681,887 | 393,330 | |
| 7960 | 706.198,227 | 4.645.664,893 | 391,720 | |
| 7961 | 706.202,187 | 4.645.661,760 | 391,540 | |
| 7962 | 706.158,736 | 4.645.631,061 | 387,430 | |
| 7963 | 706.161,815 | 4.645.629,098 | 387,440 | |
| 7964 | 704.106,160 | 4.644.535,296 | 449,423 | |
| 7965 | 704.110,601 | 4.644.513,802 | 450,091 | |
| 7966 | 704.120,872 | 4.644.514,218 | 447,421 | |
| 7967 | 705.876,594 | 4.644.738,777 | 393,239 | |
| 7968 | 705.877,532 | 4.644.752,818 | 393,488 | |
| 7969 | 704.131,698 | 4.644.521,290 | 446,703 | |
| 7970 | 705.877,784 | 4.644.757,053 | 393,270 | |
| 7971 | 704.812,284 | 4.644.670,364 | 429,435 | |
| 7972 | 704.142,855 | 4.644.532,359 | 444,557 | |
| 7973 | 704.141,706 | 4.644.527,032 | 445,754 | |
| 7974 | 704.830,775 | 4.644.632,672 | 428,103 | |
| 7975 | 704.837,478 | 4.644.618,868 | 427,716 | |
| 7976 | 704.146,409 | 4.644.515,050 | 446,116 | |
| 7977 | 704.156,125 | 4.644.516,992 | 445,183 | |
| 7978 | 704.798,058 | 4.644.678,691 | 429,885 | |
| 7979 | 704.784,541 | 4.644.673,964 | 429,881 | |
| 7980 | 704.795,513 | 4.644.656,157 | 429,131 | |
| 7981 | 704.808,196 | 4.644.653,706 | 428,939 | |
| 7982 | 704.802,789 | 4.644.642,227 | 428,695 | |
| 7983 | 704.824,089 | 4.644.618,500 | 427,988 | |
| 7984 | 704.832,662 | 4.644.604,426 | 427,742 | |
| 7985 | 704.839,241 | 4.644.590,772 | 427,659 | |
| 7986 | 704.848,201 | 4.644.578,277 | 427,467 | |
| 7987 | 704.835,458 | 4.644.541,451 | 427,093 | |
| 7988 | 704.856,785 | 4.644.575,713 | 427,292 | |
| 7989 | 704.864,482 | 4.644.585,893 | 426,468 | |
| 7990 | 704.873,095 | 4.644.593,835 | 426,224 | |
| 7991 | 704.882,251 | 4.644.600,172 | 426,562 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 7992 | 704.893,218 | 4.644.601,296 | 426,687 | |
| 7993 | 704.897,437 | 4.644.597,502 | 426,343 | |
| 7994 | 704.900,952 | 4.644.592,656 | 426,010 | |
| 7995 | 704.912,345 | 4.644.542,793 | 423,366 | |
| 7996 | 705.610,303 | 4.645.152,977 | 390,058 | |
| 7997 | 705.612,729 | 4.645.135,676 | 389,995 | |
| 7998 | 704.903,698 | 4.644.534,679 | 422,493 | |
| 7999 | 705.608,142 | 4.645.101,074 | 390,059 | |
| 8000 | 705.608,760 | 4.645.085,683 | 390,379 | |
| 8001 | 704.872,102 | 4.644.527,464 | 424,056 | |
| 8002 | 704.881,355 | 4.644.540,316 | 424,005 | |
| 8003 | 704.889,915 | 4.644.563,072 | 424,534 | |
| 8004 | 704.890,608 | 4.644.582,482 | 425,160 | |
| 8005 | 704.871,199 | 4.644.556,100 | 426,124 | |
| 8006 | 704.862,624 | 4.644.539,414 | 426,149 | |
| 8007 | 704.853,822 | 4.644.525,434 | 425,735 | |
| 8008 | 704.844,118 | 4.644.533,777 | 426,691 | |
| 8009 | 704.853,371 | 4.644.547,757 | 426,875 | |
| 8010 | 704.873,005 | 4.644.584,286 | 425,775 | |
| 8011 | 704.886,546 | 4.644.593,531 | 426,024 | |
| 8012 | 705.142,453 | 4.644.809,470 | 426,938 | |
| 8013 | 705.157,305 | 4.644.815,112 | 425,778 | |
| 8014 | 705.170,051 | 4.644.819,955 | 425,044 | |
| 8015 | 705.183,034 | 4.644.823,472 | 424,616 | |
| 8016 | 705.196,260 | 4.644.827,055 | 424,056 | |
| 8017 | 705.209,181 | 4.644.830,160 | 423,857 | |
| 8018 | 705.222,605 | 4.644.833,386 | 424,069 | |
| 8019 | 705.236,583 | 4.644.834,758 | 423,787 | |
| 8020 | 705.227,193 | 4.644.644,158 | 423,428 | |
| 8021 | 705.234,320 | 4.644.641,905 | 423,298 | |
| 8022 | 705.222,953 | 4.644.648,665 | 423,485 | |
| 8023 | 705.228,185 | 4.644.646,953 | 423,269 | |
| 8024 | 705.242,880 | 4.644.642,143 | 422,806 | |
| 8025 | 705.213,136 | 4.644.632,118 | 423,766 | |
| 8026 | 705.223,000 | 4.644.626,159 | 423,423 | |
| 8027 | 705.247,315 | 4.644.646,098 | 422,400 | |
| 8028 | 705.850,275 | 4.645.232,486 | 385,875 | |
| 8029 | 705.871,799 | 4.645.142,017 | 385,038 | |
| 8030 | 705.862,468 | 4.645.245,504 | 385,858 | |
| 8031 | 705.847,885 | 4.645.246,579 | 385,871 | |
| 8032 | 705.847,407 | 4.645.253,505 | 385,906 | |
| 8033 | 705.858,404 | 4.645.255,416 | 385,860 | |
| 8034 | 705.870,118 | 4.645.255,177 | 385,816 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8035 | 705.868,683 | 4.645.264,493 | 385,980 | |
| 8036 | 705.842,147 | 4.645.280,974 | 385,871 | |
| 8037 | 705.849,790 | 4.645.300,907 | 385,909 | |
| 8038 | 705.773,465 | 4.645.316,534 | 387,112 | |
| 8039 | 705.790,740 | 4.645.319,000 | 387,155 | |
| 8040 | 705.787,567 | 4.645.330,271 | 387,110 | |
| 8041 | 705.799,906 | 4.645.339,077 | 387,108 | |
| 8042 | 705.788,816 | 4.645.346,565 | 386,964 | |
| 8043 | 705.775,868 | 4.645.346,841 | 386,936 | |
| 8044 | 705.765,124 | 4.645.341,198 | 386,852 | |
| 8045 | 705.763,057 | 4.645.329,087 | 387,050 | |
| 8046 | 705.821,622 | 4.645.382,516 | 387,235 | |
| 8047 | 705.819,280 | 4.645.375,910 | 386,761 | |
| 8048 | 705.814,184 | 4.645.365,175 | 386,882 | |
| 8049 | 705.808,260 | 4.645.354,165 | 386,962 | |
| 8050 | 705.797,378 | 4.645.347,008 | 387,090 | |
| 8051 | 705.771,726 | 4.645.326,860 | 387,206 | |
| 8052 | 705.751,201 | 4.645.317,088 | 386,940 | |
| 8053 | 705.736,581 | 4.645.305,087 | 386,769 | |
| 8054 | 705.719,075 | 4.645.276,422 | 386,835 | |
| 8055 | 705.709,019 | 4.645.261,971 | 386,973 | |
| 8056 | 705.705,953 | 4.645.256,311 | 386,845 | |
| 8057 | 705.699,115 | 4.645.249,479 | 387,479 | |
| 8058 | 705.691,997 | 4.645.229,958 | 387,701 | |
| 8059 | 705.679,438 | 4.645.228,982 | 389,810 | |
| 8060 | 705.669,390 | 4.645.228,424 | 389,994 | |
| 8061 | 705.676,698 | 4.645.219,522 | 389,979 | |
| 8062 | 705.687,179 | 4.645.239,207 | 388,426 | |
| 8063 | 705.572,760 | 4.645.169,745 | 391,125 | |
| 8064 | 705.707,924 | 4.645.473,868 | 389,889 | |
| 8065 | 705.716,360 | 4.645.473,868 | 389,950 | |
| 8066 | 705.726,135 | 4.645.475,340 | 389,994 | |
| 8067 | 705.740,061 | 4.645.481,227 | 389,817 | |
| 8068 | 705.717,431 | 4.645.524,083 | 395,519 | |
| 8069 | 705.714,083 | 4.645.513,915 | 394,047 | |
| 8070 | 705.716,895 | 4.645.503,881 | 392,795 | |
| 8071 | 705.712,477 | 4.645.483,545 | 390,379 | |
| 8072 | 705.720,511 | 4.645.484,883 | 390,081 | |
| 8073 | 705.723,189 | 4.645.493,312 | 391,366 | |
| 8074 | 705.724,528 | 4.645.503,614 | 392,269 | |
| 8075 | 705.732,696 | 4.645.525,287 | 393,071 | |
| 8076 | 705.738,055 | 4.645.499,842 | 391,008 | |
| 8077 | 705.739,394 | 4.645.506,531 | 391,264 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8078 | 705.739,795 | 4.645.519,241 | 392,182 | |
| 8079 | 705.741,804 | 4.645.523,807 | 391,886 | |
| 8080 | 705.745,286 | 4.645.512,435 | 391,347 | |
| 8081 | 705.881,488 | 4.645.183,940 | 383,925 | |
| 8082 | 705.747,830 | 4.645.487,282 | 390,076 | |
| 8083 | 705.757,118 | 4.645.512,860 | 390,058 | |
| 8084 | 705.755,223 | 4.645.523,660 | 390,782 | |
| 8085 | 705.764,807 | 4.645.520,608 | 390,132 | |
| 8086 | 705.771,405 | 4.645.494,159 | 390,039 | |
| 8087 | 705.788,151 | 4.645.497,175 | 389,252 | |
| 8088 | 705.853,378 | 4.645.492,274 | 387,383 | |
| 8089 | 705.845,550 | 4.645.489,155 | 387,491 | |
| 8090 | 705.754,777 | 4.645.191,910 | 388,048 | |
| 8091 | 705.794,216 | 4.645.198,691 | 387,410 | |
| 8092 | 705.756,422 | 4.645.532,257 | 390,232 | |
| 8093 | 705.760,875 | 4.645.529,513 | 390,232 | |
| 8094 | 705.757,306 | 4.645.523,358 | 390,672 | |
| 8095 | 705.802,984 | 4.644.892,969 | 388,181 | |
| 8096 | 705.809,531 | 4.644.937,140 | 387,608 | |
| 8097 | 705.864,360 | 4.645.000,125 | 386,208 | |
| 8098 | 705.842,039 | 4.645.010,425 | 386,418 | |
| 8099 | 705.815,139 | 4.644.986,160 | 386,919 | |
| 8100 | 705.868,410 | 4.645.475,300 | 387,693 | |
| 8101 | 705.860,668 | 4.645.475,895 | 387,687 | |
| 8102 | 705.852,671 | 4.645.475,980 | 387,680 | |
| 8103 | 705.829,083 | 4.645.488,218 | 387,834 | |
| 8104 | 705.821,777 | 4.645.491,384 | 387,963 | |
| 8105 | 705.757,401 | 4.644.973,043 | 387,719 | |
| 8106 | 705.745,758 | 4.645.533,072 | 390,779 | |
| 8107 | 705.734,153 | 4.645.536,455 | 391,384 | |
| 8108 | 705.722,549 | 4.645.535,488 | 392,322 | |
| 8109 | 705.792,176 | 4.645.510,840 | 390,634 | |
| 8110 | 705.804,505 | 4.645.505,765 | 389,247 | |
| 8111 | 710.168,903 | 4.647.677,956 | 345,257 | |
| 8112 | 710.201,311 | 4.647.686,881 | 345,217 | |
| 8113 | 710.203,972 | 4.647.680,615 | 345,190 | |
| 8114 | 710.227,762 | 4.647.693,706 | 345,141 | |
| 8115 | 710.232,020 | 4.647.689,908 | 345,134 | |
| 8116 | 710.255,894 | 4.647.701,454 | 345,098 | |
| 8117 | 710.257,052 | 4.647.696,463 | 345,096 | |
| 8118 | 710.292,776 | 4.647.713,367 | 344,956 | |
| 8119 | 710.298,547 | 4.647.708,562 | 344,965 | |
| 8120 | 710.327,720 | 4.647.725,004 | 344,878 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8121 | 710.329,857 | 4.647.719,772 | 344,899 | |
| 8122 | 710.370,715 | 4.647.737,765 | 343,545 | |
| 8123 | 710.374,004 | 4.647.734,816 | 343,626 | |
| 8124 | 710.388,274 | 4.647.744,183 | 343,434 | |
| 8125 | 710.391,901 | 4.647.741,403 | 343,453 | |
| 8126 | 710.409,193 | 4.647.751,852 | 343,390 | |
| 8127 | 710.411,049 | 4.647.748,313 | 343,394 | |
| 8128 | 710.439,198 | 4.647.762,141 | 343,404 | |
| 8129 | 710.441,671 | 4.647.758,248 | 343,432 | |
| 8130 | 710.471,601 | 4.647.774,594 | 343,379 | |
| 8131 | 710.477,222 | 4.647.770,925 | 343,380 | |
| 8132 | 710.512,545 | 4.647.791,236 | 343,358 | |
| 8133 | 710.511,645 | 4.647.782,401 | 343,372 | |
| 8134 | 710.522,512 | 4.647.786,444 | 343,318 | |
| 8135 | 710.528,006 | 4.647.767,684 | 343,581 | |
| 8136 | 710.520,531 | 4.647.765,148 | 343,583 | |
| 8137 | 710.535,872 | 4.647.797,490 | 343,353 | |
| 8138 | 710.541,814 | 4.647.793,002 | 343,375 | |
| 8139 | 710.579,324 | 4.647.822,178 | 342,864 | |
| 8140 | 710.572,193 | 4.647.819,945 | 342,864 | |
| 8141 | 710.564,756 | 4.647.862,263 | 342,649 | |
| 8142 | 710.559,082 | 4.647.859,052 | 342,667 | |
| 8143 | 710.553,908 | 4.647.892,432 | 342,498 | |
| 8144 | 710.548,913 | 4.647.892,730 | 342,523 | |
| 8145 | 710.543,972 | 4.647.926,053 | 342,153 | |
| 8146 | 710.538,599 | 4.647.926,712 | 342,161 | |
| 8147 | 710.537,558 | 4.647.944,546 | 342,220 | |
| 8148 | 710.532,279 | 4.647.944,734 | 342,170 | |
| 8149 | 710.534,348 | 4.647.952,215 | 342,347 | |
| 8150 | 710.529,729 | 4.647.953,722 | 342,725 | |
| 8151 | 710.522,305 | 4.647.973,763 | 342,456 | |
| 8152 | 710.527,265 | 4.647.975,532 | 342,468 | |
| 8153 | 710.513,218 | 4.648.020,498 | 343,473 | |
| 8154 | 710.507,807 | 4.648.020,777 | 343,500 | |
| 8155 | 710.506,683 | 4.648.040,499 | 343,817 | |
| 8156 | 710.500,712 | 4.648.041,152 | 343,883 | |
| 8157 | 710.491,500 | 4.648.063,190 | 343,999 | |
| 8158 | 710.499,933 | 4.648.066,666 | 343,994 | |
| 8159 | 710.490,804 | 4.648.067,075 | 343,992 | |
| 8160 | 710.501,040 | 4.648.074,698 | 343,993 | |
| 8161 | 710.508,040 | 4.648.072,858 | 343,984 | |
| 8162 | 710.527,271 | 4.648.092,842 | 343,951 | |
| 8163 | 710.533,244 | 4.648.088,549 | 343,965 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8164 | 710.553,486 | 4.648.109,725 | 343,967 | |
| 8165 | 710.556,421 | 4.648.105,432 | 343,955 | |
| 8166 | 710.579,290 | 4.648.128,299 | 343,951 | |
| 8167 | 710.584,006 | 4.648.123,483 | 343,927 | |
| 8168 | 710.607,271 | 4.648.145,574 | 343,725 | |
| 8169 | 710.613,035 | 4.648.143,794 | 343,750 | |
| 8170 | 710.637,054 | 4.648.166,231 | 343,749 | |
| 8171 | 710.641,560 | 4.648.163,090 | 343,728 | |
| 8172 | 710.652,040 | 4.648.167,802 | 343,659 | |
| 8173 | 710.659,123 | 4.648.140,408 | 343,487 | |
| 8174 | 710.665,862 | 4.648.143,219 | 343,491 | |
| 8175 | 710.659,533 | 4.648.181,250 | 343,542 | |
| 8176 | 710.662,614 | 4.648.175,849 | 343,562 | |
| 8177 | 710.696,458 | 4.648.202,250 | 343,422 | |
| 8178 | 710.702,632 | 4.648.198,946 | 343,496 | |
| 8179 | 710.729,479 | 4.648.222,990 | 343,312 | |
| 8180 | 710.732,125 | 4.648.217,483 | 343,328 | |
| 8181 | 710.600,223 | 4.647.820,022 | 342,836 | |
| 8182 | 710.601,801 | 4.647.816,961 | 342,880 | |
| 8183 | 710.624,171 | 4.647.829,109 | 342,841 | |
| 8184 | 710.626,120 | 4.647.826,142 | 342,884 | |
| 8185 | 710.644,313 | 4.647.836,250 | 342,738 | |
| 8186 | 710.651,832 | 4.647.834,673 | 342,751 | |
| 8187 | 710.673,612 | 4.647.847,547 | 342,544 | |
| 8188 | 710.675,078 | 4.647.843,517 | 342,599 | |
| 8189 | 710.702,021 | 4.647.857,604 | 342,563 | |
| 8190 | 710.702,929 | 4.647.853,978 | 342,561 | |
| 8191 | 710.736,669 | 4.647.867,738 | 342,241 | |
| 8192 | 710.737,139 | 4.647.870,450 | 342,002 | |
| 8193 | 710.757,104 | 4.647.878,698 | 341,928 | |
| 8194 | 710.759,304 | 4.647.873,781 | 342,178 | |
| 8195 | 710.783,619 | 4.647.884,308 | 342,189 | |
| 8196 | 710.785,067 | 4.647.881,763 | 342,220 | |
| 8197 | 710.803,233 | 4.647.889,157 | 341,977 | |
| 8198 | 710.803,874 | 4.647.886,370 | 342,021 | |
| 8199 | 710.808,632 | 4.647.890,072 | 341,972 | |
| 8200 | 710.808,494 | 4.647.887,649 | 342,028 | |
| 8201 | 710.834,728 | 4.647.896,572 | 341,822 | |
| 8202 | 710.834,682 | 4.647.894,379 | 341,886 | |
| 8203 | 710.861,826 | 4.647.903,438 | 341,711 | |
| 8204 | 710.862,329 | 4.647.900,970 | 341,828 | |
| 8205 | 710.883,664 | 4.647.908,798 | 341,382 | |
| 8206 | 710.884,579 | 4.647.906,056 | 341,473 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8207 | 710.909,619 | 4.647.914,332 | 341,194 | |
| 8208 | 710.916,069 | 4.647.916,891 | 341,197 | |
| 8209 | 710.917,944 | 4.647.914,515 | 341,277 | |
| 8210 | 710.971,688 | 4.647.930,949 | 340,633 | |
| 8211 | 710.973,701 | 4.647.927,704 | 340,654 | |
| 8212 | 711.000,126 | 4.647.937,772 | 340,320 | |
| 8213 | 711.001,590 | 4.647.934,435 | 340,357 | |
| 8214 | 711.046,518 | 4.647.948,920 | 339,983 | |
| 8215 | 711.048,933 | 4.647.945,994 | 339,986 | |
| 8216 | 711.062,475 | 4.647.952,165 | 339,894 | |
| 8217 | 711.063,605 | 4.647.949,393 | 339,885 | |
| 8218 | 711.080,973 | 4.647.957,299 | 339,667 | |
| 8219 | 711.084,005 | 4.647.954,784 | 339,669 | |
| 8220 | 711.106,137 | 4.647.963,468 | 339,525 | |
| 8221 | 711.107,288 | 4.647.960,265 | 339,589 | |
| 8222 | 711.143,051 | 4.647.973,736 | 339,314 | |
| 8223 | 711.148,642 | 4.647.973,489 | 339,322 | |
| 8224 | 711.142,722 | 4.647.966,836 | 339,369 | |
| 8225 | 711.148,722 | 4.647.968,729 | 339,357 | |
| 8226 | 711.150,350 | 4.647.946,028 | 339,006 | |
| 8227 | 711.159,445 | 4.647.947,894 | 339,018 | |
| 8228 | 710.168,522 | 4.647.152,232 | 350,100 | |
| 8229 | 710.173,110 | 4.647.147,518 | 350,363 | |
| 8230 | 710.172,921 | 4.647.162,661 | 352,942 | |
| 8231 | 710.176,669 | 4.647.159,820 | 353,163 | |
| 8232 | 710.175,441 | 4.647.169,441 | 354,515 | |
| 8233 | 710.179,190 | 4.647.166,729 | 354,537 | |
| 8234 | 710.176,734 | 4.647.178,675 | 354,531 | |
| 8235 | 710.181,904 | 4.647.176,221 | 354,511 | |
| 8236 | 710.177,187 | 4.647.196,792 | 354,564 | |
| 8237 | 710.187,722 | 4.647.199,569 | 354,571 | |
| 8238 | 710.177,252 | 4.647.208,499 | 354,647 | |
| 8239 | 710.184,232 | 4.647.209,016 | 354,755 | |
| 8240 | 710.195,348 | 4.647.205,271 | 354,756 | |
| 8241 | 710.239,986 | 4.647.190,025 | 353,914 | |
| 8242 | 710.240,050 | 4.647.185,570 | 353,620 | |
| 8243 | 710.258,570 | 4.647.183,506 | 353,647 | |
| 8244 | 710.259,514 | 4.647.179,082 | 353,550 | |
| 8245 | 710.285,327 | 4.647.176,302 | 354,439 | |
| 8246 | 710.284,058 | 4.647.172,091 | 354,381 | |
| 8247 | 710.307,146 | 4.647.168,684 | 354,390 | |
| 8248 | 710.305,922 | 4.647.164,518 | 354,259 | |
| 8249 | 710.333,720 | 4.647.160,337 | 354,331 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8250 | 710.331,998 | 4.647.156,081 | 354,277 | |
| 8251 | 710.353,236 | 4.647.154,036 | 354,393 | |
| 8252 | 710.352,528 | 4.647.150,110 | 354,283 | |
| 8253 | 710.373,489 | 4.647.146,101 | 354,416 | |
| 8254 | 710.373,232 | 4.647.143,140 | 354,327 | |
| 8255 | 710.382,188 | 4.647.143,848 | 354,428 | |
| 8256 | 710.382,574 | 4.647.140,887 | 354,351 | |
| 8257 | 710.401,453 | 4.647.137,797 | 354,375 | |
| 8258 | 710.400,570 | 4.647.135,006 | 354,364 | |
| 8259 | 710.433,605 | 4.647.127,454 | 354,275 | |
| 8260 | 710.432,790 | 4.647.124,199 | 354,217 | |
| 8261 | 710.457,761 | 4.647.119,963 | 354,352 | |
| 8262 | 710.457,303 | 4.647.116,555 | 354,185 | |
| 8263 | 710.525,718 | 4.647.100,188 | 353,159 | |
| 8264 | 710.526,329 | 4.647.093,270 | 353,119 | |
| 8265 | 710.553,947 | 4.647.105,943 | 353,650 | |
| 8266 | 710.556,798 | 4.647.104,773 | 353,585 | |
| 8267 | 710.564,485 | 4.647.110,419 | 353,558 | |
| 8268 | 710.574,311 | 4.647.112,860 | 353,279 | |
| 8269 | 710.576,297 | 4.647.108,130 | 353,341 | |
| 8270 | 710.566,573 | 4.647.104,926 | 353,411 | |
| 8271 | 706.796,559 | 4.647.833,260 | 370,901 | |
| 8272 | 706.797,961 | 4.647.830,551 | 370,908 | |
| 8273 | 706.808,060 | 4.647.840,173 | 370,757 | |
| 8274 | 706.810,678 | 4.647.835,222 | 370,783 | |
| 8275 | 706.824,616 | 4.647.847,195 | 370,474 | |
| 8276 | 706.827,048 | 4.647.842,617 | 370,492 | |
| 8277 | 706.858,024 | 4.647.858,992 | 369,314 | |
| 8278 | 706.863,260 | 4.647.854,601 | 369,219 | |
| 8279 | 706.897,015 | 4.647.874,685 | 367,994 | |
| 8280 | 706.903,373 | 4.647.861,234 | 367,903 | |
| 8281 | 706.430,510 | 4.647.065,464 | 382,994 | |
| 8282 | 706.435,816 | 4.647.057,153 | 382,994 | |
| 8283 | 706.431,851 | 4.647.106,319 | 382,808 | |
| 8284 | 706.428,764 | 4.647.112,461 | 382,503 | |
| 8285 | 706.429,963 | 4.647.115,494 | 382,450 | |
| 8286 | 706.433,203 | 4.647.110,040 | 382,579 | |
| 8287 | 706.427,575 | 4.647.133,189 | 382,388 | |
| 8288 | 706.431,779 | 4.647.133,923 | 382,361 | |
| 8289 | 706.427,002 | 4.647.137,700 | 381,993 | |
| 8290 | 706.430,390 | 4.647.139,780 | 382,038 | |
| 8291 | 706.425,139 | 4.647.153,251 | 382,141 | |
| 8292 | 706.430,886 | 4.647.157,844 | 382,142 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8293 | 706.424,985 | 4.647.187,216 | 382,042 | |
| 8294 | 706.429,681 | 4.647.188,917 | 382,023 | |
| 8295 | 706.423,698 | 4.647.224,040 | 381,447 | |
| 8296 | 706.430,922 | 4.647.224,968 | 381,438 | |
| 8297 | 706.427,571 | 4.647.246,590 | 381,486 | |
| 8298 | 706.433,867 | 4.647.245,662 | 381,477 | |
| 8299 | 706.438,764 | 4.647.273,761 | 378,383 | |
| 8300 | 706.442,637 | 4.647.270,942 | 378,396 | |
| 8301 | 706.458,334 | 4.647.307,715 | 376,151 | |
| 8302 | 706.462,207 | 4.647.305,289 | 376,057 | |
| 8303 | 706.476,068 | 4.647.338,447 | 373,408 | |
| 8304 | 706.482,436 | 4.647.338,382 | 373,326 | |
| 8305 | 706.500,501 | 4.647.376,946 | 370,340 | |
| 8306 | 706.504,506 | 4.647.375,045 | 370,275 | |
| 8307 | 706.523,299 | 4.647.413,475 | 368,515 | |
| 8308 | 706.526,253 | 4.647.411,967 | 368,673 | |
| 8309 | 706.534,472 | 4.647.425,338 | 367,475 | |
| 8310 | 705.941,338 | 4.647.268,081 | 376,969 | |
| 8311 | 705.923,002 | 4.647.301,376 | 376,965 | |
| 8312 | 705.903,136 | 4.647.337,129 | 376,974 | |
| 8313 | 705.891,210 | 4.647.363,771 | 376,911 | |
| 8314 | 705.880,478 | 4.647.384,036 | 376,957 | |
| 8315 | 705.871,069 | 4.647.401,268 | 376,863 | |
| 8316 | 705.855,846 | 4.647.434,727 | 375,923 | |
| 8317 | 705.847,090 | 4.647.450,942 | 375,914 | |
| 8318 | 705.836,103 | 4.647.470,911 | 375,904 | |
| 8319 | 705.823,776 | 4.647.497,437 | 375,878 | |
| 8320 | 705.815,955 | 4.647.513,864 | 375,838 | |
| 8321 | 705.807,880 | 4.647.530,659 | 375,821 | |
| 8322 | 705.800,316 | 4.647.546,989 | 375,831 | |
| 8323 | 705.793,433 | 4.647.564,314 | 375,848 | |
| 8324 | 705.786,020 | 4.647.576,745 | 375,795 | |
| 8325 | 705.779,401 | 4.647.576,216 | 375,753 | |
| 8326 | 705.397,224 | 4.647.295,179 | 382,227 | |
| 8327 | 705.400,586 | 4.647.297,263 | 382,238 | |
| 8328 | 705.405,625 | 4.647.278,851 | 382,172 | |
| 8329 | 705.408,500 | 4.647.280,055 | 382,186 | |
| 8330 | 705.412,026 | 4.647.264,089 | 382,231 | |
| 8331 | 705.415,087 | 4.647.265,386 | 382,217 | |
| 8332 | 705.418,703 | 4.647.250,562 | 382,334 | |
| 8333 | 705.421,949 | 4.647.251,859 | 382,289 | |
| 8334 | 705.426,030 | 4.647.235,645 | 382,241 | |
| 8335 | 705.428,627 | 4.647.237,406 | 382,257 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8336 | 705.436,700 | 4.647.213,717 | 382,537 | |
| 8337 | 705.440,502 | 4.647.215,106 | 382,508 | |
| 8338 | 705.448,299 | 4.647.188,919 | 382,478 | |
| 8339 | 705.452,380 | 4.647.189,661 | 382,365 | |
| 8340 | 705.461,670 | 4.647.159,259 | 382,765 | |
| 8341 | 705.467,160 | 4.647.161,186 | 382,856 | |
| 8342 | 705.477,562 | 4.647.125,685 | 384,662 | |
| 8343 | 705.483,201 | 4.647.128,205 | 384,658 | |
| 8344 | 705.493,745 | 4.647.093,430 | 385,491 | |
| 8345 | 705.499,829 | 4.647.095,802 | 385,563 | |
| 8346 | 705.498,642 | 4.647.080,385 | 385,703 | |
| 8347 | 705.509,856 | 4.647.084,111 | 385,933 | |
| 8348 | 705.508,684 | 4.647.076,936 | 386,084 | |
| 8349 | 705.500,697 | 4.647.073,569 | 385,911 | |
| 8350 | 705.467,941 | 4.647.067,566 | 389,489 | |
| 8351 | 705.471,312 | 4.647.061,416 | 389,354 | |
| 8352 | 706.148,360 | 4.646.664,890 | 385,500 | |
| 8353 | 706.153,355 | 4.646.664,644 | 385,904 | |
| 8354 | 706.150,571 | 4.646.652,045 | 387,446 | |
| 8355 | 706.157,204 | 4.646.651,473 | 387,976 | |
| 8356 | 706.154,339 | 4.646.639,148 | 388,582 | |
| 8357 | 706.161,054 | 4.646.639,803 | 388,886 | |
| 8358 | 706.157,369 | 4.646.628,104 | 389,217 | |
| 8359 | 706.162,118 | 4.646.628,186 | 389,585 | |
| 8360 | 706.160,154 | 4.646.616,709 | 390,086 | |
| 8361 | 706.166,132 | 4.646.615,482 | 390,346 | |
| 8362 | 706.165,155 | 4.646.596,028 | 390,522 | |
| 8363 | 706.169,659 | 4.646.594,719 | 390,561 | |
| 8364 | 706.177,439 | 4.646.570,748 | 390,854 | |
| 8365 | 706.135,366 | 4.645.612,144 | 386,624 | |
| 8366 | 706.138,128 | 4.645.609,064 | 386,527 | |
| 8367 | 706.124,567 | 4.645.602,734 | 386,508 | |
| 8368 | 706.128,679 | 4.645.601,502 | 386,520 | |
| 8369 | 706.090,480 | 4.645.569,967 | 384,284 | |
| 8370 | 706.094,862 | 4.645.566,968 | 384,224 | |
| 8371 | 706.076,200 | 4.645.556,268 | 384,817 | |
| 8372 | 706.079,933 | 4.645.552,864 | 384,273 | |
| 8373 | 706.061,264 | 4.645.542,869 | 383,171 | |
| 8374 | 706.065,084 | 4.645.539,337 | 383,130 | |
| 8375 | 706.035,434 | 4.645.515,884 | 383,759 | |
| 8376 | 706.028,414 | 4.645.507,948 | 383,760 | |
| 8377 | 706.031,379 | 4.645.503,277 | 383,773 | |
| 8378 | 706.009,032 | 4.645.488,180 | 383,546 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8379 | 706.016,461 | 4.645.485,453 | 383,564 | |
| 8380 | 706.008,378 | 4.645.468,721 | 383,249 | |
| 8381 | 706.014,579 | 4.645.468,604 | 383,154 | |
| 8382 | 706.008,382 | 4.645.446,325 | 383,098 | |
| 8383 | 706.014,091 | 4.645.446,325 | 383,103 | |
| 8384 | 706.008,102 | 4.645.423,078 | 383,100 | |
| 8385 | 706.012,688 | 4.645.421,863 | 383,120 | |
| 8386 | 706.006,230 | 4.645.393,061 | 383,105 | |
| 8387 | 706.010,816 | 4.645.393,809 | 383,144 | |
| 8388 | 706.006,722 | 4.645.380,460 | 383,161 | |
| 8389 | 706.010,406 | 4.645.380,657 | 382,810 | |
| 8390 | 706.005,801 | 4.645.357,566 | 382,474 | |
| 8391 | 706.009,813 | 4.645.357,303 | 382,475 | |
| 8392 | 706.003,637 | 4.645.327,767 | 382,446 | |
| 8393 | 706.009,381 | 4.645.327,528 | 382,461 | |
| 8394 | 706.002,918 | 4.645.294,527 | 382,467 | |
| 8395 | 706.008,424 | 4.645.294,766 | 382,452 | |
| 8396 | 706.001,004 | 4.645.265,112 | 382,449 | |
| 8397 | 706.006,988 | 4.645.263,678 | 382,468 | |
| 8398 | 706.000,285 | 4.645.238,090 | 382,432 | |
| 8399 | 706.007,466 | 4.645.240,481 | 382,452 | |
| 8400 | 706.004,328 | 4.645.230,756 | 382,523 | |
| 8401 | 706.009,115 | 4.645.232,389 | 382,577 | |
| 8402 | 706.013,354 | 4.645.208,140 | 383,027 | |
| 8403 | 706.016,926 | 4.645.209,496 | 383,135 | |
| 8404 | 706.016,367 | 4.645.197,649 | 382,174 | |
| 8405 | 706.020,579 | 4.645.199,081 | 382,175 | |
| 8406 | 706.017,300 | 4.645.192,217 | 382,139 | |
| 8407 | 706.023,218 | 4.645.193,124 | 382,132 | |
| 8408 | 706.019,672 | 4.645.186,961 | 382,153 | |
| 8409 | 706.027,217 | 4.645.189,223 | 382,133 | |
| 8410 | 706.043,319 | 4.645.196,742 | 382,139 | |
| 8411 | 706.045,719 | 4.645.192,359 | 382,132 | |
| 8412 | 706.064,354 | 4.645.199,933 | 382,114 | |
| 8413 | 706.065,687 | 4.645.195,277 | 382,138 | |
| 8414 | 706.090,560 | 4.645.204,589 | 382,147 | |
| 8415 | 706.093,359 | 4.645.199,933 | 382,094 | |
| 8416 | 706.027,803 | 4.645.021,446 | 383,779 | |
| 8417 | 706.032,815 | 4.645.028,440 | 383,810 | |
| 8418 | 706.023,218 | 4.645.040,702 | 383,831 | |
| 8419 | 706.017,833 | 4.645.033,621 | 383,828 | |
| 8420 | 706.013,541 | 4.645.051,817 | 383,861 | |
| 8421 | 706.007,356 | 4.645.045,784 | 383,857 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8422 | 705.983,922 | 4.645.071,237 | 384,468 | |
| 8423 | 705.993,306 | 4.645.077,051 | 384,034 | |
| 8424 | 705.965,847 | 4.645.093,761 | 384,367 | |
| 8425 | 705.974,938 | 4.645.100,318 | 383,605 | |
| 8426 | 705.948,678 | 4.645.108,296 | 384,426 | |
| 8427 | 705.961,581 | 4.645.121,203 | 383,273 | |
| 8428 | 705.935,748 | 4.645.131,640 | 384,174 | |
| 8429 | 705.940,947 | 4.645.142,230 | 383,218 | |
| 8430 | 705.918,686 | 4.645.140,579 | 383,897 | |
| 8431 | 705.923,485 | 4.645.130,820 | 384,474 | |
| 8432 | 705.903,463 | 4.645.133,465 | 384,384 | |
| 8433 | 705.908,342 | 4.645.125,520 | 384,535 | |
| 8434 | 705.896,238 | 4.645.130,842 | 384,032 | |
| 8435 | 705.899,544 | 4.645.122,635 | 384,691 | |
| 8436 | 706.009,248 | 4.645.188,316 | 382,108 | |
| 8437 | 706.012,954 | 4.645.183,704 | 382,125 | |
| 8438 | 705.990,507 | 4.645.178,502 | 382,418 | |
| 8439 | 705.996,452 | 4.645.173,748 | 382,424 | |
| 8440 | 705.964,167 | 4.645.164,240 | 382,703 | |
| 8441 | 705.967,446 | 4.645.158,295 | 382,667 | |
| 8442 | 705.944,092 | 4.645.152,940 | 382,807 | |
| 8443 | 705.949,291 | 4.645.146,995 | 382,984 | |
| 8444 | 705.936,841 | 4.645.156,240 | 383,110 | |
| 8445 | 705.930,496 | 4.645.150,820 | 383,093 | |
| 8446 | 705.927,590 | 4.645.158,043 | 382,856 | |
| 8447 | 705.932,389 | 4.645.160,109 | 383,060 | |
| 8448 | 705.925,324 | 4.645.145,497 | 383,433 | |
| 8449 | 705.920,125 | 4.645.145,104 | 383,509 | |
| 8450 | 705.920,845 | 4.645.158,666 | 382,690 | |
| 8451 | 705.915,753 | 4.645.155,530 | 382,832 | |
| 8452 | 705.914,580 | 4.645.174,644 | 383,199 | |
| 8453 | 705.909,568 | 4.645.172,032 | 383,261 | |
| 8454 | 705.888,107 | 4.645.127,858 | 384,277 | |
| 8455 | 705.892,453 | 4.645.121,039 | 384,660 | |
| 8456 | 705.877,283 | 4.645.124,033 | 384,642 | |
| 8457 | 705.881,789 | 4.645.116,536 | 384,746 | |
| 8458 | 705.859,288 | 4.645.118,372 | 385,141 | |
| 8459 | 705.863,447 | 4.645.110,384 | 385,148 | |
| 8460 | 705.837,561 | 4.645.110,351 | 385,519 | |
| 8461 | 705.840,680 | 4.645.101,805 | 385,626 | |
| 8462 | 705.810,768 | 4.645.101,050 | 385,925 | |
| 8463 | 705.814,633 | 4.645.092,165 | 386,020 | |
| 8464 | 705.789,707 | 4.645.092,745 | 386,430 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8465 | 705.793,572 | 4.645.085,182 | 388,600 | |
| 8466 | 706.169,153 | 4.644.933,274 | 382,213 | |
| 8467 | 706.170,139 | 4.644.927,350 | 382,224 | |
| 8468 | 706.187,068 | 4.644.927,514 | 382,198 | |
| 8469 | 706.187,814 | 4.644.921,820 | 382,206 | |
| 8470 | 706.243,586 | 4.644.909,635 | 381,643 | |
| 8471 | 706.246,492 | 4.644.903,449 | 381,650 | |
| 8472 | 706.307,569 | 4.644.889,286 | 380,944 | |
| 8473 | 706.316,287 | 4.644.885,843 | 380,899 | |
| 8474 | 706.315,567 | 4.644.883,450 | 381,015 | |
| 8475 | 706.325,671 | 4.644.882,936 | 380,809 | |
| 8476 | 706.325,404 | 4.644.879,964 | 380,810 | |
| 8477 | 706.344,546 | 4.644.877,876 | 380,567 | |
| 8478 | 706.343,400 | 4.644.873,876 | 380,516 | |
| 8479 | 706.352,837 | 4.644.874,324 | 380,571 | |
| 8480 | 706.353,210 | 4.644.870,641 | 380,708 | |
| 8481 | 706.374,138 | 4.644.868,609 | 380,117 | |
| 8482 | 706.373,925 | 4.644.865,133 | 380,152 | |
| 8483 | 706.912,662 | 4.644.869,013 | 376,525 | |
| 8484 | 706.907,703 | 4.644.865,352 | 376,532 | |
| 8485 | 706.895,866 | 4.644.891,187 | 376,510 | |
| 8486 | 706.890,694 | 4.644.887,537 | 376,543 | |
| 8487 | 706.880,190 | 4.644.911,296 | 376,515 | |
| 8488 | 706.874,245 | 4.644.908,640 | 376,565 | |
| 8489 | 706.848,545 | 4.644.944,301 | 376,254 | |
| 8490 | 706.852,118 | 4.644.946,596 | 376,208 | |
| 8491 | 706.837,188 | 4.644.958,453 | 376,170 | |
| 8492 | 706.842,280 | 4.644.960,093 | 376,167 | |
| 8493 | 706.818,900 | 4.644.981,906 | 376,187 | |
| 8494 | 706.823,405 | 4.644.983,775 | 376,160 | |
| 8495 | 706.804,504 | 4.645.000,714 | 376,192 | |
| 8496 | 706.809,302 | 4.645.002,944 | 376,183 | |
| 8497 | 706.789,414 | 4.645.019,315 | 376,245 | |
| 8498 | 706.794,080 | 4.645.023,107 | 376,138 | |
| 8499 | 706.772,326 | 4.645.045,587 | 376,342 | |
| 8500 | 706.775,845 | 4.645.047,817 | 376,308 | |
| 8501 | 706.769,526 | 4.645.050,822 | 376,634 | |
| 8502 | 706.772,112 | 4.645.052,615 | 376,581 | |
| 8503 | 706.757,956 | 4.645.066,188 | 376,590 | |
| 8504 | 706.762,408 | 4.645.067,336 | 376,592 | |
| 8505 | 706.744,200 | 4.645.084,942 | 376,578 | |
| 8506 | 706.747,745 | 4.645.087,925 | 376,587 | |
| 8507 | 706.731,430 | 4.645.103,542 | 376,736 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8508 | 706.735,909 | 4.645.105,498 | 376,716 | |
| 8509 | 706.719,726 | 4.645.121,214 | 376,838 | |
| 8510 | 706.723,725 | 4.645.123,848 | 376,980 | |
| 8511 | 706.707,889 | 4.645.137,410 | 376,644 | |
| 8512 | 706.712,475 | 4.645.142,579 | 376,604 | |
| 8513 | 706.705,143 | 4.645.144,525 | 376,641 | |
| 8514 | 706.688,241 | 4.645.129,618 | 377,367 | |
| 8515 | 706.680,110 | 4.645.126,875 | 378,167 | |
| 8516 | 706.675,178 | 4.645.121,804 | 377,698 | |
| 8517 | 706.680,403 | 4.645.116,318 | 377,624 | |
| 8518 | 706.685,895 | 4.645.120,853 | 378,022 | |
| 8519 | 706.716,954 | 4.645.158,349 | 376,627 | |
| 8520 | 706.712,555 | 4.645.159,617 | 376,646 | |
| 8521 | 706.725,671 | 4.645.205,758 | 375,806 | |
| 8522 | 706.733,989 | 4.645.204,971 | 375,786 | |
| 8523 | 706.734,522 | 4.645.228,118 | 375,751 | |
| 8524 | 706.740,254 | 4.645.224,216 | 375,733 | |
| 8525 | 706.750,411 | 4.645.267,811 | 375,892 | |
| 8526 | 706.752,358 | 4.645.266,521 | 375,842 | |
| 8527 | 706.749,905 | 4.645.273,570 | 376,229 | |
| 8528 | 706.757,716 | 4.645.276,740 | 376,011 | |
| 8529 | 706.742,520 | 4.645.276,871 | 376,456 | |
| 8530 | 706.743,747 | 4.645.280,619 | 376,206 | |
| 8531 | 706.752,651 | 4.645.282,401 | 375,977 | |
| 8532 | 706.701,331 | 4.645.289,231 | 376,879 | |
| 8533 | 706.696,746 | 4.645.286,357 | 377,333 | |
| 8534 | 706.688,348 | 4.645.298,903 | 377,134 | |
| 8535 | 706.683,363 | 4.645.291,646 | 377,992 | |
| 8536 | 706.766,141 | 4.645.298,750 | 375,385 | |
| 8537 | 706.760,195 | 4.645.301,023 | 375,430 | |
| 8538 | 706.779,524 | 4.645.336,716 | 375,273 | |
| 8539 | 706.775,178 | 4.645.338,235 | 375,260 | |
| 8540 | 706.792,294 | 4.645.368,453 | 375,215 | |
| 8541 | 706.787,682 | 4.645.371,141 | 375,227 | |
| 8542 | 706.798,292 | 4.645.402,244 | 374,993 | |
| 8543 | 706.805,197 | 4.645.402,244 | 375,256 | |
| 8544 | 706.803,411 | 4.645.406,703 | 375,067 | |
| 8545 | 706.810,982 | 4.645.417,129 | 375,056 | |
| 8546 | 706.818,553 | 4.645.434,375 | 375,016 | |
| 8547 | 706.811,515 | 4.645.434,517 | 374,989 | |
| 8548 | 706.832,523 | 4.645.468,942 | 375,022 | |
| 8549 | 706.827,058 | 4.645.472,680 | 375,039 | |
| 8550 | 706.848,945 | 4.645.514,416 | 375,925 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8551 | 706.844,386 | 4.645.514,525 | 375,949 | |
| 8552 | 706.848,812 | 4.645.527,793 | 376,242 | |
| 8553 | 706.851,585 | 4.645.526,842 | 376,243 | |
| 8554 | 706.852,278 | 4.645.543,006 | 376,629 | |
| 8555 | 706.857,156 | 4.645.542,361 | 375,820 | |
| 8556 | 706.859,156 | 4.645.572,557 | 373,487 | |
| 8557 | 706.862,408 | 4.645.571,661 | 373,443 | |
| 8558 | 706.860,382 | 4.645.579,321 | 373,548 | |
| 8559 | 706.865,981 | 4.645.579,398 | 373,267 | |
| 8560 | 706.874,512 | 4.645.576,983 | 373,382 | |
| 8561 | 706.868,060 | 4.645.585,562 | 373,334 | |
| 8562 | 706.877,124 | 4.645.582,086 | 373,379 | |
| 8563 | 706.893,467 | 4.645.577,693 | 373,320 | |
| 8564 | 706.891,467 | 4.645.570,600 | 373,453 | |
| 8565 | 706.865,687 | 4.645.590,687 | 373,326 | |
| 8566 | 706.860,835 | 4.645.591,288 | 373,337 | |
| 8567 | 706.865,368 | 4.645.605,277 | 373,346 | |
| 8568 | 706.861,342 | 4.645.606,184 | 373,346 | |
| 8569 | 706.860,835 | 4.645.642,588 | 372,382 | |
| 8570 | 706.865,767 | 4.645.642,609 | 372,340 | |
| 8571 | 706.860,462 | 4.645.684,062 | 371,959 | |
| 8572 | 706.865,288 | 4.645.684,182 | 371,932 | |
| 8573 | 706.860,062 | 4.645.705,285 | 371,919 | |
| 8574 | 706.865,394 | 4.645.704,783 | 371,932 | |
| 8575 | 706.858,543 | 4.645.739,984 | 371,546 | |
| 8576 | 706.865,581 | 4.645.741,601 | 371,471 | |
| 8577 | 706.875,045 | 4.645.739,142 | 371,456 | |
| 8578 | 706.874,192 | 4.645.734,203 | 371,658 | |
| 8579 | 706.897,039 | 4.645.737,230 | 371,464 | |
| 8580 | 706.896,986 | 4.645.732,651 | 371,396 | |
| 8581 | 706.918,927 | 4.645.734,683 | 371,315 | |
| 8582 | 706.917,860 | 4.645.729,121 | 371,418 | |
| 8583 | 706.933,323 | 4.645.735,394 | 370,444 | |
| 8584 | 706.933,323 | 4.645.727,995 | 370,658 | |
| 8585 | 706.839,401 | 4.645.767,557 | 372,607 | |
| 8586 | 706.836,149 | 4.645.763,174 | 372,587 | |
| 8587 | 706.817,834 | 4.645.788,780 | 372,578 | |
| 8588 | 706.815,114 | 4.645.785,414 | 372,599 | |
| 8589 | 706.806,450 | 4.645.800,824 | 372,583 | |
| 8590 | 706.804,557 | 4.645.797,796 | 372,581 | |
| 8591 | 706.792,187 | 4.645.816,320 | 372,578 | |
| 8592 | 706.790,721 | 4.645.812,845 | 372,585 | |
| 8593 | 706.767,900 | 4.645.841,861 | 375,053 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8594 | 706.764,514 | 4.645.838,702 | 375,050 | |
| 8595 | 706.749,505 | 4.645.861,696 | 375,055 | |
| 8596 | 706.743,427 | 4.645.860,123 | 375,050 | |
| 8597 | 706.729,537 | 4.645.884,832 | 375,070 | |
| 8598 | 706.720,446 | 4.645.881,444 | 375,076 | |
| 8599 | 706.712,448 | 4.645.899,695 | 375,255 | |
| 8600 | 706.710,075 | 4.645.896,154 | 375,502 | |
| 8601 | 706.702,024 | 4.645.911,301 | 376,293 | |
| 8602 | 706.699,892 | 4.645.907,826 | 376,258 | |
| 8603 | 706.695,519 | 4.645.919,115 | 376,245 | |
| 8604 | 706.692,453 | 4.645.914,777 | 376,314 | |
| 8605 | 706.686,695 | 4.645.931,323 | 377,545 | |
| 8606 | 706.678,324 | 4.645.926,602 | 378,142 | |
| 8607 | 706.676,831 | 4.645.939,541 | 378,068 | |
| 8608 | 706.672,645 | 4.645.934,896 | 378,012 | |
| 8609 | 706.856,170 | 4.645.587,299 | 374,193 | |
| 8610 | 706.855,424 | 4.645.581,005 | 374,356 | |
| 8611 | 706.844,840 | 4.645.586,043 | 374,123 | |
| 8612 | 706.845,213 | 4.645.582,633 | 374,459 | |
| 8613 | 706.828,791 | 4.645.587,660 | 374,747 | |
| 8614 | 706.829,404 | 4.645.583,332 | 375,455 | |
| 8615 | 706.821,593 | 4.645.586,425 | 376,053 | |
| 8616 | 706.822,046 | 4.645.583,332 | 375,577 | |
| 8617 | 706.810,262 | 4.645.585,190 | 375,477 | |
| 8618 | 706.811,329 | 4.645.582,349 | 375,395 | |
| 8619 | 706.797,332 | 4.645.582,797 | 375,663 | |
| 8620 | 706.797,412 | 4.645.579,966 | 375,599 | |
| 8621 | 706.787,495 | 4.645.581,289 | 375,619 | |
| 8622 | 706.788,561 | 4.645.579,431 | 375,668 | |
| 8623 | 706.775,258 | 4.645.581,179 | 375,608 | |
| 8624 | 706.777,897 | 4.645.577,026 | 375,633 | |
| 8625 | 706.746,173 | 4.645.572,240 | 375,710 | |
| 8626 | 706.748,145 | 4.645.568,874 | 375,703 | |
| 8627 | 706.727,911 | 4.645.567,529 | 375,787 | |
| 8628 | 706.729,217 | 4.645.562,929 | 375,778 | |
| 8629 | 706.693,387 | 4.645.555,344 | 378,277 | |
| 8630 | 706.694,080 | 4.645.552,666 | 377,835 | |
| 8631 | 706.676,138 | 4.645.550,656 | 377,946 | |
| 8632 | 706.677,178 | 4.645.547,847 | 378,336 | |
| 8633 | 706.660,382 | 4.645.546,732 | 378,409 | |
| 8634 | 706.660,489 | 4.645.542,743 | 378,488 | |
| 8635 | 706.643,800 | 4.645.540,984 | 378,323 | |
| 8636 | 706.644,733 | 4.645.538,000 | 378,353 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8637 | 706.620,633 | 4.645.535,760 | 379,127 | |
| 8638 | 706.622,499 | 4.645.529,847 | 378,967 | |
| 8639 | 706.773,792 | 4.644.449,560 | 384,012 | |
| 8640 | 706.773,019 | 4.644.442,413 | 383,607 | |
| 8641 | 706.779,044 | 4.644.442,194 | 383,663 | |
| 8642 | 706.768,673 | 4.644.418,741 | 383,567 | |
| 8643 | 706.774,592 | 4.644.418,075 | 383,576 | |
| 8644 | 706.763,288 | 4.644.389,758 | 383,545 | |
| 8645 | 706.768,993 | 4.644.388,644 | 383,551 | |
| 8646 | 706.753,557 | 4.644.337,399 | 384,553 | |
| 8647 | 706.759,022 | 4.644.336,722 | 384,547 | |
| 8648 | 706.750,305 | 4.644.314,952 | 384,551 | |
| 8649 | 706.753,984 | 4.644.313,280 | 384,565 | |
| 8650 | 706.746,599 | 4.644.295,717 | 384,643 | |
| 8651 | 706.751,744 | 4.644.295,608 | 384,562 | |
| 8652 | 706.744,360 | 4.644.286,111 | 385,316 | |
| 8653 | 706.747,719 | 4.644.283,095 | 385,404 | |
| 8654 | 706.742,014 | 4.644.275,576 | 386,084 | |
| 8655 | 706.746,253 | 4.644.270,997 | 386,113 | |
| 8656 | 706.740,867 | 4.644.269,204 | 385,637 | |
| 8657 | 706.749,105 | 4.644.266,232 | 385,795 | |
| 8658 | 706.745,346 | 4.644.262,265 | 385,668 | |
| 8659 | 706.757,743 | 4.644.251,828 | 385,972 | |
| 8660 | 706.752,491 | 4.644.249,150 | 385,669 | |
| 8661 | 706.772,539 | 4.644.226,233 | 385,876 | |
| 8662 | 706.767,287 | 4.644.224,648 | 385,654 | |
| 8663 | 706.794,080 | 4.644.194,802 | 386,563 | |
| 8664 | 706.790,294 | 4.644.191,731 | 386,575 | |
| 8665 | 706.812,235 | 4.644.165,633 | 386,766 | |
| 8666 | 706.810,369 | 4.644.163,754 | 386,766 | |
| 8667 | 706.816,581 | 4.644.161,437 | 386,754 | |
| 8668 | 706.810,529 | 4.644.160,639 | 386,748 | |
| 8669 | 706.812,528 | 4.644.151,918 | 386,732 | |
| 8670 | 706.809,036 | 4.644.152,563 | 386,733 | |
| 8671 | 706.809,169 | 4.644.136,268 | 386,755 | |
| 8672 | 706.803,891 | 4.644.136,902 | 386,746 | |
| 8673 | 706.803,277 | 4.644.116,859 | 386,758 | |
| 8674 | 706.797,892 | 4.644.115,482 | 386,775 | |
| 8675 | 706.795,146 | 4.644.091,515 | 386,348 | |
| 8676 | 706.790,641 | 4.644.089,931 | 386,349 | |
| 8677 | 706.787,762 | 4.644.067,975 | 385,996 | |
| 8678 | 706.783,443 | 4.644.066,565 | 386,004 | |
| 8679 | 706.780,617 | 4.644.040,915 | 385,763 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8680 | 706.775,685 | 4.644.039,506 | 385,778 | |
| 8681 | 706.771,339 | 4.644.006,862 | 385,758 | |
| 8682 | 706.765,447 | 4.644.006,862 | 385,790 | |
| 8683 | 706.764,274 | 4.643.980,425 | 385,807 | |
| 8684 | 706.758,996 | 4.643.981,573 | 385,802 | |
| 8685 | 706.757,316 | 4.643.952,262 | 385,794 | |
| 8686 | 706.749,398 | 4.643.952,830 | 385,760 | |
| 8687 | 706.744,360 | 4.643.913,717 | 385,768 | |
| 8688 | 706.739,774 | 4.643.914,602 | 385,774 | |
| 8689 | 706.741,107 | 4.643.901,925 | 385,769 | |
| 8690 | 706.735,295 | 4.643.901,477 | 385,757 | |
| 8691 | 706.726,258 | 4.643.872,057 | 385,765 | |
| 8692 | 706.731,217 | 4.643.868,603 | 385,775 | |
| 8693 | 706.727,511 | 4.643.852,571 | 385,775 | |
| 8694 | 706.720,099 | 4.643.853,063 | 385,977 | |
| 8695 | 706.724,952 | 4.643.844,506 | 386,556 | |
| 8696 | 706.718,873 | 4.643.844,167 | 386,668 | |
| 8697 | 706.714,368 | 4.643.831,511 | 386,103 | |
| 8698 | 706.721,832 | 4.643.830,123 | 385,946 | |
| 8699 | 709.977,465 | 4.645.612,387 | 355,500 | |
| 8700 | 710.000,248 | 4.645.639,572 | 355,200 | |
| 8701 | 710.013,357 | 4.645.664,034 | 355,160 | |
| 8702 | 706.655,386 | 4.646.764,242 | 375,900 | |
| 8703 | 706.667,617 | 4.646.642,669 | 379,200 | |
| 8704 | 706.660,121 | 4.646.707,851 | 377,800 | |
| 8705 | 708.086,700 | 4.646.044,355 | 369,500 | |
| 8706 | 708.740,335 | 4.646.941,000 | 364,800 | |
| 8707 | 709.342,241 | 4.647.914,952 | 348,700 | |
| 8708 | 707.820,526 | 4.648.658,596 | 355,400 | |
| 8709 | 713.702,335 | 4.644.966,735 | 326,520 | |
| 8710 | 713.710,427 | 4.644.978,388 | 326,690 | |
| 8711 | 713.619,215 | 4.645.068,710 | 326,980 | |
| 8712 | 713.551,926 | 4.645.109,417 | 327,050 | |
| 8713 | 713.559,941 | 4.645.119,936 | 327,150 | |
| 8714 | 713.542,805 | 4.645.124,433 | 327,120 | |
| 8715 | 713.450,678 | 4.645.061,439 | 327,420 | |
| 8716 | 713.433,990 | 4.645.105,503 | 327,380 | |
| 8717 | 713.409,191 | 4.645.104,112 | 327,410 | |
| 8718 | 713.347,783 | 4.645.067,501 | 327,580 | |
| 8719 | 713.319,306 | 4.645.061,184 | 326,840 | |
| 8720 | 713.279,074 | 4.645.055,391 | 327,650 | |
| 8721 | 713.264,757 | 4.645.031,580 | 328,300 | |
| 8722 | 713.167,308 | 4.645.045,021 | 329,280 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8723 | 713.139,415 | 4.645.048,761 | 329,400 | |
| 8724 | 713.128,785 | 4.645.057,861 | 329,360 | |
| 8725 | 713.093,913 | 4.645.063,020 | 329,270 | |
| 8726 | 713.059,996 | 4.645.067,718 | 329,210 | |
| 8727 | 713.057,982 | 4.645.056,610 | 329,240 | |
| 8728 | 713.036,974 | 4.645.054,739 | 329,910 | |
| 8729 | 705.888,687 | 4.645.119,527 | 384,697 | |
| 8730 | 713.005,792 | 4.645.070,675 | 329,880 | |
| 8731 | 712.899,752 | 4.645.083,572 | 330,530 | |
| 8732 | 712.902,490 | 4.645.073,546 | 330,520 | |
| 8733 | 705.893,455 | 4.645.151,246 | 384,399 | |
| 8734 | 712.813,423 | 4.645.097,944 | 331,260 | |
| 8735 | 712.793,579 | 4.645.103,319 | 331,580 | |
| 8736 | 712.789,474 | 4.645.108,869 | 331,670 | |
| 8737 | 712.794,009 | 4.645.115,405 | 331,460 | |
| 8738 | 712.848,780 | 4.645.143,729 | 329,830 | |
| 8739 | 712.851,981 | 4.645.141,854 | 329,690 | |
| 8740 | 712.848,237 | 4.645.138,107 | 330,310 | |
| 8741 | 712.844,160 | 4.645.140,814 | 330,090 | |
| 8742 | 712.781,538 | 4.645.095,492 | 331,950 | |
| 8743 | 712.737,465 | 4.645.069,508 | 332,920 | |
| 8744 | 704.235,904 | 4.644.434,921 | 439,224 | |
| 8745 | 704.201,127 | 4.644.440,471 | 441,387 | |
| 8746 | 712.690,966 | 4.645.044,658 | 334,770 | |
| 8747 | 705.732,607 | 4.644.897,059 | 388,474 | |
| 8748 | 712.602,437 | 4.645.013,885 | 337,440 | |
| 8749 | 712.594,582 | 4.645.021,536 | 337,640 | |
| 8750 | 712.560,133 | 4.645.012,962 | 338,640 | |
| 8751 | 712.556,361 | 4.644.999,413 | 338,750 | |
| 8752 | 712.529,465 | 4.644.988,098 | 339,590 | |
| 8753 | 712.520,234 | 4.644.997,467 | 339,730 | |
| 8754 | 712.512,864 | 4.644.983,923 | 339,980 | |
| 8755 | 705.838,173 | 4.644.960,044 | 386,814 | |
| 8756 | 712.537,934 | 4.644.966,992 | 339,320 | |
| 8757 | 712.549,461 | 4.644.946,586 | 338,920 | |
| 8758 | 712.544,388 | 4.644.935,925 | 339,150 | |
| 8759 | 712.563,297 | 4.644.919,447 | 338,480 | |
| 8760 | 712.566,965 | 4.644.891,609 | 338,290 | |
| 8761 | 712.577,289 | 4.644.896,395 | 337,960 | |
| 8762 | 712.583,967 | 4.644.863,835 | 337,920 | |
| 8763 | 705.872,543 | 4.645.042,660 | 385,842 | |
| 8764 | 705.865,659 | 4.645.030,100 | 385,909 | |
| 8765 | 712.632,047 | 4.644.792,264 | 338,630 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8766 | 705.735,094 | 4.644.927,791 | 388,173 | |
| 8767 | 712.657,933 | 4.644.723,373 | 340,340 | |
| 8768 | 712.673,053 | 4.644.691,743 | 341,340 | |
| 8769 | 712.695,487 | 4.644.670,396 | 342,500 | |
| 8770 | 712.689,959 | 4.644.659,137 | 342,630 | |
| 8771 | 705.838,759 | 4.645.033,379 | 386,430 | |
| 8772 | 705.862,379 | 4.645.066,826 | 385,996 | |
| 8773 | 712.725,116 | 4.644.615,095 | 342,540 | |
| 8774 | 705.849,912 | 4.645.078,631 | 385,960 | |
| 8775 | 712.729,342 | 4.644.613,275 | 340,750 | |
| 8776 | 712.722,979 | 4.644.606,307 | 340,990 | |
| 8777 | 712.730,277 | 4.644.595,595 | 340,910 | |
| 8778 | 705.769,211 | 4.645.035,346 | 387,447 | |
| 8779 | 712.740,974 | 4.644.580,456 | 340,670 | |
| 8780 | 712.756,657 | 4.644.579,273 | 340,550 | |
| 8781 | 712.774,617 | 4.644.570,230 | 340,500 | |
| 8782 | 712.806,907 | 4.644.577,007 | 340,510 | |
| 8783 | 712.809,484 | 4.644.569,482 | 340,510 | |
| 8784 | 712.840,935 | 4.644.565,805 | 340,670 | |
| 8785 | 712.828,594 | 4.644.573,491 | 340,590 | |
| 8786 | 712.868,674 | 4.644.574,104 | 339,640 | |
| 8787 | 712.870,031 | 4.644.566,281 | 339,640 | |
| 8788 | 712.903,971 | 4.644.565,417 | 339,630 | |
| 8789 | 712.902,023 | 4.644.574,327 | 339,610 | |
| 8790 | 712.940,786 | 4.644.569,375 | 339,720 | |
| 8791 | 712.939,369 | 4.644.562,955 | 339,670 | |
| 8792 | 713.027,597 | 4.644.559,455 | 338,460 | |
| 8793 | 713.028,845 | 4.644.567,921 | 338,140 | |
| 8794 | 713.064,567 | 4.644.556,066 | 338,340 | |
| 8795 | 713.092,582 | 4.644.560,635 | 338,160 | |
| 8796 | 705.697,688 | 4.645.089,887 | 388,360 | |
| 8797 | 705.673,412 | 4.645.089,887 | 388,746 | |
| 8798 | 705.645,855 | 4.645.088,575 | 389,125 | |
| 8799 | 705.630,109 | 4.645.090,542 | 389,891 | |
| 8800 | 705.631,421 | 4.645.106,282 | 389,820 | |
| 8801 | 713.169,748 | 4.644.544,275 | 338,150 | |
| 8802 | 705.704,249 | 4.645.113,496 | 388,376 | |
| 8803 | 705.759,362 | 4.645.122,022 | 387,389 | |
| 8804 | 713.251,344 | 4.644.535,373 | 338,450 | |
| 8805 | 713.257,465 | 4.644.545,749 | 338,520 | |
| 8806 | 705.813,819 | 4.645.184,981 | 386,763 | |
| 8807 | 705.794,136 | 4.645.181,702 | 387,037 | |
| 8808 | 705.771,172 | 4.645.179,734 | 387,447 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8809 | 713.282,227 | 4.644.530,404 | 340,420 | |
| 8810 | 705.707,530 | 4.645.173,832 | 388,190 | |
| 8811 | 705.687,190 | 4.645.171,209 | 388,396 | |
| 8812 | 705.647,168 | 4.645.170,553 | 389,144 | |
| 8813 | 713.296,999 | 4.644.530,364 | 337,670 | |
| 8814 | 713.301,957 | 4.644.521,833 | 337,720 | |
| 8815 | 705.679,973 | 4.645.183,013 | 388,428 | |
| 8816 | 713.300,107 | 4.644.511,704 | 337,900 | |
| 8817 | 713.307,890 | 4.644.514,516 | 337,680 | |
| 8818 | 705.764,611 | 4.645.165,306 | 387,477 | |
| 8819 | 713.336,021 | 4.644.475,460 | 337,700 | |
| 8820 | 713.344,100 | 4.644.444,604 | 337,690 | |
| 8821 | 713.355,982 | 4.644.449,976 | 337,840 | |
| 8822 | 705.739,023 | 4.645.139,729 | 387,970 | |
| 8823 | 705.719,339 | 4.645.135,794 | 388,372 | |
| 8824 | 713.370,880 | 4.644.413,189 | 338,490 | |
| 8825 | 713.373,305 | 4.644.399,842 | 338,510 | |
| 8826 | 713.365,221 | 4.644.399,382 | 338,460 | |
| 8827 | 713.368,113 | 4.644.378,741 | 338,490 | |
| 8828 | 713.377,222 | 4.644.380,121 | 338,530 | |
| 8829 | 705.897,145 | 4.645.195,474 | 383,522 | |
| 8830 | 713.370,372 | 4.644.352,551 | 338,510 | |
| 8831 | 705.922,077 | 4.645.190,883 | 383,224 | |
| 8832 | 713.374,754 | 4.644.294,885 | 338,490 | |
| 8833 | 713.387,126 | 4.644.251,996 | 339,900 | |
| 8834 | 713.392,585 | 4.644.258,829 | 339,120 | |
| 8835 | 713.382,523 | 4.644.246,314 | 339,320 | |
| 8836 | 713.380,470 | 4.644.240,992 | 340,060 | |
| 8837 | 713.371,327 | 4.644.246,294 | 339,640 | |
| 8838 | 713.364,634 | 4.644.233,223 | 339,790 | |
| 8839 | 713.356,136 | 4.644.240,812 | 339,170 | |
| 8840 | 713.322,440 | 4.644.221,258 | 339,720 | |
| 8841 | 713.226,427 | 4.644.172,296 | 341,380 | |
| 8842 | 713.220,774 | 4.644.158,846 | 341,320 | |
| 8843 | 713.183,102 | 4.644.147,679 | 342,290 | |
| 8844 | 704.203,564 | 4.644.288,612 | 442,915 | |
| 8845 | 713.059,948 | 4.644.057,725 | 345,680 | |
| 8846 | 713.048,830 | 4.644.069,715 | 345,820 | |
| 8847 | 713.034,456 | 4.644.069,096 | 344,610 | |
| 8848 | 713.029,070 | 4.644.088,026 | 345,360 | |
| 8849 | 704.245,955 | 4.644.276,980 | 443,141 | |
| 8850 | 713.003,418 | 4.644.096,325 | 345,090 | |
| 8851 | 712.990,552 | 4.644.100,499 | 344,720 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8852 | 712.987,191 | 4.644.093,103 | 344,550 | |
| 8853 | 712.982,414 | 4.644.089,807 | 344,450 | |
| 8854 | 704.239,305 | 4.644.347,877 | 439,160 | |
| 8855 | 712.937,133 | 4.644.098,887 | 344,070 | |
| 8856 | 712.924,303 | 4.644.103,466 | 344,150 | |
| 8857 | 712.922,952 | 4.644.096,586 | 344,120 | |
| 8858 | 704.263,409 | 4.644.280,303 | 442,110 | |
| 8859 | 704.265,626 | 4.644.269,226 | 442,000 | |
| 8860 | 712.883,396 | 4.644.095,558 | 344,500 | |
| 8861 | 712.855,793 | 4.644.096,355 | 344,500 | |
| 8862 | 712.830,478 | 4.644.103,444 | 344,460 | |
| 8863 | 712.828,620 | 4.644.094,822 | 344,700 | |
| 8864 | 712.809,956 | 4.644.095,538 | 344,690 | |
| 8865 | 704.274,769 | 4.644.301,905 | 443,670 | |
| 8866 | 704.271,167 | 4.644.314,090 | 442,462 | |
| 8867 | 713.399,414 | 4.644.255,715 | 339,920 | |
| 8868 | 713.430,370 | 4.644.257,847 | 340,230 | |
| 8869 | 704.250,110 | 4.644.367,817 | 437,951 | |
| 8870 | 713.487,279 | 4.644.263,490 | 340,410 | |
| 8871 | 713.488,606 | 4.644.254,696 | 340,430 | |
| 8872 | 713.522,532 | 4.644.257,832 | 340,530 | |
| 8873 | 704.272,552 | 4.644.352,308 | 439,113 | |
| 8874 | 713.545,581 | 4.644.267,697 | 341,140 | |
| 8875 | 713.584,853 | 4.644.263,019 | 341,090 | |
| 8876 | 704.289,730 | 4.644.306,336 | 444,257 | |
| 8877 | 713.619,211 | 4.644.272,097 | 341,170 | |
| 8878 | 704.298,319 | 4.644.283,350 | 442,527 | |
| 8879 | 704.299,704 | 4.644.265,072 | 440,988 | |
| 8880 | 713.681,272 | 4.644.260,719 | 341,230 | |
| 8881 | 704.327,134 | 4.644.271,995 | 442,432 | |
| 8882 | 713.677,017 | 4.644.252,077 | 341,490 | |
| 8883 | 704.833,753 | 4.644.660,325 | 428,850 | |
| 8884 | 704.331,290 | 4.644.285,842 | 444,052 | |
| 8885 | 704.321,869 | 4.644.280,580 | 443,189 | |
| 8886 | 704.856,709 | 4.644.618,845 | 427,479 | |
| 8887 | 713.696,854 | 4.644.250,496 | 339,390 | |
| 8888 | 704.306,084 | 4.644.318,819 | 444,642 | |
| 8889 | 704.302,759 | 4.644.329,619 | 443,163 | |
| 8890 | 713.706,456 | 4.644.244,803 | 339,240 | |
| 8891 | 704.286,412 | 4.644.368,668 | 438,757 | |
| 8892 | 704.838,057 | 4.644.678,641 | 429,343 | |
| 8893 | 704.275,884 | 4.644.391,654 | 437,025 | |
| 8894 | 704.843,075 | 4.644.698,204 | 429,865 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8895 | 704.314,396 | 4.644.342,082 | 443,112 | |
| 8896 | 704.855,955 | 4.644.699,207 | 429,671 | |
| 8897 | 704.867,330 | 4.644.702,049 | 429,594 | |
| 8898 | 704.332,959 | 4.644.345,959 | 444,946 | |
| 8899 | 704.320,214 | 4.644.381,961 | 439,422 | |
| 8900 | 704.903,127 | 4.644.652,055 | 427,696 | |
| 8901 | 713.849,530 | 4.644.204,572 | 335,170 | |
| 8902 | 704.302,482 | 4.644.416,856 | 436,886 | |
| 8903 | 713.892,644 | 4.644.181,295 | 335,130 | |
| 8904 | 713.925,841 | 4.644.166,781 | 335,060 | |
| 8905 | 713.934,602 | 4.644.176,231 | 335,100 | |
| 8906 | 704.336,364 | 4.644.445,720 | 435,092 | |
| 8907 | 713.948,394 | 4.644.160,826 | 335,110 | |
| 8908 | 704.368,800 | 4.644.458,472 | 433,818 | |
| 8909 | 704.903,462 | 4.644.678,808 | 428,017 | |
| 8910 | 704.397,060 | 4.644.473,704 | 432,485 | |
| 8911 | 704.408,697 | 4.644.480,628 | 432,310 | |
| 8912 | 713.984,598 | 4.644.151,624 | 336,480 | |
| 8913 | 713.990,065 | 4.644.155,824 | 335,550 | |
| 8914 | 713.981,389 | 4.644.159,387 | 335,480 | |
| 8915 | 704.915,171 | 4.644.683,490 | 428,123 | |
| 8916 | 714.323,881 | 4.644.601,789 | 323,150 | |
| 8917 | 704.931,062 | 4.644.686,165 | 428,449 | |
| 8918 | 704.340,817 | 4.644.435,486 | 435,345 | |
| 8919 | 704.330,288 | 4.644.430,224 | 435,747 | |
| 8920 | 704.317,544 | 4.644.423,301 | 436,347 | |
| 8921 | 714.253,336 | 4.644.623,811 | 323,640 | |
| 8922 | 714.256,805 | 4.644.631,223 | 323,650 | |
| 8923 | 704.954,816 | 4.644.649,547 | 426,312 | |
| 8924 | 704.951,136 | 4.644.639,348 | 426,182 | |
| 8925 | 714.209,053 | 4.644.644,223 | 323,700 | |
| 8926 | 714.210,979 | 4.644.653,063 | 323,710 | |
| 8927 | 704.387,086 | 4.644.424,963 | 433,998 | |
| 8928 | 704.972,924 | 4.644.654,359 | 426,802 | |
| 8929 | 704.359,103 | 4.644.413,885 | 436,442 | |
| 8930 | 704.332,228 | 4.644.397,822 | 437,032 | |
| 8931 | 704.978,444 | 4.644.615,233 | 424,742 | |
| 8932 | 714.130,094 | 4.644.680,399 | 325,020 | |
| 8933 | 714.129,927 | 4.644.688,927 | 325,070 | |
| 8934 | 714.101,875 | 4.644.698,839 | 325,080 | |
| 8935 | 714.099,559 | 4.644.693,059 | 325,020 | |
| 8936 | 704.997,012 | 4.644.593,162 | 424,337 | |
| 8937 | 705.003,870 | 4.644.605,034 | 423,875 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8938 | 714.045,696 | 4.644.717,530 | 325,310 | |
| 8939 | 704.392,627 | 4.644.402,807 | 434,046 | |
| 8940 | 714.009,429 | 4.644.742,259 | 325,360 | |
| 8941 | 704.364,921 | 4.644.384,252 | 438,473 | |
| 8942 | 713.976,585 | 4.644.752,642 | 325,390 | |
| 8943 | 713.978,494 | 4.644.755,826 | 325,330 | |
| 8944 | 704.343,864 | 4.644.357,943 | 443,119 | |
| 8945 | 713.967,553 | 4.644.753,205 | 325,120 | |
| 8946 | 713.937,459 | 4.644.776,267 | 325,090 | |
| 8947 | 713.933,690 | 4.644.768,465 | 325,030 | |
| 8948 | 704.928,938 | 4.644.586,907 | 428,187 | |
| 8949 | 713.905,709 | 4.644.792,223 | 325,080 | |
| 8950 | 704.933,956 | 4.644.540,425 | 426,782 | |
| 8951 | 704.952,691 | 4.644.535,409 | 426,583 | |
| 8952 | 704.986,146 | 4.644.548,116 | 426,393 | |
| 8953 | 713.864,138 | 4.644.818,096 | 325,310 | |
| 8954 | 713.832,345 | 4.644.844,575 | 325,360 | |
| 8955 | 704.352,730 | 4.644.331,080 | 443,186 | |
| 8956 | 704.367,969 | 4.644.338,557 | 441,434 | |
| 8957 | 704.970,757 | 4.644.578,380 | 426,700 | |
| 8958 | 704.957,542 | 4.644.599,615 | 426,957 | |
| 8959 | 704.946,669 | 4.644.609,647 | 427,290 | |
| 8960 | 713.778,559 | 4.644.898,715 | 325,920 | |
| 8961 | 704.921,578 | 4.644.617,171 | 428,828 | |
| 8962 | 713.757,173 | 4.644.932,141 | 326,040 | |
| 8963 | 704.382,943 | 4.644.308,329 | 437,622 | |
| 8964 | 712.505,786 | 4.644.993,776 | 340,440 | |
| 8965 | 704.405,663 | 4.644.336,300 | 436,662 | |
| 8966 | 712.510,551 | 4.645.001,891 | 340,890 | |
| 8967 | 704.245,238 | 4.644.442,432 | 438,378 | |
| 8968 | 704.223,510 | 4.644.454,538 | 440,110 | |
| 8969 | 712.484,349 | 4.645.017,416 | 341,800 | |
| 8970 | 705.271,585 | 4.644.746,230 | 419,783 | |
| 8971 | 712.444,095 | 4.645.029,943 | 343,420 | |
| 8972 | 712.447,566 | 4.645.036,883 | 343,310 | |
| 8973 | 705.244,786 | 4.644.785,561 | 421,092 | |
| 8974 | 712.416,710 | 4.645.054,381 | 344,740 | |
| 8975 | 705.227,558 | 4.644.811,286 | 422,372 | |
| 8976 | 705.219,688 | 4.644.822,341 | 423,326 | |
| 8977 | 712.338,168 | 4.645.086,357 | 350,330 | |
| 8978 | 705.185,445 | 4.644.811,499 | 424,420 | |
| 8979 | 704.214,249 | 4.644.442,967 | 440,714 | |
| 8980 | 704.207,303 | 4.644.446,883 | 440,984 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 8981 | 705.198,632 | 4.644.798,743 | 424,046 | |
| 8982 | 712.270,032 | 4.645.137,513 | 353,440 | |
| 8983 | 705.219,263 | 4.644.794,703 | 422,798 | |
| 8984 | 705.210,543 | 4.644.788,750 | 423,685 | |
| 8985 | 712.198,626 | 4.645.179,598 | 356,970 | |
| 8986 | 704.150,668 | 4.644.411,279 | 443,975 | |
| 8987 | 704.139,270 | 4.644.405,582 | 444,973 | |
| 8988 | 712.160,668 | 4.645.199,185 | 358,720 | |
| 8989 | 712.116,290 | 4.645.210,755 | 361,510 | |
| 8990 | 705.227,133 | 4.644.769,616 | 423,180 | |
| 8991 | 704.165,984 | 4.644.406,650 | 443,280 | |
| 8992 | 712.065,115 | 4.645.255,642 | 363,120 | |
| 8993 | 712.011,364 | 4.645.267,689 | 363,540 | |
| 8994 | 705.246,275 | 4.644.763,026 | 421,958 | |
| 8995 | 711.968,864 | 4.645.290,982 | 362,800 | |
| 8996 | 711.977,040 | 4.645.305,693 | 362,670 | |
| 8997 | 704.215,318 | 4.644.425,520 | 440,371 | |
| 8998 | 711.929,265 | 4.645.331,014 | 361,620 | |
| 8999 | 711.880,039 | 4.645.340,592 | 361,700 | |
| 9000 | 705.260,313 | 4.644.739,427 | 421,257 | |
| 9001 | 705.267,332 | 4.644.729,010 | 421,480 | |
| 9002 | 704.164,381 | 4.644.397,215 | 443,661 | |
| 9003 | 704.151,558 | 4.644.391,162 | 444,700 | |
| 9004 | 705.246,502 | 4.644.706,437 | 423,185 | |
| 9005 | 705.261,815 | 4.644.705,587 | 423,159 | |
| 9006 | 711.768,185 | 4.645.424,137 | 348,840 | |
| 9007 | 704.193,234 | 4.644.402,912 | 441,935 | |
| 9008 | 711.727,413 | 4.645.447,954 | 346,260 | |
| 9009 | 704.216,921 | 4.644.416,263 | 439,973 | |
| 9010 | 705.247,565 | 4.644.681,988 | 422,820 | |
| 9011 | 705.218,426 | 4.644.728,548 | 424,425 | |
| 9012 | 704.094,346 | 4.644.408,430 | 449,391 | |
| 9013 | 705.195,455 | 4.644.764,052 | 425,490 | |
| 9014 | 704.118,568 | 4.644.425,698 | 446,860 | |
| 9015 | 704.136,556 | 4.644.428,013 | 445,245 | |
| 9016 | 704.153,831 | 4.644.447,773 | 443,506 | |
| 9017 | 710.864,466 | 4.646.705,264 | 340,760 | |
| 9018 | 710.896,043 | 4.646.679,896 | 340,750 | |
| 9019 | 710.887,799 | 4.646.668,920 | 340,720 | |
| 9020 | 704.163,449 | 4.644.460,413 | 442,472 | |
| 9021 | 704.194,082 | 4.644.448,307 | 441,330 | |
| 9022 | 710.930,261 | 4.646.634,058 | 339,790 | |
| 9023 | 710.935,235 | 4.646.640,560 | 339,780 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9024 | 704.184,643 | 4.644.474,654 | 441,507 | |
| 9025 | 705.603,258 | 4.645.189,785 | 389,485 | |
| 9026 | 710.951,407 | 4.646.613,545 | 339,800 | |
| 9027 | 705.580,043 | 4.645.189,312 | 389,835 | |
| 9028 | 704.214,207 | 4.644.463,261 | 440,584 | |
| 9029 | 710.989,686 | 4.646.608,727 | 339,840 | |
| 9030 | 705.600,702 | 4.645.224,420 | 390,322 | |
| 9031 | 705.613,201 | 4.645.233,534 | 389,453 | |
| 9032 | 705.625,000 | 4.645.233,374 | 389,330 | |
| 9033 | 704.223,129 | 4.644.511,019 | 439,329 | |
| 9034 | 711.092,328 | 4.646.598,447 | 341,910 | |
| 9035 | 704.211,042 | 4.644.542,068 | 437,904 | |
| 9036 | 705.698,348 | 4.645.269,873 | 388,377 | |
| 9037 | 704.185,574 | 4.644.536,371 | 439,782 | |
| 9038 | 704.183,436 | 4.644.528,538 | 440,801 | |
| 9039 | 704.202,315 | 4.644.532,098 | 438,718 | |
| 9040 | 705.670,284 | 4.645.256,963 | 388,759 | |
| 9041 | 704.220,303 | 4.644.529,250 | 438,485 | |
| 9042 | 705.665,022 | 4.645.281,508 | 388,832 | |
| 9043 | 711.266,667 | 4.646.556,699 | 343,150 | |
| 9044 | 704.172,356 | 4.644.511,059 | 443,241 | |
| 9045 | 704.183,399 | 4.644.501,267 | 442,685 | |
| 9046 | 705.683,219 | 4.645.304,222 | 388,453 | |
| 9047 | 711.348,927 | 4.646.550,807 | 343,030 | |
| 9048 | 711.345,836 | 4.646.541,928 | 343,030 | |
| 9049 | 704.165,232 | 4.644.485,067 | 442,733 | |
| 9050 | 711.387,687 | 4.646.533,332 | 341,370 | |
| 9051 | 711.426,577 | 4.646.532,932 | 341,370 | |
| 9052 | 711.424,776 | 4.646.525,802 | 341,360 | |
| 9053 | 704.145,642 | 4.644.493,612 | 444,116 | |
| 9054 | 704.150,094 | 4.644.487,738 | 443,685 | |
| 9055 | 704.153,300 | 4.644.476,700 | 443,322 | |
| 9056 | 705.698,048 | 4.645.357,296 | 388,347 | |
| 9057 | 704.141,545 | 4.644.488,450 | 444,198 | |
| 9058 | 705.668,231 | 4.645.358,571 | 388,372 | |
| 9059 | 711.550,740 | 4.646.502,207 | 338,300 | |
| 9060 | 705.681,776 | 4.645.376,036 | 388,356 | |
| 9061 | 704.117,502 | 4.644.474,386 | 446,705 | |
| 9062 | 711.556,483 | 4.646.524,022 | 339,520 | |
| 9063 | 704.140,655 | 4.644.479,549 | 444,108 | |
| 9064 | 704.121,420 | 4.644.467,799 | 446,386 | |
| 9065 | 705.670,455 | 4.645.394,524 | 388,403 | |
| 9066 | 705.675,239 | 4.645.404,087 | 388,280 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9067 | 704.119,427 | 4.644.444,780 | 447,307 | |
| 9068 | 704.111,947 | 4.644.440,151 | 448,163 | |
| 9069 | 704.105,358 | 4.644.436,057 | 448,581 | |
| 9070 | 705.662,482 | 4.645.410,303 | 388,562 | |
| 9071 | 705.661,207 | 4.645.415,563 | 388,562 | |
| 9072 | 704.076,149 | 4.644.430,538 | 450,763 | |
| 9073 | 704.076,327 | 4.644.422,527 | 451,084 | |
| 9074 | 704.090,575 | 4.644.429,470 | 449,544 | |
| 9075 | 704.199,955 | 4.644.495,180 | 442,137 | |
| 9076 | 705.717,367 | 4.645.437,556 | 387,452 | |
| 9077 | 705.715,613 | 4.645.401,377 | 387,385 | |
| 9078 | 705.716,569 | 4.645.389,582 | 387,376 | |
| 9079 | 705.717,526 | 4.645.378,426 | 387,361 | |
| 9080 | 705.717,852 | 4.645.366,910 | 387,347 | |
| 9081 | 705.718,011 | 4.645.354,318 | 387,419 | |
| 9082 | 711.614,888 | 4.646.492,664 | 337,380 | |
| 9083 | 705.730,927 | 4.645.365,316 | 387,392 | |
| 9084 | 705.728,695 | 4.645.376,313 | 387,416 | |
| 9085 | 705.728,216 | 4.645.390,657 | 387,460 | |
| 9086 | 711.678,100 | 4.646.482,802 | 336,590 | |
| 9087 | 704.953,959 | 4.644.706,271 | 430,016 | |
| 9088 | 704.963,691 | 4.644.697,171 | 429,778 | |
| 9089 | 705.733,956 | 4.645.447,302 | 387,404 | |
| 9090 | 705.737,942 | 4.645.423,395 | 387,432 | |
| 9091 | 711.731,573 | 4.646.487,523 | 335,710 | |
| 9092 | 711.703,122 | 4.646.460,874 | 335,750 | |
| 9093 | 705.738,421 | 4.645.388,171 | 387,414 | |
| 9094 | 705.079,529 | 4.644.727,295 | 427,740 | |
| 9095 | 705.064,147 | 4.644.721,019 | 427,632 | |
| 9096 | 705.031,812 | 4.644.707,526 | 427,980 | |
| 9097 | 705.747,997 | 4.645.367,064 | 387,490 | |
| 9098 | 705.748,634 | 4.645.383,161 | 387,348 | |
| 9099 | 704.996,967 | 4.644.673,637 | 428,980 | |
| 9100 | 711.695,553 | 4.646.356,255 | 334,690 | |
| 9101 | 711.682,470 | 4.646.353,922 | 334,680 | |
| 9102 | 705.064,147 | 4.644.702,820 | 427,456 | |
| 9103 | 705.104,368 | 4.644.704,944 | 426,453 | |
| 9104 | 705.759,160 | 4.645.410,328 | 387,434 | |
| 9105 | 705.083,021 | 4.644.695,531 | 427,099 | |
| 9106 | 705.759,638 | 4.645.383,551 | 387,341 | |
| 9107 | 705.773,032 | 4.645.371,757 | 387,411 | |
| 9108 | 705.770,959 | 4.645.383,711 | 387,421 | |
| 9109 | 711.687,860 | 4.646.303,889 | 335,200 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9110 | 705.770,640 | 4.645.409,212 | 387,435 | |
| 9111 | 705.770,959 | 4.645.419,253 | 387,436 | |
| 9112 | 705.052,570 | 4.644.667,290 | 427,405 | |
| 9113 | 711.927,478 | 4.646.446,667 | 334,710 | |
| 9114 | 705.106,251 | 4.644.688,941 | 426,462 | |
| 9115 | 711.913,760 | 4.646.461,999 | 334,710 | |
| 9116 | 705.132,307 | 4.644.692,079 | 425,760 | |
| 9117 | 705.781,004 | 4.645.415,906 | 387,361 | |
| 9118 | 705.780,845 | 4.645.405,706 | 387,363 | |
| 9119 | 705.073,603 | 4.644.658,504 | 427,020 | |
| 9120 | 711.819,274 | 4.646.475,957 | 334,940 | |
| 9121 | 705.041,269 | 4.644.629,321 | 427,243 | |
| 9122 | 705.792,166 | 4.645.396,461 | 387,365 | |
| 9123 | 705.793,760 | 4.645.412,081 | 387,322 | |
| 9124 | 705.794,079 | 4.645.424,034 | 387,332 | |
| 9125 | 705.791,847 | 4.645.456,230 | 387,346 | |
| 9126 | 705.155,851 | 4.644.675,762 | 424,906 | |
| 9127 | 711.196,860 | 4.646.939,814 | 350,660 | |
| 9128 | 705.131,993 | 4.644.662,269 | 426,048 | |
| 9129 | 705.805,241 | 4.645.439,813 | 387,358 | |
| 9130 | 705.804,603 | 4.645.429,613 | 387,352 | |
| 9131 | 705.804,284 | 4.645.419,731 | 387,342 | |
| 9132 | 705.086,474 | 4.644.632,773 | 426,597 | |
| 9133 | 711.182,100 | 4.646.897,808 | 350,790 | |
| 9134 | 705.043,152 | 4.644.606,101 | 426,136 | |
| 9135 | 705.034,990 | 4.644.598,884 | 424,585 | |
| 9136 | 705.814,330 | 4.645.419,094 | 387,320 | |
| 9137 | 711.133,896 | 4.646.868,936 | 350,720 | |
| 9138 | 705.070,778 | 4.644.604,532 | 426,639 | |
| 9139 | 711.122,593 | 4.646.848,114 | 351,260 | |
| 9140 | 705.814,330 | 4.645.467,546 | 387,355 | |
| 9141 | 705.825,544 | 4.645.451,601 | 387,286 | |
| 9142 | 711.099,232 | 4.646.831,769 | 351,440 | |
| 9143 | 705.824,587 | 4.645.418,290 | 387,288 | |
| 9144 | 705.837,981 | 4.645.428,650 | 387,309 | |
| 9145 | 705.161,816 | 4.644.650,031 | 425,102 | |
| 9146 | 705.838,300 | 4.645.453,354 | 387,308 | |
| 9147 | 705.849,462 | 4.645.446,660 | 387,361 | |
| 9148 | 705.117,553 | 4.644.619,594 | 425,712 | |
| 9149 | 705.857,434 | 4.645.438,372 | 387,352 | |
| 9150 | 705.910,552 | 4.645.198,520 | 383,469 | |
| 9151 | 705.096,520 | 4.644.586,646 | 425,760 | |
| 9152 | 705.113,786 | 4.644.598,256 | 425,527 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9153 | 705.924,606 | 4.645.159,680 | 382,709 | |
| 9154 | 705.177,198 | 4.644.630,577 | 424,466 | |
| 9155 | 705.168,722 | 4.644.619,594 | 424,523 | |
| 9156 | 705.158,677 | 4.644.610,494 | 424,602 | |
| 9157 | 705.144,236 | 4.644.602,336 | 424,802 | |
| 9158 | 705.133,563 | 4.644.558,091 | 424,575 | |
| 9159 | 705.144,236 | 4.644.569,702 | 424,594 | |
| 9160 | 705.162,444 | 4.644.588,529 | 424,362 | |
| 9161 | 705.178,140 | 4.644.612,691 | 424,262 | |
| 9162 | 705.187,872 | 4.644.623,359 | 424,275 | |
| 9163 | 705.197,604 | 4.644.634,970 | 424,119 | |
| 9164 | 705.078,408 | 4.644.769,658 | 427,922 | |
| 9165 | 705.119,533 | 4.644.786,602 | 427,018 | |
| 9166 | 705.130,520 | 4.644.793,819 | 427,309 | |
| 9167 | 705.149,355 | 4.644.788,799 | 427,070 | |
| 9168 | 705.123,614 | 4.644.778,130 | 426,819 | |
| 9169 | 705.105,720 | 4.644.768,089 | 427,220 | |
| 9170 | 705.092,221 | 4.644.762,127 | 427,726 | |
| 9171 | 705.100,383 | 4.644.751,772 | 427,663 | |
| 9172 | 705.111,998 | 4.644.757,420 | 427,131 | |
| 9173 | 705.124,555 | 4.644.764,323 | 426,610 | |
| 9174 | 710.789,026 | 4.646.767,200 | 342,340 | |
| 9175 | 705.151,867 | 4.644.777,502 | 426,609 | |
| 9176 | 705.160,971 | 4.644.780,954 | 426,778 | |
| 9177 | 710.751,265 | 4.646.786,061 | 342,490 | |
| 9178 | 710.723,323 | 4.646.795,833 | 342,540 | |
| 9179 | 705.139,938 | 4.644.761,185 | 426,290 | |
| 9180 | 710.685,153 | 4.646.793,824 | 342,370 | |
| 9181 | 705.113,254 | 4.644.744,868 | 427,224 | |
| 9182 | 710.646,707 | 4.646.813,920 | 342,540 | |
| 9183 | 705.125,183 | 4.644.729,807 | 426,768 | |
| 9184 | 705.136,485 | 4.644.721,648 | 426,356 | |
| 9185 | 705.148,100 | 4.644.729,179 | 426,083 | |
| 9186 | 705.136,485 | 4.644.737,024 | 426,462 | |
| 9187 | 710.565,891 | 4.646.820,506 | 342,170 | |
| 9188 | 710.529,517 | 4.646.828,625 | 342,030 | |
| 9189 | 710.530,835 | 4.646.841,706 | 342,420 | |
| 9190 | 705.160,343 | 4.644.734,827 | 425,680 | |
| 9191 | 705.172,586 | 4.644.742,672 | 425,481 | |
| 9192 | 710.480,079 | 4.646.840,830 | 342,300 | |
| 9193 | 705.185,457 | 4.644.756,479 | 425,798 | |
| 9194 | 710.488,885 | 4.646.816,333 | 342,990 | |
| 9195 | 710.471,987 | 4.646.820,179 | 342,960 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9196 | 705.165,052 | 4.644.722,589 | 425,547 | |
| 9197 | 705.149,042 | 4.644.714,117 | 425,986 | |
| 9198 | 705.155,320 | 4.644.705,331 | 425,826 | |
| 9199 | 710.471,162 | 4.646.843,231 | 342,250 | |
| 9200 | 710.469,982 | 4.646.855,407 | 342,580 | |
| 9201 | 705.183,887 | 4.644.683,366 | 424,274 | |
| 9202 | 710.432,134 | 4.646.850,928 | 342,270 | |
| 9203 | 705.206,804 | 4.644.669,559 | 422,902 | |
| 9204 | 705.218,419 | 4.644.664,539 | 422,542 | |
| 9205 | 705.228,778 | 4.644.658,890 | 422,337 | |
| 9206 | 710.349,324 | 4.646.868,312 | 343,130 | |
| 9207 | 710.313,218 | 4.646.876,936 | 343,340 | |
| 9208 | 705.216,849 | 4.644.680,542 | 423,610 | |
| 9209 | 705.207,746 | 4.644.685,876 | 424,062 | |
| 9210 | 710.270,979 | 4.646.885,346 | 343,350 | |
| 9211 | 710.231,108 | 4.646.894,247 | 343,550 | |
| 9212 | 705.182,004 | 4.644.705,331 | 425,165 | |
| 9213 | 710.199,072 | 4.646.912,573 | 343,830 | |
| 9214 | 705.188,282 | 4.644.718,510 | 424,872 | |
| 9215 | 705.196,758 | 4.644.708,469 | 424,731 | |
| 9216 | 710.150,569 | 4.646.913,027 | 344,020 | |
| 9217 | 705.217,791 | 4.644.690,897 | 424,115 | |
| 9218 | 705.229,720 | 4.644.684,307 | 423,649 | |
| 9219 | 710.083,827 | 4.646.898,738 | 344,280 | |
| 9220 | 710.092,622 | 4.646.923,208 | 344,160 | |
| 9221 | 710.104,108 | 4.646.959,561 | 344,140 | |
| 9222 | 705.202,409 | 4.644.728,551 | 424,780 | |
| 9223 | 704.099,360 | 4.644.512,554 | 451,704 | |
| 9224 | 704.113,516 | 4.644.521,013 | 451,331 | |
| 9225 | 709.814,773 | 4.646.867,543 | 346,590 | |
| 9226 | 709.810,834 | 4.646.874,259 | 346,510 | |
| 9227 | 704.122,890 | 4.644.524,916 | 447,781 | |
| 9228 | 704.122,574 | 4.644.530,361 | 447,064 | |
| 9229 | 704.131,143 | 4.644.530,858 | 445,670 | |
| 9230 | 705.877,569 | 4.644.753,323 | 393,464 | |
| 9231 | 709.759,567 | 4.646.855,772 | 347,530 | |
| 9232 | 704.139,288 | 4.644.515,832 | 446,419 | |
| 9233 | 709.712,436 | 4.646.831,825 | 348,620 | |
| 9234 | 709.709,215 | 4.646.838,684 | 348,660 | |
| 9235 | 704.162,648 | 4.644.526,698 | 443,182 | |
| 9236 | 704.821,047 | 4.644.607,696 | 428,036 | |
| 9237 | 705.837,298 | 4.645.200,401 | 386,299 | |
| 9238 | 704.829,584 | 4.644.593,490 | 427,939 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9239 | 709.652,293 | 4.646.806,972 | 351,880 | |
| 9240 | 709.649,076 | 4.646.813,673 | 351,690 | |
| 9241 | 709.633,894 | 4.646.801,990 | 351,810 | |
| 9242 | 709.619,489 | 4.646.793,440 | 353,290 | |
| 9243 | 704.841,870 | 4.644.552,927 | 427,280 | |
| 9244 | 704.848,422 | 4.644.564,653 | 427,482 | |
| 9245 | 705.636,737 | 4.645.190,030 | 389,318 | |
| 9246 | 705.609,448 | 4.645.165,381 | 389,814 | |
| 9247 | 704.912,345 | 4.644.553,361 | 423,915 | |
| 9248 | 705.608,750 | 4.645.115,172 | 389,968 | |
| 9249 | 709.555,188 | 4.646.685,240 | 350,750 | |
| 9250 | 704.894,670 | 4.644.536,483 | 422,599 | |
| 9251 | 704.899,801 | 4.644.574,595 | 424,581 | |
| 9252 | 704.881,129 | 4.644.571,433 | 425,427 | |
| 9253 | 709.546,639 | 4.646.655,896 | 349,900 | |
| 9254 | 709.554,063 | 4.646.653,066 | 349,880 | |
| 9255 | 709.545,850 | 4.646.617,777 | 349,760 | |
| 9256 | 709.537,549 | 4.646.619,538 | 349,870 | |
| 9257 | 709.526,193 | 4.646.583,064 | 349,810 | |
| 9258 | 709.523,871 | 4.646.541,348 | 349,820 | |
| 9259 | 709.516,014 | 4.646.542,826 | 349,870 | |
| 9260 | 709.509,761 | 4.646.523,879 | 349,890 | |
| 9261 | 705.221,504 | 4.644.645,957 | 423,630 | |
| 9262 | 705.240,339 | 4.644.640,620 | 423,034 | |
| 9263 | 705.220,477 | 4.644.641,056 | 423,765 | |
| 9264 | 705.871,791 | 4.645.245,862 | 385,910 | |
| 9265 | 705.853,144 | 4.645.245,145 | 385,886 | |
| 9266 | 705.847,646 | 4.645.262,104 | 385,900 | |
| 9267 | 705.844,538 | 4.645.271,659 | 385,896 | |
| 9268 | 705.865,098 | 4.645.273,092 | 385,894 | |
| 9269 | 709.433,422 | 4.646.474,455 | 351,060 | |
| 9270 | 709.427,575 | 4.646.480,852 | 351,090 | |
| 9271 | 709.410,880 | 4.646.463,071 | 351,580 | |
| 9272 | 705.860,788 | 4.645.289,442 | 385,963 | |
| 9273 | 709.370,123 | 4.646.453,350 | 351,650 | |
| 9274 | 705.839,272 | 4.645.301,385 | 385,946 | |
| 9275 | 709.332,309 | 4.646.424,985 | 352,090 | |
| 9276 | 709.340,626 | 4.646.421,296 | 351,900 | |
| 9277 | 705.855,289 | 4.645.307,595 | 385,917 | |
| 9278 | 705.802,021 | 4.645.330,976 | 387,093 | |
| 9279 | 705.777,383 | 4.645.335,830 | 387,564 | |
| 9280 | 709.286,126 | 4.646.255,600 | 351,710 | |
| 9281 | 709.277,207 | 4.646.266,554 | 351,660 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9282 | 705.780,144 | 4.645.333,768 | 387,192 | |
| 9283 | 709.280,700 | 4.646.237,776 | 351,170 | |
| 9284 | 705.742,780 | 4.645.310,868 | 386,831 | |
| 9285 | 709.258,643 | 4.646.206,527 | 351,200 | |
| 9286 | 705.731,623 | 4.645.298,756 | 386,764 | |
| 9287 | 705.726,788 | 4.645.288,533 | 386,851 | |
| 9288 | 709.249,089 | 4.646.175,385 | 350,510 | |
| 9289 | 709.235,692 | 4.646.138,356 | 351,090 | |
| 9290 | 709.249,496 | 4.646.128,880 | 351,440 | |
| 9291 | 709.494,309 | 4.646.475,588 | 349,920 | |
| 9292 | 709.508,188 | 4.646.482,866 | 349,930 | |
| 9293 | 709.535,570 | 4.646.456,784 | 349,890 | |
| 9294 | 709.558,883 | 4.646.417,341 | 349,910 | |
| 9295 | 709.572,542 | 4.646.428,977 | 349,940 | |
| 9296 | 709.612,284 | 4.646.394,304 | 350,000 | |
| 9297 | 705.693,721 | 4.645.219,746 | 388,039 | |
| 9298 | 705.673,382 | 4.645.233,204 | 389,955 | |
| 9299 | 705.574,044 | 4.645.189,145 | 390,967 | |
| 9300 | 709.709,510 | 4.646.313,893 | 349,760 | |
| 9301 | 709.744,721 | 4.646.317,783 | 349,690 | |
| 9302 | 705.733,500 | 4.645.478,551 | 389,888 | |
| 9303 | 709.783,956 | 4.646.313,542 | 349,300 | |
| 9304 | 705.715,958 | 4.645.493,446 | 392,769 | |
| 9305 | 709.903,494 | 4.646.299,435 | 348,400 | |
| 9306 | 705.726,938 | 4.645.511,373 | 393,114 | |
| 9307 | 705.724,930 | 4.645.526,625 | 393,739 | |
| 9308 | 710.046,819 | 4.646.268,387 | 348,040 | |
| 9309 | 705.732,161 | 4.645.497,459 | 391,144 | |
| 9310 | 710.095,778 | 4.646.271,793 | 347,690 | |
| 9311 | 710.131,715 | 4.646.255,939 | 347,460 | |
| 9312 | 710.133,744 | 4.646.266,636 | 347,300 | |
| 9313 | 710.165,638 | 4.646.269,980 | 346,930 | |
| 9314 | 710.176,179 | 4.646.259,510 | 347,040 | |
| 9315 | 710.210,302 | 4.646.279,321 | 346,120 | |
| 9316 | 710.218,086 | 4.646.267,127 | 346,190 | |
| 9317 | 710.270,244 | 4.646.279,258 | 345,710 | |
| 9318 | 705.884,916 | 4.645.174,284 | 384,181 | |
| 9319 | 710.296,323 | 4.646.284,638 | 345,030 | |
| 9320 | 710.304,831 | 4.646.290,094 | 345,030 | |
| 9321 | 705.744,348 | 4.645.492,634 | 390,449 | |
| 9322 | 705.753,530 | 4.645.485,668 | 389,844 | |
| 9323 | 705.758,011 | 4.645.502,585 | 390,624 | |
| 9324 | 710.352,106 | 4.646.255,387 | 344,350 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9325 | 710.346,739 | 4.646.246,297 | 344,350 | |
| 9326 | 705.872,333 | 4.645.482,690 | 387,827 | |
| 9327 | 705.868,188 | 4.645.487,510 | 387,736 | |
| 9328 | 705.825,472 | 4.645.503,791 | 388,231 | |
| 9329 | 710.446,240 | 4.646.143,384 | 343,420 | |
| 9330 | 705.749,560 | 4.645.517,427 | 391,136 | |
| 9331 | 705.847,993 | 4.644.942,866 | 386,927 | |
| 9332 | 705.861,086 | 4.644.974,767 | 386,468 | |
| 9333 | 705.825,080 | 4.644.949,410 | 387,068 | |
| 9334 | 710.605,025 | 4.646.178,246 | 341,380 | |
| 9335 | 710.647,848 | 4.646.187,629 | 341,410 | |
| 9336 | 705.805,440 | 4.644.957,590 | 387,367 | |
| 9337 | 705.879,908 | 4.645.014,849 | 385,878 | |
| 9338 | 705.830,229 | 4.644.997,964 | 386,722 | |
| 9339 | 705.846,534 | 4.645.482,204 | 387,398 | |
| 9340 | 710.940,867 | 4.646.178,613 | 338,500 | |
| 9341 | 710.941,787 | 4.646.165,803 | 338,480 | |
| 9342 | 710.982,959 | 4.646.162,444 | 338,760 | |
| 9343 | 705.860,410 | 4.645.050,430 | 386,029 | |
| 9344 | 711.024,213 | 4.646.173,047 | 338,100 | |
| 9345 | 711.023,684 | 4.646.159,033 | 338,080 | |
| 9346 | 711.054,793 | 4.646.173,341 | 337,860 | |
| 9347 | 709.312,100 | 4.646.408,156 | 352,130 | |
| 9348 | 709.287,700 | 4.646.403,664 | 352,200 | |
| 9349 | 705.748,872 | 4.645.027,476 | 387,812 | |
| 9350 | 705.710,162 | 4.644.989,439 | 388,212 | |
| 9351 | 709.222,995 | 4.646.116,284 | 352,360 | |
| 9352 | 705.754,121 | 4.644.999,932 | 387,682 | |
| 9353 | 705.837,446 | 4.645.052,398 | 386,429 | |
| 9354 | 705.827,597 | 4.645.102,347 | 385,691 | |
| 9355 | 709.061,374 | 4.646.102,721 | 353,290 | |
| 9356 | 708.938,778 | 4.646.086,289 | 353,910 | |
| 9357 | 705.715,403 | 4.645.093,166 | 388,240 | |
| 9358 | 708.897,033 | 4.646.089,555 | 353,740 | |
| 9359 | 708.861,938 | 4.646.082,743 | 353,750 | |
| 9360 | 708.821,801 | 4.646.061,753 | 353,790 | |
| 9361 | 705.657,009 | 4.645.106,282 | 389,209 | |
| 9362 | 705.685,222 | 4.645.110,217 | 388,686 | |
| 9363 | 708.721,707 | 4.646.057,595 | 354,850 | |
| 9364 | 705.833,502 | 4.645.188,260 | 386,230 | |
| 9365 | 705.725,901 | 4.645.173,832 | 388,064 | |
| 9366 | 708.632,377 | 4.646.063,506 | 355,250 | |
| 9367 | 708.595,867 | 4.646.043,139 | 355,250 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9368 | 708.559,489 | 4.646.040,257 | 355,600 | |
| 9369 | 708.560,390 | 4.646.056,393 | 355,970 | |
| 9370 | 708.503,038 | 4.646.038,033 | 355,570 | |
| 9371 | 708.449,488 | 4.646.040,879 | 356,400 | |
| 9372 | 705.633,389 | 4.645.123,989 | 389,991 | |
| 9373 | 708.393,255 | 4.646.055,436 | 357,890 | |
| 9374 | 708.360,893 | 4.646.051,839 | 357,930 | |
| 9375 | 705.692,439 | 4.645.156,125 | 388,500 | |
| 9376 | 705.706,217 | 4.645.148,255 | 388,505 | |
| 9377 | 708.263,788 | 4.646.040,770 | 358,880 | |
| 9378 | 708.184,664 | 4.646.038,503 | 360,420 | |
| 9379 | 708.167,502 | 4.646.050,631 | 362,580 | |
| 9380 | 708.171,104 | 4.646.039,176 | 361,970 | |
| 9381 | 708.154,083 | 4.646.053,671 | 364,380 | |
| 9382 | 708.143,835 | 4.646.042,282 | 367,480 | |
| 9383 | 708.128,671 | 4.646.041,882 | 367,540 | |
| 9384 | 708.126,188 | 4.646.052,032 | 366,940 | |
| 9385 | 708.066,754 | 4.646.052,886 | 370,050 | |
| 9386 | 708.017,236 | 4.646.055,091 | 367,730 | |
| 9387 | 708.014,420 | 4.646.036,166 | 364,920 | |
| 9388 | 707.992,694 | 4.646.036,299 | 363,780 | |
| 9389 | 705.702,695 | 4.645.455,647 | 389,104 | |
| 9390 | 707.984,919 | 4.646.036,187 | 362,850 | |
| 9391 | 707.983,629 | 4.646.049,836 | 363,380 | |
| 9392 | 707.977,293 | 4.646.035,059 | 362,870 | |
| 9393 | 707.967,240 | 4.646.035,920 | 363,150 | |
| 9394 | 707.904,589 | 4.646.046,556 | 365,360 | |
| 9395 | 707.903,301 | 4.646.036,009 | 365,480 | |
| 9396 | 707.820,971 | 4.646.030,503 | 364,650 | |
| 9397 | 707.770,566 | 4.646.043,849 | 364,410 | |
| 9398 | 704.184,447 | 4.644.293,597 | 442,560 | |
| 9399 | 707.675,756 | 4.646.038,683 | 363,890 | |
| 9400 | 704.219,357 | 4.644.302,459 | 441,808 | |
| 9401 | 704.223,513 | 4.644.291,381 | 442,505 | |
| 9402 | 704.226,837 | 4.644.283,350 | 443,299 | |
| 9403 | 707.587,147 | 4.646.023,539 | 365,210 | |
| 9404 | 704.226,837 | 4.644.334,584 | 439,976 | |
| 9405 | 704.249,279 | 4.644.327,660 | 439,700 | |
| 9406 | 707.606,759 | 4.645.985,921 | 363,990 | |
| 9407 | 704.259,253 | 4.644.293,043 | 442,364 | |
| 9408 | 707.602,811 | 4.645.966,617 | 363,590 | |
| 9409 | 707.592,154 | 4.645.965,385 | 364,380 | |
| 9410 | 704.279,756 | 4.644.279,750 | 442,183 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9411 | 704.276,708 | 4.644.291,104 | 443,272 | |
| 9412 | 704.268,397 | 4.644.322,398 | 441,193 | |
| 9413 | 707.611,478 | 4.645.897,187 | 362,300 | |
| 9414 | 704.261,470 | 4.644.338,184 | 439,424 | |
| 9415 | 704.252,881 | 4.644.358,955 | 438,449 | |
| 9416 | 704.260,362 | 4.644.380,279 | 437,322 | |
| 9417 | 704.265,903 | 4.644.369,478 | 437,954 | |
| 9418 | 704.270,336 | 4.644.360,616 | 438,659 | |
| 9419 | 707.603,506 | 4.645.791,574 | 364,100 | |
| 9420 | 704.340,710 | 4.644.290,827 | 444,422 | |
| 9421 | 704.324,917 | 4.644.297,751 | 444,989 | |
| 9422 | 704.841,770 | 4.644.647,037 | 428,384 | |
| 9423 | 704.848,940 | 4.644.633,539 | 427,985 | |
| 9424 | 704.317,159 | 4.644.291,935 | 444,208 | |
| 9425 | 704.313,281 | 4.644.304,674 | 444,969 | |
| 9426 | 704.872,125 | 4.644.611,080 | 427,000 | |
| 9427 | 704.866,150 | 4.644.624,460 | 427,591 | |
| 9428 | 704.852,287 | 4.644.650,263 | 428,345 | |
| 9429 | 704.845,235 | 4.644.664,120 | 428,858 | |
| 9430 | 704.831,031 | 4.644.691,014 | 429,829 | |
| 9431 | 704.265,356 | 4.644.399,409 | 437,255 | |
| 9432 | 704.851,104 | 4.644.680,814 | 429,137 | |
| 9433 | 704.856,625 | 4.644.669,110 | 428,760 | |
| 9434 | 704.873,519 | 4.644.632,158 | 427,796 | |
| 9435 | 704.309,131 | 4.644.357,867 | 442,018 | |
| 9436 | 704.873,185 | 4.644.662,924 | 428,342 | |
| 9437 | 707.619,749 | 4.645.514,133 | 367,090 | |
| 9438 | 704.860,472 | 4.644.687,837 | 429,152 | |
| 9439 | 704.339,331 | 4.644.315,772 | 445,188 | |
| 9440 | 704.874,858 | 4.644.688,673 | 428,847 | |
| 9441 | 704.879,876 | 4.644.675,297 | 428,414 | |
| 9442 | 704.891,083 | 4.644.653,226 | 427,916 | |
| 9443 | 707.621,566 | 4.645.462,236 | 367,860 | |
| 9444 | 707.632,413 | 4.645.459,892 | 367,920 | |
| 9445 | 707.633,836 | 4.645.435,516 | 367,830 | |
| 9446 | 704.883,891 | 4.644.697,368 | 429,060 | |
| 9447 | 704.881,381 | 4.644.705,393 | 429,517 | |
| 9448 | 704.351,325 | 4.644.453,474 | 434,304 | |
| 9449 | 704.901,455 | 4.644.689,676 | 428,439 | |
| 9450 | 707.627,430 | 4.645.389,873 | 367,430 | |
| 9451 | 707.636,531 | 4.645.392,228 | 367,420 | |
| 9452 | 707.636,930 | 4.645.382,000 | 367,430 | |
| 9453 | 707.634,088 | 4.645.372,891 | 367,720 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9454 | 707.644,282 | 4.645.367,629 | 367,720 | |
| 9455 | 704.919,186 | 4.644.665,933 | 427,405 | |
| 9456 | 707.668,717 | 4.645.364,663 | 367,190 | |
| 9457 | 704.913,164 | 4.644.696,364 | 429,021 | |
| 9458 | 707.677,661 | 4.645.350,785 | 367,270 | |
| 9459 | 704.933,070 | 4.644.674,628 | 427,625 | |
| 9460 | 704.932,568 | 4.644.662,756 | 427,057 | |
| 9461 | 704.934,575 | 4.644.649,547 | 426,836 | |
| 9462 | 704.943,274 | 4.644.644,698 | 426,471 | |
| 9463 | 704.335,275 | 4.644.416,654 | 435,929 | |
| 9464 | 704.350,791 | 4.644.425,516 | 435,386 | |
| 9465 | 704.382,099 | 4.644.440,194 | 433,600 | |
| 9466 | 707.630,662 | 4.645.359,471 | 367,640 | |
| 9467 | 707.621,225 | 4.645.362,395 | 367,390 | |
| 9468 | 704.426,152 | 4.644.443,795 | 430,731 | |
| 9469 | 707.621,816 | 4.645.344,615 | 367,510 | |
| 9470 | 707.634,004 | 4.645.309,784 | 367,450 | |
| 9471 | 704.967,572 | 4.644.646,500 | 426,112 | |
| 9472 | 707.623,796 | 4.645.266,291 | 367,500 | |
| 9473 | 704.978,946 | 4.644.636,468 | 425,505 | |
| 9474 | 704.969,913 | 4.644.622,924 | 425,300 | |
| 9475 | 704.353,284 | 4.644.392,284 | 438,011 | |
| 9476 | 704.366,861 | 4.644.400,315 | 437,829 | |
| 9477 | 704.435,018 | 4.644.417,762 | 430,274 | |
| 9478 | 704.420,056 | 4.644.411,392 | 431,164 | |
| 9479 | 707.625,471 | 4.645.213,930 | 369,330 | |
| 9480 | 707.627,605 | 4.645.176,324 | 369,250 | |
| 9481 | 707.636,875 | 4.645.175,009 | 369,260 | |
| 9482 | 704.910,537 | 4.644.624,863 | 428,965 | |
| 9483 | 707.640,809 | 4.645.094,389 | 369,710 | |
| 9484 | 707.633,095 | 4.645.090,441 | 369,720 | |
| 9485 | 704.390,688 | 4.644.383,144 | 435,412 | |
| 9486 | 704.406,203 | 4.644.389,237 | 433,447 | |
| 9487 | 704.424,766 | 4.644.396,161 | 431,491 | |
| 9488 | 704.933,287 | 4.644.554,804 | 427,124 | |
| 9489 | 704.430,585 | 4.644.385,360 | 431,976 | |
| 9490 | 707.637,143 | 4.645.024,347 | 370,080 | |
| 9491 | 707.644,078 | 4.645.022,974 | 370,070 | |
| 9492 | 704.356,055 | 4.644.347,419 | 443,121 | |
| 9493 | 705.005,717 | 4.644.559,988 | 425,483 | |
| 9494 | 704.980,961 | 4.644.574,033 | 426,209 | |
| 9495 | 707.635,918 | 4.644.974,795 | 371,360 | |
| 9496 | 707.646,870 | 4.644.977,352 | 371,400 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9497 | 707.644,474 | 4.644.961,777 | 371,420 | |
| 9498 | 704.385,978 | 4.644.335,511 | 438,700 | |
| 9499 | 704.359,934 | 4.644.321,387 | 441,394 | |
| 9500 | 704.935,127 | 4.644.604,129 | 428,286 | |
| 9501 | 704.940,982 | 4.644.591,422 | 428,060 | |
| 9502 | 704.946,000 | 4.644.564,335 | 427,332 | |
| 9503 | 704.945,498 | 4.644.552,631 | 426,981 | |
| 9504 | 707.692,352 | 4.644.980,228 | 369,050 | |
| 9505 | 704.237,758 | 4.644.445,281 | 438,906 | |
| 9506 | 707.717,927 | 4.644.977,558 | 369,030 | |
| 9507 | 707.719,502 | 4.644.984,215 | 369,010 | |
| 9508 | 704.212,112 | 4.644.454,182 | 440,710 | |
| 9509 | 705.263,078 | 4.644.756,648 | 420,212 | |
| 9510 | 705.253,719 | 4.644.772,380 | 420,759 | |
| 9511 | 704.241,320 | 4.644.438,694 | 438,688 | |
| 9512 | 704.247,019 | 4.644.435,846 | 438,343 | |
| 9513 | 704.237,580 | 4.644.431,395 | 439,182 | |
| 9514 | 705.201,184 | 4.644.816,601 | 423,702 | |
| 9515 | 704.222,976 | 4.644.437,804 | 440,069 | |
| 9516 | 705.174,172 | 4.644.808,097 | 425,051 | |
| 9517 | 705.180,978 | 4.644.795,766 | 425,154 | |
| 9518 | 705.213,095 | 4.644.807,247 | 422,961 | |
| 9519 | 704.181,835 | 4.644.430,149 | 442,159 | |
| 9520 | 707.880,789 | 4.645.011,849 | 367,630 | |
| 9521 | 707.912,359 | 4.645.017,059 | 367,660 | |
| 9522 | 707.914,006 | 4.645.009,458 | 367,610 | |
| 9523 | 704.132,324 | 4.644.400,953 | 445,817 | |
| 9524 | 704.152,449 | 4.644.400,419 | 444,235 | |
| 9525 | 704.178,808 | 4.644.415,017 | 442,510 | |
| 9526 | 705.231,599 | 4.644.760,262 | 423,103 | |
| 9527 | 704.200,536 | 4.644.429,081 | 441,374 | |
| 9528 | 705.251,167 | 4.644.751,333 | 421,857 | |
| 9529 | 708.002,461 | 4.645.025,245 | 368,490 | |
| 9530 | 708.000,423 | 4.645.031,288 | 368,480 | |
| 9531 | 704.197,330 | 4.644.414,661 | 440,999 | |
| 9532 | 704.185,931 | 4.644.407,896 | 442,244 | |
| 9533 | 704.177,027 | 4.644.403,268 | 442,825 | |
| 9534 | 705.258,398 | 4.644.724,333 | 421,976 | |
| 9535 | 705.242,872 | 4.644.718,592 | 422,907 | |
| 9536 | 704.159,395 | 4.644.383,151 | 445,062 | |
| 9537 | 704.170,437 | 4.644.389,026 | 444,000 | |
| 9538 | 704.206,413 | 4.644.408,786 | 440,430 | |
| 9539 | 704.123,733 | 4.644.402,378 | 446,642 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9540 | 704.115,718 | 4.644.401,131 | 447,511 | |
| 9541 | 708.110,381 | 4.645.042,607 | 370,670 | |
| 9542 | 708.111,705 | 4.645.050,483 | 370,690 | |
| 9543 | 708.152,197 | 4.645.056,778 | 370,670 | |
| 9544 | 708.151,104 | 4.645.049,339 | 370,640 | |
| 9545 | 708.199,786 | 4.645.057,875 | 370,680 | |
| 9546 | 705.173,724 | 4.644.790,893 | 425,835 | |
| 9547 | 704.119,636 | 4.644.418,222 | 446,675 | |
| 9548 | 705.246,322 | 4.644.670,243 | 422,387 | |
| 9549 | 705.255,894 | 4.644.674,707 | 422,120 | |
| 9550 | 704.146,173 | 4.644.421,426 | 444,472 | |
| 9551 | 705.270,144 | 4.644.668,967 | 421,005 | |
| 9552 | 705.270,144 | 4.644.679,810 | 421,768 | |
| 9553 | 708.320,837 | 4.645.086,071 | 368,740 | |
| 9554 | 708.319,753 | 4.645.078,672 | 368,750 | |
| 9555 | 708.340,551 | 4.645.081,161 | 368,740 | |
| 9556 | 704.167,723 | 4.644.435,846 | 442,887 | |
| 9557 | 704.179,656 | 4.644.440,118 | 442,076 | |
| 9558 | 704.168,436 | 4.644.455,250 | 442,569 | |
| 9559 | 705.579,095 | 4.645.159,162 | 391,174 | |
| 9560 | 708.390,778 | 4.645.088,771 | 370,050 | |
| 9561 | 708.391,151 | 4.645.098,526 | 369,390 | |
| 9562 | 705.591,098 | 4.645.180,788 | 389,680 | |
| 9563 | 705.590,624 | 4.645.160,424 | 390,145 | |
| 9564 | 704.210,467 | 4.644.467,356 | 440,722 | |
| 9565 | 705.572,160 | 4.645.228,086 | 391,037 | |
| 9566 | 705.580,452 | 4.645.224,102 | 390,785 | |
| 9567 | 705.586,033 | 4.645.226,811 | 390,642 | |
| 9568 | 705.596,237 | 4.645.219,798 | 389,348 | |
| 9569 | 704.232,212 | 4.644.498,735 | 439,714 | |
| 9570 | 708.507,685 | 4.645.118,639 | 364,390 | |
| 9571 | 704.232,212 | 4.644.507,992 | 439,421 | |
| 9572 | 705.638,235 | 4.645.234,968 | 389,213 | |
| 9573 | 705.650,193 | 4.645.237,837 | 389,152 | |
| 9574 | 704.217,251 | 4.644.517,784 | 439,294 | |
| 9575 | 705.694,202 | 4.645.261,585 | 388,541 | |
| 9576 | 704.198,575 | 4.644.539,575 | 438,495 | |
| 9577 | 705.689,897 | 4.645.270,989 | 388,544 | |
| 9578 | 705.680,170 | 4.645.264,135 | 388,653 | |
| 9579 | 704.220,481 | 4.644.535,837 | 438,184 | |
| 9580 | 705.657,050 | 4.645.251,544 | 388,943 | |
| 9581 | 704.204,986 | 4.644.523,909 | 439,168 | |
| 9582 | 705.674,590 | 4.645.272,901 | 388,643 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9583 | 708.642,937 | 4.645.139,208 | 361,510 | |
| 9584 | 708.646,946 | 4.645.146,515 | 361,460 | |
| 9585 | 704.179,518 | 4.644.514,830 | 442,682 | |
| 9586 | 705.699,464 | 4.645.296,012 | 388,377 | |
| 9587 | 705.663,906 | 4.645.294,099 | 388,650 | |
| 9588 | 708.699,395 | 4.645.157,876 | 359,810 | |
| 9589 | 708.699,734 | 4.645.149,074 | 359,780 | |
| 9590 | 708.780,696 | 4.645.176,507 | 359,230 | |
| 9591 | 708.781,437 | 4.645.165,607 | 359,250 | |
| 9592 | 705.667,115 | 4.645.336,736 | 388,396 | |
| 9593 | 705.666,477 | 4.645.347,255 | 388,343 | |
| 9594 | 705.683,538 | 4.645.347,255 | 388,302 | |
| 9595 | 705.698,208 | 4.645.347,892 | 388,337 | |
| 9596 | 704.146,176 | 4.644.481,151 | 443,774 | |
| 9597 | 708.818,836 | 4.645.178,182 | 358,690 | |
| 9598 | 704.134,599 | 4.644.494,325 | 445,117 | |
| 9599 | 708.816,218 | 4.645.208,774 | 358,680 | |
| 9600 | 708.822,849 | 4.645.207,904 | 358,680 | |
| 9601 | 704.112,515 | 4.644.489,340 | 447,418 | |
| 9602 | 704.127,475 | 4.644.490,942 | 445,648 | |
| 9603 | 704.129,435 | 4.644.484,533 | 445,177 | |
| 9604 | 708.829,092 | 4.645.279,013 | 357,880 | |
| 9605 | 705.666,947 | 4.645.388,468 | 388,334 | |
| 9606 | 705.679,384 | 4.645.386,396 | 388,300 | |
| 9607 | 705.695,329 | 4.645.388,468 | 388,350 | |
| 9608 | 705.667,266 | 4.645.399,465 | 388,329 | |
| 9609 | 704.125,839 | 4.644.449,943 | 446,415 | |
| 9610 | 705.691,662 | 4.645.403,769 | 388,321 | |
| 9611 | 708.863,172 | 4.645.400,872 | 357,030 | |
| 9612 | 704.085,054 | 4.644.438,193 | 450,093 | |
| 9613 | 708.889,168 | 4.645.490,074 | 356,700 | |
| 9614 | 705.687,038 | 4.645.420,185 | 388,315 | |
| 9615 | 705.694,692 | 4.645.422,576 | 388,373 | |
| 9616 | 708.874,238 | 4.645.489,351 | 356,730 | |
| 9617 | 708.890,198 | 4.645.500,550 | 356,260 | |
| 9618 | 705.716,410 | 4.645.415,562 | 387,412 | |
| 9619 | 704.951,761 | 4.644.720,705 | 430,027 | |
| 9620 | 708.896,572 | 4.645.537,576 | 356,320 | |
| 9621 | 704.980,015 | 4.644.729,178 | 429,227 | |
| 9622 | 708.898,774 | 4.645.576,581 | 356,390 | |
| 9623 | 708.905,534 | 4.645.614,715 | 356,350 | |
| 9624 | 708.915,274 | 4.645.612,783 | 356,370 | |
| 9625 | 708.925,601 | 4.645.650,552 | 356,330 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9626 | 705.057,868 | 4.644.758,674 | 428,500 | |
| 9627 | 705.734,116 | 4.645.323,876 | 387,293 | |
| 9628 | 705.052,845 | 4.644.744,240 | 428,277 | |
| 9629 | 708.940,684 | 4.645.707,198 | 356,190 | |
| 9630 | 705.018,314 | 4.644.730,433 | 428,447 | |
| 9631 | 704.999,164 | 4.644.723,843 | 428,773 | |
| 9632 | 704.984,724 | 4.644.717,568 | 429,134 | |
| 9633 | 704.968,399 | 4.644.712,233 | 429,608 | |
| 9634 | 705.726,621 | 4.645.415,266 | 387,434 | |
| 9635 | 705.726,143 | 4.645.427,698 | 387,345 | |
| 9636 | 705.726,940 | 4.645.440,608 | 387,480 | |
| 9637 | 708.938,065 | 4.645.752,525 | 356,780 | |
| 9638 | 708.946,957 | 4.645.750,568 | 356,780 | |
| 9639 | 708.955,100 | 4.645.788,547 | 356,820 | |
| 9640 | 708.945,922 | 4.645.790,987 | 356,800 | |
| 9641 | 708.952,696 | 4.645.834,565 | 356,850 | |
| 9642 | 708.964,531 | 4.645.834,214 | 356,810 | |
| 9643 | 705.738,270 | 4.645.365,789 | 387,420 | |
| 9644 | 705.018,627 | 4.644.699,682 | 428,354 | |
| 9645 | 708.969,743 | 4.645.866,957 | 356,390 | |
| 9646 | 708.880,542 | 4.645.552,673 | 356,560 | |
| 9647 | 705.749,910 | 4.645.397,028 | 387,319 | |
| 9648 | 705.030,243 | 4.644.687,758 | 428,082 | |
| 9649 | 708.878,673 | 4.645.544,007 | 356,650 | |
| 9650 | 708.861,111 | 4.645.557,685 | 356,460 | |
| 9651 | 708.860,793 | 4.645.549,720 | 356,450 | |
| 9652 | 708.862,288 | 4.645.471,177 | 356,770 | |
| 9653 | 705.759,160 | 4.645.396,302 | 387,397 | |
| 9654 | 705.029,968 | 4.644.671,369 | 428,027 | |
| 9655 | 705.013,016 | 4.644.664,780 | 428,590 | |
| 9656 | 705.020,864 | 4.644.651,914 | 428,084 | |
| 9657 | 708.833,001 | 4.645.481,415 | 356,810 | |
| 9658 | 705.770,162 | 4.645.432,960 | 387,441 | |
| 9659 | 705.071,406 | 4.644.674,507 | 427,179 | |
| 9660 | 705.768,248 | 4.645.459,577 | 387,316 | |
| 9661 | 705.778,453 | 4.645.463,721 | 387,403 | |
| 9662 | 708.750,813 | 4.645.497,813 | 356,670 | |
| 9663 | 705.121,634 | 4.644.684,862 | 425,984 | |
| 9664 | 705.104,054 | 4.644.674,821 | 426,716 | |
| 9665 | 708.687,529 | 4.645.524,397 | 356,940 | |
| 9666 | 705.781,802 | 4.645.384,189 | 387,401 | |
| 9667 | 705.782,439 | 4.645.370,163 | 387,390 | |
| 9668 | 705.794,877 | 4.645.368,251 | 387,270 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9669 | 705.795,036 | 4.645.383,073 | 387,356 | |
| 9670 | 708.617,977 | 4.645.533,539 | 357,350 | |
| 9671 | 705.128,226 | 4.644.670,741 | 425,989 | |
| 9672 | 705.141,725 | 4.644.678,900 | 425,323 | |
| 9673 | 705.805,082 | 4.645.469,458 | 387,401 | |
| 9674 | 705.144,550 | 4.644.670,114 | 425,427 | |
| 9675 | 708.564,607 | 4.645.543,679 | 357,990 | |
| 9676 | 705.118,808 | 4.644.654,424 | 426,238 | |
| 9677 | 705.106,565 | 4.644.644,697 | 426,247 | |
| 9678 | 705.097,148 | 4.644.640,618 | 426,389 | |
| 9679 | 705.804,763 | 4.645.405,546 | 387,370 | |
| 9680 | 705.804,125 | 4.645.397,099 | 387,321 | |
| 9681 | 708.504,563 | 4.645.565,398 | 358,230 | |
| 9682 | 708.491,625 | 4.645.590,539 | 358,250 | |
| 9683 | 708.486,169 | 4.645.585,863 | 358,280 | |
| 9684 | 705.813,214 | 4.645.395,505 | 387,328 | |
| 9685 | 705.042,525 | 4.644.589,470 | 424,199 | |
| 9686 | 705.055,709 | 4.644.596,374 | 426,170 | |
| 9687 | 708.449,915 | 4.645.626,398 | 358,240 | |
| 9688 | 708.442,738 | 4.645.647,570 | 358,280 | |
| 9689 | 708.436,304 | 4.645.644,593 | 358,280 | |
| 9690 | 708.427,523 | 4.645.658,815 | 358,280 | |
| 9691 | 705.130,110 | 4.644.642,187 | 425,828 | |
| 9692 | 705.825,544 | 4.645.439,966 | 387,341 | |
| 9693 | 708.426,986 | 4.645.684,799 | 358,760 | |
| 9694 | 708.419,058 | 4.645.697,483 | 358,730 | |
| 9695 | 708.428,943 | 4.645.697,010 | 358,610 | |
| 9696 | 708.431,560 | 4.645.717,754 | 358,410 | |
| 9697 | 708.424,457 | 4.645.716,943 | 358,430 | |
| 9698 | 705.130,737 | 4.644.628,066 | 425,505 | |
| 9699 | 705.088,672 | 4.644.599,198 | 426,168 | |
| 9700 | 705.912,619 | 4.645.187,984 | 383,234 | |
| 9701 | 708.434,319 | 4.645.759,170 | 360,530 | |
| 9702 | 708.438,476 | 4.645.776,875 | 360,500 | |
| 9703 | 705.932,047 | 4.645.200,379 | 383,313 | |
| 9704 | 705.946,928 | 4.645.197,280 | 382,771 | |
| 9705 | 708.434,835 | 4.645.795,327 | 362,100 | |
| 9706 | 705.159,933 | 4.644.629,949 | 424,961 | |
| 9707 | 705.170,920 | 4.644.640,618 | 424,710 | |
| 9708 | 704.813,882 | 4.644.697,448 | 430,927 | |
| 9709 | 704.827,069 | 4.644.701,948 | 430,679 | |
| 9710 | 709.600,118 | 4.645.292,206 | 355,990 | |
| 9711 | 709.659,117 | 4.645.309,104 | 355,720 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9712 | 709.842,844 | 4.645.335,609 | 357,410 | |
| 9713 | 709.839,514 | 4.645.343,396 | 357,370 | |
| 9714 | 709.885,552 | 4.645.352,498 | 357,170 | |
| 9715 | 705.888,848 | 4.645.165,594 | 384,307 | |
| 9716 | 709.925,348 | 4.645.341,521 | 357,140 | |
| 9717 | 705.876,837 | 4.645.197,672 | 384,452 | |
| 9718 | 710.184,600 | 4.645.414,282 | 355,340 | |
| 9719 | 710.209,678 | 4.645.410,204 | 355,340 | |
| 9720 | 710.249,001 | 4.645.417,950 | 355,350 | |
| 9721 | 710.294,690 | 4.645.433,152 | 355,320 | |
| 9722 | 710.296,019 | 4.645.425,394 | 355,350 | |
| 9723 | 704.208,311 | 4.644.454,321 | 440,890 | |
| 9724 | 710.324,673 | 4.645.431,989 | 355,400 | |
| 9725 | 705.692,509 | 4.644.942,048 | 388,478 | |
| 9726 | 710.335,593 | 4.645.434,152 | 354,890 | |
| 9727 | 710.332,593 | 4.645.441,251 | 354,860 | |
| 9728 | 705.753,066 | 4.644.882,335 | 388,614 | |
| 9729 | 705.791,528 | 4.644.879,882 | 388,517 | |
| 9730 | 705.817,715 | 4.644.910,147 | 387,884 | |
| 9731 | 705.830,808 | 4.644.926,507 | 387,622 | |
| 9732 | 710.470,439 | 4.645.458,519 | 353,820 | |
| 9733 | 710.509,587 | 4.645.465,842 | 353,810 | |
| 9734 | 705.754,703 | 4.644.915,873 | 388,072 | |
| 9735 | 705.791,528 | 4.644.945,320 | 387,743 | |
| 9736 | 705.881,545 | 4.645.033,662 | 385,845 | |
| 9737 | 710.610,269 | 4.645.495,634 | 353,100 | |
| 9738 | 710.622,217 | 4.645.483,000 | 352,930 | |
| 9739 | 710.612,198 | 4.645.476,645 | 352,990 | |
| 9740 | 705.782,989 | 4.644.965,829 | 387,570 | |
| 9741 | 710.624,880 | 4.645.449,958 | 352,970 | |
| 9742 | 705.792,175 | 4.644.997,964 | 386,988 | |
| 9743 | 705.735,094 | 4.645.016,983 | 387,918 | |
| 9744 | 705.720,003 | 4.645.005,834 | 388,053 | |
| 9745 | 705.717,379 | 4.644.962,550 | 388,208 | |
| 9746 | 705.732,469 | 4.644.978,946 | 387,986 | |
| 9747 | 705.863,027 | 4.645.104,315 | 385,730 | |
| 9748 | 710.857,516 | 4.645.506,026 | 351,150 | |
| 9749 | 710.897,796 | 4.645.520,354 | 350,790 | |
| 9750 | 710.936,133 | 4.645.525,119 | 350,540 | |
| 9751 | 711.012,734 | 4.645.529,455 | 350,570 | |
| 9752 | 705.843,344 | 4.645.132,515 | 385,638 | |
| 9753 | 711.025,915 | 4.645.541,701 | 350,450 | |
| 9754 | 711.063,806 | 4.645.539,506 | 350,420 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9755 | 705.775,765 | 4.645.110,217 | 387,133 | |
| 9756 | 705.756,082 | 4.645.101,691 | 387,477 | |
| 9757 | 705.738,367 | 4.645.097,756 | 387,770 | |
| 9758 | 711.156,028 | 4.645.563,727 | 349,530 | |
| 9759 | 711.162,531 | 4.645.565,200 | 349,480 | |
| 9760 | 711.168,807 | 4.645.557,297 | 349,580 | |
| 9761 | 711.198,013 | 4.645.561,030 | 349,390 | |
| 9762 | 705.782,982 | 4.645.129,236 | 386,863 | |
| 9763 | 711.220,691 | 4.645.560,491 | 349,670 | |
| 9764 | 705.834,814 | 4.645.143,008 | 385,842 | |
| 9765 | 705.851,217 | 4.645.151,534 | 385,507 | |
| 9766 | 711.280,198 | 4.645.574,569 | 349,600 | |
| 9767 | 711.293,212 | 4.645.564,732 | 349,590 | |
| 9768 | 711.306,784 | 4.645.570,230 | 349,610 | |
| 9769 | 705.746,896 | 4.645.175,143 | 387,812 | |
| 9770 | 705.651,104 | 4.645.181,046 | 388,870 | |
| 9771 | 711.536,070 | 4.645.503,339 | 344,400 | |
| 9772 | 711.576,875 | 4.645.500,741 | 343,480 | |
| 9773 | 711.574,135 | 4.645.493,509 | 343,500 | |
| 9774 | 711.615,657 | 4.645.491,413 | 342,870 | |
| 9775 | 705.826,285 | 4.645.160,715 | 386,070 | |
| 9776 | 705.806,602 | 4.645.153,501 | 386,435 | |
| 9777 | 705.663,570 | 4.645.127,268 | 389,171 | |
| 9778 | 711.697,730 | 4.645.511,161 | 341,870 | |
| 9779 | 711.301,114 | 4.645.585,303 | 349,530 | |
| 9780 | 705.908,955 | 4.645.167,274 | 383,363 | |
| 9781 | 705.910,923 | 4.645.157,436 | 383,397 | |
| 9782 | 711.309,557 | 4.645.628,334 | 349,310 | |
| 9783 | 712.993,710 | 4.644.044,720 | 343,510 | |
| 9784 | 713.006,040 | 4.644.038,670 | 343,600 | |
| 9785 | 713.005,310 | 4.644.044,010 | 343,590 | |
| 9786 | 713.073,830 | 4.644.045,440 | 343,570 | |
| 9787 | 712.936,260 | 4.644.070,480 | 343,470 | |
| 9788 | 712.924,900 | 4.644.075,310 | 343,580 | |
| 9789 | 712.944,210 | 4.644.073,130 | 344,060 | |
| 9790 | 712.971,660 | 4.644.055,200 | 343,630 | |
| 9791 | 712.960,160 | 4.644.059,920 | 343,550 | |
| 9792 | 712.969,470 | 4.644.061,210 | 343,610 | |
| 9793 | 712.947,950 | 4.644.065,930 | 343,630 | |
| 9794 | 712.955,430 | 4.644.066,890 | 343,720 | |
| 9795 | 712.981,520 | 4.644.050,090 | 343,750 | |
| 9796 | 712.993,870 | 4.644.048,940 | 343,570 | |
| 9797 | 712.981,270 | 4.644.054,740 | 343,610 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9798 | 713.072,190 | 4.644.050,010 | 344,050 | |
| 9799 | 713.074,110 | 4.644.055,490 | 344,300 | |
| 9800 | 713.080,770 | 4.644.051,080 | 343,270 | |
| 9801 | 713.086,830 | 4.644.059,700 | 343,310 | |
| 9802 | 713.079,670 | 4.644.060,250 | 343,990 | |
| 9803 | 713.090,320 | 4.644.070,140 | 343,290 | |
| 9804 | 713.097,750 | 4.644.073,720 | 343,330 | |
| 9805 | 712.812,290 | 4.644.096,220 | 344,810 | |
| 9806 | 712.808,430 | 4.644.100,810 | 344,740 | |
| 9807 | 712.822,530 | 4.644.082,500 | 343,590 | |
| 9808 | 712.831,740 | 4.644.080,650 | 343,630 | |
| 9809 | 712.828,660 | 4.644.088,060 | 343,780 | |
| 9810 | 712.842,930 | 4.644.086,960 | 343,880 | |
| 9811 | 712.817,700 | 4.644.089,290 | 343,680 | |
| 9812 | 712.822,930 | 4.644.090,970 | 344,010 | |
| 9813 | 712.825,040 | 4.644.095,170 | 344,680 | |
| 9814 | 712.847,050 | 4.644.081,930 | 343,810 | |
| 9815 | 712.860,820 | 4.644.081,750 | 343,580 | |
| 9816 | 712.858,430 | 4.644.086,170 | 343,760 | |
| 9817 | 712.888,760 | 4.644.080,580 | 343,620 | |
| 9818 | 712.876,670 | 4.644.080,810 | 343,890 | |
| 9819 | 712.871,640 | 4.644.087,680 | 343,600 | |
| 9820 | 712.883,450 | 4.644.085,080 | 343,630 | |
| 9821 | 712.909,850 | 4.644.077,990 | 343,680 | |
| 9822 | 712.919,710 | 4.644.079,410 | 343,620 | |
| 9823 | 712.902,120 | 4.644.082,870 | 343,740 | |
| 9824 | 712.933,860 | 4.644.077,420 | 343,710 | |
| 9825 | 712.920,940 | 4.644.082,520 | 343,870 | |
| 9826 | 713.097,940 | 4.644.082,330 | 343,260 | |
| 9827 | 713.107,280 | 4.644.086,570 | 343,340 | |
| 9828 | 713.109,240 | 4.644.096,670 | 343,430 | |
| 9829 | 713.116,610 | 4.644.099,040 | 343,350 | |
| 9830 | 712.761,700 | 4.644.113,950 | 343,000 | |
| 9831 | 712.761,810 | 4.644.117,060 | 343,190 | |
| 9832 | 712.768,260 | 4.644.113,190 | 344,110 | |
| 9833 | 712.770,650 | 4.644.111,230 | 344,110 | |
| 9834 | 712.772,970 | 4.644.113,250 | 344,460 | |
| 9835 | 712.779,180 | 4.644.112,450 | 345,330 | |
| 9836 | 712.782,550 | 4.644.111,240 | 345,560 | |
| 9837 | 712.787,570 | 4.644.110,550 | 345,840 | |
| 9838 | 712.767,620 | 4.644.116,900 | 344,340 | |
| 9839 | 712.770,910 | 4.644.116,840 | 344,420 | |
| 9840 | 712.777,100 | 4.644.113,950 | 344,940 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9841 | 712.775,260 | 4.644.116,960 | 344,900 | |
| 9842 | 712.780,240 | 4.644.115,160 | 345,390 | |
| 9843 | 712.784,740 | 4.644.115,160 | 345,690 | |
| 9844 | 712.809,670 | 4.644.104,760 | 345,090 | |
| 9845 | 712.805,380 | 4.644.109,240 | 344,730 | |
| 9846 | 712.804,050 | 4.644.106,710 | 344,830 | |
| 9847 | 712.792,410 | 4.644.112,710 | 345,810 | |
| 9848 | 712.800,150 | 4.644.109,350 | 344,540 | |
| 9849 | 712.798,140 | 4.644.112,010 | 344,750 | |
| 9850 | 712.803,550 | 4.644.111,250 | 344,530 | |
| 9851 | 712.790,980 | 4.644.115,490 | 346,010 | |
| 9852 | 712.795,360 | 4.644.114,870 | 345,380 | |
| 9853 | 713.116,760 | 4.644.106,200 | 343,330 | |
| 9854 | 713.124,450 | 4.644.108,530 | 343,250 | |
| 9855 | 713.120,430 | 4.644.110,830 | 343,280 | |
| 9856 | 713.128,470 | 4.644.121,830 | 343,300 | |
| 9857 | 713.131,560 | 4.644.118,470 | 343,270 | |
| 9858 | 713.139,500 | 4.644.130,340 | 343,350 | |
| 9859 | 713.137,710 | 4.644.135,530 | 343,570 | |
| 9860 | 713.148,740 | 4.644.142,770 | 343,500 | |
| 9861 | 713.148,850 | 4.644.149,960 | 343,450 | |
| 9862 | 713.726,960 | 4.644.134,260 | 339,180 | |
| 9863 | 713.733,490 | 4.644.136,610 | 339,200 | |
| 9864 | 713.735,480 | 4.644.138,300 | 338,420 | |
| 9865 | 713.720,250 | 4.644.142,900 | 339,150 | |
| 9866 | 713.728,690 | 4.644.147,860 | 339,190 | |
| 9867 | 713.732,520 | 4.644.147,190 | 339,230 | |
| 9868 | 713.733,970 | 4.644.151,290 | 338,470 | |
| 9869 | 713.745,320 | 4.644.140,430 | 338,260 | |
| 9870 | 713.745,290 | 4.644.146,090 | 338,250 | |
| 9871 | 713.755,510 | 4.644.143,760 | 338,240 | |
| 9872 | 713.757,580 | 4.644.145,080 | 337,820 | |
| 9873 | 713.757,560 | 4.644.147,940 | 337,740 | |
| 9874 | 713.755,430 | 4.644.152,390 | 338,390 | |
| 9875 | 713.769,540 | 4.644.146,480 | 337,530 | |
| 9876 | 713.780,760 | 4.644.149,120 | 337,070 | |
| 9877 | 713.768,710 | 4.644.152,050 | 337,550 | |
| 9878 | 713.779,590 | 4.644.150,570 | 337,620 | |
| 9879 | 713.779,990 | 4.644.153,840 | 337,140 | |
| 9880 | 713.789,920 | 4.644.151,840 | 336,860 | |
| 9881 | 713.803,550 | 4.644.153,780 | 336,640 | |
| 9882 | 713.801,590 | 4.644.153,400 | 336,980 | |
| 9883 | 713.158,360 | 4.644.156,440 | 343,790 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9884 | 713.158,450 | 4.644.163,600 | 343,590 | |
| 9885 | 713.166,900 | 4.644.166,870 | 343,440 | |
| 9886 | 713.166,850 | 4.644.175,080 | 343,400 | |
| 9887 | 713.178,000 | 4.644.179,040 | 343,340 | |
| 9888 | 713.718,030 | 4.644.154,970 | 339,190 | |
| 9889 | 713.725,370 | 4.644.156,020 | 339,180 | |
| 9890 | 713.720,260 | 4.644.171,770 | 339,190 | |
| 9891 | 713.712,960 | 4.644.176,050 | 339,220 | |
| 9892 | 713.778,670 | 4.644.154,590 | 337,690 | |
| 9893 | 713.788,580 | 4.644.157,150 | 336,880 | |
| 9894 | 713.813,380 | 4.644.157,080 | 336,170 | |
| 9895 | 713.800,240 | 4.644.162,190 | 336,970 | |
| 9896 | 713.802,030 | 4.644.163,010 | 336,270 | |
| 9897 | 713.812,500 | 4.644.162,770 | 336,180 | |
| 9898 | 713.823,830 | 4.644.157,670 | 336,160 | |
| 9899 | 713.828,570 | 4.644.159,500 | 335,440 | |
| 9900 | 713.833,900 | 4.644.162,210 | 335,130 | |
| 9901 | 713.822,750 | 4.644.166,680 | 336,260 | |
| 9902 | 713.825,260 | 4.644.168,880 | 335,330 | |
| 9903 | 713.836,970 | 4.644.168,900 | 335,170 | |
| 9904 | 713.843,500 | 4.644.165,230 | 335,170 | |
| 9905 | 713.854,340 | 4.644.168,160 | 335,180 | |
| 9906 | 713.864,050 | 4.644.169,360 | 335,110 | |
| 9907 | 713.849,450 | 4.644.173,310 | 335,220 | |
| 9908 | 713.860,000 | 4.644.174,610 | 335,150 | |
| 9909 | 713.868,430 | 4.644.174,870 | 335,150 | |
| 9910 | 713.873,690 | 4.644.169,400 | 335,160 | |
| 9911 | 713.885,230 | 4.644.168,620 | 335,130 | |
| 9912 | 713.879,040 | 4.644.173,850 | 335,150 | |
| 9913 | 713.893,030 | 4.644.173,080 | 335,130 | |
| 9914 | 713.913,620 | 4.644.165,150 | 335,150 | |
| 9915 | 713.898,450 | 4.644.167,560 | 335,160 | |
| 9916 | 713.906,570 | 4.644.172,680 | 335,190 | |
| 9917 | 713.925,460 | 4.644.164,610 | 335,120 | |
| 9918 | 713.926,320 | 4.644.169,520 | 335,120 | |
| 9919 | 713.955,510 | 4.644.164,710 | 335,150 | |
| 9920 | 713.960,850 | 4.644.163,940 | 335,130 | |
| 9921 | 713.969,770 | 4.644.166,030 | 335,190 | |
| 9922 | 713.959,110 | 4.644.168,470 | 335,150 | |
| 9923 | 713.977,610 | 4.644.161,850 | 335,410 | |
| 9924 | 713.983,090 | 4.644.162,020 | 335,490 | |
| 9925 | 713.994,030 | 4.644.161,330 | 335,650 | |
| 9926 | 713.980,990 | 4.644.165,660 | 335,480 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9927 | 713.989,120 | 4.644.164,980 | 335,670 | |
| 9928 | 713.999,140 | 4.644.163,760 | 335,770 | |
| 9929 | 713.178,130 | 4.644.189,120 | 343,330 | |
| 9930 | 713.188,120 | 4.644.194,420 | 343,330 | |
| 9931 | 713.189,730 | 4.644.205,660 | 343,290 | |
| 9932 | 713.709,240 | 4.644.190,760 | 339,200 | |
| 9933 | 713.703,730 | 4.644.205,330 | 339,250 | |
| 9934 | 713.718,080 | 4.644.188,040 | 339,190 | |
| 9935 | 713.712,770 | 4.644.201,880 | 339,240 | |
| 9936 | 713.203,690 | 4.644.216,060 | 343,690 | |
| 9937 | 713.204,830 | 4.644.225,870 | 343,470 | |
| 9938 | 713.707,630 | 4.644.225,980 | 339,300 | |
| 9939 | 713.219,820 | 4.644.235,850 | 343,450 | |
| 9940 | 713.219,980 | 4.644.248,690 | 343,410 | |
| 9941 | 713.232,120 | 4.644.258,810 | 344,570 | |
| 9942 | 713.697,640 | 4.644.233,000 | 339,290 | |
| 9943 | 713.695,630 | 4.644.245,280 | 339,260 | |
| 9944 | 713.703,900 | 4.644.246,670 | 339,310 | |
| 9945 | 713.235,110 | 4.644.274,390 | 343,380 | |
| 9946 | 713.247,790 | 4.644.283,440 | 343,240 | |
| 9947 | 713.250,210 | 4.644.296,780 | 343,410 | |
| 9948 | 713.263,160 | 4.644.309,610 | 343,400 | |
| 9949 | 713.266,660 | 4.644.323,450 | 343,440 | |
| 9950 | 713.279,400 | 4.644.332,070 | 343,460 | |
| 9951 | 713.279,930 | 4.644.343,290 | 343,400 | |
| 9952 | 713.328,900 | 4.644.397,630 | 339,660 | |
| 9953 | 713.319,620 | 4.644.400,590 | 339,660 | |
| 9954 | 713.338,790 | 4.644.410,620 | 339,700 | |
| 9955 | 713.337,390 | 4.644.421,620 | 339,700 | |
| 9956 | 713.354,770 | 4.644.422,830 | 339,390 | |
| 9957 | 713.356,410 | 4.644.426,260 | 338,610 | |
| 9958 | 713.349,120 | 4.644.431,420 | 340,000 | |
| 9959 | 713.350,780 | 4.644.433,560 | 337,650 | |
| 9960 | 713.354,900 | 4.644.436,150 | 337,570 | |
| 9961 | 713.358,240 | 4.644.434,470 | 337,550 | |
| 9962 | 712.982,480 | 4.644.550,410 | 339,730 | |
| 9963 | 712.991,060 | 4.644.548,510 | 339,760 | |
| 9964 | 713.010,050 | 4.644.543,160 | 339,880 | |
| 9965 | 713.001,450 | 4.644.544,170 | 339,760 | |
| 9966 | 713.018,930 | 4.644.547,630 | 339,790 | |
| 9967 | 713.029,440 | 4.644.550,280 | 339,240 | |
| 9968 | 713.196,740 | 4.644.551,580 | 338,150 | |
| 9969 | 713.215,860 | 4.644.550,370 | 338,230 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 9970 | 713.229,540 | 4.644.548,800 | 338,280 | |
| 9971 | 713.248,240 | 4.644.546,550 | 338,250 | |
| 9972 | 713.271,700 | 4.644.541,460 | 339,140 | |
| 9973 | 713.265,490 | 4.644.545,500 | 338,640 | |
| 9974 | 713.267,210 | 4.644.549,090 | 338,580 | |
| 9975 | 712.878,370 | 4.644.574,300 | 339,590 | |
| 9976 | 712.892,870 | 4.644.570,770 | 339,590 | |
| 9977 | 712.933,630 | 4.644.559,650 | 339,720 | |
| 9978 | 712.943,070 | 4.644.557,870 | 339,710 | |
| 9979 | 712.935,460 | 4.644.565,680 | 339,790 | |
| 9980 | 712.949,590 | 4.644.555,250 | 339,770 | |
| 9981 | 712.968,670 | 4.644.552,760 | 339,740 | |
| 9982 | 712.948,490 | 4.644.562,040 | 339,740 | |
| 9983 | 712.988,380 | 4.644.555,660 | 339,810 | |
| 9984 | 712.977,340 | 4.644.557,970 | 339,790 | |
| 9985 | 712.999,880 | 4.644.552,610 | 339,770 | |
| 9986 | 713.010,360 | 4.644.551,780 | 339,830 | |
| 9987 | 713.015,570 | 4.644.553,490 | 340,090 | |
| 9988 | 713.022,200 | 4.644.555,310 | 338,340 | |
| 9989 | 713.017,620 | 4.644.556,050 | 338,760 | |
| 9990 | 713.026,290 | 4.644.556,350 | 337,940 | |
| 9991 | 713.030,270 | 4.644.554,910 | 338,380 | |
| 9992 | 713.037,650 | 4.644.554,050 | 338,070 | |
| 9993 | 713.042,940 | 4.644.554,540 | 337,830 | |
| 9994 | 713.048,180 | 4.644.554,840 | 338,090 | |
| 9995 | 713.032,860 | 4.644.557,420 | 337,960 | |
| 9996 | 713.031,460 | 4.644.555,950 | 338,090 | |
| 9997 | 713.045,290 | 4.644.562,050 | 338,040 | |
| 9998 | 713.070,960 | 4.644.559,090 | 338,120 | |
| 9999 | 713.071,120 | 4.644.564,820 | 338,110 | |
| 10000 | 713.089,110 | 4.644.559,900 | 338,130 | |
| 10001 | 713.081,160 | 4.644.565,530 | 338,130 | |
| 10002 | 713.099,940 | 4.644.566,190 | 338,110 | |
| 10003 | 713.108,420 | 4.644.558,960 | 338,170 | |
| 10004 | 713.123,730 | 4.644.558,850 | 338,170 | |
| 10005 | 713.115,500 | 4.644.564,950 | 338,180 | |
| 10006 | 713.137,870 | 4.644.558,220 | 338,110 | |
| 10007 | 713.153,820 | 4.644.555,890 | 338,110 | |
| 10008 | 713.143,700 | 4.644.562,830 | 338,130 | |
| 10009 | 713.130,510 | 4.644.564,470 | 338,180 | |
| 10010 | 713.178,640 | 4.644.553,210 | 338,170 | |
| 10011 | 713.166,030 | 4.644.559,870 | 338,190 | |
| 10012 | 713.187,330 | 4.644.557,970 | 338,220 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10013 | 713.206,550 | 4.644.557,170 | 338,180 | |
| 10014 | 713.221,690 | 4.644.554,250 | 338,210 | |
| 10015 | 713.240,250 | 4.644.553,070 | 338,200 | |
| 10016 | 713.252,680 | 4.644.552,130 | 338,150 | |
| 10017 | 712.778,460 | 4.644.599,820 | 339,800 | |
| 10018 | 712.798,280 | 4.644.594,800 | 339,700 | |
| 10019 | 712.809,390 | 4.644.598,400 | 339,700 | |
| 10020 | 712.790,160 | 4.644.604,560 | 339,690 | |
| 10021 | 712.835,860 | 4.644.585,740 | 339,710 | |
| 10022 | 712.817,110 | 4.644.590,520 | 339,710 | |
| 10023 | 712.826,970 | 4.644.594,600 | 339,740 | |
| 10024 | 712.858,250 | 4.644.579,380 | 339,630 | |
| 10025 | 712.848,320 | 4.644.588,970 | 339,620 | |
| 10026 | 712.868,530 | 4.644.583,690 | 339,600 | |
| 10027 | 712.894,040 | 4.644.576,630 | 339,630 | |
| 10028 | 712.730,180 | 4.644.607,420 | 340,710 | |
| 10029 | 712.733,380 | 4.644.605,210 | 340,620 | |
| 10030 | 712.736,100 | 4.644.613,800 | 340,600 | |
| 10031 | 712.732,600 | 4.644.615,720 | 340,740 | |
| 10032 | 712.728,080 | 4.644.619,800 | 342,070 | |
| 10033 | 712.735,210 | 4.644.621,040 | 340,920 | |
| 10034 | 712.732,760 | 4.644.618,450 | 341,020 | |
| 10035 | 712.724,220 | 4.644.623,560 | 342,330 | |
| 10036 | 712.731,120 | 4.644.625,090 | 341,850 | |
| 10037 | 712.725,320 | 4.644.628,160 | 342,270 | |
| 10038 | 712.759,800 | 4.644.606,360 | 339,790 | |
| 10039 | 712.740,050 | 4.644.611,600 | 340,120 | |
| 10040 | 712.744,260 | 4.644.609,720 | 339,810 | |
| 10041 | 712.742,900 | 4.644.616,190 | 340,410 | |
| 10042 | 712.752,990 | 4.644.613,450 | 339,750 | |
| 10043 | 712.737,080 | 4.644.619,930 | 340,530 | |
| 10044 | 712.740,800 | 4.644.619,370 | 340,430 | |
| 10045 | 712.771,100 | 4.644.608,040 | 339,770 | |
| 10046 | 712.694,010 | 4.644.646,100 | 342,540 | |
| 10047 | 712.697,860 | 4.644.650,040 | 342,720 | |
| 10048 | 712.714,710 | 4.644.630,180 | 342,670 | |
| 10049 | 712.717,230 | 4.644.633,990 | 342,760 | |
| 10050 | 712.676,420 | 4.644.662,840 | 342,330 | |
| 10051 | 712.663,750 | 4.644.672,830 | 341,890 | |
| 10052 | 712.674,700 | 4.644.671,480 | 341,980 | |
| 10053 | 712.661,490 | 4.644.681,030 | 341,700 | |
| 10054 | 712.684,890 | 4.644.654,370 | 342,580 | |
| 10055 | 712.690,080 | 4.644.658,210 | 342,730 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10056 | 712.629,390 | 4.644.700,710 | 341,670 | |
| 10057 | 712.628,310 | 4.644.705,460 | 341,620 | |
| 10058 | 712.649,220 | 4.644.685,600 | 341,730 | |
| 10059 | 712.639,280 | 4.644.693,020 | 341,710 | |
| 10060 | 712.647,500 | 4.644.691,730 | 341,600 | |
| 10061 | 712.636,330 | 4.644.699,820 | 341,660 | |
| 10062 | 712.513,110 | 4.644.708,580 | 344,240 | |
| 10063 | 712.510,300 | 4.644.713,000 | 344,160 | |
| 10064 | 712.529,590 | 4.644.733,500 | 342,930 | |
| 10065 | 712.599,010 | 4.644.719,320 | 341,470 | |
| 10066 | 712.600,850 | 4.644.729,590 | 341,220 | |
| 10067 | 712.593,700 | 4.644.734,150 | 341,220 | |
| 10068 | 712.610,700 | 4.644.712,600 | 341,650 | |
| 10069 | 712.615,450 | 4.644.714,380 | 341,480 | |
| 10070 | 712.605,440 | 4.644.720,350 | 341,480 | |
| 10071 | 712.525,820 | 4.644.737,320 | 342,880 | |
| 10072 | 712.540,770 | 4.644.747,970 | 342,020 | |
| 10073 | 712.537,780 | 4.644.753,070 | 341,990 | |
| 10074 | 712.596,830 | 4.644.745,740 | 340,770 | |
| 10075 | 712.588,800 | 4.644.750,560 | 340,720 | |
| 10076 | 712.550,690 | 4.644.762,280 | 341,130 | |
| 10077 | 712.547,510 | 4.644.766,410 | 341,200 | |
| 10078 | 712.556,400 | 4.644.771,530 | 341,130 | |
| 10079 | 712.555,410 | 4.644.777,380 | 341,180 | |
| 10080 | 712.566,270 | 4.644.783,330 | 340,200 | |
| 10081 | 712.562,490 | 4.644.788,210 | 340,140 | |
| 10082 | 712.592,300 | 4.644.762,680 | 340,180 | |
| 10083 | 712.584,110 | 4.644.766,530 | 340,260 | |
| 10084 | 712.579,440 | 4.644.777,320 | 339,950 | |
| 10085 | 712.587,970 | 4.644.788,950 | 339,890 | |
| 10086 | 712.562,090 | 4.644.802,850 | 340,180 | |
| 10087 | 712.549,900 | 4.644.841,340 | 339,050 | |
| 10088 | 712.560,920 | 4.644.823,660 | 339,070 | |
| 10089 | 712.546,090 | 4.644.885,020 | 339,140 | |
| 10090 | 712.531,280 | 4.644.908,370 | 339,160 | |
| 10091 | 712.522,750 | 4.644.964,320 | 339,220 | |
| 10092 | 712.532,740 | 4.645.005,920 | 339,190 | |
| 10093 | 712.542,660 | 4.645.015,530 | 339,220 | |
| 10094 | 712.554,270 | 4.645.018,610 | 339,290 | |
| 10095 | 712.567,890 | 4.645.030,140 | 338,400 | |
| 10096 | 712.576,440 | 4.645.029,010 | 338,190 | |
| 10097 | 712.595,890 | 4.645.042,080 | 337,390 | |
| 10098 | 712.602,550 | 4.645.050,650 | 337,570 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10099 | 712.610,220 | 4.645.050,700 | 337,550 | |
| 10100 | 712.628,500 | 4.645.059,010 | 336,660 | |
| 10101 | 712.643,840 | 4.645.074,560 | 337,790 | |
| 10102 | 713.193,670 | 4.645.072,460 | 328,770 | |
| 10103 | 713.198,010 | 4.645.073,580 | 328,720 | |
| 10104 | 713.195,790 | 4.645.077,770 | 328,700 | |
| 10105 | 712.666,770 | 4.645.082,460 | 338,000 | |
| 10106 | 712.679,660 | 4.645.096,660 | 338,450 | |
| 10107 | 712.692,320 | 4.645.101,250 | 337,380 | |
| 10108 | 713.149,090 | 4.645.104,270 | 328,740 | |
| 10109 | 713.153,900 | 4.645.103,970 | 328,710 | |
| 10110 | 713.179,710 | 4.645.082,180 | 328,750 | |
| 10111 | 713.170,870 | 4.645.088,960 | 328,740 | |
| 10112 | 713.175,780 | 4.645.089,940 | 328,760 | |
| 10113 | 713.162,380 | 4.645.094,780 | 328,720 | |
| 10114 | 713.166,340 | 4.645.095,710 | 328,720 | |
| 10115 | 713.183,710 | 4.645.084,060 | 328,730 | |
| 10116 | 713.202,350 | 4.645.083,690 | 328,710 | |
| 10117 | 713.208,190 | 4.645.083,170 | 328,790 | |
| 10118 | 713.220,090 | 4.645.093,080 | 328,890 | |
| 10119 | 713.233,490 | 4.645.094,900 | 327,680 | |
| 10120 | 713.219,240 | 4.645.098,160 | 328,680 | |
| 10121 | 713.226,680 | 4.645.098,290 | 329,190 | |
| 10122 | 713.229,410 | 4.645.100,520 | 329,120 | |
| 10123 | 713.229,780 | 4.645.097,490 | 328,280 | |
| 10124 | 713.233,570 | 4.645.097,110 | 328,580 | |
| 10125 | 713.223,580 | 4.645.101,200 | 328,720 | |
| 10126 | 713.233,110 | 4.645.100,750 | 328,290 | |
| 10127 | 713.239,230 | 4.645.094,370 | 327,520 | |
| 10128 | 713.236,580 | 4.645.100,430 | 328,240 | |
| 10129 | 713.239,300 | 4.645.100,840 | 327,700 | |
| 10130 | 713.248,440 | 4.645.101,890 | 327,540 | |
| 10131 | 712.696,370 | 4.645.109,450 | 336,810 | |
| 10132 | 712.707,500 | 4.645.112,990 | 335,700 | |
| 10133 | 712.716,890 | 4.645.126,790 | 335,140 | |
| 10134 | 712.723,310 | 4.645.125,630 | 334,680 | |
| 10135 | 713.128,080 | 4.645.119,210 | 328,710 | |
| 10136 | 713.131,210 | 4.645.120,770 | 328,710 | |
| 10137 | 713.121,380 | 4.645.127,090 | 328,710 | |
| 10138 | 713.137,300 | 4.645.112,640 | 328,730 | |
| 10139 | 713.144,920 | 4.645.110,510 | 328,740 | |
| 10140 | 713.245,530 | 4.645.105,340 | 327,560 | |
| 10141 | 713.255,000 | 4.645.113,970 | 327,570 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10142 | 713.259,780 | 4.645.113,850 | 327,540 | |
| 10143 | 713.262,350 | 4.645.121,540 | 327,600 | |
| 10144 | 713.268,320 | 4.645.119,970 | 327,560 | |
| 10145 | 713.538,410 | 4.645.121,710 | 326,870 | |
| 10146 | 713.543,970 | 4.645.121,980 | 326,890 | |
| 10147 | 713.537,530 | 4.645.127,690 | 327,030 | |
| 10148 | 713.547,460 | 4.645.127,150 | 325,730 | |
| 10149 | 713.553,550 | 4.645.121,470 | 326,910 | |
| 10150 | 712.726,970 | 4.645.133,930 | 333,990 | |
| 10151 | 712.738,670 | 4.645.141,390 | 333,170 | |
| 10152 | 712.740,720 | 4.645.139,180 | 333,210 | |
| 10153 | 712.758,300 | 4.645.148,480 | 331,560 | |
| 10154 | 712.753,840 | 4.645.149,950 | 331,570 | |
| 10155 | 713.090,150 | 4.645.149,480 | 328,680 | |
| 10156 | 713.080,320 | 4.645.153,730 | 328,680 | |
| 10157 | 713.107,950 | 4.645.133,590 | 328,700 | |
| 10158 | 713.272,130 | 4.645.130,300 | 327,530 | |
| 10159 | 713.277,520 | 4.645.129,580 | 327,490 | |
| 10160 | 713.289,170 | 4.645.146,760 | 327,500 | |
| 10161 | 713.296,740 | 4.645.147,220 | 327,480 | |
| 10162 | 713.499,680 | 4.645.156,680 | 327,360 | |
| 10163 | 713.517,780 | 4.645.144,660 | 327,380 | |
| 10164 | 713.508,620 | 4.645.151,440 | 327,350 | |
| 10165 | 713.520,330 | 4.645.150,680 | 327,420 | |
| 10166 | 713.512,750 | 4.645.154,760 | 327,390 | |
| 10167 | 713.534,850 | 4.645.129,530 | 327,080 | |
| 10168 | 713.543,440 | 4.645.130,630 | 327,850 | |
| 10169 | 713.533,410 | 4.645.134,050 | 327,590 | |
| 10170 | 713.536,070 | 4.645.138,470 | 327,310 | |
| 10171 | 713.529,690 | 4.645.143,580 | 327,360 | |
| 10172 | 712.774,130 | 4.645.162,140 | 330,770 | |
| 10173 | 712.782,580 | 4.645.163,610 | 330,370 | |
| 10174 | 712.795,020 | 4.645.173,770 | 331,230 | |
| 10175 | 712.800,350 | 4.645.172,680 | 330,430 | |
| 10176 | 712.794,750 | 4.645.174,330 | 330,740 | |
| 10177 | 712.794,400 | 4.645.174,450 | 330,960 | |
| 10178 | 712.794,400 | 4.645.174,690 | 330,890 | |
| 10179 | 713.053,400 | 4.645.172,660 | 328,630 | |
| 10180 | 713.040,650 | 4.645.181,630 | 328,630 | |
| 10181 | 713.049,260 | 4.645.178,570 | 328,650 | |
| 10182 | 713.068,240 | 4.645.161,810 | 328,660 | |
| 10183 | 713.077,700 | 4.645.158,300 | 328,690 | |
| 10184 | 713.063,420 | 4.645.168,080 | 328,660 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10185 | 713.307,300 | 4.645.162,690 | 327,390 | |
| 10186 | 713.315,620 | 4.645.166,030 | 327,430 | |
| 10187 | 713.324,420 | 4.645.180,450 | 327,420 | |
| 10188 | 713.333,910 | 4.645.181,450 | 327,420 | |
| 10189 | 713.446,270 | 4.645.176,410 | 327,500 | |
| 10190 | 713.428,480 | 4.645.181,880 | 327,460 | |
| 10191 | 713.460,430 | 4.645.171,550 | 327,460 | |
| 10192 | 713.470,880 | 4.645.172,170 | 327,440 | |
| 10193 | 713.457,910 | 4.645.176,420 | 327,470 | |
| 10194 | 713.484,340 | 4.645.163,320 | 327,420 | |
| 10195 | 713.495,450 | 4.645.163,450 | 327,390 | |
| 10196 | 713.475,280 | 4.645.166,070 | 327,430 | |
| 10197 | 713.484,390 | 4.645.166,730 | 327,410 | |
| 10198 | 713.505,330 | 4.645.158,750 | 327,410 | |
| 10199 | 712.827,880 | 4.645.189,130 | 329,340 | |
| 10200 | 712.832,740 | 4.645.195,240 | 330,430 | |
| 10201 | 712.855,780 | 4.645.204,300 | 329,310 | |
| 10202 | 712.863,270 | 4.645.210,780 | 329,690 | |
| 10203 | 713.022,140 | 4.645.194,920 | 328,610 | |
| 10204 | 713.013,580 | 4.645.203,310 | 328,640 | |
| 10205 | 713.000,990 | 4.645.209,220 | 328,600 | |
| 10206 | 713.036,080 | 4.645.187,810 | 328,630 | |
| 10207 | 713.337,170 | 4.645.190,190 | 327,430 | |
| 10208 | 713.342,110 | 4.645.188,880 | 327,440 | |
| 10209 | 713.347,650 | 4.645.200,130 | 327,610 | |
| 10210 | 713.355,800 | 4.645.202,810 | 327,550 | |
| 10211 | 713.365,220 | 4.645.202,410 | 327,560 | |
| 10212 | 713.355,870 | 4.645.208,060 | 327,540 | |
| 10213 | 713.360,930 | 4.645.208,270 | 327,630 | |
| 10214 | 713.393,490 | 4.645.192,950 | 327,530 | |
| 10215 | 713.378,000 | 4.645.197,140 | 327,540 | |
| 10216 | 713.373,730 | 4.645.202,810 | 327,550 | |
| 10217 | 713.385,750 | 4.645.199,580 | 327,540 | |
| 10218 | 713.416,760 | 4.645.186,040 | 327,520 | |
| 10219 | 713.404,770 | 4.645.189,730 | 327,540 | |
| 10220 | 713.400,740 | 4.645.194,740 | 327,580 | |
| 10221 | 713.411,480 | 4.645.191,400 | 327,520 | |
| 10222 | 713.440,240 | 4.645.182,790 | 327,470 | |
| 10223 | 713.422,720 | 4.645.187,760 | 327,500 | |
| 10224 | 712.872,970 | 4.645.213,360 | 330,170 | |
| 10225 | 712.869,700 | 4.645.216,260 | 329,580 | |
| 10226 | 712.870,970 | 4.645.219,230 | 329,410 | |
| 10227 | 712.875,650 | 4.645.218,980 | 329,470 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10228 | 712.877,910 | 4.645.223,950 | 330,240 | |
| 10229 | 712.881,260 | 4.645.226,530 | 330,410 | |
| 10230 | 712.876,890 | 4.645.227,610 | 329,220 | |
| 10231 | 712.886,680 | 4.645.234,570 | 329,290 | |
| 10232 | 712.969,090 | 4.645.232,320 | 328,540 | |
| 10233 | 712.993,640 | 4.645.219,230 | 328,580 | |
| 10234 | 712.983,480 | 4.645.222,330 | 328,580 | |
| 10235 | 712.978,340 | 4.645.229,190 | 328,550 | |
| 10236 | 712.886,150 | 4.645.240,100 | 329,130 | |
| 10237 | 712.894,720 | 4.645.248,110 | 329,250 | |
| 10238 | 712.895,000 | 4.645.254,470 | 328,990 | |
| 10239 | 712.904,550 | 4.645.264,080 | 329,190 | |
| 10240 | 712.941,100 | 4.645.251,610 | 328,540 | |
| 10241 | 712.932,070 | 4.645.258,010 | 328,600 | |
| 10242 | 712.940,240 | 4.645.259,830 | 328,450 | |
| 10243 | 712.935,390 | 4.645.264,290 | 328,480 | |
| 10244 | 712.964,280 | 4.645.239,320 | 328,550 | |
| 10245 | 712.954,860 | 4.645.242,640 | 328,540 | |
| 10246 | 712.954,620 | 4.645.246,060 | 328,520 | |
| 10247 | 712.947,590 | 4.645.252,270 | 328,550 | |
| 10248 | 712.910,800 | 4.645.267,440 | 329,050 | |
| 10249 | 712.914,350 | 4.645.267,510 | 329,450 | |
| 10250 | 712.920,530 | 4.645.266,000 | 329,360 | |
| 10251 | 712.904,420 | 4.645.270,050 | 329,020 | |
| 10252 | 712.911,740 | 4.645.271,000 | 329,350 | |
| 10253 | 712.914,430 | 4.645.269,120 | 329,360 | |
| 10254 | 712.916,610 | 4.645.272,370 | 329,280 | |
| 10255 | 712.917,830 | 4.645.272,320 | 329,450 | |
| 10256 | 712.909,280 | 4.645.276,640 | 329,050 | |
| 10257 | 712.914,020 | 4.645.274,450 | 329,230 | |
| 10258 | 712.916,690 | 4.645.274,120 | 329,170 | |
| 10259 | 712.924,720 | 4.645.271,910 | 329,320 | |
| 10260 | 712.942,190 | 4.645.271,970 | 328,600 | |
| 10261 | 712.949,730 | 4.645.274,800 | 328,500 | |
| 10262 | 712.951,570 | 4.645.285,370 | 328,560 | |
| 10263 | 712.959,820 | 4.645.288,130 | 328,560 | |
| 10264 | 712.961,940 | 4.645.291,430 | 328,980 | |
| 10265 | 712.959,040 | 4.645.294,540 | 329,010 | |
| 10266 | 712.962,110 | 4.645.294,460 | 329,400 | |
| 10267 | 712.962,730 | 4.645.295,990 | 329,160 | |
| 10268 | 712.961,940 | 4.645.298,320 | 329,060 | |
| 10269 | 714.005,040 | 4.644.160,200 | 335,710 | |
| 10270 | 714.016,720 | 4.644.158,690 | 336,750 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10271 | 714.009,300 | 4.644.163,760 | 335,790 | |
| 10272 | 714.020,940 | 4.644.163,550 | 337,050 | |
| 10273 | 714.025,650 | 4.644.160,460 | 336,980 | |
| 10274 | 714.038,910 | 4.644.161,150 | 336,990 | |
| 10275 | 714.049,230 | 4.644.162,460 | 337,090 | |
| 10276 | 714.030,150 | 4.644.165,570 | 336,990 | |
| 10277 | 714.042,710 | 4.644.166,020 | 336,980 | |
| 10278 | 714.062,300 | 4.644.162,820 | 337,070 | |
| 10279 | 714.073,620 | 4.644.164,040 | 337,020 | |
| 10280 | 714.055,700 | 4.644.166,950 | 337,020 | |
| 10281 | 714.067,300 | 4.644.167,840 | 337,070 | |
| 10282 | 714.087,930 | 4.644.165,470 | 337,080 | |
| 10283 | 714.079,250 | 4.644.168,740 | 337,110 | |
| 10284 | 714.094,180 | 4.644.170,700 | 337,040 | |
| 10285 | 714.101,610 | 4.644.167,620 | 337,020 | |
| 10286 | 714.119,300 | 4.644.168,610 | 337,080 | |
| 10287 | 714.110,470 | 4.644.173,030 | 337,040 | |
| 10288 | 714.133,700 | 4.644.170,480 | 337,090 | |
| 10289 | 714.128,630 | 4.644.174,760 | 337,060 | |
| 10290 | 714.153,290 | 4.644.171,940 | 337,060 | |
| 10291 | 714.145,080 | 4.644.176,310 | 337,030 | |
| 10292 | 714.169,600 | 4.644.173,710 | 337,010 | |
| 10293 | 714.160,100 | 4.644.177,700 | 337,070 | |
| 10294 | 714.192,080 | 4.644.176,170 | 336,960 | |
| 10295 | 714.209,440 | 4.644.178,010 | 337,020 | |
| 10296 | 714.179,300 | 4.644.180,250 | 337,000 | |
| 10297 | 714.200,850 | 4.644.181,960 | 337,060 | |
| 10298 | 714.227,050 | 4.644.179,660 | 337,050 | |
| 10299 | 714.218,620 | 4.644.183,780 | 337,050 | |
| 10300 | 714.239,800 | 4.644.180,440 | 337,070 | |
| 10301 | 714.255,130 | 4.644.182,450 | 337,060 | |
| 10302 | 714.236,120 | 4.644.185,950 | 337,050 | |
| 10303 | 714.255,360 | 4.644.188,060 | 337,040 | |
| 10304 | 714.261,610 | 4.644.183,560 | 337,200 | |
| 10305 | 714.266,860 | 4.644.184,210 | 337,090 | |
| 10306 | 714.278,270 | 4.644.184,580 | 336,750 | |
| 10307 | 714.259,400 | 4.644.189,250 | 337,170 | |
| 10308 | 714.264,210 | 4.644.190,590 | 336,840 | |
| 10309 | 714.267,100 | 4.644.189,780 | 336,720 | |
| 10310 | 714.282,510 | 4.644.190,320 | 336,760 | |
| 10311 | 714.291,520 | 4.644.187,790 | 336,800 | |
| 10312 | 714.310,190 | 4.644.191,020 | 337,910 | |
| 10313 | 714.308,580 | 4.644.189,480 | 336,900 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10314 | 714.293,180 | 4.644.192,430 | 336,770 | |
| 10315 | 714.305,560 | 4.644.196,310 | 336,810 | |
| 10316 | 714.307,540 | 4.644.197,890 | 337,940 | |
| 10317 | 714.312,690 | 4.644.189,780 | 336,930 | |
| 10318 | 714.311,330 | 4.644.194,740 | 336,890 | |
| 10319 | 714.329,580 | 4.644.192,830 | 336,920 | |
| 10320 | 714.329,340 | 4.644.198,850 | 336,930 | |
| 10321 | 714.343,760 | 4.644.195,310 | 336,930 | |
| 10322 | 714.357,880 | 4.644.199,230 | 337,030 | |
| 10323 | 714.343,100 | 4.644.201,250 | 336,920 | |
| 10324 | 714.356,350 | 4.644.203,310 | 336,990 | |
| 10325 | 714.360,850 | 4.644.195,690 | 337,350 | |
| 10326 | 714.361,640 | 4.644.198,960 | 337,170 | |
| 10327 | 714.370,410 | 4.644.199,210 | 337,150 | |
| 10328 | 714.360,210 | 4.644.202,770 | 337,140 | |
| 10329 | 714.386,260 | 4.644.202,700 | 337,180 | |
| 10330 | 714.357,320 | 4.644.205,300 | 337,420 | |
| 10331 | 714.370,740 | 4.644.204,740 | 337,170 | |
| 10332 | 714.386,270 | 4.644.207,460 | 337,140 | |
| 10333 | 714.406,450 | 4.644.206,000 | 337,230 | |
| 10334 | 714.409,100 | 4.644.206,300 | 337,750 | |
| 10335 | 714.412,140 | 4.644.205,020 | 337,380 | |
| 10336 | 714.409,890 | 4.644.211,580 | 337,460 | |
| 10337 | 714.403,990 | 4.644.211,760 | 337,200 | |
| 10338 | 714.406,770 | 4.644.212,510 | 337,660 | |
| 10339 | 714.427,940 | 4.644.208,760 | 337,430 | |
| 10340 | 714.429,490 | 4.644.215,850 | 337,440 | |
| 10341 | 714.457,390 | 4.644.214,650 | 337,450 | |
| 10342 | 714.458,010 | 4.644.219,070 | 337,420 | |
| 10343 | 714.480,830 | 4.644.217,240 | 337,600 | |
| 10344 | 714.484,430 | 4.644.218,420 | 336,130 | |
| 10345 | 714.486,970 | 4.644.219,060 | 335,950 | |
| 10346 | 714.478,240 | 4.644.223,660 | 337,350 | |
| 10347 | 714.481,410 | 4.644.223,790 | 336,020 | |
| 10348 | 714.484,680 | 4.644.224,010 | 335,970 | |
| 10349 | 714.495,510 | 4.644.221,000 | 335,960 | |
| 10350 | 714.493,540 | 4.644.224,730 | 335,900 | |
| 10351 | 714.510,500 | 4.644.227,500 | 335,930 | |
| 10352 | 714.511,010 | 4.644.224,280 | 336,030 | |
| 10353 | 709.807,850 | 4.645.036,360 | 359,130 | |
| 10354 | 709.837,600 | 4.645.029,170 | 359,350 | |
| 10355 | 709.847,690 | 4.645.034,750 | 359,360 | |
| 10356 | 709.855,520 | 4.645.039,390 | 359,380 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10357 | 709.863,580 | 4.645.043,170 | 359,370 | |
| 10358 | 709.811,070 | 4.645.044,860 | 359,110 | |
| 10359 | 709.812,920 | 4.645.054,400 | 359,110 | |
| 10360 | 709.870,190 | 4.645.047,760 | 359,410 | |
| 10361 | 709.878,540 | 4.645.051,420 | 359,390 | |
| 10362 | 709.887,490 | 4.645.056,080 | 359,400 | |
| 10363 | 709.894,600 | 4.645.059,220 | 359,420 | |
| 10364 | 709.908,570 | 4.645.064,700 | 359,440 | |
| 10365 | 709.917,720 | 4.645.067,690 | 359,440 | |
| 10366 | 709.816,440 | 4.645.070,980 | 359,140 | |
| 10367 | 709.820,790 | 4.645.085,570 | 359,090 | |
| 10368 | 709.824,050 | 4.645.097,640 | 359,190 | |
| 10369 | 709.931,110 | 4.645.072,800 | 359,390 | |
| 10370 | 709.940,910 | 4.645.075,590 | 359,410 | |
| 10371 | 709.955,580 | 4.645.081,070 | 358,840 | |
| 10372 | 709.965,220 | 4.645.083,820 | 358,810 | |
| 10373 | 709.971,990 | 4.645.086,310 | 358,870 | |
| 10374 | 709.982,300 | 4.645.089,550 | 358,530 | |
| 10375 | 709.989,220 | 4.645.092,130 | 358,520 | |
| 10376 | 710.000,610 | 4.645.095,480 | 358,510 | |
| 10377 | 709.827,480 | 4.645.109,440 | 359,220 | |
| 10378 | 709.830,420 | 4.645.120,930 | 359,220 | |
| 10379 | 709.834,610 | 4.645.134,300 | 359,220 | |
| 10380 | 709.838,440 | 4.645.146,580 | 359,210 | |
| 10381 | 709.843,530 | 4.645.168,810 | 358,790 | |
| 10382 | 709.847,030 | 4.645.184,070 | 358,500 | |
| 10383 | 709.851,240 | 4.645.196,700 | 358,490 | |
| 10384 | 709.854,690 | 4.645.215,130 | 358,230 | |
| 10385 | 709.859,930 | 4.645.225,670 | 358,230 | |
| 10386 | 709.862,620 | 4.645.237,770 | 358,040 | |
| 10387 | 709.865,560 | 4.645.246,820 | 357,990 | |
| 10388 | 709.869,470 | 4.645.262,880 | 357,880 | |
| 10389 | 709.872,740 | 4.645.273,500 | 357,890 | |
| 10390 | 709.876,650 | 4.645.286,140 | 357,740 | |
| 10391 | 709.880,190 | 4.645.297,110 | 357,690 | |
| 10392 | 709.882,850 | 4.645.308,500 | 357,410 | |
| 10393 | 709.886,780 | 4.645.323,190 | 357,150 | |
| 10394 | 709.889,980 | 4.645.336,560 | 357,100 | |
| 10395 | 709.892,760 | 4.645.344,130 | 357,080 | |
| 10396 | 709.895,750 | 4.645.356,770 | 356,960 | |
| 10397 | 709.898,630 | 4.645.369,210 | 356,870 | |
| 10398 | 709.900,900 | 4.645.377,400 | 356,940 | |
| 10399 | 709.905,880 | 4.645.389,940 | 356,750 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10400 | 709.907,200 | 4.645.398,490 | 356,830 | |
| 10401 | 709.909,490 | 4.645.406,940 | 356,780 | |
| 10402 | 709.910,100 | 4.645.413,090 | 356,690 | |
| 10403 | 709.914,840 | 4.645.426,490 | 356,500 | |
| 10404 | 709.917,980 | 4.645.438,240 | 356,620 | |
| 10405 | 709.921,240 | 4.645.437,560 | 356,660 | |
| 10406 | 709.963,730 | 4.645.610,260 | 355,290 | |
| 10407 | 709.967,880 | 4.645.609,310 | 355,330 | |
| 10408 | 709.967,460 | 4.645.621,420 | 355,300 | |
| 10409 | 709.972,470 | 4.645.621,800 | 355,290 | |
| 10410 | 709.971,970 | 4.645.636,990 | 355,290 | |
| 10411 | 709.981,550 | 4.645.638,260 | 355,230 | |
| 10412 | 709.981,500 | 4.645.651,120 | 355,230 | |
| 10413 | 709.989,460 | 4.645.655,440 | 355,230 | |
| 10414 | 709.995,300 | 4.645.670,620 | 355,210 | |
| 10415 | 710.008,390 | 4.645.098,100 | 358,620 | |
| 10416 | 710.015,020 | 4.645.100,250 | 358,240 | |
| 10417 | 710.026,050 | 4.645.103,300 | 358,230 | |
| 10418 | 710.036,600 | 4.645.107,130 | 358,240 | |
| 10419 | 710.087,590 | 4.645.123,180 | 357,550 | |
| 10420 | 710.102,070 | 4.645.126,140 | 357,440 | |
| 10421 | 710.110,910 | 4.645.128,200 | 357,420 | |
| 10422 | 710.138,710 | 4.645.135,740 | 356,890 | |
| 10423 | 710.150,390 | 4.645.136,270 | 356,920 | |
| 10424 | 710.165,740 | 4.645.135,560 | 356,920 | |
| 10425 | 710.176,020 | 4.645.136,440 | 356,930 | |
| 10426 | 710.188,590 | 4.645.136,680 | 356,890 | |
| 10427 | 710.198,490 | 4.645.137,080 | 356,950 | |
| 10428 | 710.209,450 | 4.645.138,870 | 356,910 | |
| 10429 | 710.222,910 | 4.645.140,590 | 356,950 | |
| 10430 | 710.233,410 | 4.645.144,440 | 356,960 | |
| 10431 | 710.245,540 | 4.645.146,930 | 356,880 | |
| 10432 | 710.257,650 | 4.645.150,630 | 356,820 | |
| 10433 | 710.275,040 | 4.645.156,440 | 356,510 | |
| 10434 | 710.280,450 | 4.645.158,290 | 356,520 | |
| 10435 | 710.287,280 | 4.645.161,580 | 356,500 | |
| 10436 | 710.295,620 | 4.645.164,760 | 356,520 | |
| 10437 | 710.305,590 | 4.645.169,260 | 356,440 | |
| 10438 | 710.315,420 | 4.645.172,570 | 356,350 | |
| 10439 | 710.321,840 | 4.645.174,460 | 356,370 | |
| 10440 | 710.329,910 | 4.645.178,260 | 356,450 | |
| 10441 | 710.335,700 | 4.645.181,250 | 356,340 | |
| 10442 | 710.344,010 | 4.645.185,240 | 356,340 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10443 | 710.350,000 | 4.645.189,850 | 356,380 | |
| 10444 | 710.361,420 | 4.645.193,820 | 355,860 | |
| 10445 | 710.366,070 | 4.645.196,240 | 355,800 | |
| 10446 | 710.373,210 | 4.645.200,030 | 355,870 | |
| 10447 | 710.379,430 | 4.645.204,020 | 355,910 | |
| 10448 | 710.392,650 | 4.645.211,220 | 355,630 | |
| 10449 | 710.401,030 | 4.645.214,730 | 355,700 | |
| 10450 | 710.408,790 | 4.645.219,590 | 355,600 | |
| 10451 | 710.416,480 | 4.645.222,950 | 355,590 | |
| 10452 | 710.423,950 | 4.645.228,300 | 355,530 | |
| 10453 | 710.431,790 | 4.645.232,140 | 355,540 | |
| 10454 | 710.437,530 | 4.645.234,920 | 355,440 | |
| 10455 | 710.442,560 | 4.645.238,340 | 355,480 | |
| 10456 | 710.457,270 | 4.645.245,740 | 355,150 | |
| 10457 | 710.465,710 | 4.645.250,930 | 355,090 | |
| 10458 | 710.470,780 | 4.645.253,680 | 355,130 | |
| 10459 | 710.477,920 | 4.645.256,910 | 355,190 | |
| 10460 | 710.484,220 | 4.645.260,540 | 355,150 | |
| 10461 | 710.492,350 | 4.645.265,320 | 355,160 | |
| 10462 | 710.499,730 | 4.645.270,790 | 355,080 | |
| 10463 | 710.505,930 | 4.645.273,530 | 355,170 | |
| 10464 | 710.524,230 | 4.645.282,500 | 354,890 | |
| 10465 | 710.528,930 | 4.645.286,020 | 354,860 | |
| 10466 | 710.533,340 | 4.645.288,560 | 354,850 | |
| 10467 | 710.539,070 | 4.645.291,860 | 354,860 | |
| 10468 | 710.548,420 | 4.645.296,830 | 354,650 | |
| 10469 | 710.557,060 | 4.645.301,820 | 354,630 | |
| 10470 | 710.561,160 | 4.645.305,150 | 354,590 | |
| 10471 | 710.566,940 | 4.645.308,790 | 354,610 | |
| 10472 | 710.582,570 | 4.645.320,230 | 354,210 | |
| 10473 | 710.589,300 | 4.645.325,510 | 354,220 | |
| 10474 | 710.594,270 | 4.645.328,500 | 354,230 | |
| 10475 | 710.598,510 | 4.645.332,810 | 354,220 | |
| 10476 | 710.603,520 | 4.645.335,700 | 354,310 | |
| 10477 | 710.608,300 | 4.645.339,790 | 354,230 | |
| 10478 | 710.613,890 | 4.645.344,010 | 354,230 | |
| 10479 | 710.632,640 | 4.645.359,170 | 354,100 | |
| 10480 | 710.640,380 | 4.645.365,080 | 354,060 | |
| 10481 | 710.652,270 | 4.645.373,660 | 354,000 | |
| 10482 | 710.659,300 | 4.645.377,760 | 353,670 | |
| 10483 | 710.664,650 | 4.645.384,660 | 353,530 | |
| 10484 | 710.672,480 | 4.645.390,750 | 353,530 | |
| 10485 | 710.681,770 | 4.645.396,560 | 353,550 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10486 | 710.689,900 | 4.645.402,980 | 353,530 | |
| 10487 | 710.723,360 | 4.645.404,320 | 352,960 | |
| 10488 | 710.728,090 | 4.645.404,780 | 352,730 | |
| 10489 | 710.730,390 | 4.645.410,770 | 352,750 | |
| 10490 | 710.739,640 | 4.645.413,650 | 352,830 | |
| 10491 | 710.678,900 | 4.645.421,900 | 352,490 | |
| 10492 | 710.672,660 | 4.645.427,110 | 352,480 | |
| 10493 | 710.663,440 | 4.645.434,790 | 352,680 | |
| 10494 | 710.671,080 | 4.645.433,080 | 352,560 | |
| 10495 | 710.662,300 | 4.645.440,230 | 352,790 | |
| 10496 | 710.683,610 | 4.645.420,650 | 352,480 | |
| 10497 | 710.679,170 | 4.645.425,830 | 352,510 | |
| 10498 | 710.742,770 | 4.645.419,570 | 352,710 | |
| 10499 | 710.751,870 | 4.645.422,180 | 352,330 | |
| 10500 | 710.751,740 | 4.645.427,040 | 352,300 | |
| 10501 | 710.762,950 | 4.645.431,480 | 352,110 | |
| 10502 | 710.765,090 | 4.645.437,560 | 352,180 | |
| 10503 | 710.646,510 | 4.645.450,100 | 352,810 | |
| 10504 | 710.652,180 | 4.645.449,910 | 352,660 | |
| 10505 | 710.641,580 | 4.645.454,670 | 352,650 | |
| 10506 | 710.645,270 | 4.645.456,370 | 352,780 | |
| 10507 | 710.636,150 | 4.645.463,860 | 352,800 | |
| 10508 | 710.629,450 | 4.645.465,330 | 352,820 | |
| 10509 | 710.775,360 | 4.645.441,190 | 352,010 | |
| 10510 | 710.784,000 | 4.645.451,520 | 351,990 | |
| 10511 | 710.794,070 | 4.645.455,300 | 351,970 | |
| 10512 | 710.793,970 | 4.645.459,850 | 351,810 | |
| 10513 | 710.802,090 | 4.645.461,750 | 351,760 | |
| 10514 | 710.630,830 | 4.645.468,280 | 352,810 | |
| 10515 | 710.804,180 | 4.645.468,160 | 351,690 | |
| 10516 | 710.813,690 | 4.645.470,820 | 351,720 | |
| 10517 | 710.818,680 | 4.645.479,790 | 351,520 | |
| 10518 | 710.830,850 | 4.645.484,330 | 351,430 | |
| 10519 | 711.626,790 | 4.645.491,530 | 342,790 | |
| 10520 | 710.836,740 | 4.645.493,960 | 351,340 | |
| 10521 | 710.843,440 | 4.645.494,510 | 351,130 | |
| 10522 | 710.844,120 | 4.645.499,450 | 351,020 | |
| 10523 | 710.854,600 | 4.645.502,880 | 351,080 | |
| 10524 | 710.852,490 | 4.645.506,540 | 351,140 | |
| 10525 | 710.867,710 | 4.645.513,050 | 350,920 | |
| 10526 | 710.865,680 | 4.645.516,650 | 350,980 | |
| 10527 | 711.582,360 | 4.645.511,880 | 343,460 | |
| 10528 | 711.594,240 | 4.645.510,350 | 343,200 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10529 | 711.608,070 | 4.645.499,390 | 342,930 | |
| 10530 | 711.618,260 | 4.645.499,740 | 342,780 | |
| 10531 | 711.634,710 | 4.645.492,130 | 342,820 | |
| 10532 | 710.874,680 | 4.645.523,890 | 351,070 | |
| 10533 | 710.884,740 | 4.645.526,420 | 350,810 | |
| 10534 | 710.888,340 | 4.645.534,460 | 350,890 | |
| 10535 | 710.898,560 | 4.645.537,820 | 350,530 | |
| 10536 | 711.537,570 | 4.645.531,570 | 344,540 | |
| 10537 | 711.519,460 | 4.645.540,550 | 345,120 | |
| 10538 | 711.530,660 | 4.645.539,800 | 344,930 | |
| 10539 | 711.563,720 | 4.645.521,240 | 343,840 | |
| 10540 | 711.550,430 | 4.645.530,530 | 344,320 | |
| 10541 | 711.573,410 | 4.645.520,360 | 343,740 | |
| 10542 | 710.906,280 | 4.645.548,530 | 350,680 | |
| 10543 | 710.917,600 | 4.645.553,990 | 350,520 | |
| 10544 | 710.920,870 | 4.645.560,320 | 350,900 | |
| 10545 | 710.925,900 | 4.645.560,780 | 350,530 | |
| 10546 | 710.930,580 | 4.645.568,940 | 350,620 | |
| 10547 | 710.934,900 | 4.645.567,610 | 350,590 | |
| 10548 | 711.461,930 | 4.645.567,670 | 347,090 | |
| 10549 | 711.490,970 | 4.645.553,560 | 346,160 | |
| 10550 | 711.480,040 | 4.645.563,310 | 346,550 | |
| 10551 | 711.504,770 | 4.645.551,000 | 345,860 | |
| 10552 | 710.938,070 | 4.645.574,920 | 350,640 | |
| 10553 | 710.947,350 | 4.645.576,490 | 350,570 | |
| 10554 | 710.955,820 | 4.645.583,920 | 350,590 | |
| 10555 | 710.955,100 | 4.645.587,670 | 350,640 | |
| 10556 | 710.959,450 | 4.645.591,080 | 350,590 | |
| 10557 | 710.964,830 | 4.645.590,270 | 350,660 | |
| 10558 | 711.411,350 | 4.645.595,090 | 348,820 | |
| 10559 | 711.440,810 | 4.645.577,760 | 348,180 | |
| 10560 | 711.418,640 | 4.645.587,580 | 348,820 | |
| 10561 | 711.430,540 | 4.645.586,780 | 348,710 | |
| 10562 | 711.453,070 | 4.645.575,690 | 347,800 | |
| 10563 | 710.981,070 | 4.645.602,920 | 350,610 | |
| 10564 | 710.977,680 | 4.645.605,800 | 350,580 | |
| 10565 | 710.992,270 | 4.645.611,510 | 350,490 | |
| 10566 | 710.995,290 | 4.645.619,310 | 350,460 | |
| 10567 | 711.351,860 | 4.645.617,700 | 349,470 | |
| 10568 | 711.379,610 | 4.645.605,560 | 349,230 | |
| 10569 | 711.364,360 | 4.645.616,300 | 349,450 | |
| 10570 | 711.400,310 | 4.645.596,240 | 348,880 | |
| 10571 | 711.392,890 | 4.645.604,880 | 348,950 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10572 | 711.017,440 | 4.645.631,310 | 349,340 | |
| 10573 | 711.014,830 | 4.645.634,800 | 349,360 | |
| 10574 | 711.027,410 | 4.645.639,180 | 349,330 | |
| 10575 | 711.027,570 | 4.645.645,380 | 349,330 | |
| 10576 | 711.045,100 | 4.645.649,330 | 349,300 | |
| 10577 | 711.307,760 | 4.645.643,480 | 349,300 | |
| 10578 | 711.291,080 | 4.645.646,220 | 348,760 | |
| 10579 | 711.328,340 | 4.645.629,100 | 349,310 | |
| 10580 | 711.311,130 | 4.645.636,000 | 349,360 | |
| 10581 | 711.322,210 | 4.645.636,500 | 349,300 | |
| 10582 | 711.343,500 | 4.645.626,880 | 349,500 | |
| 10583 | 710.003,700 | 4.645.674,220 | 355,210 | |
| 10584 | 711.034,620 | 4.645.649,500 | 349,290 | |
| 10585 | 711.065,720 | 4.645.657,400 | 349,230 | |
| 10586 | 711.054,960 | 4.645.658,180 | 349,310 | |
| 10587 | 711.076,550 | 4.645.665,720 | 349,340 | |
| 10588 | 711.091,110 | 4.645.666,510 | 349,290 | |
| 10589 | 711.105,730 | 4.645.671,400 | 349,260 | |
| 10590 | 711.250,550 | 4.645.664,690 | 348,210 | |
| 10591 | 711.241,500 | 4.645.668,620 | 348,270 | |
| 10592 | 711.254,920 | 4.645.667,690 | 348,230 | |
| 10593 | 711.246,130 | 4.645.671,480 | 348,280 | |
| 10594 | 711.273,840 | 4.645.654,200 | 348,830 | |
| 10595 | 711.258,810 | 4.645.660,790 | 348,290 | |
| 10596 | 711.273,800 | 4.645.658,590 | 348,820 | |
| 10597 | 711.264,300 | 4.645.663,390 | 348,290 | |
| 10598 | 711.286,910 | 4.645.652,460 | 348,780 | |
| 10599 | 710.000,800 | 4.645.678,470 | 355,230 | |
| 10600 | 711.099,560 | 4.645.674,560 | 349,270 | |
| 10601 | 711.107,560 | 4.645.677,600 | 349,220 | |
| 10602 | 711.119,630 | 4.645.677,080 | 349,240 | |
| 10603 | 711.126,340 | 4.645.685,950 | 349,330 | |
| 10604 | 711.137,040 | 4.645.684,440 | 349,210 | |
| 10605 | 711.167,420 | 4.645.702,120 | 346,390 | |
| 10606 | 711.171,510 | 4.645.698,740 | 346,420 | |
| 10607 | 711.201,600 | 4.645.688,390 | 346,380 | |
| 10608 | 711.192,980 | 4.645.691,480 | 346,390 | |
| 10609 | 711.204,520 | 4.645.691,520 | 346,410 | |
| 10610 | 711.183,260 | 4.645.696,290 | 346,400 | |
| 10611 | 711.191,350 | 4.645.696,850 | 346,370 | |
| 10612 | 711.184,740 | 4.645.701,070 | 346,360 | |
| 10613 | 711.223,050 | 4.645.678,060 | 346,420 | |
| 10614 | 711.213,810 | 4.645.682,400 | 346,410 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10615 | 711.221,940 | 4.645.683,280 | 346,420 | |
| 10616 | 711.213,210 | 4.645.687,700 | 346,350 | |
| 10617 | 711.233,260 | 4.645.677,020 | 346,520 | |
| 10618 | 710.050,220 | 4.645.708,620 | 354,580 | |
| 10619 | 710.053,300 | 4.645.713,340 | 354,480 | |
| 10620 | 710.061,380 | 4.645.713,420 | 354,400 | |
| 10621 | 710.058,300 | 4.645.719,130 | 354,420 | |
| 10622 | 710.068,260 | 4.645.723,930 | 354,380 | |
| 10623 | 710.238,080 | 4.645.726,510 | 353,590 | |
| 10624 | 710.251,670 | 4.645.723,530 | 353,560 | |
| 10625 | 710.271,300 | 4.645.720,540 | 353,350 | |
| 10626 | 710.282,740 | 4.645.721,200 | 353,350 | |
| 10627 | 710.263,770 | 4.645.724,570 | 353,320 | |
| 10628 | 710.309,160 | 4.645.712,830 | 353,290 | |
| 10629 | 710.288,070 | 4.645.716,800 | 353,290 | |
| 10630 | 710.300,290 | 4.645.717,990 | 353,290 | |
| 10631 | 710.318,300 | 4.645.712,080 | 353,320 | |
| 10632 | 710.318,610 | 4.645.717,540 | 353,390 | |
| 10633 | 710.318,640 | 4.645.716,110 | 353,360 | |
| 10634 | 710.319,280 | 4.645.716,690 | 353,370 | |
| 10635 | 710.322,950 | 4.645.716,140 | 353,370 | |
| 10636 | 710.325,470 | 4.645.715,180 | 353,330 | |
| 10637 | 710.332,720 | 4.645.718,650 | 353,120 | |
| 10638 | 710.333,840 | 4.645.716,410 | 353,360 | |
| 10639 | 710.327,020 | 4.645.719,170 | 353,120 | |
| 10640 | 710.330,540 | 4.645.720,060 | 353,110 | |
| 10641 | 710.337,900 | 4.645.719,920 | 353,080 | |
| 10642 | 710.337,550 | 4.645.722,190 | 352,780 | |
| 10643 | 710.340,170 | 4.645.721,220 | 352,860 | |
| 10644 | 710.344,100 | 4.645.722,150 | 352,570 | |
| 10645 | 710.349,400 | 4.645.725,900 | 352,520 | |
| 10646 | 710.357,560 | 4.645.725,590 | 352,540 | |
| 10647 | 711.174,000 | 4.645.704,120 | 346,420 | |
| 10648 | 711.179,170 | 4.645.706,350 | 346,380 | |
| 10649 | 711.189,640 | 4.645.705,330 | 346,400 | |
| 10650 | 711.184,760 | 4.645.708,250 | 346,420 | |
| 10651 | 711.197,060 | 4.645.709,680 | 346,320 | |
| 10652 | 711.198,400 | 4.645.709,530 | 346,190 | |
| 10653 | 711.200,180 | 4.645.709,940 | 345,610 | |
| 10654 | 711.201,400 | 4.645.709,820 | 345,250 | |
| 10655 | 711.194,900 | 4.645.711,470 | 346,270 | |
| 10656 | 711.193,780 | 4.645.710,920 | 346,530 | |
| 10657 | 711.197,850 | 4.645.712,610 | 345,350 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10658 | 711.203,180 | 4.645.711,560 | 345,050 | |
| 10659 | 711.200,570 | 4.645.714,480 | 345,080 | |
| 10660 | 711.208,510 | 4.645.717,570 | 345,080 | |
| 10661 | 711.212,130 | 4.645.715,120 | 345,050 | |
| 10662 | 711.218,980 | 4.645.721,710 | 345,130 | |
| 10663 | 711.222,590 | 4.645.719,800 | 345,110 | |
| 10664 | 711.229,750 | 4.645.722,730 | 345,070 | |
| 10665 | 711.225,620 | 4.645.724,360 | 345,120 | |
| 10666 | 711.236,670 | 4.645.725,430 | 345,070 | |
| 10667 | 711.232,750 | 4.645.727,600 | 345,040 | |
| 10668 | 710.028,710 | 4.645.750,010 | 351,810 | |
| 10669 | 710.033,700 | 4.645.751,590 | 351,860 | |
| 10670 | 710.028,930 | 4.645.754,440 | 351,920 | |
| 10671 | 710.073,620 | 4.645.732,720 | 354,440 | |
| 10672 | 710.069,470 | 4.645.735,690 | 354,440 | |
| 10673 | 710.079,990 | 4.645.742,060 | 354,370 | |
| 10674 | 710.086,910 | 4.645.743,570 | 354,390 | |
| 10675 | 710.096,770 | 4.645.742,150 | 354,440 | |
| 10676 | 710.099,560 | 4.645.746,350 | 354,400 | |
| 10677 | 710.107,360 | 4.645.742,520 | 354,340 | |
| 10678 | 710.117,470 | 4.645.742,290 | 354,370 | |
| 10679 | 710.126,970 | 4.645.742,550 | 354,360 | |
| 10680 | 710.115,900 | 4.645.746,490 | 354,440 | |
| 10681 | 710.126,890 | 4.645.746,320 | 354,420 | |
| 10682 | 710.105,960 | 4.645.747,960 | 354,430 | |
| 10683 | 710.149,810 | 4.645.739,380 | 354,380 | |
| 10684 | 710.154,680 | 4.645.738,580 | 354,310 | |
| 10685 | 710.134,860 | 4.645.742,250 | 354,360 | |
| 10686 | 710.139,590 | 4.645.742,010 | 354,360 | |
| 10687 | 710.134,460 | 4.645.745,990 | 354,350 | |
| 10688 | 710.140,150 | 4.645.745,060 | 354,370 | |
| 10689 | 710.149,700 | 4.645.743,850 | 354,280 | |
| 10690 | 710.176,900 | 4.645.735,110 | 353,620 | |
| 10691 | 710.167,490 | 4.645.737,550 | 353,730 | |
| 10692 | 710.156,930 | 4.645.742,640 | 354,380 | |
| 10693 | 710.171,270 | 4.645.740,560 | 353,700 | |
| 10694 | 710.189,280 | 4.645.732,660 | 353,640 | |
| 10695 | 710.204,240 | 4.645.731,950 | 353,570 | |
| 10696 | 710.185,220 | 4.645.738,090 | 353,620 | |
| 10697 | 710.199,390 | 4.645.735,550 | 353,610 | |
| 10698 | 710.219,640 | 4.645.728,900 | 353,590 | |
| 10699 | 710.231,130 | 4.645.729,750 | 353,560 | |
| 10700 | 710.215,530 | 4.645.732,570 | 353,590 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10701 | 710.374,480 | 4.645.730,590 | 352,290 | |
| 10702 | 710.365,820 | 4.645.731,560 | 352,550 | |
| 10703 | 710.392,140 | 4.645.739,340 | 352,190 | |
| 10704 | 710.399,710 | 4.645.737,890 | 352,130 | |
| 10705 | 710.408,430 | 4.645.743,200 | 351,960 | |
| 10706 | 710.416,940 | 4.645.742,380 | 352,000 | |
| 10707 | 710.440,890 | 4.645.749,800 | 351,820 | |
| 10708 | 710.440,800 | 4.645.752,800 | 351,860 | |
| 10709 | 711.241,240 | 4.645.731,150 | 345,060 | |
| 10710 | 711.246,400 | 4.645.729,400 | 345,060 | |
| 10711 | 711.253,150 | 4.645.734,870 | 345,060 | |
| 10712 | 711.257,710 | 4.645.733,560 | 345,050 | |
| 10713 | 711.269,870 | 4.645.738,670 | 345,030 | |
| 10714 | 711.264,710 | 4.645.739,640 | 345,050 | |
| 10715 | 711.280,880 | 4.645.742,920 | 345,060 | |
| 10716 | 711.279,270 | 4.645.745,330 | 345,050 | |
| 10717 | 711.291,510 | 4.645.751,500 | 345,060 | |
| 10718 | 711.292,270 | 4.645.747,790 | 345,050 | |
| 10719 | 711.301,120 | 4.645.754,340 | 345,120 | |
| 10720 | 711.303,370 | 4.645.752,360 | 345,090 | |
| 10721 | 711.311,650 | 4.645.755,900 | 345,100 | |
| 10722 | 710.031,170 | 4.645.757,500 | 351,740 | |
| 10723 | 710.028,850 | 4.645.761,450 | 350,670 | |
| 10724 | 710.028,870 | 4.645.760,020 | 350,770 | |
| 10725 | 710.030,450 | 4.645.762,210 | 350,770 | |
| 10726 | 710.027,770 | 4.645.767,550 | 350,630 | |
| 10727 | 710.030,410 | 4.645.765,060 | 350,660 | |
| 10728 | 710.029,970 | 4.645.771,640 | 350,600 | |
| 10729 | 710.027,500 | 4.645.774,280 | 350,590 | |
| 10730 | 711.310,220 | 4.645.758,010 | 345,090 | |
| 10731 | 711.320,230 | 4.645.759,520 | 345,070 | |
| 10732 | 711.319,420 | 4.645.761,400 | 345,030 | |
| 10733 | 711.326,410 | 4.645.761,350 | 344,960 | |
| 10734 | 711.330,440 | 4.645.761,950 | 344,980 | |
| 10735 | 711.326,390 | 4.645.764,150 | 344,980 | |
| 10736 | 711.330,410 | 4.645.764,850 | 345,000 | |
| 10737 | 711.336,930 | 4.645.765,100 | 344,960 | |
| 10738 | 711.336,910 | 4.645.766,490 | 344,950 | |
| 10739 | 711.342,350 | 4.645.768,060 | 345,000 | |
| 10740 | 711.344,720 | 4.645.766,270 | 344,980 | |
| 10741 | 711.352,670 | 4.645.770,530 | 344,980 | |
| 10742 | 711.352,690 | 4.645.769,060 | 344,870 | |
| 10743 | 711.368,050 | 4.645.770,310 | 342,940 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10744 | 711.375,730 | 4.645.770,810 | 342,960 | |
| 10745 | 711.385,830 | 4.645.772,190 | 342,970 | |
| 10746 | 711.368,350 | 4.645.772,840 | 342,980 | |
| 10747 | 711.379,070 | 4.645.774,700 | 342,960 | |
| 10748 | 711.391,110 | 4.645.775,640 | 342,950 | |
| 10749 | 711.394,550 | 4.645.776,220 | 343,040 | |
| 10750 | 711.405,230 | 4.645.773,730 | 343,040 | |
| 10751 | 711.407,960 | 4.645.775,590 | 342,450 | |
| 10752 | 711.398,250 | 4.645.777,230 | 342,890 | |
| 10753 | 711.403,990 | 4.645.777,240 | 342,380 | |
| 10754 | 711.413,770 | 4.645.772,990 | 343,640 | |
| 10755 | 711.418,120 | 4.645.776,180 | 341,910 | |
| 10756 | 711.415,550 | 4.645.778,060 | 341,970 | |
| 10757 | 711.424,330 | 4.645.777,250 | 342,040 | |
| 10758 | 711.425,420 | 4.645.779,370 | 342,020 | |
| 10759 | 711.435,010 | 4.645.780,320 | 342,020 | |
| 10760 | 711.438,780 | 4.645.778,360 | 341,940 | |
| 10761 | 711.452,290 | 4.645.779,530 | 342,020 | |
| 10762 | 711.462,200 | 4.645.780,440 | 342,040 | |
| 10763 | 710.029,790 | 4.645.781,940 | 350,630 | |
| 10764 | 710.028,080 | 4.645.788,430 | 350,580 | |
| 10765 | 710.030,620 | 4.645.792,980 | 350,580 | |
| 10766 | 710.029,050 | 4.645.797,940 | 350,610 | |
| 10767 | 710.032,720 | 4.645.805,280 | 350,620 | |
| 10768 | 711.449,730 | 4.645.782,210 | 341,980 | |
| 10769 | 711.459,520 | 4.645.787,300 | 342,120 | |
| 10770 | 711.462,680 | 4.645.788,040 | 342,080 | |
| 10771 | 711.459,250 | 4.645.790,990 | 342,000 | |
| 10772 | 711.459,250 | 4.645.795,950 | 341,940 | |
| 10773 | 711.460,070 | 4.645.794,430 | 342,070 | |
| 10774 | 711.463,970 | 4.645.795,720 | 341,810 | |
| 10775 | 711.463,920 | 4.645.797,110 | 341,870 | |
| 10776 | 711.460,590 | 4.645.801,800 | 341,550 | |
| 10777 | 711.463,790 | 4.645.801,260 | 341,550 | |
| 10778 | 711.468,970 | 4.645.784,360 | 342,090 | |
| 10779 | 711.471,520 | 4.645.781,760 | 342,010 | |
| 10780 | 711.473,020 | 4.645.784,460 | 342,270 | |
| 10781 | 711.477,370 | 4.645.783,310 | 342,260 | |
| 10782 | 711.486,610 | 4.645.784,430 | 341,090 | |
| 10783 | 711.480,480 | 4.645.785,420 | 341,260 | |
| 10784 | 711.465,880 | 4.645.791,210 | 341,910 | |
| 10785 | 711.494,240 | 4.645.786,530 | 340,930 | |
| 10786 | 711.496,580 | 4.645.784,840 | 340,860 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10787 | 711.524,890 | 4.645.787,210 | 340,830 | |
| 10788 | 711.524,840 | 4.645.789,530 | 340,890 | |
| 10789 | 710.030,420 | 4.645.809,940 | 350,570 | |
| 10790 | 710.035,340 | 4.645.815,110 | 350,410 | |
| 10791 | 710.033,020 | 4.645.820,510 | 350,080 | |
| 10792 | 710.037,230 | 4.645.824,380 | 349,860 | |
| 10793 | 710.036,760 | 4.645.829,440 | 349,770 | |
| 10794 | 710.040,560 | 4.645.832,370 | 349,800 | |
| 10795 | 711.461,270 | 4.645.809,210 | 341,570 | |
| 10796 | 711.462,420 | 4.645.817,630 | 341,590 | |
| 10797 | 711.463,240 | 4.645.824,830 | 341,600 | |
| 10798 | 711.463,580 | 4.645.833,380 | 341,560 | |
| 10799 | 711.466,050 | 4.645.812,560 | 341,560 | |
| 10800 | 711.467,190 | 4.645.820,280 | 341,570 | |
| 10801 | 711.467,830 | 4.645.828,900 | 341,590 | |
| 10802 | 710.012,320 | 4.645.855,200 | 350,670 | |
| 10803 | 710.014,110 | 4.645.854,990 | 350,620 | |
| 10804 | 710.015,880 | 4.645.857,160 | 350,640 | |
| 10805 | 710.015,130 | 4.645.859,060 | 350,620 | |
| 10806 | 710.018,780 | 4.645.860,000 | 350,710 | |
| 10807 | 710.039,710 | 4.645.837,470 | 349,840 | |
| 10808 | 710.043,850 | 4.645.840,560 | 349,850 | |
| 10809 | 710.043,160 | 4.645.846,790 | 349,800 | |
| 10810 | 710.047,780 | 4.645.849,520 | 349,820 | |
| 10811 | 710.045,950 | 4.645.857,140 | 349,950 | |
| 10812 | 710.046,260 | 4.645.856,140 | 349,800 | |
| 10813 | 710.047,050 | 4.645.855,050 | 349,760 | |
| 10814 | 710.049,710 | 4.645.856,140 | 349,760 | |
| 10815 | 710.048,680 | 4.645.857,320 | 349,820 | |
| 10816 | 710.048,650 | 4.645.858,830 | 349,980 | |
| 10817 | 711.464,640 | 4.645.844,260 | 341,570 | |
| 10818 | 711.469,770 | 4.645.839,340 | 341,580 | |
| 10819 | 711.470,850 | 4.645.851,930 | 341,560 | |
| 10820 | 710.021,090 | 4.645.865,490 | 350,650 | |
| 10821 | 710.043,510 | 4.645.861,250 | 349,920 | |
| 10822 | 710.040,070 | 4.645.866,190 | 348,190 | |
| 10823 | 710.043,280 | 4.645.863,510 | 349,470 | |
| 10824 | 710.041,130 | 4.645.864,840 | 348,240 | |
| 10825 | 710.046,900 | 4.645.862,750 | 349,940 | |
| 10826 | 710.046,880 | 4.645.865,620 | 349,220 | |
| 10827 | 710.024,180 | 4.645.869,680 | 350,620 | |
| 10828 | 710.029,410 | 4.645.867,320 | 350,040 | |
| 10829 | 710.028,280 | 4.645.869,860 | 350,060 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10830 | 710.028,610 | 4.645.869,760 | 350,050 | |
| 10831 | 710.031,630 | 4.645.870,280 | 350,080 | |
| 10832 | 710.034,490 | 4.645.868,250 | 348,930 | |
| 10833 | 710.037,840 | 4.645.867,940 | 348,280 | |
| 10834 | 710.039,260 | 4.645.867,520 | 348,200 | |
| 10835 | 710.037,740 | 4.645.868,710 | 348,200 | |
| 10836 | 710.043,460 | 4.645.868,410 | 348,130 | |
| 10837 | 710.042,340 | 4.645.870,110 | 348,170 | |
| 10838 | 710.047,710 | 4.645.869,090 | 348,220 | |
| 10839 | 710.026,880 | 4.645.873,640 | 350,640 | |
| 10840 | 710.030,120 | 4.645.872,390 | 350,030 | |
| 10841 | 710.033,360 | 4.645.872,550 | 350,080 | |
| 10842 | 710.039,180 | 4.645.870,760 | 348,240 | |
| 10843 | 710.040,000 | 4.645.870,620 | 348,170 | |
| 10844 | 710.040,960 | 4.645.874,960 | 348,380 | |
| 10845 | 711.466,570 | 4.645.858,740 | 341,570 | |
| 10846 | 711.472,910 | 4.645.863,610 | 341,620 | |
| 10847 | 711.468,570 | 4.645.873,740 | 341,570 | |
| 10848 | 711.474,500 | 4.645.878,040 | 341,560 | |
| 10849 | 711.469,710 | 4.645.886,560 | 341,610 | |
| 10850 | 711.475,500 | 4.645.898,150 | 341,630 | |
| 10851 | 711.471,650 | 4.645.902,760 | 341,590 | |
| 10852 | 711.477,680 | 4.645.909,020 | 341,600 | |
| 10853 | 711.473,320 | 4.645.916,630 | 341,630 | |
| 10854 | 711.478,320 | 4.645.925,230 | 341,590 | |
| 10855 | 711.475,470 | 4.645.931,240 | 341,680 | |
| 10856 | 711.479,750 | 4.645.931,250 | 341,720 | |
| 10857 | 711.475,720 | 4.645.935,590 | 341,760 | |
| 10858 | 711.475,760 | 4.645.934,150 | 341,930 | |
| 10859 | 711.478,030 | 4.645.933,920 | 342,720 | |
| 10860 | 711.431,180 | 4.645.962,400 | 340,910 | |
| 10861 | 711.438,540 | 4.645.964,240 | 340,880 | |
| 10862 | 711.461,660 | 4.645.949,090 | 340,870 | |
| 10863 | 711.443,900 | 4.645.957,960 | 340,910 | |
| 10864 | 711.453,730 | 4.645.958,240 | 340,880 | |
| 10865 | 711.476,920 | 4.645.936,790 | 341,380 | |
| 10866 | 711.476,830 | 4.645.939,610 | 341,310 | |
| 10867 | 711.479,380 | 4.645.939,290 | 341,310 | |
| 10868 | 711.484,850 | 4.645.936,410 | 341,590 | |
| 10869 | 711.478,170 | 4.645.942,860 | 340,940 | |
| 10870 | 711.479,420 | 4.645.942,550 | 340,920 | |
| 10871 | 711.487,300 | 4.645.942,150 | 340,920 | |
| 10872 | 711.479,180 | 4.645.946,380 | 340,930 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10873 | 711.487,080 | 4.645.945,680 | 340,910 | |
| 10874 | 711.471,150 | 4.645.949,720 | 340,920 | |
| 10875 | 711.504,290 | 4.645.942,910 | 340,880 | |
| 10876 | 711.504,220 | 4.645.945,760 | 340,900 | |
| 10877 | 711.522,940 | 4.645.942,260 | 340,910 | |
| 10878 | 711.531,450 | 4.645.943,710 | 341,140 | |
| 10879 | 711.536,220 | 4.645.944,180 | 341,030 | |
| 10880 | 711.537,450 | 4.645.944,290 | 341,250 | |
| 10881 | 711.540,600 | 4.645.943,250 | 340,990 | |
| 10882 | 711.521,500 | 4.645.946,930 | 340,940 | |
| 10883 | 711.532,550 | 4.645.945,860 | 341,000 | |
| 10884 | 711.536,570 | 4.645.946,400 | 341,050 | |
| 10885 | 711.538,040 | 4.645.946,460 | 341,180 | |
| 10886 | 711.541,520 | 4.645.947,970 | 341,040 | |
| 10887 | 711.547,560 | 4.645.943,480 | 340,540 | |
| 10888 | 711.563,320 | 4.645.943,760 | 340,580 | |
| 10889 | 711.546,470 | 4.645.947,560 | 340,570 | |
| 10890 | 711.561,980 | 4.645.946,370 | 340,560 | |
| 10891 | 711.579,420 | 4.645.943,980 | 340,520 | |
| 10892 | 711.577,930 | 4.645.946,940 | 340,530 | |
| 10893 | 711.602,270 | 4.645.943,820 | 340,530 | |
| 10894 | 711.600,720 | 4.645.947,290 | 340,520 | |
| 10895 | 711.625,020 | 4.645.943,600 | 340,510 | |
| 10896 | 711.625,010 | 4.645.947,920 | 340,550 | |
| 10897 | 711.409,560 | 4.645.972,290 | 341,080 | |
| 10898 | 711.412,380 | 4.645.975,250 | 340,930 | |
| 10899 | 712.922,571 | 4.645.265,811 | 329,120 | |
| 10900 | 712.908,744 | 4.645.275,494 | 329,162 | |
| 10901 | 712.874,039 | 4.645.224,390 | 329,183 | |
| 10902 | 712.866,923 | 4.645.211,795 | 329,638 | |
| 10903 | 712.785,505 | 4.645.169,716 | 331,047 | |
| 10904 | 712.787,484 | 4.645.166,023 | 331,068 | |
| 10905 | 712.727,473 | 4.645.128,995 | 334,317 | |
| 10906 | 712.723,581 | 4.645.134,092 | 334,348 | |
| 10907 | 712.673,531 | 4.645.092,634 | 336,964 | |
| 10908 | 712.675,103 | 4.645.086,253 | 336,814 | |
| 10909 | 712.658,442 | 4.645.083,238 | 337,244 | |
| 10910 | 712.661,549 | 4.645.077,389 | 336,911 | |
| 10911 | 712.608,043 | 4.645.054,948 | 337,707 | |
| 10912 | 712.610,521 | 4.645.049,512 | 337,404 | |
| 10913 | 712.550,884 | 4.645.014,928 | 338,935 | |
| 10914 | 712.547,881 | 4.645.019,282 | 339,262 | |
| 10915 | 712.516,990 | 4.645.000,744 | 339,679 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10916 | 712.512,929 | 4.644.992,735 | 339,953 | |
| 10917 | 712.499,611 | 4.644.984,060 | 340,547 | |
| 10918 | 712.467,543 | 4.644.938,996 | 342,004 | |
| 10919 | 712.503,677 | 4.644.937,954 | 340,458 | |
| 10920 | 712.509,397 | 4.644.946,119 | 340,211 | |
| 10921 | 712.517,402 | 4.644.916,063 | 339,785 | |
| 10922 | 712.511,606 | 4.644.907,850 | 340,049 | |
| 10923 | 712.519,535 | 4.644.877,539 | 339,706 | |
| 10924 | 712.525,458 | 4.644.885,639 | 339,459 | |
| 10925 | 712.535,336 | 4.644.848,045 | 339,294 | |
| 10926 | 712.529,623 | 4.644.839,780 | 339,540 | |
| 10927 | 712.547,405 | 4.644.802,743 | 340,248 | |
| 10928 | 712.541,555 | 4.644.794,490 | 340,618 | |
| 10929 | 712.558,197 | 4.644.776,484 | 340,821 | |
| 10930 | 712.555,450 | 4.644.772,280 | 341,010 | |
| 10931 | 712.552,546 | 4.644.768,309 | 341,233 | |
| 10932 | 712.549,750 | 4.644.764,286 | 341,416 | |
| 10933 | 712.546,663 | 4.644.760,158 | 341,675 | |
| 10934 | 712.543,817 | 4.644.756,036 | 341,916 | |
| 10935 | 712.540,950 | 4.644.752,084 | 342,107 | |
| 10936 | 712.538,002 | 4.644.747,958 | 342,278 | |
| 10937 | 712.535,071 | 4.644.743,809 | 342,478 | |
| 10938 | 712.532,269 | 4.644.739,716 | 342,737 | |
| 10939 | 712.529,433 | 4.644.735,826 | 342,952 | |
| 10940 | 712.526,462 | 4.644.731,603 | 343,240 | |
| 10941 | 712.523,685 | 4.644.727,592 | 343,447 | |
| 10942 | 712.520,678 | 4.644.723,517 | 343,692 | |
| 10943 | 712.515,818 | 4.644.726,936 | 343,803 | |
| 10944 | 712.525,704 | 4.644.720,581 | 343,638 | |
| 10945 | 712.530,158 | 4.644.717,409 | 343,561 | |
| 10946 | 712.559,055 | 4.644.766,729 | 341,318 | |
| 10947 | 712.564,191 | 4.644.764,198 | 341,208 | |
| 10948 | 712.629,075 | 4.644.695,183 | 341,706 | |
| 10949 | 712.684,013 | 4.644.650,192 | 342,730 | |
| 10950 | 713.291,790 | 4.644.350,641 | 343,121 | |
| 10951 | 713.031,839 | 4.644.037,803 | 343,830 | |
| 10952 | 712.779,439 | 4.644.114,273 | 345,258 | |
| 10953 | 711.685,907 | 4.645.445,773 | 345,264 | |
| 10954 | 711.687,517 | 4.645.447,300 | 345,177 | |
| 10955 | 711.688,789 | 4.645.449,844 | 345,153 | |
| 10956 | 711.689,976 | 4.645.452,455 | 345,056 | |
| 10957 | 706.228,190 | 4.645.672,283 | 392,001 | |
| 10958 | 706.230,815 | 4.645.670,490 | 391,708 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 10959 | 706.245,191 | 4.645.675,512 | 390,996 | |
| 10960 | 707.044,267 | 4.647.211,540 | 373,979 | |
| 10961 | 707.061,886 | 4.647.222,517 | 371,979 | |
| 10962 | 707.617,308 | 4.645.981,784 | 364,146 | |
| 10963 | 708.041,015 | 4.646.022,222 | 365,565 | |
| 10964 | 708.099,426 | 4.646.022,976 | 366,753 | |
| 10965 | 709.251,011 | 4.646.107,988 | 351,385 | |
| 10966 | 713.296,545 | 4.644.350,925 | 343,005 | |
| 10967 | 713.278,212 | 4.644.349,106 | 343,662 | |
| 10968 | 713.273,839 | 4.644.339,939 | 343,375 | |
| 10969 | 713.264,520 | 4.644.325,490 | 343,328 | |
| 10970 | 713.241,022 | 4.644.288,136 | 343,337 | |
| 10971 | 713.067,564 | 4.644.051,932 | 345,242 | |
| 10972 | 713.068,435 | 4.644.046,843 | 344,822 | |
| 10973 | 713.078,430 | 4.644.037,278 | 344,643 | |
| 10974 | 713.068,892 | 4.644.041,633 | 344,552 | |
| 10975 | 713.061,022 | 4.644.049,275 | 344,884 | |
| 10976 | 713.055,559 | 4.644.047,268 | 343,659 | |
| 10977 | 713.059,162 | 4.644.040,615 | 343,753 | |
| 10978 | 713.047,461 | 4.644.035,258 | 343,716 | |
| 10979 | 713.039,966 | 4.644.045,038 | 343,689 | |
| 10980 | 713.025,909 | 4.644.038,411 | 344,129 | |
| 10981 | 713.028,109 | 4.644.030,612 | 344,119 | |
| 10982 | 713.016,509 | 4.644.029,342 | 344,087 | |
| 10983 | 713.012,866 | 4.644.032,299 | 343,945 | |
| 10984 | 713.021,045 | 4.644.040,787 | 344,096 | |
| 10985 | 713.321,327 | 4.644.365,373 | 340,936 | |
| 10986 | 713.325,463 | 4.644.380,055 | 340,851 | |
| 10987 | 713.328,057 | 4.644.383,154 | 340,166 | |
| 10988 | 713.315,425 | 4.644.394,494 | 339,703 | |
| 10989 | 713.313,662 | 4.644.393,440 | 341,030 | |
| 10990 | 713.294,117 | 4.644.375,102 | 340,889 | |
| 10991 | 713.319,691 | 4.644.333,285 | 340,537 | |
| 10992 | 713.330,816 | 4.644.335,578 | 340,461 | |
| 10993 | 713.335,154 | 4.644.329,094 | 339,557 | |
| 10994 | 713.332,401 | 4.644.329,778 | 340,494 | |
| 10995 | 713.335,820 | 4.644.314,004 | 339,756 | |
| 10996 | 713.334,888 | 4.644.314,363 | 340,428 | |
| 10997 | 713.365,466 | 4.644.283,227 | 339,765 | |
| 10998 | 713.364,198 | 4.644.299,238 | 339,566 | |
| 10999 | 713.365,890 | 4.644.299,636 | 338,545 | |
| 11000 | 713.367,773 | 4.644.279,217 | 338,539 | |
| 11001 | 713.390,266 | 4.644.276,405 | 338,566 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11002 | 713.390,611 | 4.644.284,035 | 338,709 | |
| 11003 | 713.392,045 | 4.644.283,918 | 338,295 | |
| 11004 | 713.393,085 | 4.644.284,157 | 338,567 | |
| 11005 | 713.399,315 | 4.644.283,248 | 338,510 | |
| 11006 | 713.394,570 | 4.644.275,822 | 339,814 | |
| 11007 | 713.395,227 | 4.644.265,586 | 339,730 | |
| 11008 | 713.704,881 | 4.644.257,473 | 339,357 | |
| 11009 | 713.692,250 | 4.644.245,464 | 339,406 | |
| 11010 | 713.699,057 | 4.644.214,197 | 339,202 | |
| 11011 | 713.708,675 | 4.644.163,791 | 339,132 | |
| 11012 | 713.720,516 | 4.644.134,048 | 339,173 | |
| 11013 | 713.734,828 | 4.644.132,686 | 338,880 | |
| 11014 | 713.736,723 | 4.644.133,002 | 338,349 | |
| 11015 | 713.757,383 | 4.644.138,028 | 338,129 | |
| 11016 | 713.759,098 | 4.644.138,645 | 337,719 | |
| 11017 | 713.779,991 | 4.644.145,102 | 337,508 | |
| 11018 | 713.782,108 | 4.644.145,722 | 336,942 | |
| 11019 | 713.802,856 | 4.644.151,951 | 336,885 | |
| 11020 | 713.804,550 | 4.644.152,689 | 336,326 | |
| 11021 | 713.825,832 | 4.644.157,013 | 336,156 | |
| 11022 | 713.827,039 | 4.644.162,217 | 335,386 | |
| 11023 | 713.831,255 | 4.644.159,561 | 335,440 | |
| 11024 | 713.911,591 | 4.644.159,234 | 335,274 | |
| 11025 | 713.927,167 | 4.644.158,991 | 335,032 | |
| 11026 | 713.967,566 | 4.644.163,090 | 335,154 | |
| 11027 | 713.967,955 | 4.644.162,228 | 335,546 | |
| 11028 | 713.968,345 | 4.644.161,518 | 334,999 | |
| 11029 | 713.972,412 | 4.644.165,240 | 335,191 | |
| 11030 | 713.973,609 | 4.644.164,559 | 335,711 | |
| 11031 | 713.974,202 | 4.644.164,011 | 334,982 | |
| 11032 | 713.975,776 | 4.644.171,354 | 335,258 | |
| 11033 | 713.976,802 | 4.644.171,117 | 335,571 | |
| 11034 | 713.977,615 | 4.644.170,935 | 334,979 | |
| 11035 | 713.979,047 | 4.644.170,149 | 335,333 | |
| 11036 | 713.977,976 | 4.644.167,256 | 335,278 | |
| 11037 | 713.976,308 | 4.644.163,728 | 335,386 | |
| 11038 | 713.973,302 | 4.644.161,486 | 335,361 | |
| 11039 | 713.987,148 | 4.644.157,932 | 335,470 | |
| 11040 | 713.993,404 | 4.644.166,215 | 335,708 | |
| 11041 | 714.011,694 | 4.644.157,572 | 335,860 | |
| 11042 | 714.015,002 | 4.644.158,395 | 335,853 | |
| 11043 | 714.017,110 | 4.644.159,341 | 336,849 | |
| 11044 | 714.013,906 | 4.644.166,273 | 336,937 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11045 | 714.010,934 | 4.644.163,400 | 336,251 | |
| 11046 | 713.256,547 | 4.644.543,557 | 338,316 | |
| 11047 | 713.260,886 | 4.644.551,713 | 338,421 | |
| 11048 | 712.581,454 | 4.644.774,005 | 340,251 | |
| 11049 | 712.585,934 | 4.644.780,314 | 340,059 | |
| 11050 | 712.591,919 | 4.644.788,948 | 339,742 | |
| 11051 | 712.591,048 | 4.644.775,388 | 340,058 | |
| 11052 | 712.570,385 | 4.644.768,537 | 340,740 | |
| 11053 | 712.567,094 | 4.644.788,556 | 340,202 | |
| 11054 | 712.564,987 | 4.644.796,077 | 339,966 | |
| 11055 | 711.671,356 | 4.645.477,892 | 342,824 | |
| 11056 | 711.661,763 | 4.645.471,429 | 342,913 | |
| 11057 | 711.581,811 | 4.645.504,773 | 343,420 | |
| 11058 | 711.591,907 | 4.645.519,131 | 343,288 | |
| 11059 | 711.541,224 | 4.645.540,363 | 344,693 | |
| 11060 | 711.532,398 | 4.645.527,258 | 344,703 | |
| 11061 | 711.490,359 | 4.645.545,831 | 346,069 | |
| 11062 | 711.496,931 | 4.645.562,435 | 346,364 | |
| 11063 | 711.456,219 | 4.645.578,453 | 347,850 | |
| 11064 | 711.449,605 | 4.645.562,728 | 347,609 | |
| 11065 | 711.400,807 | 4.645.586,808 | 348,963 | |
| 11066 | 711.408,661 | 4.645.602,848 | 348,894 | |
| 11067 | 711.383,047 | 4.645.616,071 | 349,154 | |
| 11068 | 711.364,016 | 4.645.606,359 | 349,208 | |
| 11069 | 711.355,555 | 4.645.603,223 | 349,573 | |
| 11070 | 711.354,777 | 4.645.604,304 | 349,577 | |
| 11071 | 711.377,222 | 4.645.614,451 | 349,780 | |
| 11072 | 711.376,650 | 4.645.615,076 | 349,467 | |
| 11073 | 711.352,686 | 4.645.637,843 | 349,286 | |
| 11074 | 711.326,562 | 4.645.623,401 | 349,469 | |
| 11075 | 711.326,396 | 4.645.624,144 | 349,266 | |
| 11076 | 711.300,810 | 4.645.643,503 | 349,419 | |
| 11077 | 711.308,685 | 4.645.647,587 | 349,325 | |
| 11078 | 711.308,609 | 4.645.648,538 | 349,629 | |
| 11079 | 711.307,900 | 4.645.649,424 | 348,798 | |
| 11080 | 711.291,967 | 4.645.638,492 | 349,374 | |
| 11081 | 711.291,250 | 4.645.639,753 | 349,603 | |
| 11082 | 711.290,755 | 4.645.640,719 | 348,775 | |
| 11083 | 711.259,411 | 4.645.653,941 | 348,854 | |
| 11084 | 711.259,079 | 4.645.654,482 | 349,092 | |
| 11085 | 711.258,267 | 4.645.655,544 | 348,340 | |
| 11086 | 711.272,252 | 4.645.662,679 | 348,311 | |
| 11087 | 711.272,922 | 4.645.661,470 | 349,049 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11088 | 711.273,295 | 4.645.661,018 | 348,888 | |
| 11089 | 711.252,609 | 4.645.676,387 | 348,441 | |
| 11090 | 711.243,250 | 4.645.671,694 | 348,423 | |
| 11091 | 711.231,533 | 4.645.665,420 | 348,366 | |
| 11092 | 711.229,883 | 4.645.666,816 | 347,243 | |
| 11093 | 711.241,584 | 4.645.673,587 | 347,034 | |
| 11094 | 711.232,772 | 4.645.679,558 | 346,485 | |
| 11095 | 711.229,541 | 4.645.673,885 | 346,529 | |
| 11096 | 711.228,706 | 4.645.672,513 | 347,081 | |
| 11097 | 711.209,850 | 4.645.680,713 | 346,406 | |
| 11098 | 711.209,541 | 4.645.679,922 | 347,023 | |
| 11099 | 711.164,490 | 4.645.698,403 | 346,572 | |
| 11100 | 711.164,180 | 4.645.697,419 | 347,126 | |
| 11101 | 711.162,022 | 4.645.704,520 | 346,573 | |
| 11102 | 711.151,894 | 4.645.700,655 | 346,774 | |
| 11103 | 711.153,067 | 4.645.697,781 | 347,240 | |
| 11104 | 711.152,749 | 4.645.687,810 | 347,193 | |
| 11105 | 711.156,242 | 4.645.684,752 | 347,076 | |
| 11106 | 711.149,299 | 4.645.677,412 | 349,360 | |
| 11107 | 711.148,468 | 4.645.694,096 | 349,167 | |
| 11108 | 711.102,691 | 4.645.677,457 | 349,308 | |
| 11109 | 711.071,079 | 4.645.665,932 | 349,319 | |
| 11110 | 711.028,536 | 4.645.647,802 | 349,319 | |
| 11111 | 711.009,743 | 4.645.635,746 | 349,383 | |
| 11112 | 710.999,788 | 4.645.625,382 | 349,669 | |
| 11113 | 711.017,800 | 4.645.628,744 | 349,363 | |
| 11114 | 711.018,957 | 4.645.626,924 | 350,404 | |
| 11115 | 710.998,205 | 4.645.623,404 | 350,443 | |
| 11116 | 710.991,498 | 4.645.619,955 | 350,479 | |
| 11117 | 710.982,444 | 4.645.612,238 | 350,496 | |
| 11118 | 710.950,537 | 4.645.587,058 | 350,624 | |
| 11119 | 710.930,139 | 4.645.568,639 | 350,536 | |
| 11120 | 710.934,982 | 4.645.561,216 | 350,637 | |
| 11121 | 710.934,798 | 4.645.560,407 | 350,981 | |
| 11122 | 710.933,597 | 4.645.559,344 | 350,905 | |
| 11123 | 710.933,135 | 4.645.558,866 | 350,665 | |
| 11124 | 710.929,668 | 4.645.566,561 | 350,971 | |
| 11125 | 710.928,756 | 4.645.565,359 | 351,023 | |
| 11126 | 710.927,380 | 4.645.563,626 | 350,534 | |
| 11127 | 710.901,445 | 4.645.544,741 | 350,671 | |
| 11128 | 710.845,336 | 4.645.502,615 | 351,334 | |
| 11129 | 710.797,061 | 4.645.464,414 | 351,778 | |
| 11130 | 710.744,513 | 4.645.423,467 | 352,579 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11131 | 710.737,515 | 4.645.418,331 | 352,964 | |
| 11132 | 710.726,369 | 4.645.409,988 | 353,055 | |
| 11133 | 710.725,742 | 4.645.410,566 | 352,887 | |
| 11134 | 710.725,418 | 4.645.411,275 | 353,149 | |
| 11135 | 710.722,851 | 4.645.413,859 | 353,291 | |
| 11136 | 710.720,749 | 4.645.416,575 | 352,276 | |
| 11137 | 710.719,391 | 4.645.418,084 | 352,061 | |
| 11138 | 710.710,209 | 4.645.411,577 | 352,088 | |
| 11139 | 710.711,001 | 4.645.410,516 | 352,757 | |
| 11140 | 710.710,613 | 4.645.411,203 | 352,191 | |
| 11141 | 710.711,758 | 4.645.409,635 | 352,384 | |
| 11142 | 710.712,652 | 4.645.408,168 | 353,267 | |
| 11143 | 710.713,192 | 4.645.407,656 | 353,474 | |
| 11144 | 710.715,801 | 4.645.404,119 | 353,346 | |
| 11145 | 710.716,459 | 4.645.403,269 | 353,096 | |
| 11146 | 710.717,179 | 4.645.402,544 | 353,602 | |
| 11147 | 710.717,572 | 4.645.401,843 | 353,237 | |
| 11148 | 710.701,622 | 4.645.399,378 | 353,563 | |
| 11149 | 710.701,323 | 4.645.401,039 | 352,537 | |
| 11150 | 710.700,731 | 4.645.401,537 | 352,569 | |
| 11151 | 710.699,166 | 4.645.403,243 | 353,643 | |
| 11152 | 710.707,470 | 4.645.408,391 | 352,952 | |
| 11153 | 710.702,118 | 4.645.408,425 | 353,692 | |
| 11154 | 710.685,513 | 4.645.409,050 | 353,679 | |
| 11155 | 710.692,358 | 4.645.398,079 | 353,631 | |
| 11156 | 710.666,451 | 4.645.377,357 | 353,754 | |
| 11157 | 710.663,524 | 4.645.374,684 | 354,211 | |
| 11158 | 710.649,617 | 4.645.376,885 | 354,272 | |
| 11159 | 710.649,955 | 4.645.377,819 | 353,773 | |
| 11160 | 710.636,585 | 4.645.352,985 | 354,233 | |
| 11161 | 710.633,996 | 4.645.350,919 | 354,278 | |
| 11162 | 710.633,796 | 4.645.349,782 | 353,628 | |
| 11163 | 710.617,647 | 4.645.350,851 | 354,189 | |
| 11164 | 710.617,596 | 4.645.349,690 | 353,677 | |
| 11165 | 710.617,656 | 4.645.348,665 | 353,688 | |
| 11166 | 710.617,590 | 4.645.347,421 | 354,401 | |
| 11167 | 710.629,334 | 4.645.347,618 | 354,336 | |
| 11168 | 710.623,971 | 4.645.344,686 | 354,106 | |
| 11169 | 710.609,075 | 4.645.329,251 | 354,388 | |
| 11170 | 710.582,842 | 4.645.308,730 | 354,445 | |
| 11171 | 710.579,412 | 4.645.306,487 | 354,740 | |
| 11172 | 710.577,060 | 4.645.305,177 | 354,936 | |
| 11173 | 710.569,659 | 4.645.317,534 | 354,402 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11174 | 710.567,376 | 4.645.315,346 | 354,588 | |
| 11175 | 710.566,108 | 4.645.314,165 | 354,775 | |
| 11176 | 710.546,620 | 4.645.293,648 | 354,852 | |
| 11177 | 710.538,638 | 4.645.299,092 | 354,844 | |
| 11178 | 710.537,975 | 4.645.298,319 | 355,015 | |
| 11179 | 710.548,750 | 4.645.288,687 | 355,002 | |
| 11180 | 710.524,164 | 4.645.273,760 | 355,088 | |
| 11181 | 710.520,973 | 4.645.271,952 | 355,359 | |
| 11182 | 710.517,006 | 4.645.276,616 | 355,261 | |
| 11183 | 710.518,481 | 4.645.277,727 | 354,989 | |
| 11184 | 710.509,788 | 4.645.283,943 | 355,010 | |
| 11185 | 710.509,061 | 4.645.282,775 | 355,281 | |
| 11186 | 710.447,411 | 4.645.243,082 | 355,338 | |
| 11187 | 710.446,096 | 4.645.242,698 | 355,588 | |
| 11188 | 710.447,995 | 4.645.236,752 | 355,572 | |
| 11189 | 710.449,272 | 4.645.236,486 | 355,487 | |
| 11190 | 710.452,209 | 4.645.231,954 | 355,360 | |
| 11191 | 710.450,494 | 4.645.230,798 | 355,579 | |
| 11192 | 710.424,581 | 4.645.216,100 | 355,565 | |
| 11193 | 710.422,458 | 4.645.214,685 | 355,863 | |
| 11194 | 710.420,989 | 4.645.221,723 | 355,634 | |
| 11195 | 710.419,789 | 4.645.221,283 | 355,769 | |
| 11196 | 710.416,219 | 4.645.234,224 | 355,619 | |
| 11197 | 710.415,317 | 4.645.233,881 | 355,752 | |
| 11198 | 710.385,489 | 4.645.208,390 | 355,817 | |
| 11199 | 710.384,438 | 4.645.207,985 | 355,976 | |
| 11200 | 710.391,011 | 4.645.197,255 | 355,764 | |
| 11201 | 710.389,244 | 4.645.196,082 | 355,977 | |
| 11202 | 710.363,234 | 4.645.181,012 | 356,173 | |
| 11203 | 710.361,157 | 4.645.179,711 | 356,471 | |
| 11204 | 710.360,744 | 4.645.185,028 | 356,081 | |
| 11205 | 710.359,297 | 4.645.184,103 | 356,443 | |
| 11206 | 710.355,380 | 4.645.198,670 | 355,959 | |
| 11207 | 710.353,750 | 4.645.198,280 | 356,424 | |
| 11208 | 710.301,961 | 4.645.167,041 | 356,509 | |
| 11209 | 710.300,694 | 4.645.167,145 | 356,690 | |
| 11210 | 710.299,675 | 4.645.156,384 | 356,662 | |
| 11211 | 710.302,901 | 4.645.157,327 | 356,489 | |
| 11212 | 710.301,170 | 4.645.161,296 | 356,521 | |
| 11213 | 710.300,194 | 4.645.161,509 | 356,642 | |
| 11214 | 710.271,024 | 4.645.158,051 | 356,628 | |
| 11215 | 710.270,061 | 4.645.158,194 | 356,802 | |
| 11216 | 710.269,287 | 4.645.158,258 | 356,268 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11217 | 710.269,452 | 4.645.150,055 | 356,866 | |
| 11218 | 710.268,996 | 4.645.149,923 | 356,264 | |
| 11219 | 710.270,430 | 4.645.150,353 | 356,662 | |
| 11220 | 710.271,097 | 4.645.147,407 | 356,796 | |
| 11221 | 710.270,087 | 4.645.147,127 | 356,351 | |
| 11222 | 710.268,943 | 4.645.146,951 | 356,838 | |
| 11223 | 710.268,297 | 4.645.149,364 | 356,310 | |
| 11224 | 710.268,122 | 4.645.149,276 | 356,730 | |
| 11225 | 710.261,785 | 4.645.144,354 | 356,976 | |
| 11226 | 710.265,060 | 4.645.155,750 | 356,946 | |
| 11227 | 710.247,187 | 4.645.133,638 | 357,027 | |
| 11228 | 710.207,862 | 4.645.127,785 | 357,012 | |
| 11229 | 710.172,887 | 4.645.125,787 | 357,047 | |
| 11230 | 710.104,342 | 4.645.118,275 | 357,603 | |
| 11231 | 710.089,166 | 4.645.117,171 | 357,581 | |
| 11232 | 710.088,319 | 4.645.115,596 | 358,235 | |
| 11233 | 710.079,162 | 4.645.119,994 | 357,926 | |
| 11234 | 710.079,824 | 4.645.121,074 | 357,610 | |
| 11235 | 710.075,087 | 4.645.122,756 | 357,955 | |
| 11236 | 710.071,834 | 4.645.117,560 | 357,959 | |
| 11237 | 710.069,121 | 4.645.115,711 | 357,937 | |
| 11238 | 710.070,233 | 4.645.110,072 | 358,343 | |
| 11239 | 710.054,163 | 4.645.104,148 | 358,620 | |
| 11240 | 710.052,767 | 4.645.107,519 | 358,074 | |
| 11241 | 710.044,565 | 4.645.112,373 | 358,052 | |
| 11242 | 710.042,787 | 4.645.111,208 | 358,075 | |
| 11243 | 710.042,288 | 4.645.110,696 | 358,423 | |
| 11244 | 710.041,726 | 4.645.110,187 | 358,305 | |
| 11245 | 710.049,246 | 4.645.106,425 | 358,168 | |
| 11246 | 710.048,700 | 4.645.105,297 | 358,575 | |
| 11247 | 710.047,606 | 4.645.104,652 | 358,648 | |
| 11248 | 710.048,744 | 4.645.102,528 | 358,763 | |
| 11249 | 710.041,302 | 4.645.101,643 | 358,321 | |
| 11250 | 710.014,730 | 4.645.093,299 | 358,558 | |
| 11251 | 709.979,526 | 4.645.082,192 | 358,807 | |
| 11252 | 709.976,444 | 4.645.081,049 | 359,044 | |
| 11253 | 709.951,425 | 4.645.073,728 | 359,175 | |
| 11254 | 709.949,523 | 4.645.072,799 | 359,693 | |
| 11255 | 709.943,696 | 4.645.078,652 | 358,970 | |
| 11256 | 709.942,571 | 4.645.077,902 | 359,602 | |
| 11257 | 709.933,210 | 4.645.066,905 | 359,518 | |
| 11258 | 709.906,139 | 4.645.057,034 | 359,417 | |
| 11259 | 709.871,980 | 4.645.040,178 | 359,478 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11260 | 709.845,371 | 4.645.023,563 | 359,355 | |
| 11261 | 709.824,075 | 4.645.012,182 | 359,616 | |
| 11262 | 709.828,415 | 4.645.027,789 | 359,572 | |
| 11263 | 709.820,004 | 4.645.009,510 | 360,652 | |
| 11264 | 709.815,933 | 4.645.009,467 | 360,519 | |
| 11265 | 709.819,821 | 4.645.021,948 | 360,257 | |
| 11266 | 709.823,344 | 4.645.023,184 | 360,357 | |
| 11267 | 709.814,701 | 4.645.025,353 | 360,234 | |
| 11268 | 709.812,363 | 4.645.016,944 | 360,211 | |
| 11269 | 709.809,879 | 4.645.005,754 | 360,494 | |
| 11270 | 709.806,500 | 4.645.005,615 | 359,682 | |
| 11271 | 709.809,236 | 4.645.013,702 | 359,247 | |
| 11272 | 709.803,040 | 4.645.011,246 | 359,454 | |
| 11273 | 709.801,703 | 4.645.010,985 | 359,823 | |
| 11274 | 709.800,684 | 4.645.010,801 | 359,592 | |
| 11275 | 709.805,466 | 4.645.029,638 | 359,190 | |
| 11276 | 709.813,317 | 4.645.028,465 | 359,230 | |
| 11277 | 709.818,463 | 4.645.045,712 | 359,277 | |
| 11278 | 709.828,658 | 4.645.081,100 | 359,177 | |
| 11279 | 709.840,311 | 4.645.122,657 | 359,157 | |
| 11280 | 709.848,732 | 4.645.151,837 | 359,163 | |
| 11281 | 709.849,144 | 4.645.162,939 | 359,213 | |
| 11282 | 709.853,590 | 4.645.178,708 | 359,061 | |
| 11283 | 709.854,492 | 4.645.181,003 | 358,759 | |
| 11284 | 709.844,839 | 4.645.180,791 | 358,712 | |
| 11285 | 709.844,751 | 4.645.179,509 | 358,997 | |
| 11286 | 709.861,739 | 4.645.201,494 | 358,700 | |
| 11287 | 709.860,776 | 4.645.209,449 | 358,720 | |
| 11288 | 709.860,677 | 4.645.211,911 | 358,559 | |
| 11289 | 709.861,374 | 4.645.213,473 | 358,390 | |
| 11290 | 709.856,512 | 4.645.212,957 | 358,522 | |
| 11291 | 709.857,111 | 4.645.211,285 | 358,519 | |
| 11292 | 709.856,117 | 4.645.211,639 | 358,111 | |
| 11293 | 709.855,963 | 4.645.210,298 | 358,620 | |
| 11294 | 709.856,031 | 4.645.210,782 | 358,062 | |
| 11295 | 709.845,380 | 4.645.211,364 | 358,655 | |
| 11296 | 709.845,494 | 4.645.212,142 | 358,576 | |
| 11297 | 709.845,728 | 4.645.212,891 | 358,038 | |
| 11298 | 709.846,013 | 4.645.213,850 | 358,027 | |
| 11299 | 709.846,526 | 4.645.214,849 | 358,524 | |
| 11300 | 709.846,584 | 4.645.215,842 | 358,263 | |
| 11301 | 709.863,994 | 4.645.221,437 | 358,408 | |
| 11302 | 709.868,096 | 4.645.237,518 | 358,158 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11303 | 709.877,273 | 4.645.271,296 | 357,997 | |
| 11304 | 709.880,373 | 4.645.283,153 | 357,772 | |
| 11305 | 709.884,158 | 4.645.300,168 | 357,780 | |
| 11306 | 709.884,445 | 4.645.300,654 | 357,830 | |
| 11307 | 709.884,720 | 4.645.301,323 | 357,580 | |
| 11308 | 709.884,870 | 4.645.302,273 | 357,614 | |
| 11309 | 709.885,010 | 4.645.302,849 | 357,899 | |
| 11310 | 709.885,456 | 4.645.304,283 | 357,592 | |
| 11311 | 709.873,300 | 4.645.304,679 | 357,824 | |
| 11312 | 709.873,264 | 4.645.305,411 | 357,509 | |
| 11313 | 709.873,326 | 4.645.305,826 | 357,511 | |
| 11314 | 709.873,578 | 4.645.306,635 | 357,804 | |
| 11315 | 709.873,876 | 4.645.307,700 | 357,563 | |
| 11316 | 709.887,123 | 4.645.311,258 | 357,481 | |
| 11317 | 709.887,657 | 4.645.312,580 | 357,240 | |
| 11318 | 709.881,309 | 4.645.319,179 | 357,310 | |
| 11319 | 709.880,444 | 4.645.318,622 | 357,517 | |
| 11320 | 709.896,341 | 4.645.345,475 | 357,272 | |
| 11321 | 709.896,787 | 4.645.347,695 | 357,039 | |
| 11322 | 709.905,534 | 4.645.381,065 | 357,058 | |
| 11323 | 709.906,201 | 4.645.383,896 | 356,852 | |
| 11324 | 709.915,317 | 4.645.414,930 | 356,914 | |
| 11325 | 709.960,117 | 4.645.611,229 | 355,326 | |
| 11326 | 709.980,242 | 4.645.634,394 | 355,246 | |
| 11327 | 709.987,648 | 4.645.646,514 | 355,270 | |
| 11328 | 710.008,017 | 4.645.676,226 | 355,251 | |
| 11329 | 710.063,147 | 4.645.708,028 | 354,397 | |
| 11330 | 710.063,008 | 4.645.706,497 | 354,614 | |
| 11331 | 710.074,276 | 4.645.727,438 | 354,367 | |
| 11332 | 710.082,091 | 4.645.738,323 | 354,315 | |
| 11333 | 710.079,170 | 4.645.748,577 | 354,598 | |
| 11334 | 710.078,560 | 4.645.749,822 | 354,425 | |
| 11335 | 710.121,079 | 4.645.747,312 | 354,344 | |
| 11336 | 710.158,063 | 4.645.743,513 | 354,391 | |
| 11337 | 710.159,316 | 4.645.743,268 | 354,524 | |
| 11338 | 710.153,823 | 4.645.732,827 | 354,333 | |
| 11339 | 710.154,375 | 4.645.732,528 | 354,441 | |
| 11340 | 710.155,565 | 4.645.732,187 | 353,781 | |
| 11341 | 710.161,929 | 4.645.742,331 | 353,670 | |
| 11342 | 710.168,455 | 4.645.742,079 | 353,762 | |
| 11343 | 710.205,827 | 4.645.735,043 | 353,616 | |
| 11344 | 710.256,755 | 4.645.726,519 | 353,689 | |
| 11345 | 710.257,927 | 4.645.726,230 | 353,469 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11346 | 710.258,826 | 4.645.726,090 | 353,682 | |
| 11347 | 710.260,514 | 4.645.725,952 | 353,382 | |
| 11348 | 710.254,988 | 4.645.719,180 | 353,563 | |
| 11349 | 710.255,356 | 4.645.719,003 | 353,438 | |
| 11350 | 710.255,981 | 4.645.718,647 | 353,618 | |
| 11351 | 710.257,455 | 4.645.717,888 | 353,362 | |
| 11352 | 710.271,042 | 4.645.725,317 | 353,314 | |
| 11353 | 710.342,226 | 4.645.716,086 | 353,321 | |
| 11354 | 710.343,796 | 4.645.719,909 | 353,031 | |
| 11355 | 710.343,688 | 4.645.721,408 | 352,480 | |
| 11356 | 710.371,414 | 4.645.728,758 | 352,551 | |
| 11357 | 710.373,056 | 4.645.729,610 | 352,336 | |
| 11358 | 710.369,603 | 4.645.736,992 | 352,428 | |
| 11359 | 710.371,156 | 4.645.737,425 | 352,208 | |
| 11360 | 710.401,101 | 4.645.736,877 | 352,280 | |
| 11361 | 710.403,914 | 4.645.737,561 | 352,188 | |
| 11362 | 710.434,512 | 4.645.745,353 | 352,018 | |
| 11363 | 710.448,490 | 4.645.750,030 | 351,844 | |
| 11364 | 708.173,787 | 4.645.701,480 | 363,059 | |
| 11365 | 705.883,050 | 4.645.147,517 | 384,731 | ACEQUIA |
| 11366 | 705.887,046 | 4.645.138,377 | 384,329 | ACEQUIA |
| 11367 | 708.151,562 | 4.645.710,580 | 361,949 | |
| 11368 | 708.176,892 | 4.645.713,147 | 361,673 | |
| 11369 | 705.889,588 | 4.645.133,562 | 384,341 | ACEQUIA |
| 11370 | 713.671,851 | 4.645.003,786 | 325,840 | ACEQUIA |
| 11371 | 708.148,730 | 4.645.687,731 | 362,029 | |
| 11372 | 704.875,470 | 4.644.717,001 | 431,291 | ACEQUIA |
| 11373 | 704.898,314 | 4.644.719,416 | 431,412 | ACEQUIA |
| 11374 | 713.517,703 | 4.645.110,756 | 325,950 | ACEQUIA |
| 11375 | 708.166,029 | 4.645.601,390 | 364,244 | |
| 11376 | 708.171,827 | 4.645.583,572 | 364,702 | |
| 11377 | 708.182,418 | 4.645.559,086 | 365,142 | |
| 11378 | 712.811,948 | 4.645.099,866 | 330,230 | ACEQUIA |
| 11379 | 708.194,428 | 4.645.505,948 | 365,658 | |
| 11380 | 708.199,046 | 4.645.485,061 | 365,873 | |
| 11381 | 708.213,812 | 4.645.428,567 | 367,657 | |
| 11382 | 708.221,076 | 4.645.430,264 | 367,883 | |
| 11383 | 713.948,126 | 4.644.158,418 | 334,960 | ACEQUIA |
| 11384 | 713.970,393 | 4.644.161,300 | 334,950 | ACEQUIA |
| 11385 | 713.893,957 | 4.644.804,289 | 323,040 | ACEQUIA |
| 11386 | 708.268,936 | 4.645.384,410 | 368,069 | |
| 11387 | 708.270,360 | 4.645.382,394 | 367,608 | |
| 11388 | 708.265,775 | 4.645.380,503 | 367,562 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11389 | 708.272,376 | 4.645.368,561 | 367,220 | |
| 11390 | 711.119,907 | 4.646.845,436 | 351,010 | ACEQUIA |
| 11391 | 708.311,719 | 4.645.324,262 | 366,991 | |
| 11392 | 708.323,417 | 4.645.309,642 | 367,145 | |
| 11393 | 708.336,582 | 4.645.291,475 | 367,367 | |
| 11394 | 708.344,457 | 4.645.278,505 | 367,792 | |
| 11395 | 708.356,093 | 4.645.263,530 | 367,852 | |
| 11396 | 709.561,600 | 4.646.665,767 | 348,390 | ACEQUIA |
| 11397 | 708.387,726 | 4.645.222,986 | 367,837 | |
| 11398 | 709.490,127 | 4.646.496,814 | 347,780 | ACEQUIA |
| 11399 | 709.493,123 | 4.646.490,829 | 348,040 | ACEQUIA |
| 11400 | 709.275,322 | 4.646.262,883 | 351,130 | ACEQUIA |
| 11401 | 708.397,047 | 4.645.213,936 | 367,270 | |
| 11402 | 709.271,715 | 4.646.408,973 | 351,800 | ACEQUIA |
| 11403 | 708.410,509 | 4.645.212,580 | 366,740 | |
| 11404 | 708.400,332 | 4.645.179,489 | 366,660 | |
| 11405 | 707.598,675 | 4.645.819,842 | 361,280 | ACEQUIA |
| 11406 | 707.629,673 | 4.645.498,107 | 366,790 | ACEQUIA |
| 11407 | 708.416,864 | 4.645.172,580 | 366,376 | |
| 11408 | 707.632,574 | 4.645.055,861 | 367,650 | ACEQUIA |
| 11409 | 707.644,462 | 4.645.055,872 | 367,290 | ACEQUIA |
| 11410 | 708.409,274 | 4.645.155,760 | 366,341 | |
| 11411 | 708.409,283 | 4.645.152,213 | 366,115 | |
| 11412 | 708.420,258 | 4.645.139,353 | 366,016 | |
| 11413 | 708.417,853 | 4.645.134,376 | 366,022 | |
| 11414 | 708.280,814 | 4.645.075,119 | 368,520 | ACEQUIA |
| 11415 | 708.803,322 | 4.645.181,268 | 356,830 | ACEQUIA |
| 11416 | 708.405,907 | 4.645.138,068 | 366,431 | |
| 11417 | 708.819,190 | 4.645.228,020 | 358,710 | ACEQUIA |
| 11418 | 708.890,134 | 4.645.492,504 | 355,390 | ACEQUIA |
| 11419 | 708.879,956 | 4.645.495,482 | 355,530 | ACEQUIA |
| 11420 | 708.410,814 | 4.645.129,272 | 366,359 | |
| 11421 | 708.926,937 | 4.645.706,142 | 355,440 | ACEQUIA |
| 11422 | 708.946,381 | 4.645.744,806 | 356,440 | ACEQUIA |
| 11423 | 708.385,401 | 4.645.101,608 | 369,234 | |
| 11424 | 708.430,763 | 4.645.804,249 | 362,620 | ACEQUIA |
| 11425 | 708.388,513 | 4.645.092,300 | 369,888 | |
| 11426 | 708.387,749 | 4.645.089,583 | 369,391 | |
| 11427 | 708.376,325 | 4.645.090,579 | 369,314 | |
| 11428 | 709.036,640 | 4.645.197,763 | 360,260 | ACEQUIA |
| 11429 | 708.981,184 | 4.645.193,896 | 358,220 | ACEQUIA |
| 11430 | 708.961,575 | 4.645.198,110 | 358,010 | ACEQUIA |
| 11431 | 708.323,906 | 4.645.026,076 | 369,258 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11432 | 708.928,723 | 4.645.178,735 | 357,880 | ACEQUIA |
| 11433 | 708.824,230 | 4.645.168,030 | 357,040 | ACEQUIA |
| 11434 | 708.815,637 | 4.645.174,534 | 356,890 | ACEQUIA |
| 11435 | 708.267,959 | 4.644.990,754 | 369,368 | |
| 11436 | 709.099,260 | 4.644.508,964 | 365,410 | ACEQUIA |
| 11437 | 708.261,359 | 4.644.999,931 | 369,504 | |
| 11438 | 708.262,468 | 4.644.989,940 | 369,684 | |
| 11439 | 708.259,270 | 4.644.988,161 | 369,569 | |
| 11440 | 708.231,526 | 4.644.990,122 | 369,537 | |
| 11441 | 708.202,138 | 4.644.993,943 | 369,534 | |
| 11442 | 708.200,807 | 4.644.994,132 | 369,497 | |
| 11443 | 708.194,838 | 4.644.994,335 | 369,654 | |
| 11444 | 708.196,629 | 4.645.000,097 | 369,641 | |
| 11445 | 710.168,492 | 4.645.403,252 | 353,710 | ACEQUIA |
| 11446 | 708.202,868 | 4.645.007,073 | 370,762 | |
| 11447 | 708.191,585 | 4.644.999,342 | 370,703 | |
| 11448 | 708.186,806 | 4.644.994,080 | 370,782 | |
| 11449 | 708.180,466 | 4.644.993,926 | 370,717 | |
| 11450 | 710.808,037 | 4.645.497,011 | 350,590 | ACEQUIA |
| 11451 | 711.282,648 | 4.645.565,541 | 349,680 | ACEQUIA |
| 11452 | 708.111,562 | 4.644.966,826 | 370,580 | |
| 11453 | 711.679,951 | 4.645.475,240 | 340,930 | ACEQUIA |
| 11454 | 708.070,415 | 4.644.949,620 | 370,674 | |
| 11455 | 711.355,683 | 4.645.781,281 | 340,820 | ACEQUIA |
| 11456 | 711.364,075 | 4.645.782,630 | 340,630 | ACEQUIA |
| 11457 | 708.056,419 | 4.644.942,326 | 372,473 | |
| 11458 | 708.051,651 | 4.644.948,180 | 372,666 | |
| 11459 | 708.051,108 | 4.644.940,393 | 372,718 | |
| 11460 | 708.042,431 | 4.644.934,494 | 372,823 | |
| 11461 | 708.031,554 | 4.644.928,639 | 372,996 | |
| 11462 | 710.439,661 | 4.645.738,225 | 350,300 | ACEQUIA |
| 11463 | 708.013,016 | 4.644.919,700 | 372,815 | |
| 11464 | 708.001,494 | 4.644.910,785 | 372,805 | |
| 11465 | 707.991,033 | 4.644.900,523 | 373,217 | |
| 11466 | 707.963,963 | 4.644.873,915 | 374,347 | |
| 11467 | 710.019,341 | 4.645.724,151 | 352,300 | ACEQUIA |
| 11468 | 707.936,221 | 4.644.848,511 | 375,694 | |
| 11469 | 707.921,181 | 4.644.835,305 | 375,727 | |
| 11470 | 710.040,881 | 4.645.734,463 | 352,610 | ACEQUIA |
| 11471 | 707.888,790 | 4.644.822,306 | 375,765 | |
| 11472 | 710.045,634 | 4.645.716,064 | 352,210 | ACEQUIA |
| 11473 | 710.003,850 | 4.645.799,251 | 347,150 | ACEQUIA |
| 11474 | 709.997,215 | 4.645.790,115 | 347,380 | ACEQUIA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11475 | 707.571,015 | 4.644.964,979 | 372,860 | ACEQUIA |
| 11476 | 707.591,257 | 4.644.963,510 | 374,050 | ACEQUIA |
| 11477 | 708.460,912 | 4.644.978,503 | 368,204 | |
| 11478 | 707.569,331 | 4.644.954,481 | 372,700 | ACEQUIA |
| 11479 | 707.377,425 | 4.644.911,545 | 372,710 | ACEQUIA |
| 11480 | 707.381,111 | 4.644.920,963 | 372,750 | ACEQUIA |
| 11481 | 707.244,093 | 4.644.904,124 | 373,870 | ACEQUIA |
| 11482 | 707.234,680 | 4.644.893,494 | 374,100 | ACEQUIA |
| 11483 | 706.804,909 | 4.644.829,259 | 377,130 | ACEQUIA |
| 11484 | 706.791,981 | 4.644.838,228 | 377,120 | ACEQUIA |
| 11485 | 708.573,348 | 4.644.980,367 | 364,705 | |
| 11486 | 706.443,447 | 4.644.843,742 | 378,530 | ACEQUIA |
| 11487 | 706.444,839 | 4.644.833,720 | 378,700 | ACEQUIA |
| 11488 | 706.293,971 | 4.644.856,265 | 379,850 | ACEQUIA |
| 11489 | 708.588,971 | 4.644.995,396 | 362,565 | |
| 11490 | 708.592,759 | 4.644.991,756 | 362,394 | |
| 11491 | 708.596,222 | 4.644.989,918 | 362,485 | |
| 11492 | 708.607,646 | 4.644.991,007 | 361,979 | |
| 11493 | 708.624,832 | 4.644.992,016 | 361,998 | |
| 11494 | 706.040,644 | 4.644.989,001 | 382,050 | ACEQUIA |
| 11495 | 706.123,067 | 4.645.275,945 | 379,958 | CA |
| 11496 | 706.122,263 | 4.645.277,813 | 379,790 | CA |
| 11497 | 707.879,650 | 4.644.801,600 | 373,900 | |
| 11498 | 707.886,620 | 4.644.813,160 | 373,850 | |
| 11499 | 705.950,803 | 4.645.184,631 | 382,807 | CA |
| 11500 | 707.907,380 | 4.644.833,360 | 375,750 | |
| 11501 | 707.915,150 | 4.644.841,570 | 375,620 | |
| 11502 | 707.926,960 | 4.644.851,030 | 375,720 | |
| 11503 | 707.935,360 | 4.644.858,540 | 375,710 | |
| 11504 | 705.880,783 | 4.645.205,947 | 383,829 | CA |
| 11505 | 707.961,180 | 4.644.882,570 | 374,200 | |
| 11506 | 706.090,186 | 4.645.271,902 | 382,475 | CA |
| 11507 | 707.983,530 | 4.644.902,270 | 373,420 | |
| 11508 | 707.993,130 | 4.644.910,880 | 372,900 | |
| 11509 | 706.013,926 | 4.645.236,382 | 382,812 | CA |
| 11510 | 705.993,510 | 4.645.226,259 | 382,747 | CA |
| 11511 | 709.057,850 | 4.644.349,720 | 365,060 | |
| 11512 | 705.969,153 | 4.645.225,029 | 383,169 | CA |
| 11513 | 709.064,920 | 4.644.374,510 | 365,050 | |
| 11514 | 708.597,420 | 4.644.394,130 | 369,320 | |
| 11515 | 708.587,110 | 4.644.406,820 | 369,250 | |
| 11516 | 705.910,611 | 4.645.223,527 | 384,236 | CA |
| 11517 | 708.611,800 | 4.644.386,450 | 369,280 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11518 | 708.602,690 | 4.644.396,280 | 369,210 | |
| 11519 | 709.072,700 | 4.644.387,290 | 365,090 | |
| 11520 | 709.070,990 | 4.644.395,780 | 365,090 | |
| 11521 | 705.824,859 | 4.645.198,664 | 386,941 | CA |
| 11522 | 705.521,104 | 4.645.288,805 | 391,845 | CA |
| 11523 | 705.511,773 | 4.645.115,879 | 391,774 | CA |
| 11524 | 705.559,917 | 4.645.354,183 | 392,062 | CA |
| 11525 | 705.556,989 | 4.645.321,728 | 391,759 | CA |
| 11526 | 708.590,250 | 4.644.408,870 | 369,290 | |
| 11527 | 708.579,950 | 4.644.415,420 | 370,080 | |
| 11528 | 708.584,040 | 4.644.416,400 | 369,760 | |
| 11529 | 708.582,150 | 4.644.412,650 | 369,300 | |
| 11530 | 705.778,369 | 4.645.203,478 | 386,210 | CA |
| 11531 | 708.576,050 | 4.644.419,980 | 369,460 | |
| 11532 | 708.580,010 | 4.644.420,400 | 369,430 | |
| 11533 | 708.577,260 | 4.644.418,650 | 369,570 | |
| 11534 | 705.891,612 | 4.645.484,140 | 387,032 | CA |
| 11535 | 708.579,230 | 4.644.427,740 | 369,440 | |
| 11536 | 707.311,105 | 4.644.248,203 | 382,669 | CA |
| 11537 | 711.065,302 | 4.647.356,323 | 343,831 | CA |
| 11538 | 710.432,795 | 4.647.554,850 | 346,820 | CA |
| 11539 | 705.639,809 | 4.645.427,256 | 389,276 | CA |
| 11540 | 708.610,300 | 4.644.429,450 | 369,450 | |
| 11541 | 705.699,278 | 4.645.456,744 | 388,844 | CA |
| 11542 | 705.786,956 | 4.645.480,935 | 388,306 | CA |
| 11543 | 705.801,583 | 4.645.484,161 | 388,085 | CA |
| 11544 | 705.815,867 | 4.645.487,508 | 388,107 | CA |
| 11545 | 708.645,390 | 4.644.434,690 | 369,040 | |
| 11546 | 709.077,780 | 4.644.420,890 | 365,070 | |
| 11547 | 708.478,320 | 4.644.463,820 | 369,880 | |
| 11548 | 705.917,871 | 4.645.463,048 | 384,337 | CA |
| 11549 | 708.501,390 | 4.644.453,910 | 369,930 | |
| 11550 | 705.885,040 | 4.645.480,773 | 387,598 | CA |
| 11551 | 708.491,580 | 4.644.458,020 | 369,890 | |
| 11552 | 705.820,314 | 4.645.491,577 | 388,049 | CA |
| 11553 | 708.536,620 | 4.644.437,640 | 369,460 | |
| 11554 | 708.547,560 | 4.644.438,780 | 369,470 | |
| 11555 | 705.205,393 | 4.644.656,564 | 423,918 | CA |
| 11556 | 705.976,679 | 4.645.214,458 | 383,009 | CA |
| 11557 | 708.527,730 | 4.644.442,650 | 369,950 | |
| 11558 | 708.533,370 | 4.644.444,680 | 369,760 | |
| 11559 | 706.114,761 | 4.645.274,205 | 381,892 | CA |
| 11560 | 706.115,523 | 4.645.271,864 | 381,891 | CA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11561 | 706.036,526 | 4.645.230,444 | 382,562 | CA |
| 11562 | 706.032,764 | 4.645.236,660 | 380,397 | CA |
| 11563 | 705.993,312 | 4.645.229,700 | 382,733 | CA |
| 11564 | 708.644,140 | 4.644.438,440 | 368,220 | |
| 11565 | 705.900,591 | 4.645.222,683 | 384,223 | CA |
| 11566 | 705.878,140 | 4.645.221,375 | 385,092 | CA |
| 11567 | 705.849,962 | 4.645.220,035 | 385,274 | CA |
| 11568 | 705.848,263 | 4.645.224,041 | 385,308 | CA |
| 11569 | 708.667,480 | 4.644.440,840 | 367,260 | |
| 11570 | 708.668,810 | 4.644.443,470 | 367,260 | |
| 11571 | 708.672,690 | 4.644.441,960 | 367,390 | |
| 11572 | 708.678,360 | 4.644.443,040 | 366,780 | |
| 11573 | 708.676,770 | 4.644.445,130 | 366,820 | |
| 11574 | 708.675,600 | 4.644.442,620 | 366,960 | |
| 11575 | 705.517,188 | 4.645.297,984 | 392,150 | CA |
| 11576 | 705.518,698 | 4.645.332,810 | 392,130 | CA |
| 11577 | 705.518,381 | 4.645.342,374 | 392,127 | CA |
| 11578 | 705.885,759 | 4.645.095,047 | 385,249 | CA |
| 11579 | 705.895,532 | 4.645.083,374 | 385,115 | CA |
| 11580 | 708.691,360 | 4.644.447,740 | 366,910 | |
| 11581 | 705.891,304 | 4.645.140,101 | 383,695 | CA |
| 11582 | 705.542,886 | 4.645.061,047 | 391,769 | CA |
| 11583 | 705.550,921 | 4.645.100,662 | 391,767 | CA |
| 11584 | 705.823,158 | 4.645.200,817 | 385,363 | CA |
| 11585 | 705.821,704 | 4.645.204,943 | 385,253 | CA |
| 11586 | 705.790,946 | 4.645.204,084 | 386,045 | CA |
| 11587 | 708.746,690 | 4.644.456,200 | 366,920 | |
| 11588 | 708.750,750 | 4.644.459,260 | 366,930 | |
| 11589 | 708.760,400 | 4.644.459,320 | 366,910 | |
| 11590 | 708.760,460 | 4.644.460,740 | 366,910 | |
| 11591 | 708.773,220 | 4.644.461,290 | 366,890 | |
| 11592 | 708.775,830 | 4.644.463,630 | 366,850 | |
| 11593 | 705.803,781 | 4.645.488,551 | 388,275 | CA |
| 11594 | 705.941,253 | 4.645.469,386 | 384,083 | CA |
| 11595 | 708.788,860 | 4.644.463,130 | 366,620 | |
| 11596 | 708.786,370 | 4.644.464,490 | 366,940 | |
| 11597 | 705.849,080 | 4.645.203,383 | 384,574 | CA |
| 11598 | 709.082,600 | 4.644.440,400 | 365,080 | |
| 11599 | 709.084,300 | 4.644.449,600 | 365,070 | |
| 11600 | 708.426,790 | 4.644.484,600 | 370,020 | |
| 11601 | 708.429,560 | 4.644.485,930 | 369,620 | |
| 11602 | 708.462,430 | 4.644.471,790 | 369,620 | |
| 11603 | 708.465,530 | 4.644.473,110 | 369,690 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11604 | 708.463,640 | 4.644.470,710 | 369,910 | |
| 11605 | 708.453,270 | 4.644.475,820 | 369,510 | |
| 11606 | 708.457,430 | 4.644.476,740 | 369,450 | |
| 11607 | 705.553,231 | 4.645.232,330 | 391,859 | CA |
| 11608 | 708.445,580 | 4.644.481,990 | 369,430 | |
| 11609 | 705.549,462 | 4.645.163,941 | 391,961 | CA |
| 11610 | 708.475,820 | 4.644.469,140 | 369,890 | |
| 11611 | 708.484,200 | 4.644.465,730 | 369,870 | |
| 11612 | 708.468,070 | 4.644.472,540 | 369,920 | |
| 11613 | 705.835,250 | 4.645.201,961 | 384,935 | CA |
| 11614 | 708.787,570 | 4.644.465,830 | 366,730 | |
| 11615 | 708.814,600 | 4.644.467,510 | 366,380 | |
| 11616 | 708.804,630 | 4.644.470,420 | 366,170 | |
| 11617 | 708.820,280 | 4.644.473,390 | 366,320 | |
| 11618 | 708.829,290 | 4.644.471,490 | 366,520 | |
| 11619 | 708.839,040 | 4.644.476,240 | 367,400 | |
| 11620 | 705.733,382 | 4.645.193,652 | 387,094 | CA |
| 11621 | 705.726,422 | 4.645.190,845 | 387,652 | CA |
| 11622 | 708.853,870 | 4.644.479,640 | 366,240 | |
| 11623 | 708.864,120 | 4.644.481,180 | 365,920 | |
| 11624 | 708.871,050 | 4.644.479,110 | 365,970 | |
| 11625 | 706.265,408 | 4.646.006,159 | 387,076 | CA |
| 11626 | 706.218,130 | 4.646.248,814 | 388,849 | CA |
| 11627 | 706.213,114 | 4.646.243,013 | 388,925 | CA |
| 11628 | 706.087,002 | 4.646.746,366 | 387,247 | CA |
| 11629 | 706.081,414 | 4.646.744,697 | 387,269 | CA |
| 11630 | 706.516,921 | 4.645.377,031 | 381,005 | CA |
| 11631 | 708.927,060 | 4.644.490,230 | 365,660 | |
| 11632 | 709.090,800 | 4.644.466,440 | 365,110 | |
| 11633 | 706.846,101 | 4.644.921,624 | 377,504 | CA |
| 11634 | 706.847,850 | 4.644.922,973 | 377,404 | CA |
| 11635 | 708.374,220 | 4.644.509,760 | 371,340 | |
| 11636 | 707.296,000 | 4.644.297,917 | 382,949 | CA |
| 11637 | 707.293,406 | 4.644.296,910 | 382,878 | CA |
| 11638 | 708.378,560 | 4.644.507,600 | 370,100 | |
| 11639 | 711.066,076 | 4.647.360,555 | 343,788 | CA |
| 11640 | 710.434,251 | 4.647.558,624 | 346,723 | CA |
| 11641 | 704.857,617 | 4.644.714,193 | 430,814 | CA |
| 11642 | 704.874,893 | 4.644.718,462 | 431,099 | CA |
| 11643 | 708.397,060 | 4.644.499,450 | 370,060 | |
| 11644 | 705.523,498 | 4.645.332,179 | 391,854 | CA |
| 11645 | 705.504,728 | 4.645.082,408 | 391,936 | CA |
| 11646 | 705.507,859 | 4.645.142,587 | 392,022 | CA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11647 | 705.512,402 | 4.645.209,019 | 391,858 | CA |
| 11648 | 708.421,150 | 4.644.492,070 | 369,990 | |
| 11649 | 705.514,254 | 4.645.257,817 | 391,982 | CA |
| 11650 | 705.558,010 | 4.645.341,033 | 391,730 | CA |
| 11651 | 708.916,580 | 4.644.490,650 | 365,890 | |
| 11652 | 705.885,295 | 4.645.123,080 | 384,455 | CA |
| 11653 | 708.939,300 | 4.644.491,700 | 365,710 | |
| 11654 | 708.941,620 | 4.644.496,030 | 365,430 | |
| 11655 | 708.953,390 | 4.644.494,930 | 365,740 | |
| 11656 | 708.956,620 | 4.644.498,810 | 365,510 | |
| 11657 | 705.545,429 | 4.645.090,316 | 391,942 | CA |
| 11658 | 708.970,720 | 4.644.500,480 | 365,380 | |
| 11659 | 708.980,340 | 4.644.499,530 | 365,530 | |
| 11660 | 705.559,983 | 4.645.273,703 | 391,929 | CA |
| 11661 | 705.562,356 | 4.645.317,803 | 391,902 | CA |
| 11662 | 705.752,519 | 4.645.192,270 | 386,833 | CA |
| 11663 | 709.012,850 | 4.644.506,690 | 365,030 | |
| 11664 | 704.279,245 | 4.644.440,332 | 435,383 | CA |
| 11665 | 709.022,220 | 4.644.512,110 | 364,980 | |
| 11666 | 705.654,024 | 4.645.435,746 | 389,284 | CA |
| 11667 | 709.052,280 | 4.644.513,230 | 365,010 | |
| 11668 | 709.060,190 | 4.644.517,770 | 365,800 | |
| 11669 | 705.671,125 | 4.645.445,647 | 389,028 | CA |
| 11670 | 705.815,519 | 4.645.482,963 | 387,772 | CA |
| 11671 | 708.290,340 | 4.644.545,810 | 372,210 | |
| 11672 | 708.318,440 | 4.644.533,200 | 371,770 | |
| 11673 | 708.315,230 | 4.644.533,900 | 371,670 | |
| 11674 | 705.926,892 | 4.645.471,596 | 384,175 | CA |
| 11675 | 708.318,020 | 4.644.537,770 | 371,680 | |
| 11676 | 705.876,101 | 4.645.478,065 | 387,786 | CA |
| 11677 | 705.900,821 | 4.645.461,815 | 384,568 | CA |
| 11678 | 708.301,950 | 4.644.540,050 | 371,740 | |
| 11679 | 705.825,569 | 4.645.485,893 | 387,821 | CA |
| 11680 | 708.343,880 | 4.644.522,590 | 371,020 | |
| 11681 | 708.347,770 | 4.644.519,900 | 371,180 | |
| 11682 | 708.349,310 | 4.644.519,320 | 371,270 | |
| 11683 | 706.016,125 | 4.645.216,611 | 382,943 | CA |
| 11684 | 705.191,141 | 4.644.665,027 | 424,141 | CA |
| 11685 | 706.124,664 | 4.645.272,236 | 382,312 | CA |
| 11686 | 708.336,320 | 4.644.531,370 | 371,090 | |
| 11687 | 708.361,210 | 4.644.519,420 | 370,590 | |
| 11688 | 706.115,296 | 4.645.272,911 | 381,286 | CA |
| 11689 | 705.944,985 | 4.645.179,435 | 382,791 | CA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11690 | 705.914,285 | 4.645.208,694 | 383,516 | CA |
| 11691 | 706.062,871 | 4.645.257,916 | 382,511 | CA |
| 11692 | 709.113,110 | 4.644.535,730 | 365,030 | |
| 11693 | 709.119,720 | 4.644.538,750 | 365,510 | |
| 11694 | 709.118,480 | 4.644.540,860 | 365,050 | |
| 11695 | 705.945,236 | 4.645.224,102 | 383,370 | CA |
| 11696 | 705.933,372 | 4.645.223,681 | 383,477 | CA |
| 11697 | 705.928,233 | 4.645.227,639 | 383,729 | CA |
| 11698 | 708.264,880 | 4.644.557,240 | 372,290 | |
| 11699 | 705.887,432 | 4.645.226,024 | 384,531 | CA |
| 11700 | 708.261,010 | 4.644.563,340 | 372,910 | |
| 11701 | 708.264,020 | 4.644.563,540 | 373,010 | |
| 11702 | 704.898,259 | 4.644.720,890 | 431,262 | CA |
| 11703 | 704.919,202 | 4.644.721,581 | 431,156 | CA |
| 11704 | 705.522,234 | 4.645.308,952 | 391,883 | CA |
| 11705 | 708.295,810 | 4.644.547,790 | 372,900 | |
| 11706 | 705.559,369 | 4.645.365,163 | 392,257 | CA |
| 11707 | 708.277,460 | 4.644.556,130 | 372,240 | |
| 11708 | 709.122,820 | 4.644.548,190 | 364,920 | |
| 11709 | 705.555,725 | 4.645.299,993 | 391,877 | CA |
| 11710 | 709.131,030 | 4.644.559,240 | 364,750 | |
| 11711 | 705.553,315 | 4.645.254,350 | 391,761 | CA |
| 11712 | 705.552,182 | 4.645.232,648 | 391,612 | CA |
| 11713 | 708.126,480 | 4.644.584,120 | 375,400 | |
| 11714 | 705.764,691 | 4.645.195,519 | 386,749 | CA |
| 11715 | 705.898,402 | 4.645.481,491 | 386,068 | CA |
| 11716 | 708.130,030 | 4.644.586,560 | 375,280 | |
| 11717 | 708.131,910 | 4.644.591,300 | 374,980 | |
| 11718 | 706.307,943 | 4.645.789,356 | 384,165 | CA |
| 11719 | 708.133,260 | 4.644.598,150 | 374,570 | |
| 11720 | 706.313,220 | 4.645.790,948 | 384,101 | CA |
| 11721 | 708.135,330 | 4.644.595,520 | 374,750 | |
| 11722 | 708.135,730 | 4.644.600,340 | 374,520 | |
| 11723 | 707.316,045 | 4.644.250,088 | 382,706 | CA |
| 11724 | 711.066,925 | 4.647.364,551 | 343,719 | CA |
| 11725 | 710.432,985 | 4.647.550,425 | 346,697 | CA |
| 11726 | 708.201,620 | 4.644.582,810 | 373,580 | |
| 11727 | 705.698,203 | 4.645.461,134 | 389,020 | CA |
| 11728 | 705.745,725 | 4.645.475,260 | 388,690 | CA |
| 11729 | 705.766,235 | 4.645.480,587 | 388,572 | CA |
| 11730 | 705.858,461 | 4.645.462,999 | 386,153 | CA |
| 11731 | 705.914,533 | 4.645.474,559 | 384,470 | CA |
| 11732 | 705.906,842 | 4.645.475,638 | 384,834 | CA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11733 | 705.895,166 | 4.645.479,088 | 386,460 | CA |
| 11734 | 705.881,126 | 4.645.477,825 | 387,754 | CA |
| 11735 | 705.824,563 | 4.645.489,840 | 388,062 | CA |
| 11736 | 708.219,210 | 4.644.580,730 | 373,610 | |
| 11737 | 709.146,990 | 4.644.577,010 | 364,710 | |
| 11738 | 709.149,540 | 4.644.585,770 | 364,710 | |
| 11739 | 709.150,490 | 4.644.588,860 | 364,400 | |
| 11740 | 709.151,600 | 4.644.591,350 | 363,720 | |
| 11741 | 709.156,900 | 4.644.590,680 | 364,640 | |
| 11742 | 705.991,016 | 4.645.211,051 | 383,042 | CA |
| 11743 | 709.157,150 | 4.644.599,540 | 363,760 | |
| 11744 | 705.950,288 | 4.645.213,533 | 383,375 | CA |
| 11745 | 708.160,200 | 4.644.601,810 | 373,450 | |
| 11746 | 708.156,020 | 4.644.608,880 | 373,490 | |
| 11747 | 705.949,257 | 4.645.189,199 | 382,794 | CA |
| 11748 | 709.164,170 | 4.644.607,750 | 363,670 | |
| 11749 | 709.169,770 | 4.644.612,700 | 363,660 | |
| 11750 | 709.174,300 | 4.644.611,760 | 363,680 | |
| 11751 | 706.093,787 | 4.645.269,411 | 382,387 | CA |
| 11752 | 709.176,200 | 4.644.612,910 | 364,550 | |
| 11753 | 706.064,824 | 4.645.255,593 | 382,516 | CA |
| 11754 | 709.176,880 | 4.644.617,560 | 363,960 | |
| 11755 | 709.179,460 | 4.644.616,070 | 364,450 | |
| 11756 | 706.004,711 | 4.645.228,995 | 382,729 | CA |
| 11757 | 706.002,060 | 4.645.231,601 | 382,720 | CA |
| 11758 | 705.960,243 | 4.645.224,746 | 383,342 | CA |
| 11759 | 705.959,492 | 4.645.227,375 | 383,302 | CA |
| 11760 | 705.932,136 | 4.645.226,919 | 383,375 | CA |
| 11761 | 709.191,820 | 4.644.627,660 | 364,330 | |
| 11762 | 709.197,430 | 4.644.632,770 | 364,210 | |
| 11763 | 705.876,739 | 4.645.225,279 | 385,163 | CA |
| 11764 | 709.203,740 | 4.644.637,190 | 364,190 | |
| 11765 | 709.208,110 | 4.644.637,230 | 364,170 | |
| 11766 | 704.827,158 | 4.644.705,512 | 430,572 | CA |
| 11767 | 709.226,770 | 4.644.650,290 | 364,110 | |
| 11768 | 709.237,250 | 4.644.661,900 | 364,090 | |
| 11769 | 705.516,549 | 4.645.204,692 | 391,706 | CA |
| 11770 | 709.255,180 | 4.644.676,150 | 363,900 | |
| 11771 | 709.263,050 | 4.644.677,700 | 363,850 | |
| 11772 | 705.510,222 | 4.645.183,410 | 391,950 | CA |
| 11773 | 709.269,580 | 4.644.682,510 | 363,140 | |
| 11774 | 709.267,140 | 4.644.684,810 | 363,050 | |
| 11775 | 709.267,120 | 4.644.683,290 | 363,630 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11776 | 709.268,800 | 4.644.683,670 | 363,050 | |
| 11777 | 705.885,966 | 4.645.135,934 | 384,153 | CA |
| 11778 | 705.893,370 | 4.645.137,943 | 383,916 | CA |
| 11779 | 709.274,180 | 4.644.689,620 | 363,000 | |
| 11780 | 709.277,160 | 4.644.688,510 | 362,990 | |
| 11781 | 705.551,896 | 4.645.122,406 | 391,800 | CA |
| 11782 | 709.292,140 | 4.644.700,020 | 362,970 | |
| 11783 | 705.564,095 | 4.645.342,129 | 391,898 | CA |
| 11784 | 709.295,770 | 4.644.705,290 | 362,860 | |
| 11785 | 709.299,320 | 4.644.704,700 | 362,820 | |
| 11786 | 709.298,090 | 4.644.703,990 | 362,910 | |
| 11787 | 705.606,536 | 4.645.226,176 | 390,202 | CA |
| 11788 | 705.642,421 | 4.645.225,834 | 390,220 | CA |
| 11789 | 709.309,540 | 4.644.712,730 | 362,600 | |
| 11790 | 709.313,840 | 4.644.719,600 | 362,720 | |
| 11791 | 705.727,035 | 4.645.465,642 | 388,784 | CA |
| 11792 | 709.315,090 | 4.644.721,930 | 362,590 | |
| 11793 | 705.748,116 | 4.645.471,058 | 388,676 | CA |
| 11794 | 709.321,280 | 4.644.720,970 | 362,450 | |
| 11795 | 705.874,026 | 4.645.458,769 | 385,525 | CA |
| 11796 | 705.900,726 | 4.645.461,774 | 384,590 | CA |
| 11797 | 705.898,570 | 4.645.448,703 | 385,468 | CA |
| 11798 | 709.324,750 | 4.644.727,320 | 362,500 | |
| 11799 | 709.326,240 | 4.644.726,750 | 362,570 | |
| 11800 | 713.281,293 | 4.644.355,773 | 343,235 | CA |
| 11801 | 709.328,720 | 4.644.729,590 | 362,420 | |
| 11802 | 713.682,003 | 4.645.007,126 | 327,200 | CABEZA |
| 11803 | 709.333,820 | 4.644.730,570 | 362,440 | |
| 11804 | 713.502,207 | 4.645.102,884 | 327,750 | CABEZA |
| 11805 | 709.340,770 | 4.644.736,710 | 362,460 | |
| 11806 | 713.450,975 | 4.645.047,862 | 327,410 | CABEZA |
| 11807 | 709.352,340 | 4.644.744,140 | 362,340 | |
| 11808 | 709.357,460 | 4.644.744,720 | 362,310 | |
| 11809 | 709.361,660 | 4.644.750,410 | 362,330 | |
| 11810 | 709.371,530 | 4.644.753,270 | 362,200 | |
| 11811 | 709.373,120 | 4.644.757,740 | 362,140 | |
| 11812 | 709.380,660 | 4.644.758,840 | 362,090 | |
| 11813 | 709.387,340 | 4.644.765,470 | 362,090 | |
| 11814 | 712.614,984 | 4.644.820,510 | 338,360 | CABEZA |
| 11815 | 709.399,600 | 4.644.772,180 | 362,060 | |
| 11816 | 709.406,760 | 4.644.774,370 | 362,090 | |
| 11817 | 709.412,540 | 4.644.780,290 | 362,090 | |
| 11818 | 709.420,240 | 4.644.781,350 | 362,000 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11819 | 709.427,250 | 4.644.788,470 | 361,940 | |
| 11820 | 709.435,070 | 4.644.790,710 | 361,950 | |
| 11821 | 709.441,550 | 4.644.797,590 | 361,840 | |
| 11822 | 709.448,800 | 4.644.799,030 | 361,910 | |
| 11823 | 713.817,522 | 4.644.208,433 | 336,370 | CABEZA |
| 11824 | 714.146,946 | 4.644.679,130 | 325,180 | CABEZA |
| 11825 | 709.460,550 | 4.644.808,560 | 361,820 | |
| 11826 | 709.462,600 | 4.644.806,990 | 361,820 | |
| 11827 | 709.465,660 | 4.644.809,260 | 361,830 | |
| 11828 | 713.817,326 | 4.644.875,364 | 325,920 | CABEZA |
| 11829 | 712.508,399 | 4.645.003,551 | 340,940 | CABEZA |
| 11830 | 709.466,790 | 4.644.812,230 | 361,860 | |
| 11831 | 709.470,790 | 4.644.812,020 | 361,830 | |
| 11832 | 709.461,060 | 4.644.817,080 | 361,810 | |
| 11833 | 711.557,649 | 4.646.513,854 | 339,560 | CABEZA |
| 11834 | 711.552,431 | 4.646.540,029 | 340,850 | CABEZA |
| 11835 | 709.478,510 | 4.644.818,360 | 361,780 | |
| 11836 | 709.484,510 | 4.644.819,530 | 361,790 | |
| 11837 | 711.549,726 | 4.646.571,213 | 341,550 | CABEZA |
| 11838 | 709.450,850 | 4.644.834,690 | 361,160 | |
| 11839 | 711.552,352 | 4.646.595,047 | 343,150 | CABEZA |
| 11840 | 711.553,601 | 4.646.616,394 | 344,340 | CABEZA |
| 11841 | 711.582,274 | 4.646.498,069 | 338,330 | CABEZA |
| 11842 | 711.695,777 | 4.646.479,260 | 336,690 | CABEZA |
| 11843 | 711.702,986 | 4.646.437,538 | 335,780 | CABEZA |
| 11844 | 709.449,630 | 4.644.843,720 | 360,570 | |
| 11845 | 709.456,410 | 4.644.823,500 | 361,120 | |
| 11846 | 711.858,779 | 4.646.458,428 | 334,920 | CABEZA |
| 11847 | 711.770,961 | 4.646.472,075 | 335,830 | CABEZA |
| 11848 | 711.762,945 | 4.646.468,115 | 335,840 | CABEZA |
| 11849 | 711.785,225 | 4.646.479,357 | 335,860 | CABEZA |
| 11850 | 711.214,674 | 4.646.967,593 | 350,830 | CABEZA |
| 11851 | 709.500,670 | 4.644.829,990 | 361,740 | |
| 11852 | 711.155,658 | 4.646.870,675 | 350,750 | CABEZA |
| 11853 | 709.513,740 | 4.644.835,250 | 361,710 | |
| 11854 | 709.513,830 | 4.644.836,700 | 361,720 | |
| 11855 | 709.519,540 | 4.644.837,580 | 361,690 | |
| 11856 | 711.055,680 | 4.646.776,423 | 349,900 | CABEZA |
| 11857 | 711.037,214 | 4.646.753,588 | 348,560 | CABEZA |
| 11858 | 709.525,400 | 4.644.841,410 | 361,680 | |
| 11859 | 709.531,910 | 4.644.843,960 | 361,610 | |
| 11860 | 709.532,080 | 4.644.846,940 | 361,660 | |
| 11861 | 709.540,080 | 4.644.849,040 | 361,560 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11862 | 710.980,189 | 4.646.695,792 | 343,490 | CABEZA |
| 11863 | 710.980,604 | 4.646.678,455 | 342,200 | CABEZA |
| 11864 | 710.979,391 | 4.646.675,033 | 342,200 | CABEZA |
| 11865 | 709.442,570 | 4.644.861,540 | 360,500 | |
| 11866 | 710.959,074 | 4.646.664,429 | 342,210 | CABEZA |
| 11867 | 709.438,620 | 4.644.868,900 | 360,560 | |
| 11868 | 709.436,220 | 4.644.873,200 | 360,260 | |
| 11869 | 709.435,690 | 4.644.874,660 | 360,240 | |
| 11870 | 709.432,850 | 4.644.875,350 | 360,330 | |
| 11871 | 710.037,123 | 4.646.915,981 | 344,530 | CABEZA |
| 11872 | 709.539,080 | 4.644.851,150 | 361,580 | |
| 11873 | 709.960,663 | 4.646.930,747 | 345,190 | CABEZA |
| 11874 | 709.543,670 | 4.644.854,520 | 361,090 | |
| 11875 | 709.544,510 | 4.644.854,570 | 360,980 | |
| 11876 | 709.546,360 | 4.644.852,910 | 360,920 | |
| 11877 | 709.550,420 | 4.644.853,820 | 360,650 | |
| 11878 | 709.671,836 | 4.646.820,909 | 351,990 | CABEZA |
| 11879 | 709.551,540 | 4.644.856,090 | 360,610 | |
| 11880 | 709.549,880 | 4.644.857,720 | 360,580 | |
| 11881 | 709.556,890 | 4.644.859,240 | 360,610 | |
| 11882 | 709.556,430 | 4.644.862,890 | 360,620 | |
| 11883 | 709.563,770 | 4.644.863,960 | 360,620 | |
| 11884 | 709.563,260 | 4.644.867,230 | 360,590 | |
| 11885 | 709.572,850 | 4.644.870,460 | 360,590 | |
| 11886 | 709.572,220 | 4.644.872,990 | 360,620 | |
| 11887 | 709.428,480 | 4.644.886,380 | 360,200 | |
| 11888 | 709.482,032 | 4.646.511,581 | 350,770 | CABEZA |
| 11889 | 709.481,994 | 4.646.511,304 | 350,660 | CABEZA |
| 11890 | 709.480,640 | 4.646.500,915 | 351,090 | CABEZA |
| 11891 | 709.475,461 | 4.646.507,238 | 351,120 | CABEZA |
| 11892 | 709.460,204 | 4.646.498,435 | 350,990 | CABEZA |
| 11893 | 709.274,473 | 4.646.260,050 | 352,240 | CABEZA |
| 11894 | 709.598,030 | 4.644.892,790 | 360,550 | |
| 11895 | 709.611,530 | 4.644.898,000 | 360,550 | |
| 11896 | 709.609,530 | 4.644.901,500 | 360,540 | |
| 11897 | 709.617,740 | 4.644.903,100 | 360,540 | |
| 11898 | 710.458,139 | 4.646.188,772 | 342,890 | CABEZA |
| 11899 | 710.503,471 | 4.646.181,162 | 342,380 | CABEZA |
| 11900 | 708.003,840 | 4.644.918,470 | 372,770 | |
| 11901 | 708.020,510 | 4.644.928,770 | 372,840 | |
| 11902 | 710.555,685 | 4.646.189,990 | 342,060 | CABEZA |
| 11903 | 710.681,314 | 4.646.186,472 | 341,540 | CABEZA |
| 11904 | 709.417,710 | 4.644.918,150 | 360,000 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11905 | 710.730,428 | 4.646.181,696 | 340,950 | CABEZA |
| 11906 | 710.734,501 | 4.646.192,384 | 341,000 | CABEZA |
| 11907 | 710.784,840 | 4.646.187,183 | 340,300 | CABEZA |
| 11908 | 710.780,857 | 4.646.178,267 | 340,320 | CABEZA |
| 11909 | 709.410,820 | 4.644.929,400 | 359,850 | |
| 11910 | 710.932,464 | 4.646.165,245 | 339,190 | CABEZA |
| 11911 | 709.629,190 | 4.644.915,690 | 360,410 | |
| 11912 | 709.015,365 | 4.646.110,588 | 353,600 | CABEZA |
| 11913 | 709.016,942 | 4.646.097,402 | 353,570 | CABEZA |
| 11914 | 708.755,754 | 4.646.082,039 | 355,120 | CABEZA |
| 11915 | 708.421,278 | 4.646.054,452 | 357,980 | CABEZA |
| 11916 | 709.642,540 | 4.644.925,890 | 360,360 | |
| 11917 | 709.650,800 | 4.644.928,960 | 360,340 | |
| 11918 | 709.650,940 | 4.644.931,970 | 360,320 | |
| 11919 | 708.033,290 | 4.644.937,360 | 372,810 | |
| 11920 | 708.050,390 | 4.644.945,110 | 372,710 | |
| 11921 | 708.063,320 | 4.644.952,560 | 370,590 | |
| 11922 | 707.823,258 | 4.646.042,672 | 365,530 | CABEZA |
| 11923 | 707.713,580 | 4.646.038,402 | 364,760 | CABEZA |
| 11924 | 707.620,651 | 4.646.035,547 | 365,460 | CABEZA |
| 11925 | 707.585,349 | 4.645.996,922 | 365,580 | CABEZA |
| 11926 | 707.603,128 | 4.645.998,331 | 364,390 | CABEZA |
| 11927 | 707.601,385 | 4.645.802,703 | 364,210 | CABEZA |
| 11928 | 709.657,530 | 4.644.933,150 | 360,360 | |
| 11929 | 707.619,661 | 4.645.735,565 | 365,450 | CABEZA |
| 11930 | 707.618,273 | 4.645.703,357 | 365,760 | CABEZA |
| 11931 | 709.672,960 | 4.644.943,870 | 360,350 | |
| 11932 | 709.673,100 | 4.644.947,000 | 360,250 | |
| 11933 | 707.624,321 | 4.645.667,458 | 365,960 | CABEZA |
| 11934 | 709.682,360 | 4.644.949,700 | 360,530 | |
| 11935 | 707.615,037 | 4.645.590,692 | 366,710 | CABEZA |
| 11936 | 707.629,038 | 4.645.586,143 | 366,590 | CABEZA |
| 11937 | 709.690,130 | 4.644.954,440 | 359,900 | |
| 11938 | 708.087,750 | 4.644.962,940 | 370,620 | |
| 11939 | 708.099,670 | 4.644.968,180 | 370,610 | |
| 11940 | 708.108,040 | 4.644.970,690 | 370,630 | |
| 11941 | 708.119,070 | 4.644.975,090 | 370,620 | |
| 11942 | 708.134,490 | 4.644.981,980 | 370,600 | |
| 11943 | 708.146,930 | 4.644.986,470 | 370,620 | |
| 11944 | 707.631,416 | 4.645.217,977 | 369,330 | CABEZA |
| 11945 | 707.629,767 | 4.645.128,734 | 369,770 | CABEZA |
| 11946 | 708.454,980 | 4.644.985,300 | 368,030 | |
| 11947 | 708.445,490 | 4.644.986,630 | 368,070 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11948 | 707.668,980 | 4.644.959,377 | 371,510 | CABEZA |
| 11949 | 707.652,907 | 4.644.976,558 | 371,520 | CABEZA |
| 11950 | 707.732,984 | 4.644.980,832 | 369,210 | CABEZA |
| 11951 | 708.505,440 | 4.644.984,350 | 367,190 | |
| 11952 | 708.517,060 | 4.644.983,200 | 367,240 | |
| 11953 | 708.527,740 | 4.644.983,720 | 367,220 | |
| 11954 | 707.966,607 | 4.645.018,571 | 367,780 | CABEZA |
| 11955 | 707.975,190 | 4.645.033,751 | 368,770 | CABEZA |
| 11956 | 709.400,000 | 4.644.960,630 | 359,800 | |
| 11957 | 708.029,854 | 4.645.027,924 | 370,880 | CABEZA |
| 11958 | 709.392,960 | 4.644.967,270 | 359,840 | |
| 11959 | 708.046,430 | 4.645.012,518 | 370,690 | CABEZA |
| 11960 | 708.038,739 | 4.645.008,719 | 370,690 | CABEZA |
| 11961 | 709.390,010 | 4.644.972,830 | 359,710 | |
| 11962 | 709.393,100 | 4.644.970,290 | 359,780 | |
| 11963 | 708.379,728 | 4.645.093,379 | 369,430 | CABEZA |
| 11964 | 709.390,370 | 4.644.977,550 | 359,720 | |
| 11965 | 709.394,090 | 4.644.973,620 | 359,290 | |
| 11966 | 709.393,050 | 4.644.975,850 | 359,700 | |
| 11967 | 709.397,810 | 4.644.974,220 | 359,620 | |
| 11968 | 708.525,077 | 4.645.122,609 | 364,560 | CABEZA |
| 11969 | 708.592,264 | 4.645.137,698 | 362,770 | CABEZA |
| 11970 | 709.389,720 | 4.644.982,560 | 359,750 | |
| 11971 | 709.690,280 | 4.644.957,450 | 359,860 | |
| 11972 | 709.700,590 | 4.644.959,330 | 360,170 | |
| 11973 | 709.701,730 | 4.644.960,470 | 360,000 | |
| 11974 | 708.827,376 | 4.645.221,700 | 358,800 | CABEZA |
| 11975 | 709.701,120 | 4.644.962,670 | 360,040 | |
| 11976 | 709.704,740 | 4.644.961,470 | 359,950 | |
| 11977 | 709.706,350 | 4.644.964,400 | 359,900 | |
| 11978 | 708.595,731 | 4.645.531,755 | 358,730 | CABEZA |
| 11979 | 708.425,652 | 4.645.737,170 | 360,720 | CABEZA |
| 11980 | 709.736,850 | 4.644.976,470 | 359,760 | |
| 11981 | 709.733,020 | 4.644.978,900 | 359,710 | |
| 11982 | 709.734,800 | 4.644.979,250 | 359,680 | |
| 11983 | 709.752,880 | 4.644.983,400 | 359,720 | |
| 11984 | 709.755,030 | 4.644.987,600 | 359,670 | |
| 11985 | 709.016,939 | 4.645.195,276 | 360,090 | CABEZA |
| 11986 | 708.981,176 | 4.645.192,729 | 360,130 | CABEZA |
| 11987 | 708.177,540 | 4.644.999,060 | 370,630 | |
| 11988 | 708.939,297 | 4.645.183,994 | 359,790 | CABEZA |
| 11989 | 708.196,590 | 4.645.002,190 | 370,650 | |
| 11990 | 708.946,541 | 4.645.191,907 | 359,150 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 11991 | 708.936,060 | 4.645.187,664 | 358,980 | CABEZA |
| 11992 | 708.230,950 | 4.644.998,210 | 369,510 | |
| 11993 | 708.257,450 | 4.644.995,700 | 369,470 | |
| 11994 | 708.271,390 | 4.644.995,400 | 369,220 | |
| 11995 | 708.824,971 | 4.645.168,994 | 358,810 | CABEZA |
| 11996 | 708.297,900 | 4.644.993,590 | 369,250 | |
| 11997 | 708.309,270 | 4.644.991,760 | 368,870 | |
| 11998 | 708.856,317 | 4.645.018,131 | 360,970 | CABEZA |
| 11999 | 708.916,352 | 4.644.919,951 | 364,090 | CABEZA |
| 12000 | 708.906,365 | 4.644.920,752 | 364,070 | CABEZA |
| 12001 | 708.988,564 | 4.644.749,071 | 364,340 | CABEZA |
| 12002 | 708.978,633 | 4.644.763,131 | 364,430 | CABEZA |
| 12003 | 709.009,995 | 4.644.720,450 | 364,370 | CABEZA |
| 12004 | 709.022,553 | 4.644.703,208 | 364,390 | CABEZA |
| 12005 | 709.051,272 | 4.644.641,295 | 364,390 | CABEZA |
| 12006 | 708.417,730 | 4.644.987,200 | 368,050 | |
| 12007 | 709.094,403 | 4.644.556,244 | 364,790 | CABEZA |
| 12008 | 708.606,510 | 4.644.995,240 | 361,880 | |
| 12009 | 708.617,520 | 4.644.997,490 | 361,880 | |
| 12010 | 708.634,260 | 4.644.999,560 | 361,920 | |
| 12011 | 709.094,541 | 4.644.532,874 | 364,860 | CABEZA |
| 12012 | 709.066,279 | 4.644.330,952 | 365,060 | CABEZA |
| 12013 | 708.673,080 | 4.645.011,530 | 360,890 | |
| 12014 | 709.501,162 | 4.645.453,910 | 357,510 | CABEZA |
| 12015 | 709.505,060 | 4.645.444,908 | 357,410 | CABEZA |
| 12016 | 709.486,027 | 4.645.417,552 | 357,840 | CABEZA |
| 12017 | 709.382,500 | 4.645.000,670 | 359,710 | |
| 12018 | 709.462,958 | 4.645.396,247 | 358,220 | CABEZA |
| 12019 | 709.378,630 | 4.645.007,980 | 359,740 | |
| 12020 | 709.419,054 | 4.645.331,207 | 358,850 | CABEZA |
| 12021 | 709.422,659 | 4.645.321,375 | 358,830 | CABEZA |
| 12022 | 709.394,507 | 4.645.291,971 | 359,380 | CABEZA |
| 12023 | 709.768,440 | 4.644.992,900 | 359,550 | |
| 12024 | 709.766,650 | 4.644.992,600 | 359,900 | |
| 12025 | 709.769,190 | 4.644.990,940 | 359,610 | |
| 12026 | 709.446,546 | 4.645.263,438 | 358,770 | CABEZA |
| 12027 | 709.786,910 | 4.645.001,880 | 359,490 | |
| 12028 | 709.460,324 | 4.645.276,802 | 358,380 | CABEZA |
| 12029 | 709.798,810 | 4.645.008,510 | 359,540 | |
| 12030 | 709.524,614 | 4.645.275,767 | 357,670 | CABEZA |
| 12031 | 709.547,056 | 4.645.290,603 | 357,260 | CABEZA |
| 12032 | 709.599,013 | 4.645.291,779 | 356,380 | CABEZA |
| 12033 | 708.346,950 | 4.645.039,820 | 369,200 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12034 | 709.622,634 | 4.645.303,259 | 356,020 | CABEZA |
| 12035 | 709.624,350 | 4.645.295,122 | 355,950 | CABEZA |
| 12036 | 709.639,436 | 4.645.308,279 | 355,700 | CABEZA |
| 12037 | 708.707,190 | 4.645.037,870 | 360,360 | |
| 12038 | 709.367,590 | 4.645.029,630 | 359,760 | |
| 12039 | 709.367,780 | 4.645.034,210 | 359,780 | |
| 12040 | 709.363,960 | 4.645.037,910 | 359,790 | |
| 12041 | 709.364,910 | 4.645.041,260 | 359,800 | |
| 12042 | 709.375,360 | 4.645.015,800 | 359,730 | |
| 12043 | 709.372,130 | 4.645.018,550 | 359,770 | |
| 12044 | 709.810,191 | 4.645.337,442 | 357,610 | CABEZA |
| 12045 | 708.347,070 | 4.645.050,280 | 369,200 | |
| 12046 | 709.816,900 | 4.645.329,367 | 357,680 | CABEZA |
| 12047 | 709.815,165 | 4.645.328,002 | 357,780 | CABEZA |
| 12048 | 708.728,060 | 4.645.054,980 | 360,050 | |
| 12049 | 709.948,415 | 4.645.345,574 | 357,140 | CABEZA |
| 12050 | 709.998,784 | 4.645.359,485 | 356,730 | CABEZA |
| 12051 | 710.148,589 | 4.645.404,044 | 355,820 | CABEZA |
| 12052 | 709.360,110 | 4.645.047,310 | 359,810 | |
| 12053 | 710.168,559 | 4.645.412,337 | 355,780 | CABEZA |
| 12054 | 710.174,144 | 4.645.411,409 | 355,650 | CABEZA |
| 12055 | 710.363,690 | 4.645.444,916 | 354,990 | CABEZA |
| 12056 | 710.370,197 | 4.645.439,241 | 355,000 | CABEZA |
| 12057 | 710.404,865 | 4.645.454,443 | 354,590 | CABEZA |
| 12058 | 708.747,180 | 4.645.075,530 | 360,040 | |
| 12059 | 710.672,976 | 4.645.475,121 | 352,770 | CABEZA |
| 12060 | 708.759,310 | 4.645.093,030 | 360,000 | |
| 12061 | 710.705,222 | 4.645.477,921 | 352,660 | CABEZA |
| 12062 | 710.747,312 | 4.645.496,314 | 352,490 | CABEZA |
| 12063 | 710.800,354 | 4.645.503,764 | 351,900 | CABEZA |
| 12064 | 709.348,570 | 4.645.079,150 | 359,810 | |
| 12065 | 709.344,420 | 4.645.083,470 | 359,830 | |
| 12066 | 709.344,580 | 4.645.088,150 | 359,810 | |
| 12067 | 708.398,340 | 4.645.111,210 | 367,900 | |
| 12068 | 711.672,161 | 4.645.468,834 | 342,870 | CABEZA |
| 12069 | 708.779,410 | 4.645.105,520 | 359,910 | |
| 12070 | 708.783,390 | 4.645.106,300 | 360,080 | |
| 12071 | 708.785,440 | 4.645.108,210 | 359,900 | |
| 12072 | 711.337,206 | 4.645.692,346 | 348,720 | CABEZA |
| 12073 | 711.322,623 | 4.645.685,821 | 348,680 | CABEZA |
| 12074 | 711.325,301 | 4.645.696,219 | 348,170 | CABEZA |
| 12075 | 711.333,785 | 4.645.694,271 | 348,120 | CABEZA |
| 12076 | 708.786,520 | 4.645.110,720 | 359,840 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12077 | 708.787,790 | 4.645.110,590 | 359,760 | |
| 12078 | 711.403,430 | 4.645.773,607 | 342,930 | CABEZA |
| 12079 | 708.790,200 | 4.645.115,380 | 359,740 | |
| 12080 | 708.795,800 | 4.645.118,690 | 359,810 | |
| 12081 | 708.791,770 | 4.645.121,510 | 359,770 | |
| 12082 | 711.554,438 | 4.645.790,865 | 341,000 | CABEZA |
| 12083 | 709.337,690 | 4.645.104,010 | 359,880 | |
| 12084 | 709.336,600 | 4.645.100,570 | 359,830 | |
| 12085 | 709.329,610 | 4.645.114,400 | 359,850 | |
| 12086 | 710.418,203 | 4.645.955,698 | 351,330 | CABEZA |
| 12087 | 709.329,940 | 4.645.120,850 | 359,860 | |
| 12088 | 708.410,370 | 4.645.146,170 | 365,990 | |
| 12089 | 708.415,920 | 4.645.142,570 | 366,000 | |
| 12090 | 708.415,700 | 4.645.148,010 | 366,110 | |
| 12091 | 709.325,180 | 4.645.129,680 | 359,850 | |
| 12092 | 709.325,450 | 4.645.131,670 | 359,850 | |
| 12093 | 709.322,080 | 4.645.134,690 | 359,860 | |
| 12094 | 709.322,220 | 4.645.139,890 | 359,840 | |
| 12095 | 709.318,150 | 4.645.144,490 | 359,880 | |
| 12096 | 708.407,120 | 4.645.166,930 | 366,690 | |
| 12097 | 708.411,020 | 4.645.176,290 | 366,690 | |
| 12098 | 709.317,470 | 4.645.151,550 | 359,900 | |
| 12099 | 710.020,379 | 4.645.748,707 | 351,940 | CABEZA |
| 12100 | 710.029,087 | 4.645.754,226 | 351,820 | CABEZA |
| 12101 | 710.002,540 | 4.645.779,374 | 350,560 | CABEZA |
| 12102 | 710.009,092 | 4.645.792,848 | 350,590 | CABEZA |
| 12103 | 709.310,420 | 4.645.161,720 | 359,850 | |
| 12104 | 709.314,380 | 4.645.158,260 | 359,870 | |
| 12105 | 709.294,810 | 4.645.166,000 | 360,210 | |
| 12106 | 709.298,670 | 4.645.165,370 | 360,060 | |
| 12107 | 707.570,029 | 4.644.965,219 | 374,090 | CABEZA |
| 12108 | 709.313,900 | 4.645.163,880 | 359,890 | |
| 12109 | 709.317,860 | 4.645.165,750 | 359,890 | |
| 12110 | 709.293,890 | 4.645.168,010 | 360,140 | |
| 12111 | 707.440,281 | 4.644.936,409 | 374,860 | CABEZA |
| 12112 | 707.455,497 | 4.644.928,035 | 375,110 | CABEZA |
| 12113 | 709.302,310 | 4.645.166,950 | 360,420 | |
| 12114 | 707.380,717 | 4.644.910,768 | 374,950 | CABEZA |
| 12115 | 709.302,890 | 4.645.178,130 | 359,780 | |
| 12116 | 709.318,850 | 4.645.172,300 | 359,860 | |
| 12117 | 708.403,830 | 4.645.181,820 | 366,660 | |
| 12118 | 708.407,700 | 4.645.189,140 | 366,710 | |
| 12119 | 708.400,540 | 4.645.195,930 | 366,610 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12120 | 709.298,770 | 4.645.178,450 | 359,730 | |
| 12121 | 707.245,487 | 4.644.903,426 | 374,330 | CABEZA |
| 12122 | 707.243,157 | 4.644.905,025 | 374,440 | CABEZA |
| 12123 | 709.310,580 | 4.645.196,500 | 359,710 | |
| 12124 | 707.235,595 | 4.644.892,302 | 374,700 | CABEZA |
| 12125 | 707.220,370 | 4.644.889,746 | 375,450 | CABEZA |
| 12126 | 707.208,910 | 4.644.902,143 | 375,410 | CABEZA |
| 12127 | 707.162,896 | 4.644.883,754 | 375,620 | CABEZA |
| 12128 | 707.171,367 | 4.644.895,113 | 375,580 | CABEZA |
| 12129 | 709.327,610 | 4.645.184,530 | 359,930 | |
| 12130 | 707.124,956 | 4.644.889,360 | 375,680 | CABEZA |
| 12131 | 709.335,460 | 4.645.196,930 | 359,560 | |
| 12132 | 707.010,863 | 4.644.864,046 | 376,670 | CABEZA |
| 12133 | 706.806,195 | 4.644.830,851 | 377,520 | CABEZA |
| 12134 | 708.407,180 | 4.645.207,980 | 366,710 | |
| 12135 | 708.394,280 | 4.645.221,520 | 367,850 | |
| 12136 | 706.793,715 | 4.644.831,973 | 377,820 | CABEZA |
| 12137 | 706.575,452 | 4.644.835,701 | 379,000 | CABEZA |
| 12138 | 706.567,715 | 4.644.824,912 | 378,890 | CABEZA |
| 12139 | 709.324,460 | 4.645.212,570 | 359,540 | |
| 12140 | 706.395,446 | 4.644.851,053 | 380,020 | CABEZA |
| 12141 | 709.351,530 | 4.645.221,910 | 359,780 | |
| 12142 | 706.360,981 | 4.644.846,031 | 380,880 | CABEZA |
| 12143 | 706.293,283 | 4.644.857,090 | 381,560 | CABEZA |
| 12144 | 708.376,130 | 4.645.253,490 | 367,770 | |
| 12145 | 706.285,267 | 4.644.880,343 | 381,630 | CABEZA |
| 12146 | 706.239,833 | 4.644.879,074 | 382,280 | CABEZA |
| 12147 | 706.208,050 | 4.644.913,304 | 382,270 | CABEZA |
| 12148 | 708.367,660 | 4.645.265,900 | 367,810 | |
| 12149 | 708.359,720 | 4.645.276,890 | 367,760 | |
| 12150 | 708.342,810 | 4.645.294,210 | 367,620 | |
| 12151 | 706.145,876 | 4.644.926,839 | 382,930 | CABEZA |
| 12152 | 706.152,844 | 4.644.944,872 | 382,870 | CABEZA |
| 12153 | 708.325,290 | 4.645.320,320 | 367,260 | |
| 12154 | 708.313,680 | 4.645.333,250 | 367,280 | |
| 12155 | 708.305,910 | 4.645.343,180 | 367,360 | |
| 12156 | 708.298,970 | 4.645.349,660 | 367,260 | |
| 12157 | 708.292,070 | 4.645.356,690 | 367,270 | |
| 12158 | 708.286,700 | 4.645.364,460 | 367,340 | |
| 12159 | 706.250,875 | 4.645.165,977 | 381,260 | CABEZA |
| 12160 | 708.257,150 | 4.645.399,300 | 368,620 | |
| 12161 | 708.276,950 | 4.645.373,410 | 367,280 | |
| 12162 | 706.287,019 | 4.645.157,410 | 381,010 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12163 | 708.249,460 | 4.645.408,870 | 368,430 | |
| 12164 | 708.245,940 | 4.645.414,310 | 368,390 | |
| 12165 | 708.228,090 | 4.645.434,820 | 367,750 | |
| 12166 | 708.221,390 | 4.645.444,730 | 367,090 | |
| 12167 | 706.510,825 | 4.644.637,338 | 382,120 | CABEZA |
| 12168 | 706.545,893 | 4.644.626,816 | 382,080 | CABEZA |
| 12169 | 706.593,783 | 4.644.576,634 | 382,230 | CABEZA |
| 12170 | 708.192,840 | 4.645.488,360 | 365,830 | |
| 12171 | 708.185,790 | 4.645.511,250 | 365,520 | |
| 12172 | 708.182,580 | 4.645.523,820 | 365,430 | |
| 12173 | 708.178,830 | 4.645.541,840 | 365,180 | |
| 12174 | 708.176,220 | 4.645.558,720 | 365,000 | |
| 12175 | 706.873,981 | 4.644.459,512 | 382,880 | CABEZA |
| 12176 | 708.167,920 | 4.645.584,460 | 364,620 | |
| 12177 | 708.161,160 | 4.645.601,630 | 364,180 | |
| 12178 | 708.159,680 | 4.645.611,090 | 364,050 | |
| 12179 | 708.165,820 | 4.645.594,600 | 364,450 | |
| 12180 | 708.157,340 | 4.645.621,430 | 363,850 | |
| 12181 | 707.069,445 | 4.644.427,896 | 383,540 | CABEZA |
| 12182 | 707.157,392 | 4.644.421,053 | 382,360 | CABEZA |
| 12183 | 707.164,087 | 4.644.411,344 | 382,350 | CABEZA |
| 12184 | 708.146,390 | 4.645.672,920 | 362,520 | |
| 12185 | 707.249,587 | 4.644.302,781 | 383,710 | CABEZA |
| 12186 | 708.142,020 | 4.645.700,150 | 361,640 | |
| 12187 | 708.145,020 | 4.645.705,420 | 361,540 | |
| 12188 | 706.087,848 | 4.645.107,206 | 383,194 | |
| 12189 | 706.090,315 | 4.645.115,470 | 383,053 | |
| 12190 | 706.096,517 | 4.645.113,548 | 383,127 | |
| 12191 | 706.097,420 | 4.645.113,296 | 382,738 | |
| 12192 | 706.083,796 | 4.645.094,507 | 383,312 | |
| 12193 | 706.089,534 | 4.645.092,873 | 383,292 | |
| 12194 | 706.090,321 | 4.645.092,694 | 382,788 | |
| 12195 | 706.119,909 | 4.645.096,678 | 382,653 | |
| 12196 | 706.121,611 | 4.645.096,865 | 382,567 | |
| 12197 | 706.129,537 | 4.645.084,942 | 382,709 | |
| 12198 | 706.130,537 | 4.645.085,037 | 382,467 | |
| 12199 | 706.152,592 | 4.645.095,664 | 381,034 | |
| 12200 | 706.153,597 | 4.645.096,287 | 381,480 | |
| 12201 | 706.154,580 | 4.645.097,072 | 381,236 | |
| 12202 | 706.163,755 | 4.645.081,750 | 380,977 | |
| 12203 | 706.164,427 | 4.645.082,120 | 381,540 | |
| 12204 | 706.165,790 | 4.645.082,552 | 381,285 | |
| 12205 | 706.132,975 | 4.645.263,735 | 382,153 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12206 | 706.366,257 | 4.645.082,075 | 380,483 | |
| 12207 | 706.363,665 | 4.645.054,597 | 380,179 | LE |
| 12208 | 706.361,485 | 4.645.050,415 | 380,186 | |
| 12209 | 706.355,300 | 4.645.038,750 | 380,200 | |
| 12210 | 706.379,914 | 4.645.049,641 | 380,028 | |
| 12211 | 706.385,609 | 4.645.031,258 | 380,061 | |
| 12212 | 706.473,153 | 4.645.029,764 | 380,448 | |
| 12213 | 706.476,756 | 4.645.032,430 | 380,383 | |
| 12214 | 706.471,971 | 4.645.027,852 | 379,896 | |
| 12215 | 706.483,292 | 4.645.014,871 | 379,967 | |
| 12216 | 706.485,027 | 4.645.016,106 | 380,396 | |
| 12217 | 706.488,547 | 4.645.019,034 | 380,353 | |
| 12218 | 706.491,113 | 4.645.021,584 | 380,233 | |
| 12219 | 706.484,553 | 4.645.031,327 | 380,027 | |
| 12220 | 707.113,990 | 4.643.693,860 | 381,190 | |
| 12221 | 707.120,660 | 4.643.697,220 | 381,160 | |
| 12222 | 707.113,580 | 4.643.705,310 | 380,880 | |
| 12223 | 707.120,600 | 4.643.706,800 | 380,940 | |
| 12224 | 707.119,830 | 4.643.710,970 | 380,990 | |
| 12225 | 707.115,190 | 4.643.715,170 | 381,110 | |
| 12226 | 707.115,350 | 4.643.717,970 | 380,800 | |
| 12227 | 707.120,030 | 4.643.718,400 | 380,790 | |
| 12228 | 707.118,220 | 4.643.715,420 | 380,870 | |
| 12229 | 707.115,590 | 4.643.722,230 | 380,750 | |
| 12230 | 707.112,210 | 4.643.734,380 | 380,470 | |
| 12231 | 707.109,720 | 4.643.746,400 | 380,260 | |
| 12232 | 707.118,860 | 4.643.726,730 | 380,400 | |
| 12233 | 707.113,820 | 4.643.728,550 | 380,660 | |
| 12234 | 707.117,190 | 4.643.734,920 | 380,340 | |
| 12235 | 707.114,210 | 4.643.749,430 | 380,300 | |
| 12236 | 707.102,890 | 4.643.760,100 | 380,330 | |
| 12237 | 707.105,210 | 4.643.770,540 | 380,250 | |
| 12238 | 707.095,280 | 4.643.778,410 | 380,210 | |
| 12239 | 707.098,870 | 4.643.793,600 | 380,300 | |
| 12240 | 707.088,530 | 4.643.801,520 | 380,260 | |
| 12241 | 707.079,400 | 4.643.821,210 | 380,280 | |
| 12242 | 707.090,370 | 4.643.814,340 | 380,290 | |
| 12243 | 707.080,530 | 4.643.841,850 | 380,290 | |
| 12244 | 707.071,850 | 4.643.849,120 | 380,230 | |
| 12245 | 707.074,480 | 4.643.859,370 | 380,290 | |
| 12246 | 707.064,120 | 4.643.864,910 | 380,250 | |
| 12247 | 707.069,220 | 4.643.872,680 | 380,250 | |
| 12248 | 707.058,120 | 4.643.885,760 | 380,250 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12249 | 707.059,790 | 4.643.895,650 | 380,240 | |
| 12250 | 707.050,830 | 4.643.903,140 | 380,310 | |
| 12251 | 707.053,380 | 4.643.914,200 | 380,350 | |
| 12252 | 707.039,970 | 4.643.934,020 | 379,930 | |
| 12253 | 707.041,010 | 4.643.932,220 | 379,930 | |
| 12254 | 707.044,890 | 4.643.933,940 | 379,750 | |
| 12255 | 707.045,740 | 4.643.935,360 | 379,450 | |
| 12256 | 707.029,780 | 4.643.964,370 | 380,730 | |
| 12257 | 707.041,650 | 4.643.943,710 | 380,490 | |
| 12258 | 707.036,250 | 4.643.944,990 | 380,550 | |
| 12259 | 707.033,410 | 4.643.953,400 | 380,630 | |
| 12260 | 707.037,440 | 4.643.955,380 | 380,600 | |
| 12261 | 707.025,050 | 4.643.977,070 | 381,050 | |
| 12262 | 707.028,770 | 4.643.984,200 | 381,210 | |
| 12263 | 707.031,990 | 4.643.971,220 | 380,670 | |
| 12264 | 707.176,880 | 4.643.989,650 | 379,680 | |
| 12265 | 707.201,580 | 4.643.984,380 | 380,290 | |
| 12266 | 707.208,640 | 4.643.983,210 | 379,700 | |
| 12267 | 707.196,860 | 4.643.985,900 | 379,690 | |
| 12268 | 707.207,800 | 4.643.988,440 | 380,070 | |
| 12269 | 707.216,490 | 4.643.986,310 | 380,000 | |
| 12270 | 707.220,300 | 4.643.981,810 | 379,940 | |
| 12271 | 707.222,620 | 4.643.983,670 | 379,770 | |
| 12272 | 707.019,740 | 4.643.990,850 | 381,570 | |
| 12273 | 707.022,690 | 4.643.996,430 | 381,450 | |
| 12274 | 707.018,500 | 4.643.997,760 | 381,480 | |
| 12275 | 707.136,990 | 4.643.996,780 | 380,480 | |
| 12276 | 707.159,600 | 4.643.992,870 | 379,680 | |
| 12277 | 707.142,580 | 4.643.995,290 | 380,410 | |
| 12278 | 707.150,690 | 4.643.993,750 | 379,700 | |
| 12279 | 707.164,670 | 4.643.996,660 | 379,690 | |
| 12280 | 707.157,140 | 4.643.998,030 | 379,670 | |
| 12281 | 707.173,200 | 4.643.995,910 | 379,680 | |
| 12282 | 707.194,020 | 4.643.991,760 | 379,700 | |
| 12283 | 707.121,240 | 4.643.999,430 | 380,470 | |
| 12284 | 707.009,000 | 4.644.019,080 | 381,700 | |
| 12285 | 707.004,380 | 4.644.022,730 | 381,740 | |
| 12286 | 707.014,130 | 4.644.009,510 | 381,760 | |
| 12287 | 707.018,270 | 4.644.008,810 | 381,760 | |
| 12288 | 707.015,570 | 4.644.017,730 | 381,770 | |
| 12289 | 707.029,360 | 4.644.018,730 | 381,830 | |
| 12290 | 707.034,470 | 4.644.016,740 | 381,140 | |
| 12291 | 707.018,900 | 4.644.020,270 | 381,710 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12292 | 707.031,380 | 4.644.021,730 | 381,760 | |
| 12293 | 707.057,970 | 4.644.013,770 | 381,120 | |
| 12294 | 707.037,780 | 4.644.018,210 | 381,140 | |
| 12295 | 707.051,020 | 4.644.018,590 | 381,170 | |
| 12296 | 707.076,830 | 4.644.009,490 | 381,110 | |
| 12297 | 707.075,370 | 4.644.013,840 | 381,130 | |
| 12298 | 707.105,510 | 4.644.002,270 | 381,110 | |
| 12299 | 707.112,130 | 4.644.000,600 | 380,600 | |
| 12300 | 707.096,600 | 4.644.003,300 | 381,030 | |
| 12301 | 707.112,890 | 4.644.006,880 | 381,300 | |
| 12302 | 707.109,670 | 4.644.006,580 | 381,080 | |
| 12303 | 707.096,930 | 4.644.009,070 | 381,090 | |
| 12304 | 707.141,570 | 4.644.002,010 | 380,580 | |
| 12305 | 707.117,350 | 4.644.006,230 | 380,530 | |
| 12306 | 707.131,550 | 4.644.003,960 | 380,470 | |
| 12307 | 707.146,410 | 4.644.001,420 | 379,710 | |
| 12308 | 706.943,390 | 4.644.047,290 | 384,260 | |
| 12309 | 706.946,690 | 4.644.046,380 | 383,140 | |
| 12310 | 706.951,280 | 4.644.044,260 | 383,120 | |
| 12311 | 706.985,340 | 4.644.030,590 | 382,600 | |
| 12312 | 706.959,470 | 4.644.038,760 | 383,080 | |
| 12313 | 706.969,530 | 4.644.036,460 | 383,200 | |
| 12314 | 706.973,370 | 4.644.035,700 | 382,640 | |
| 12315 | 706.974,430 | 4.644.039,080 | 382,650 | |
| 12316 | 706.972,080 | 4.644.040,820 | 383,300 | |
| 12317 | 706.959,850 | 4.644.045,840 | 383,140 | |
| 12318 | 706.993,890 | 4.644.026,410 | 382,740 | |
| 12319 | 707.002,010 | 4.644.024,730 | 381,760 | |
| 12320 | 707.004,760 | 4.644.029,810 | 381,780 | |
| 12321 | 707.003,640 | 4.644.029,740 | 381,780 | |
| 12322 | 707.009,550 | 4.644.029,130 | 381,720 | |
| 12323 | 706.988,810 | 4.644.035,210 | 382,730 | |
| 12324 | 706.996,650 | 4.644.032,040 | 383,510 | |
| 12325 | 707.016,550 | 4.644.025,860 | 381,740 | |
| 12326 | 706.861,900 | 4.644.075,310 | 385,830 | |
| 12327 | 706.869,100 | 4.644.073,000 | 385,770 | |
| 12328 | 706.901,440 | 4.644.061,030 | 384,720 | |
| 12329 | 706.906,850 | 4.644.061,070 | 384,660 | |
| 12330 | 706.907,000 | 4.644.063,940 | 384,710 | |
| 12331 | 706.894,700 | 4.644.065,750 | 384,690 | |
| 12332 | 706.899,720 | 4.644.067,200 | 384,750 | |
| 12333 | 706.881,680 | 4.644.069,920 | 384,650 | |
| 12334 | 706.886,050 | 4.644.069,260 | 384,680 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12335 | 706.886,780 | 4.644.072,150 | 384,680 | |
| 12336 | 706.880,460 | 4.644.073,850 | 384,790 | |
| 12337 | 706.930,690 | 4.644.050,260 | 383,920 | |
| 12338 | 706.916,050 | 4.644.055,420 | 384,070 | |
| 12339 | 706.927,690 | 4.644.058,900 | 384,040 | |
| 12340 | 706.912,950 | 4.644.062,650 | 384,610 | |
| 12341 | 706.944,680 | 4.644.051,830 | 384,190 | |
| 12342 | 706.948,630 | 4.644.050,660 | 383,150 | |
| 12343 | 706.936,590 | 4.644.056,230 | 383,920 | |
| 12344 | 706.626,470 | 4.644.088,590 | 391,110 | |
| 12345 | 706.632,820 | 4.644.091,260 | 390,940 | |
| 12346 | 706.634,010 | 4.644.098,510 | 390,930 | |
| 12347 | 706.640,130 | 4.644.100,630 | 390,730 | |
| 12348 | 706.820,660 | 4.644.091,550 | 386,310 | |
| 12349 | 706.826,320 | 4.644.090,290 | 386,360 | |
| 12350 | 706.830,300 | 4.644.091,770 | 386,390 | |
| 12351 | 706.802,740 | 4.644.094,620 | 386,370 | |
| 12352 | 706.827,910 | 4.644.093,960 | 386,350 | |
| 12353 | 706.804,690 | 4.644.101,030 | 386,370 | |
| 12354 | 706.807,400 | 4.644.097,500 | 386,390 | |
| 12355 | 706.813,550 | 4.644.098,460 | 386,370 | |
| 12356 | 706.845,250 | 4.644.083,270 | 385,970 | |
| 12357 | 706.834,030 | 4.644.087,080 | 386,010 | |
| 12358 | 706.853,460 | 4.644.085,320 | 385,960 | |
| 12359 | 706.841,660 | 4.644.089,070 | 386,000 | |
| 12360 | 706.856,160 | 4.644.077,670 | 386,010 | |
| 12361 | 706.864,520 | 4.644.078,940 | 386,020 | |
| 12362 | 706.868,670 | 4.644.078,970 | 386,070 | |
| 12363 | 706.859,700 | 4.644.080,940 | 385,970 | |
| 12364 | 706.639,000 | 4.644.105,720 | 390,710 | |
| 12365 | 706.644,340 | 4.644.107,300 | 390,390 | |
| 12366 | 706.644,020 | 4.644.113,440 | 390,100 | |
| 12367 | 706.652,000 | 4.644.114,110 | 389,240 | |
| 12368 | 706.649,070 | 4.644.120,230 | 389,290 | |
| 12369 | 706.657,440 | 4.644.122,930 | 388,730 | |
| 12370 | 706.787,330 | 4.644.112,980 | 386,780 | |
| 12371 | 706.793,020 | 4.644.117,260 | 386,770 | |
| 12372 | 706.782,340 | 4.644.123,850 | 386,760 | |
| 12373 | 706.657,180 | 4.644.129,640 | 388,710 | |
| 12374 | 706.661,980 | 4.644.131,890 | 388,650 | |
| 12375 | 706.662,220 | 4.644.136,190 | 388,660 | |
| 12376 | 706.667,380 | 4.644.139,550 | 388,620 | |
| 12377 | 706.667,690 | 4.644.145,260 | 388,360 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12378 | 706.671,220 | 4.644.138,440 | 388,580 | |
| 12379 | 706.672,190 | 4.644.145,000 | 388,370 | |
| 12380 | 706.676,390 | 4.644.148,310 | 388,080 | |
| 12381 | 706.673,470 | 4.644.152,940 | 387,540 | |
| 12382 | 706.776,140 | 4.644.138,060 | 387,130 | |
| 12383 | 706.772,720 | 4.644.147,620 | 386,550 | |
| 12384 | 706.776,900 | 4.644.150,970 | 386,640 | |
| 12385 | 706.778,600 | 4.644.132,390 | 386,870 | |
| 12386 | 706.788,150 | 4.644.130,580 | 386,770 | |
| 12387 | 706.778,640 | 4.644.134,830 | 387,140 | |
| 12388 | 706.782,870 | 4.644.136,830 | 386,850 | |
| 12389 | 706.783,120 | 4.644.141,110 | 387,000 | |
| 12390 | 706.780,510 | 4.644.142,100 | 387,080 | |
| 12391 | 706.683,300 | 4.644.157,800 | 387,450 | |
| 12392 | 706.679,370 | 4.644.159,250 | 387,450 | |
| 12393 | 706.685,910 | 4.644.169,970 | 386,780 | |
| 12394 | 706.690,560 | 4.644.168,620 | 386,800 | |
| 12395 | 706.695,200 | 4.644.172,650 | 386,760 | |
| 12396 | 706.689,350 | 4.644.177,150 | 386,700 | |
| 12397 | 706.697,940 | 4.644.178,270 | 386,830 | |
| 12398 | 706.769,180 | 4.644.155,910 | 386,550 | |
| 12399 | 706.771,040 | 4.644.164,620 | 386,600 | |
| 12400 | 706.761,810 | 4.644.168,190 | 386,580 | |
| 12401 | 706.765,200 | 4.644.178,380 | 386,610 | |
| 12402 | 706.695,220 | 4.644.182,220 | 386,890 | |
| 12403 | 706.697,490 | 4.644.185,400 | 386,390 | |
| 12404 | 706.701,580 | 4.644.180,250 | 386,440 | |
| 12405 | 706.706,430 | 4.644.186,560 | 386,420 | |
| 12406 | 706.701,760 | 4.644.191,780 | 386,430 | |
| 12407 | 706.712,900 | 4.644.195,950 | 386,560 | |
| 12408 | 706.711,690 | 4.644.203,190 | 386,180 | |
| 12409 | 706.709,670 | 4.644.200,400 | 386,540 | |
| 12410 | 706.714,530 | 4.644.200,080 | 386,160 | |
| 12411 | 706.756,060 | 4.644.182,510 | 386,600 | |
| 12412 | 706.760,250 | 4.644.187,120 | 386,590 | |
| 12413 | 706.751,460 | 4.644.190,890 | 385,920 | |
| 12414 | 706.755,580 | 4.644.194,620 | 385,620 | |
| 12415 | 706.744,070 | 4.644.205,840 | 385,620 | |
| 12416 | 706.748,290 | 4.644.211,060 | 385,670 | |
| 12417 | 706.726,880 | 4.644.217,630 | 386,460 | |
| 12418 | 706.729,980 | 4.644.219,390 | 385,690 | |
| 12419 | 706.724,560 | 4.644.220,540 | 386,390 | |
| 12420 | 706.727,390 | 4.644.223,010 | 385,700 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12421 | 706.734,250 | 4.644.222,220 | 385,680 | |
| 12422 | 706.741,070 | 4.644.228,220 | 385,680 | |
| 12423 | 706.730,820 | 4.644.233,730 | 385,690 | |
| 12424 | 706.740,460 | 4.644.239,390 | 385,680 | |
| 12425 | 706.735,250 | 4.644.240,910 | 385,670 | |
| 12426 | 706.742,810 | 4.644.251,460 | 385,610 | |
| 12427 | 706.737,550 | 4.644.258,110 | 385,690 | |
| 12428 | 707.146,030 | 4.644.342,670 | 382,640 | |
| 12429 | 707.149,550 | 4.644.339,280 | 383,490 | |
| 12430 | 707.145,720 | 4.644.352,320 | 382,530 | |
| 12431 | 707.151,340 | 4.644.352,940 | 382,560 | |
| 12432 | 707.145,340 | 4.644.368,330 | 382,530 | |
| 12433 | 707.151,630 | 4.644.376,290 | 382,630 | |
| 12434 | 707.144,120 | 4.644.384,230 | 382,480 | |
| 12435 | 706.916,330 | 4.644.406,220 | 385,520 | |
| 12436 | 706.920,470 | 4.644.408,160 | 385,630 | |
| 12437 | 706.916,650 | 4.644.411,930 | 385,600 | |
| 12438 | 707.051,950 | 4.644.410,800 | 383,720 | |
| 12439 | 707.085,250 | 4.644.402,080 | 383,690 | |
| 12440 | 707.066,260 | 4.644.406,420 | 383,710 | |
| 12441 | 707.081,280 | 4.644.407,520 | 383,700 | |
| 12442 | 707.086,890 | 4.644.406,460 | 382,720 | |
| 12443 | 707.069,610 | 4.644.411,560 | 383,670 | |
| 12444 | 707.098,210 | 4.644.398,180 | 382,530 | |
| 12445 | 707.090,540 | 4.644.401,680 | 382,570 | |
| 12446 | 707.106,410 | 4.644.401,840 | 382,550 | |
| 12447 | 707.131,720 | 4.644.388,580 | 382,580 | |
| 12448 | 707.114,790 | 4.644.394,850 | 382,530 | |
| 12449 | 707.126,490 | 4.644.398,160 | 382,600 | |
| 12450 | 707.156,810 | 4.644.391,440 | 382,550 | |
| 12451 | 707.148,060 | 4.644.394,200 | 382,570 | |
| 12452 | 707.159,910 | 4.644.401,600 | 382,520 | |
| 12453 | 707.167,380 | 4.644.396,800 | 382,590 | |
| 12454 | 706.924,750 | 4.644.423,800 | 384,270 | |
| 12455 | 706.920,890 | 4.644.427,150 | 384,150 | |
| 12456 | 706.926,810 | 4.644.434,700 | 382,680 | |
| 12457 | 706.932,820 | 4.644.436,390 | 382,510 | |
| 12458 | 706.946,380 | 4.644.433,240 | 382,600 | |
| 12459 | 706.985,420 | 4.644.425,910 | 383,640 | |
| 12460 | 706.958,760 | 4.644.431,810 | 382,620 | |
| 12461 | 706.975,310 | 4.644.429,370 | 383,810 | |
| 12462 | 706.983,630 | 4.644.430,370 | 383,770 | |
| 12463 | 706.966,720 | 4.644.433,800 | 382,700 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12464 | 707.003,730 | 4.644.421,830 | 383,720 | |
| 12465 | 706.993,520 | 4.644.425,030 | 383,750 | |
| 12466 | 706.999,550 | 4.644.427,520 | 383,670 | |
| 12467 | 707.010,320 | 4.644.426,340 | 383,750 | |
| 12468 | 707.031,470 | 4.644.414,370 | 383,660 | |
| 12469 | 707.016,490 | 4.644.418,050 | 383,740 | |
| 12470 | 707.023,290 | 4.644.421,200 | 383,730 | |
| 12471 | 707.039,200 | 4.644.413,650 | 383,650 | |
| 12472 | 707.059,220 | 4.644.412,700 | 383,680 | |
| 12473 | 707.036,170 | 4.644.419,070 | 383,720 | |
| 12474 | 707.048,000 | 4.644.417,250 | 383,720 | |
| 12475 | 706.845,050 | 4.644.460,230 | 382,130 | |
| 12476 | 706.834,130 | 4.644.462,030 | 382,670 | |
| 12477 | 706.839,080 | 4.644.461,720 | 382,070 | |
| 12478 | 706.879,800 | 4.644.450,800 | 382,770 | |
| 12479 | 706.855,870 | 4.644.456,930 | 382,100 | |
| 12480 | 706.864,870 | 4.644.456,130 | 382,110 | |
| 12481 | 706.868,720 | 4.644.455,920 | 383,060 | |
| 12482 | 706.861,080 | 4.644.460,450 | 382,100 | |
| 12483 | 706.895,480 | 4.644.447,070 | 382,960 | |
| 12484 | 706.885,350 | 4.644.456,390 | 382,730 | |
| 12485 | 706.923,150 | 4.644.439,190 | 382,660 | |
| 12486 | 706.911,460 | 4.644.443,910 | 383,980 | |
| 12487 | 706.953,510 | 4.644.438,320 | 382,620 | |
| 12488 | 706.942,940 | 4.644.441,720 | 382,610 | |
| 12489 | 706.826,840 | 4.644.466,720 | 382,580 | |
| 12490 | 706.722,850 | 4.644.499,820 | 382,760 | |
| 12491 | 706.722,360 | 4.644.503,860 | 382,150 | |
| 12492 | 706.715,760 | 4.644.510,620 | 382,140 | |
| 12493 | 706.694,170 | 4.644.519,850 | 382,020 | |
| 12494 | 706.692,740 | 4.644.527,430 | 382,140 | |
| 12495 | 706.675,290 | 4.644.542,190 | 382,040 | |
| 12496 | 706.644,650 | 4.644.563,880 | 381,920 | |
| 12497 | 706.649,010 | 4.644.559,000 | 382,230 | |
| 12498 | 706.653,180 | 4.644.556,950 | 382,050 | |
| 12499 | 706.634,500 | 4.644.573,020 | 381,830 | |
| 12500 | 706.625,960 | 4.644.579,300 | 381,800 | |
| 12501 | 706.577,130 | 4.644.616,650 | 382,010 | |
| 12502 | 706.605,370 | 4.644.596,650 | 381,840 | |
| 12503 | 706.595,210 | 4.644.606,100 | 381,920 | |
| 12504 | 706.681,670 | 4.644.598,600 | 381,140 | |
| 12505 | 706.683,720 | 4.644.601,760 | 381,180 | |
| 12506 | 706.676,640 | 4.644.605,540 | 381,230 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12507 | 706.677,950 | 4.644.616,270 | 381,190 | |
| 12508 | 706.671,720 | 4.644.619,340 | 381,200 | |
| 12509 | 706.556,650 | 4.644.635,580 | 381,410 | |
| 12510 | 706.573,480 | 4.644.621,690 | 381,520 | |
| 12511 | 706.665,430 | 4.644.634,340 | 381,180 | |
| 12512 | 706.667,100 | 4.644.644,490 | 381,170 | |
| 12513 | 706.672,340 | 4.644.630,580 | 381,160 | |
| 12514 | 706.509,640 | 4.644.670,380 | 381,430 | |
| 12515 | 706.538,700 | 4.644.648,860 | 381,420 | |
| 12516 | 706.528,310 | 4.644.657,200 | 381,530 | |
| 12517 | 706.660,350 | 4.644.653,620 | 380,110 | |
| 12518 | 706.657,510 | 4.644.656,900 | 379,300 | |
| 12519 | 706.663,510 | 4.644.656,160 | 379,940 | |
| 12520 | 706.660,700 | 4.644.659,070 | 379,210 | |
| 12521 | 706.653,910 | 4.644.665,900 | 379,230 | |
| 12522 | 706.480,580 | 4.644.692,710 | 380,790 | |
| 12523 | 706.500,500 | 4.644.676,980 | 381,700 | |
| 12524 | 706.496,620 | 4.644.681,490 | 380,780 | |
| 12525 | 706.642,300 | 4.644.696,260 | 379,250 | |
| 12526 | 706.656,310 | 4.644.673,170 | 379,250 | |
| 12527 | 706.648,740 | 4.644.679,670 | 379,250 | |
| 12528 | 706.650,340 | 4.644.691,500 | 379,260 | |
| 12529 | 706.465,270 | 4.644.707,470 | 380,800 | |
| 12530 | 706.448,530 | 4.644.719,320 | 380,770 | |
| 12531 | 706.639,110 | 4.644.708,640 | 379,320 | |
| 12532 | 706.640,920 | 4.644.716,840 | 379,280 | |
| 12533 | 706.646,620 | 4.644.703,210 | 379,280 | |
| 12534 | 706.435,990 | 4.644.728,760 | 380,870 | |
| 12535 | 706.425,980 | 4.644.735,020 | 380,810 | |
| 12536 | 706.633,020 | 4.644.724,400 | 379,280 | |
| 12537 | 706.630,480 | 4.644.730,670 | 379,270 | |
| 12538 | 706.633,230 | 4.644.735,050 | 379,440 | |
| 12539 | 706.637,030 | 4.644.732,220 | 379,260 | |
| 12540 | 706.627,720 | 4.644.738,930 | 378,920 | |
| 12541 | 706.631,050 | 4.644.741,030 | 378,910 | |
| 12542 | 706.629,320 | 4.644.747,680 | 378,750 | |
| 12543 | 706.382,510 | 4.644.755,930 | 381,530 | |
| 12544 | 706.372,940 | 4.644.758,920 | 382,210 | |
| 12545 | 706.397,460 | 4.644.748,940 | 381,160 | |
| 12546 | 706.391,210 | 4.644.752,900 | 380,670 | |
| 12547 | 706.620,540 | 4.644.756,830 | 378,810 | |
| 12548 | 706.616,850 | 4.644.766,350 | 378,850 | |
| 12549 | 706.620,100 | 4.644.768,670 | 378,940 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12550 | 706.617,000 | 4.644.769,270 | 378,680 | |
| 12551 | 706.620,260 | 4.644.771,670 | 378,640 | |
| 12552 | 706.613,860 | 4.644.776,760 | 378,620 | |
| 12553 | 706.624,540 | 4.644.748,910 | 378,790 | |
| 12554 | 706.623,770 | 4.644.761,200 | 378,770 | |
| 12555 | 706.616,330 | 4.644.782,610 | 378,610 | |
| 12556 | 706.610,280 | 4.644.785,950 | 378,640 | |
| 12557 | 706.613,290 | 4.644.792,290 | 378,670 | |
| 12558 | 706.606,950 | 4.644.794,210 | 378,850 | |
| 12559 | 706.607,100 | 4.644.797,180 | 378,720 | |
| 12560 | 706.612,260 | 4.644.797,070 | 379,060 | |
| 12561 | 706.610,540 | 4.644.799,940 | 378,720 | |
| 12562 | 706.603,090 | 4.644.807,750 | 378,750 | |
| 12563 | 706.608,650 | 4.644.806,240 | 378,710 | |
| 12564 | 706.604,870 | 4.644.816,300 | 378,690 | |
| 12565 | 706.589,140 | 4.644.842,780 | 378,640 | |
| 12566 | 706.587,970 | 4.644.854,420 | 379,070 | |
| 12567 | 706.590,600 | 4.644.853,040 | 378,720 | |
| 12568 | 706.595,760 | 4.644.841,340 | 378,710 | |
| 12569 | 706.599,730 | 4.644.853,540 | 378,760 | |
| 12570 | 706.564,360 | 4.644.877,360 | 378,760 | |
| 12571 | 706.582,680 | 4.644.856,090 | 378,950 | |
| 12572 | 706.594,870 | 4.644.855,990 | 378,790 | |
| 12573 | 706.585,110 | 4.644.859,040 | 378,950 | |
| 12574 | 706.577,010 | 4.644.866,680 | 378,740 | |
| 12575 | 706.573,030 | 4.644.867,470 | 378,770 | |
| 12576 | 706.573,330 | 4.644.873,330 | 378,710 | |
| 12577 | 706.540,950 | 4.644.906,200 | 378,750 | |
| 12578 | 706.564,820 | 4.644.886,360 | 378,730 | |
| 12579 | 706.557,450 | 4.644.888,690 | 378,750 | |
| 12580 | 706.557,150 | 4.644.895,510 | 378,710 | |
| 12581 | 706.548,960 | 4.644.898,510 | 378,750 | |
| 12582 | 706.549,400 | 4.644.907,540 | 378,720 | |
| 12583 | 706.232,690 | 4.644.927,800 | 381,660 | |
| 12584 | 706.257,160 | 4.644.910,640 | 381,700 | |
| 12585 | 706.245,210 | 4.644.914,760 | 381,650 | |
| 12586 | 706.244,420 | 4.644.926,030 | 381,720 | |
| 12587 | 706.535,220 | 4.644.917,050 | 378,740 | |
| 12588 | 706.540,890 | 4.644.916,270 | 378,740 | |
| 12589 | 706.527,290 | 4.644.923,330 | 379,430 | |
| 12590 | 706.531,370 | 4.644.922,430 | 378,780 | |
| 12591 | 706.530,750 | 4.644.929,340 | 378,820 | |
| 12592 | 707.417,590 | 4.644.930,710 | 374,650 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12593 | 707.424,890 | 4.644.930,080 | 374,610 | |
| 12594 | 706.221,050 | 4.644.939,830 | 381,740 | |
| 12595 | 706.232,110 | 4.644.939,140 | 381,710 | |
| 12596 | 706.211,200 | 4.644.952,900 | 381,760 | |
| 12597 | 706.220,820 | 4.644.953,450 | 382,020 | |
| 12598 | 706.513,510 | 4.644.945,650 | 378,930 | |
| 12599 | 706.504,950 | 4.644.956,200 | 379,040 | |
| 12600 | 706.513,200 | 4.644.953,740 | 378,930 | |
| 12601 | 706.521,790 | 4.644.935,870 | 378,990 | |
| 12602 | 706.525,360 | 4.644.935,910 | 379,180 | |
| 12603 | 706.520,330 | 4.644.944,430 | 378,980 | |
| 12604 | 707.311,460 | 4.644.955,470 | 372,740 | |
| 12605 | 707.320,610 | 4.644.953,910 | 372,740 | |
| 12606 | 707.301,590 | 4.644.958,410 | 372,760 | |
| 12607 | 707.334,180 | 4.644.950,920 | 372,760 | |
| 12608 | 707.343,710 | 4.644.954,960 | 372,730 | |
| 12609 | 707.329,130 | 4.644.958,550 | 372,730 | |
| 12610 | 707.366,220 | 4.644.944,360 | 372,750 | |
| 12611 | 707.348,170 | 4.644.947,780 | 372,750 | |
| 12612 | 707.358,910 | 4.644.952,260 | 372,690 | |
| 12613 | 707.394,690 | 4.644.934,980 | 374,710 | |
| 12614 | 707.401,820 | 4.644.934,470 | 374,610 | |
| 12615 | 707.385,540 | 4.644.938,640 | 372,760 | |
| 12616 | 707.381,630 | 4.644.941,020 | 372,750 | |
| 12617 | 707.386,630 | 4.644.941,020 | 372,760 | |
| 12618 | 707.386,750 | 4.644.943,980 | 372,740 | |
| 12619 | 707.399,000 | 4.644.941,460 | 374,650 | |
| 12620 | 707.377,870 | 4.644.947,110 | 372,760 | |
| 12621 | 707.407,210 | 4.644.939,740 | 374,650 | |
| 12622 | 707.414,920 | 4.644.937,700 | 374,630 | |
| 12623 | 707.423,110 | 4.644.938,090 | 374,630 | |
| 12624 | 706.202,510 | 4.644.964,290 | 381,750 | |
| 12625 | 706.195,000 | 4.644.972,370 | 381,780 | |
| 12626 | 706.201,500 | 4.644.972,880 | 381,800 | |
| 12627 | 706.194,030 | 4.644.980,750 | 381,990 | |
| 12628 | 706.187,850 | 4.644.982,520 | 382,190 | |
| 12629 | 706.210,660 | 4.644.961,620 | 381,770 | |
| 12630 | 706.492,780 | 4.644.973,070 | 379,000 | |
| 12631 | 706.487,330 | 4.644.981,220 | 379,010 | |
| 12632 | 706.498,810 | 4.644.964,380 | 379,010 | |
| 12633 | 706.507,570 | 4.644.962,320 | 379,000 | |
| 12634 | 706.498,590 | 4.644.971,570 | 379,000 | |
| 12635 | 706.493,970 | 4.644.979,490 | 378,980 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12636 | 707.186,540 | 4.644.982,750 | 373,550 | |
| 12637 | 707.207,710 | 4.644.979,830 | 373,590 | |
| 12638 | 707.219,080 | 4.644.983,260 | 373,540 | |
| 12639 | 707.244,650 | 4.644.972,450 | 373,630 | |
| 12640 | 707.226,920 | 4.644.975,610 | 373,600 | |
| 12641 | 707.245,690 | 4.644.976,610 | 372,820 | |
| 12642 | 707.236,200 | 4.644.978,560 | 373,610 | |
| 12643 | 707.251,830 | 4.644.972,150 | 372,820 | |
| 12644 | 707.266,540 | 4.644.972,120 | 372,790 | |
| 12645 | 707.251,640 | 4.644.977,350 | 372,840 | |
| 12646 | 707.296,380 | 4.644.960,590 | 372,720 | |
| 12647 | 707.271,920 | 4.644.965,040 | 372,860 | |
| 12648 | 707.281,020 | 4.644.963,130 | 372,840 | |
| 12649 | 707.292,050 | 4.644.962,600 | 372,920 | |
| 12650 | 707.279,710 | 4.644.969,410 | 372,840 | |
| 12651 | 707.287,670 | 4.644.968,170 | 372,860 | |
| 12652 | 707.293,090 | 4.644.966,080 | 372,790 | |
| 12653 | 707.297,930 | 4.644.965,010 | 372,680 | |
| 12654 | 707.304,530 | 4.644.964,200 | 372,760 | |
| 12655 | 707.312,530 | 4.644.962,470 | 372,730 | |
| 12656 | 706.171,470 | 4.645.004,870 | 382,200 | |
| 12657 | 706.174,140 | 4.645.010,290 | 382,300 | |
| 12658 | 706.180,730 | 4.644.992,940 | 382,210 | |
| 12659 | 706.187,050 | 4.644.990,430 | 382,190 | |
| 12660 | 706.485,280 | 4.644.989,400 | 379,000 | |
| 12661 | 706.478,740 | 4.644.990,870 | 379,000 | |
| 12662 | 706.473,120 | 4.644.998,710 | 378,990 | |
| 12663 | 706.478,580 | 4.644.998,370 | 379,040 | |
| 12664 | 706.466,580 | 4.645.005,810 | 379,980 | |
| 12665 | 706.473,450 | 4.645.006,050 | 380,130 | |
| 12666 | 707.088,160 | 4.645.007,790 | 373,750 | |
| 12667 | 707.104,010 | 4.645.002,960 | 373,750 | |
| 12668 | 707.099,550 | 4.645.010,000 | 373,700 | |
| 12669 | 707.112,360 | 4.645.007,240 | 373,710 | |
| 12670 | 707.141,080 | 4.644.994,940 | 373,720 | |
| 12671 | 707.121,530 | 4.644.999,620 | 373,730 | |
| 12672 | 707.131,020 | 4.645.004,190 | 373,690 | |
| 12673 | 707.158,830 | 4.644.990,480 | 373,690 | |
| 12674 | 707.165,960 | 4.644.994,220 | 373,930 | |
| 12675 | 707.152,370 | 4.644.999,550 | 373,660 | |
| 12676 | 707.169,480 | 4.644.988,870 | 373,870 | |
| 12677 | 707.170,430 | 4.644.989,360 | 373,420 | |
| 12678 | 707.171,270 | 4.644.988,190 | 373,490 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12679 | 707.174,230 | 4.644.988,180 | 372,970 | |
| 12680 | 707.176,050 | 4.644.989,310 | 372,770 | |
| 12681 | 707.180,280 | 4.644.986,820 | 373,570 | |
| 12682 | 707.186,160 | 4.644.989,450 | 373,540 | |
| 12683 | 707.170,060 | 4.644.993,270 | 372,710 | |
| 12684 | 707.172,980 | 4.644.991,980 | 372,740 | |
| 12685 | 707.172,890 | 4.644.990,460 | 372,770 | |
| 12686 | 707.171,530 | 4.644.992,950 | 372,710 | |
| 12687 | 707.180,540 | 4.644.991,610 | 372,760 | |
| 12688 | 707.175,780 | 4.644.994,670 | 372,670 | |
| 12689 | 707.201,270 | 4.644.989,760 | 373,550 | |
| 12690 | 706.153,960 | 4.645.031,630 | 382,620 | |
| 12691 | 706.165,690 | 4.645.010,910 | 382,190 | |
| 12692 | 706.165,850 | 4.645.015,430 | 382,650 | |
| 12693 | 706.169,920 | 4.645.015,660 | 382,370 | |
| 12694 | 706.167,930 | 4.645.022,510 | 382,440 | |
| 12695 | 706.404,350 | 4.645.032,620 | 379,740 | |
| 12696 | 706.391,250 | 4.645.036,830 | 379,900 | |
| 12697 | 706.437,750 | 4.645.026,080 | 379,750 | |
| 12698 | 706.425,380 | 4.645.027,980 | 379,720 | |
| 12699 | 706.415,670 | 4.645.031,340 | 379,750 | |
| 12700 | 706.422,490 | 4.645.033,410 | 379,760 | |
| 12701 | 706.433,840 | 4.645.033,100 | 379,750 | |
| 12702 | 706.462,300 | 4.645.012,820 | 379,710 | |
| 12703 | 706.456,270 | 4.645.021,050 | 379,730 | |
| 12704 | 706.461,470 | 4.645.022,490 | 379,730 | |
| 12705 | 706.450,170 | 4.645.024,400 | 379,780 | |
| 12706 | 706.445,110 | 4.645.030,130 | 379,730 | |
| 12707 | 706.455,800 | 4.645.027,590 | 379,730 | |
| 12708 | 706.467,450 | 4.645.012,740 | 379,710 | |
| 12709 | 706.507,920 | 4.645.022,550 | 379,770 | |
| 12710 | 706.503,470 | 4.645.029,100 | 379,940 | |
| 12711 | 706.537,760 | 4.645.022,400 | 379,090 | |
| 12712 | 706.519,360 | 4.645.023,030 | 379,750 | |
| 12713 | 706.525,430 | 4.645.025,640 | 380,120 | |
| 12714 | 706.531,070 | 4.645.024,910 | 379,180 | |
| 12715 | 706.518,540 | 4.645.029,930 | 379,720 | |
| 12716 | 706.522,730 | 4.645.030,020 | 379,780 | |
| 12717 | 706.527,190 | 4.645.030,740 | 379,330 | |
| 12718 | 706.540,660 | 4.645.031,360 | 379,030 | |
| 12719 | 706.559,410 | 4.645.022,090 | 379,060 | |
| 12720 | 706.564,150 | 4.645.032,470 | 379,020 | |
| 12721 | 706.578,920 | 4.645.024,870 | 379,090 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12722 | 706.589,780 | 4.645.024,090 | 379,370 | |
| 12723 | 706.588,560 | 4.645.034,590 | 379,050 | |
| 12724 | 706.581,780 | 4.645.035,760 | 379,050 | |
| 12725 | 706.610,760 | 4.645.026,300 | 378,800 | |
| 12726 | 706.604,380 | 4.645.032,140 | 379,380 | |
| 12727 | 706.620,070 | 4.645.033,780 | 378,360 | |
| 12728 | 706.623,550 | 4.645.028,660 | 378,260 | |
| 12729 | 706.633,140 | 4.645.028,720 | 377,960 | |
| 12730 | 706.648,490 | 4.645.029,080 | 377,900 | |
| 12731 | 706.629,930 | 4.645.034,330 | 377,850 | |
| 12732 | 706.655,210 | 4.645.034,200 | 377,910 | |
| 12733 | 706.675,900 | 4.645.028,740 | 377,940 | |
| 12734 | 706.690,310 | 4.645.030,280 | 377,920 | |
| 12735 | 706.697,600 | 4.645.030,670 | 377,800 | |
| 12736 | 706.674,520 | 4.645.034,790 | 377,930 | |
| 12737 | 706.697,770 | 4.645.034,030 | 377,500 | |
| 12738 | 706.687,430 | 4.645.035,160 | 377,990 | |
| 12739 | 706.707,330 | 4.645.029,800 | 377,480 | |
| 12740 | 706.720,680 | 4.645.030,700 | 377,420 | |
| 12741 | 706.702,770 | 4.645.034,190 | 377,450 | |
| 12742 | 706.724,050 | 4.645.036,650 | 377,410 | |
| 12743 | 706.742,800 | 4.645.030,270 | 377,180 | |
| 12744 | 706.730,440 | 4.645.032,530 | 377,430 | |
| 12745 | 706.739,090 | 4.645.036,310 | 377,680 | |
| 12746 | 706.760,840 | 4.645.034,100 | 376,950 | |
| 12747 | 706.764,420 | 4.645.031,900 | 377,010 | |
| 12748 | 706.768,980 | 4.645.032,980 | 377,010 | |
| 12749 | 706.771,890 | 4.645.033,370 | 376,840 | |
| 12750 | 706.759,760 | 4.645.035,610 | 376,940 | |
| 12751 | 706.793,200 | 4.645.032,810 | 376,140 | |
| 12752 | 706.801,940 | 4.645.033,810 | 376,190 | |
| 12753 | 706.820,790 | 4.645.033,900 | 375,690 | |
| 12754 | 706.834,360 | 4.645.033,100 | 375,650 | |
| 12755 | 706.855,920 | 4.645.032,670 | 375,640 | |
| 12756 | 706.863,380 | 4.645.033,320 | 375,570 | |
| 12757 | 706.880,050 | 4.645.033,350 | 375,460 | |
| 12758 | 706.903,140 | 4.645.034,510 | 375,390 | |
| 12759 | 706.909,320 | 4.645.034,850 | 375,150 | |
| 12760 | 706.929,710 | 4.645.034,720 | 375,180 | |
| 12761 | 706.947,090 | 4.645.034,100 | 375,300 | |
| 12762 | 706.950,370 | 4.645.034,040 | 374,980 | |
| 12763 | 706.967,860 | 4.645.034,300 | 374,960 | |
| 12764 | 706.983,590 | 4.645.034,980 | 374,970 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12765 | 706.995,460 | 4.645.035,460 | 374,620 | |
| 12766 | 707.025,610 | 4.645.034,560 | 374,470 | |
| 12767 | 707.012,570 | 4.645.036,120 | 374,820 | |
| 12768 | 707.019,010 | 4.645.036,450 | 374,400 | |
| 12769 | 707.061,370 | 4.645.014,410 | 374,130 | |
| 12770 | 707.057,490 | 4.645.017,590 | 374,250 | |
| 12771 | 707.061,730 | 4.645.021,020 | 374,100 | |
| 12772 | 707.052,090 | 4.645.025,040 | 372,000 | |
| 12773 | 707.058,080 | 4.645.028,140 | 371,870 | |
| 12774 | 707.076,520 | 4.645.012,210 | 373,770 | |
| 12775 | 707.067,580 | 4.645.017,380 | 373,690 | |
| 12776 | 707.084,940 | 4.645.014,740 | 373,680 | |
| 12777 | 706.149,370 | 4.645.042,630 | 382,620 | |
| 12778 | 706.153,020 | 4.645.047,800 | 382,590 | |
| 12779 | 706.138,310 | 4.645.055,760 | 382,580 | |
| 12780 | 706.146,000 | 4.645.057,800 | 382,580 | |
| 12781 | 706.159,070 | 4.645.038,390 | 382,640 | |
| 12782 | 706.280,670 | 4.645.061,430 | 380,820 | |
| 12783 | 706.309,770 | 4.645.052,090 | 380,670 | |
| 12784 | 706.294,320 | 4.645.056,710 | 380,980 | |
| 12785 | 706.298,230 | 4.645.057,590 | 380,710 | |
| 12786 | 706.288,610 | 4.645.063,210 | 380,770 | |
| 12787 | 706.297,720 | 4.645.062,510 | 380,790 | |
| 12788 | 706.300,770 | 4.645.060,610 | 380,720 | |
| 12789 | 706.327,800 | 4.645.048,890 | 380,640 | |
| 12790 | 706.316,280 | 4.645.058,790 | 380,630 | |
| 12791 | 706.332,270 | 4.645.057,360 | 380,700 | |
| 12792 | 706.409,320 | 4.645.037,340 | 379,760 | |
| 12793 | 706.389,440 | 4.645.040,760 | 380,100 | |
| 12794 | 706.582,430 | 4.645.048,540 | 379,030 | |
| 12795 | 706.590,620 | 4.645.052,720 | 379,040 | |
| 12796 | 706.692,990 | 4.645.035,120 | 377,440 | |
| 12797 | 706.710,340 | 4.645.035,310 | 377,460 | |
| 12798 | 706.760,680 | 4.645.037,420 | 377,030 | |
| 12799 | 706.764,800 | 4.645.038,560 | 377,010 | |
| 12800 | 706.766,910 | 4.645.041,100 | 376,940 | |
| 12801 | 706.787,180 | 4.645.038,700 | 376,400 | |
| 12802 | 706.793,570 | 4.645.038,970 | 376,130 | |
| 12803 | 706.802,220 | 4.645.038,450 | 376,150 | |
| 12804 | 706.811,420 | 4.645.038,080 | 377,330 | |
| 12805 | 706.829,940 | 4.645.038,540 | 375,630 | |
| 12806 | 706.814,200 | 4.645.039,860 | 375,620 | |
| 12807 | 706.850,700 | 4.645.039,760 | 375,620 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12808 | 706.876,570 | 4.645.038,670 | 375,420 | |
| 12809 | 706.857,990 | 4.645.039,670 | 375,650 | |
| 12810 | 706.900,250 | 4.645.038,890 | 375,360 | |
| 12811 | 706.905,210 | 4.645.039,610 | 375,170 | |
| 12812 | 706.925,910 | 4.645.039,590 | 375,220 | |
| 12813 | 706.942,530 | 4.645.042,210 | 375,180 | |
| 12814 | 706.944,940 | 4.645.042,010 | 374,920 | |
| 12815 | 706.980,190 | 4.645.035,060 | 374,970 | |
| 12816 | 706.962,560 | 4.645.042,050 | 374,960 | |
| 12817 | 706.976,700 | 4.645.040,500 | 374,970 | |
| 12818 | 706.981,160 | 4.645.039,550 | 374,830 | |
| 12819 | 706.990,920 | 4.645.039,550 | 374,650 | |
| 12820 | 707.007,910 | 4.645.039,950 | 374,840 | |
| 12821 | 707.019,610 | 4.645.038,570 | 374,320 | |
| 12822 | 707.032,440 | 4.645.036,510 | 374,200 | |
| 12823 | 707.012,830 | 4.645.041,220 | 374,430 | |
| 12824 | 707.024,910 | 4.645.040,910 | 374,250 | |
| 12825 | 707.042,700 | 4.645.035,710 | 374,210 | |
| 12826 | 707.049,520 | 4.645.037,500 | 374,290 | |
| 12827 | 707.042,970 | 4.645.040,680 | 374,260 | |
| 12828 | 707.058,070 | 4.645.042,820 | 374,230 | |
| 12829 | 707.048,330 | 4.645.044,420 | 374,270 | |
| 12830 | 707.055,180 | 4.645.051,280 | 374,290 | |
| 12831 | 707.063,030 | 4.645.057,130 | 374,190 | |
| 12832 | 707.072,220 | 4.645.053,770 | 374,230 | |
| 12833 | 707.076,910 | 4.645.062,870 | 374,250 | |
| 12834 | 706.124,100 | 4.645.079,340 | 382,630 | |
| 12835 | 706.125,880 | 4.645.087,560 | 382,610 | |
| 12836 | 706.129,930 | 4.645.066,780 | 382,640 | |
| 12837 | 706.136,370 | 4.645.073,960 | 382,590 | |
| 12838 | 706.169,800 | 4.645.085,380 | 381,190 | |
| 12839 | 706.179,080 | 4.645.085,040 | 381,190 | |
| 12840 | 706.182,590 | 4.645.083,120 | 381,080 | |
| 12841 | 706.188,670 | 4.645.081,360 | 381,080 | |
| 12842 | 706.181,510 | 4.645.087,300 | 381,200 | |
| 12843 | 706.186,370 | 4.645.086,890 | 380,950 | |
| 12844 | 706.197,280 | 4.645.085,710 | 381,050 | |
| 12845 | 706.232,120 | 4.645.070,920 | 380,910 | |
| 12846 | 706.220,440 | 4.645.073,090 | 381,050 | |
| 12847 | 706.225,920 | 4.645.073,480 | 380,880 | |
| 12848 | 706.209,550 | 4.645.076,860 | 381,110 | |
| 12849 | 706.225,350 | 4.645.079,010 | 381,080 | |
| 12850 | 706.229,430 | 4.645.078,640 | 380,840 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12851 | 706.208,980 | 4.645.082,630 | 381,040 | |
| 12852 | 706.244,330 | 4.645.068,110 | 380,880 | |
| 12853 | 706.249,130 | 4.645.073,460 | 380,890 | |
| 12854 | 706.235,760 | 4.645.076,220 | 380,930 | |
| 12855 | 706.258,650 | 4.645.065,200 | 380,930 | |
| 12856 | 706.263,000 | 4.645.064,900 | 380,810 | |
| 12857 | 706.262,240 | 4.645.070,760 | 380,850 | |
| 12858 | 706.265,980 | 4.645.068,510 | 380,800 | |
| 12859 | 706.274,740 | 4.645.068,300 | 380,840 | |
| 12860 | 706.583,280 | 4.645.064,650 | 379,060 | |
| 12861 | 706.587,420 | 4.645.071,090 | 379,030 | |
| 12862 | 706.575,340 | 4.645.078,150 | 378,950 | |
| 12863 | 706.570,910 | 4.645.084,240 | 379,070 | |
| 12864 | 706.575,170 | 4.645.085,960 | 379,140 | |
| 12865 | 707.070,130 | 4.645.063,730 | 374,200 | |
| 12866 | 707.087,940 | 4.645.069,840 | 374,220 | |
| 12867 | 707.081,590 | 4.645.075,460 | 374,250 | |
| 12868 | 707.093,940 | 4.645.087,930 | 374,230 | |
| 12869 | 707.100,710 | 4.645.085,160 | 374,160 | |
| 12870 | 706.038,220 | 4.645.108,600 | 383,220 | |
| 12871 | 706.073,580 | 4.645.101,550 | 383,100 | |
| 12872 | 706.076,940 | 4.645.111,290 | 383,000 | |
| 12873 | 706.099,150 | 4.645.096,910 | 382,630 | |
| 12874 | 706.085,880 | 4.645.100,820 | 383,120 | |
| 12875 | 706.088,380 | 4.645.109,130 | 383,030 | |
| 12876 | 706.114,370 | 4.645.091,530 | 382,620 | |
| 12877 | 706.103,720 | 4.645.107,040 | 382,630 | |
| 12878 | 706.145,080 | 4.645.090,980 | 383,450 | |
| 12879 | 706.137,460 | 4.645.101,580 | 383,960 | |
| 12880 | 706.170,670 | 4.645.090,040 | 381,310 | |
| 12881 | 706.567,560 | 4.645.088,950 | 379,280 | |
| 12882 | 706.563,770 | 4.645.095,150 | 379,320 | |
| 12883 | 706.569,400 | 4.645.096,100 | 379,140 | |
| 12884 | 706.555,450 | 4.645.105,040 | 379,080 | |
| 12885 | 706.561,980 | 4.645.105,670 | 379,130 | |
| 12886 | 706.551,000 | 4.645.111,530 | 379,230 | |
| 12887 | 706.571,380 | 4.645.092,060 | 379,160 | |
| 12888 | 707.092,590 | 4.645.089,120 | 374,250 | |
| 12889 | 707.105,830 | 4.645.090,380 | 374,060 | |
| 12890 | 707.098,460 | 4.645.093,130 | 374,120 | |
| 12891 | 707.104,290 | 4.645.095,990 | 374,110 | |
| 12892 | 707.111,500 | 4.645.094,430 | 373,830 | |
| 12893 | 707.111,410 | 4.645.092,800 | 374,050 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12894 | 707.115,220 | 4.645.096,150 | 373,650 | |
| 12895 | 707.106,200 | 4.645.097,240 | 373,800 | |
| 12896 | 707.108,250 | 4.645.098,980 | 373,610 | |
| 12897 | 707.121,120 | 4.645.103,430 | 373,870 | |
| 12898 | 707.125,350 | 4.645.103,830 | 372,690 | |
| 12899 | 707.118,620 | 4.645.106,520 | 373,880 | |
| 12900 | 707.121,380 | 4.645.108,430 | 372,840 | |
| 12901 | 707.127,890 | 4.645.113,810 | 372,510 | |
| 12902 | 706.007,100 | 4.645.116,900 | 383,150 | |
| 12903 | 706.009,830 | 4.645.128,160 | 382,770 | |
| 12904 | 706.027,790 | 4.645.124,130 | 382,700 | |
| 12905 | 706.062,130 | 4.645.115,520 | 382,670 | |
| 12906 | 706.547,220 | 4.645.120,040 | 378,340 | |
| 12907 | 706.551,460 | 4.645.121,100 | 378,690 | |
| 12908 | 706.724,740 | 4.645.134,820 | 376,370 | |
| 12909 | 706.720,020 | 4.645.140,330 | 376,470 | |
| 12910 | 707.134,970 | 4.645.115,490 | 372,500 | |
| 12911 | 707.135,340 | 4.645.122,100 | 372,490 | |
| 12912 | 707.141,880 | 4.645.122,580 | 372,540 | |
| 12913 | 707.142,770 | 4.645.129,300 | 372,500 | |
| 12914 | 707.151,620 | 4.645.131,080 | 372,470 | |
| 12915 | 707.157,190 | 4.645.135,820 | 372,570 | |
| 12916 | 707.152,620 | 4.645.138,020 | 372,470 | |
| 12917 | 707.160,940 | 4.645.138,690 | 371,930 | |
| 12918 | 706.725,280 | 4.645.144,180 | 376,510 | |
| 12919 | 706.727,070 | 4.645.154,730 | 376,660 | |
| 12920 | 706.726,340 | 4.645.162,980 | 376,780 | |
| 12921 | 706.728,200 | 4.645.165,940 | 375,950 | |
| 12922 | 707.155,710 | 4.645.142,240 | 371,890 | |
| 12923 | 707.161,970 | 4.645.148,010 | 371,920 | |
| 12924 | 707.168,680 | 4.645.145,720 | 371,920 | |
| 12925 | 707.172,650 | 4.645.156,880 | 371,930 | |
| 12926 | 707.179,310 | 4.645.156,130 | 371,910 | |
| 12927 | 707.187,150 | 4.645.161,090 | 372,420 | |
| 12928 | 707.181,730 | 4.645.164,280 | 372,260 | |
| 12929 | 707.184,240 | 4.645.165,720 | 371,600 | |
| 12930 | 707.188,340 | 4.645.163,320 | 371,510 | |
| 12931 | 706.729,850 | 4.645.169,950 | 375,800 | |
| 12932 | 706.730,650 | 4.645.184,130 | 375,770 | |
| 12933 | 707.192,190 | 4.645.167,890 | 371,500 | |
| 12934 | 707.189,310 | 4.645.171,070 | 371,480 | |
| 12935 | 707.204,370 | 4.645.175,520 | 371,480 | |
| 12936 | 707.197,370 | 4.645.178,610 | 371,500 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12937 | 707.207,170 | 4.645.187,480 | 371,230 | |
| 12938 | 707.216,960 | 4.645.189,100 | 371,250 | |
| 12939 | 707.218,210 | 4.645.196,770 | 371,260 | |
| 12940 | 707.223,440 | 4.645.201,140 | 371,400 | |
| 12941 | 707.232,230 | 4.645.203,950 | 371,320 | |
| 12942 | 707.234,730 | 4.645.210,090 | 371,420 | |
| 12943 | 707.243,040 | 4.645.213,210 | 371,440 | |
| 12944 | 707.238,020 | 4.645.216,180 | 371,340 | |
| 12945 | 707.247,600 | 4.645.219,070 | 371,510 | |
| 12946 | 707.243,270 | 4.645.221,180 | 371,450 | |
| 12947 | 707.252,850 | 4.645.223,000 | 370,600 | |
| 12948 | 707.247,480 | 4.645.225,010 | 370,650 | |
| 12949 | 707.252,700 | 4.645.229,220 | 370,620 | |
| 12950 | 707.261,510 | 4.645.229,730 | 370,660 | |
| 12951 | 707.262,830 | 4.645.240,010 | 370,640 | |
| 12952 | 707.277,070 | 4.645.242,620 | 370,770 | |
| 12953 | 706.014,250 | 4.645.253,090 | 382,790 | |
| 12954 | 706.014,000 | 4.645.266,520 | 382,500 | |
| 12955 | 706.724,660 | 4.645.251,520 | 376,100 | |
| 12956 | 706.720,940 | 4.645.255,220 | 376,400 | |
| 12957 | 706.723,630 | 4.645.257,430 | 376,440 | |
| 12958 | 706.710,260 | 4.645.263,390 | 376,380 | |
| 12959 | 706.705,930 | 4.645.265,400 | 376,710 | |
| 12960 | 706.715,980 | 4.645.266,400 | 376,490 | |
| 12961 | 706.715,180 | 4.645.267,840 | 376,690 | |
| 12962 | 706.702,370 | 4.645.270,240 | 376,770 | |
| 12963 | 706.730,680 | 4.645.245,140 | 375,950 | |
| 12964 | 706.736,820 | 4.645.249,520 | 375,980 | |
| 12965 | 706.727,440 | 4.645.253,380 | 376,330 | |
| 12966 | 706.733,780 | 4.645.254,270 | 376,150 | |
| 12967 | 706.738,410 | 4.645.253,430 | 376,070 | |
| 12968 | 706.735,970 | 4.645.256,530 | 376,160 | |
| 12969 | 706.738,650 | 4.645.261,180 | 376,690 | |
| 12970 | 706.740,380 | 4.645.264,960 | 376,210 | |
| 12971 | 707.281,270 | 4.645.255,150 | 370,580 | |
| 12972 | 707.292,900 | 4.645.257,640 | 370,580 | |
| 12973 | 707.292,270 | 4.645.263,970 | 370,570 | |
| 12974 | 707.296,850 | 4.645.267,460 | 369,860 | |
| 12975 | 707.299,780 | 4.645.262,920 | 370,670 | |
| 12976 | 707.304,260 | 4.645.265,520 | 369,860 | |
| 12977 | 706.030,390 | 4.645.278,270 | 382,440 | |
| 12978 | 706.028,270 | 4.645.288,000 | 382,410 | |
| 12979 | 706.042,700 | 4.645.294,890 | 382,420 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 12980 | 706.678,810 | 4.645.296,570 | 378,360 | |
| 12981 | 706.700,630 | 4.645.271,580 | 376,520 | |
| 12982 | 706.708,580 | 4.645.275,080 | 376,860 | |
| 12983 | 706.706,850 | 4.645.277,240 | 376,770 | |
| 12984 | 706.744,390 | 4.645.268,770 | 376,210 | |
| 12985 | 707.299,990 | 4.645.271,180 | 369,730 | |
| 12986 | 707.309,220 | 4.645.272,220 | 369,740 | |
| 12987 | 707.308,070 | 4.645.279,710 | 369,760 | |
| 12988 | 707.317,470 | 4.645.278,580 | 369,740 | |
| 12989 | 707.317,230 | 4.645.288,220 | 369,760 | |
| 12990 | 707.324,940 | 4.645.286,950 | 369,750 | |
| 12991 | 707.324,630 | 4.645.293,290 | 369,750 | |
| 12992 | 707.333,940 | 4.645.293,910 | 369,730 | |
| 12993 | 707.335,700 | 4.645.296,510 | 369,770 | |
| 12994 | 706.040,680 | 4.645.304,590 | 382,430 | |
| 12995 | 706.051,630 | 4.645.310,850 | 382,470 | |
| 12996 | 706.050,680 | 4.645.321,430 | 382,470 | |
| 12997 | 706.648,170 | 4.645.320,770 | 378,360 | |
| 12998 | 706.672,220 | 4.645.300,810 | 378,390 | |
| 12999 | 706.658,960 | 4.645.312,410 | 378,350 | |
| 13000 | 706.667,810 | 4.645.312,260 | 378,370 | |
| 13001 | 706.659,420 | 4.645.319,460 | 378,340 | |
| 13002 | 706.678,580 | 4.645.303,110 | 378,570 | |
| 13003 | 707.331,050 | 4.645.299,240 | 369,830 | |
| 13004 | 707.338,360 | 4.645.298,640 | 369,740 | |
| 13005 | 707.333,210 | 4.645.301,800 | 369,270 | |
| 13006 | 707.342,400 | 4.645.303,110 | 369,190 | |
| 13007 | 707.335,950 | 4.645.306,250 | 369,200 | |
| 13008 | 707.348,420 | 4.645.314,320 | 369,160 | |
| 13009 | 707.353,630 | 4.645.310,610 | 369,130 | |
| 13010 | 707.360,960 | 4.645.317,920 | 369,230 | |
| 13011 | 706.063,140 | 4.645.330,810 | 382,320 | |
| 13012 | 706.060,020 | 4.645.337,660 | 382,310 | |
| 13013 | 706.072,260 | 4.645.347,380 | 382,440 | |
| 13014 | 706.620,610 | 4.645.347,040 | 378,320 | |
| 13015 | 706.639,710 | 4.645.329,740 | 378,370 | |
| 13016 | 706.632,310 | 4.645.335,450 | 378,360 | |
| 13017 | 706.640,220 | 4.645.335,610 | 378,370 | |
| 13018 | 706.631,730 | 4.645.342,960 | 378,330 | |
| 13019 | 706.648,830 | 4.645.327,420 | 378,370 | |
| 13020 | 707.355,720 | 4.645.322,820 | 369,160 | |
| 13021 | 707.369,830 | 4.645.325,230 | 369,180 | |
| 13022 | 707.362,510 | 4.645.329,250 | 369,340 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13023 | 707.369,690 | 4.645.331,240 | 368,900 | |
| 13024 | 707.372,240 | 4.645.335,290 | 368,850 | |
| 13025 | 707.377,860 | 4.645.327,050 | 368,940 | |
| 13026 | 707.377,120 | 4.645.331,890 | 368,740 | |
| 13027 | 707.378,570 | 4.645.340,970 | 368,820 | |
| 13028 | 707.385,070 | 4.645.338,640 | 368,830 | |
| 13029 | 707.385,750 | 4.645.347,630 | 368,750 | |
| 13030 | 706.068,550 | 4.645.348,470 | 382,310 | |
| 13031 | 706.073,990 | 4.645.350,350 | 382,630 | |
| 13032 | 706.069,750 | 4.645.351,720 | 382,570 | |
| 13033 | 706.073,670 | 4.645.359,590 | 382,510 | |
| 13034 | 706.083,210 | 4.645.365,180 | 382,480 | |
| 13035 | 706.623,600 | 4.645.350,770 | 378,390 | |
| 13036 | 707.394,930 | 4.645.347,740 | 368,710 | |
| 13037 | 707.393,900 | 4.645.355,470 | 368,730 | |
| 13038 | 707.402,420 | 4.645.355,490 | 368,720 | |
| 13039 | 707.400,630 | 4.645.362,660 | 368,750 | |
| 13040 | 707.414,530 | 4.645.363,390 | 368,770 | |
| 13041 | 707.408,000 | 4.645.369,330 | 368,800 | |
| 13042 | 707.422,430 | 4.645.371,540 | 368,760 | |
| 13043 | 706.081,600 | 4.645.377,100 | 382,460 | |
| 13044 | 706.100,600 | 4.645.395,200 | 382,470 | |
| 13045 | 706.094,350 | 4.645.400,170 | 382,420 | |
| 13046 | 707.415,460 | 4.645.375,020 | 368,750 | |
| 13047 | 707.422,800 | 4.645.382,790 | 368,760 | |
| 13048 | 707.431,030 | 4.645.380,280 | 368,750 | |
| 13049 | 707.432,710 | 4.645.391,120 | 368,790 | |
| 13050 | 707.436,940 | 4.645.388,790 | 368,850 | |
| 13051 | 707.437,410 | 4.645.394,920 | 368,860 | |
| 13052 | 707.443,200 | 4.645.391,380 | 369,240 | |
| 13053 | 707.447,130 | 4.645.395,270 | 369,220 | |
| 13054 | 707.451,110 | 4.645.399,100 | 369,220 | |
| 13055 | 707.453,010 | 4.645.401,240 | 368,430 | |
| 13056 | 707.477,300 | 4.645.399,600 | 368,430 | |
| 13057 | 707.491,140 | 4.645.396,950 | 368,460 | |
| 13058 | 707.498,750 | 4.645.399,090 | 368,470 | |
| 13059 | 707.504,430 | 4.645.395,760 | 368,460 | |
| 13060 | 707.486,090 | 4.645.401,430 | 368,470 | |
| 13061 | 707.530,120 | 4.645.390,470 | 368,470 | |
| 13062 | 707.514,990 | 4.645.392,990 | 368,470 | |
| 13063 | 707.525,790 | 4.645.393,970 | 368,450 | |
| 13064 | 707.511,640 | 4.645.396,810 | 368,450 | |
| 13065 | 707.548,600 | 4.645.386,330 | 368,400 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13066 | 707.544,710 | 4.645.390,880 | 368,430 | |
| 13067 | 707.554,310 | 4.645.388,070 | 368,470 | |
| 13068 | 707.547,600 | 4.645.394,170 | 368,370 | |
| 13069 | 707.554,600 | 4.645.393,910 | 368,360 | |
| 13070 | 707.551,140 | 4.645.397,830 | 368,240 | |
| 13071 | 707.552,340 | 4.645.400,640 | 368,290 | |
| 13072 | 707.557,600 | 4.645.401,130 | 368,360 | |
| 13073 | 707.559,930 | 4.645.397,460 | 368,220 | |
| 13074 | 706.112,590 | 4.645.412,240 | 382,430 | |
| 13075 | 706.108,700 | 4.645.420,950 | 382,440 | |
| 13076 | 707.447,560 | 4.645.402,680 | 368,410 | |
| 13077 | 707.445,360 | 4.645.405,040 | 368,410 | |
| 13078 | 707.452,380 | 4.645.407,890 | 368,420 | |
| 13079 | 707.453,270 | 4.645.410,540 | 368,500 | |
| 13080 | 707.455,990 | 4.645.403,180 | 368,420 | |
| 13081 | 707.458,450 | 4.645.406,540 | 368,490 | |
| 13082 | 707.466,780 | 4.645.405,380 | 368,460 | |
| 13083 | 707.458,770 | 4.645.409,860 | 368,750 | |
| 13084 | 707.454,190 | 4.645.412,570 | 368,940 | |
| 13085 | 707.455,680 | 4.645.415,750 | 368,750 | |
| 13086 | 707.459,120 | 4.645.411,940 | 368,730 | |
| 13087 | 707.459,840 | 4.645.414,750 | 368,670 | |
| 13088 | 707.456,790 | 4.645.417,940 | 368,950 | |
| 13089 | 707.460,310 | 4.645.416,760 | 368,670 | |
| 13090 | 707.458,050 | 4.645.422,740 | 368,620 | |
| 13091 | 707.463,210 | 4.645.420,840 | 368,770 | |
| 13092 | 707.556,890 | 4.645.407,780 | 368,440 | |
| 13093 | 706.122,620 | 4.645.433,310 | 382,430 | |
| 13094 | 706.116,860 | 4.645.437,490 | 382,430 | |
| 13095 | 706.128,250 | 4.645.446,560 | 382,440 | |
| 13096 | 706.122,010 | 4.645.451,420 | 382,460 | |
| 13097 | 707.461,750 | 4.645.430,690 | 368,260 | |
| 13098 | 707.468,550 | 4.645.435,090 | 368,230 | |
| 13099 | 707.466,980 | 4.645.444,950 | 368,240 | |
| 13100 | 707.473,970 | 4.645.450,170 | 368,240 | |
| 13101 | 706.122,720 | 4.645.456,100 | 382,450 | |
| 13102 | 706.122,550 | 4.645.460,780 | 382,990 | |
| 13103 | 706.125,400 | 4.645.465,050 | 383,120 | |
| 13104 | 706.130,800 | 4.645.455,750 | 382,450 | |
| 13105 | 706.139,190 | 4.645.459,480 | 383,000 | |
| 13106 | 706.133,230 | 4.645.464,670 | 383,050 | |
| 13107 | 706.130,120 | 4.645.475,270 | 383,020 | |
| 13108 | 706.136,230 | 4.645.474,130 | 383,060 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13109 | 707.473,680 | 4.645.462,740 | 368,240 | |
| 13110 | 707.479,530 | 4.645.478,500 | 368,330 | |
| 13111 | 707.482,490 | 4.645.469,520 | 368,300 | |
| 13112 | 706.137,760 | 4.645.479,900 | 383,180 | |
| 13113 | 706.130,710 | 4.645.482,300 | 382,910 | |
| 13114 | 706.132,760 | 4.645.484,790 | 383,600 | |
| 13115 | 706.137,540 | 4.645.486,240 | 383,530 | |
| 13116 | 706.135,260 | 4.645.491,550 | 383,110 | |
| 13117 | 706.140,420 | 4.645.494,410 | 384,470 | |
| 13118 | 706.136,260 | 4.645.497,970 | 384,380 | |
| 13119 | 707.486,930 | 4.645.483,350 | 368,330 | |
| 13120 | 707.486,100 | 4.645.493,380 | 368,280 | |
| 13121 | 707.491,500 | 4.645.496,630 | 368,220 | |
| 13122 | 707.494,950 | 4.645.503,600 | 368,320 | |
| 13123 | 706.145,790 | 4.645.508,320 | 384,280 | |
| 13124 | 706.136,470 | 4.645.517,300 | 384,280 | |
| 13125 | 706.149,150 | 4.645.527,910 | 384,230 | |
| 13126 | 706.577,620 | 4.645.530,560 | 380,640 | |
| 13127 | 707.490,430 | 4.645.506,100 | 368,330 | |
| 13128 | 707.492,880 | 4.645.509,920 | 367,760 | |
| 13129 | 707.496,720 | 4.645.508,040 | 367,720 | |
| 13130 | 707.495,260 | 4.645.518,400 | 367,660 | |
| 13131 | 707.501,120 | 4.645.521,850 | 367,670 | |
| 13132 | 707.500,190 | 4.645.530,540 | 367,710 | |
| 13133 | 706.141,710 | 4.645.541,560 | 384,210 | |
| 13134 | 706.148,250 | 4.645.549,700 | 384,280 | |
| 13135 | 706.144,200 | 4.645.555,260 | 384,280 | |
| 13136 | 706.568,620 | 4.645.535,320 | 382,330 | |
| 13137 | 706.589,450 | 4.645.531,870 | 380,240 | |
| 13138 | 706.587,240 | 4.645.537,010 | 380,240 | |
| 13139 | 707.507,860 | 4.645.537,640 | 367,740 | |
| 13140 | 707.510,770 | 4.645.546,920 | 367,710 | |
| 13141 | 707.507,540 | 4.645.549,360 | 367,710 | |
| 13142 | 707.510,700 | 4.645.549,780 | 367,360 | |
| 13143 | 707.509,350 | 4.645.550,720 | 367,390 | |
| 13144 | 706.150,160 | 4.645.557,880 | 386,880 | |
| 13145 | 706.145,690 | 4.645.563,710 | 386,750 | |
| 13146 | 706.151,000 | 4.645.564,940 | 386,540 | |
| 13147 | 706.146,620 | 4.645.575,420 | 386,470 | |
| 13148 | 706.153,320 | 4.645.583,350 | 386,520 | |
| 13149 | 707.512,070 | 4.645.560,720 | 367,330 | |
| 13150 | 707.515,400 | 4.645.559,370 | 367,330 | |
| 13151 | 707.514,930 | 4.645.569,390 | 367,360 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13152 | 707.518,240 | 4.645.567,650 | 367,390 | |
| 13153 | 707.521,110 | 4.645.569,140 | 367,020 | |
| 13154 | 707.515,040 | 4.645.572,080 | 367,160 | |
| 13155 | 707.519,610 | 4.645.579,220 | 367,090 | |
| 13156 | 707.525,660 | 4.645.583,010 | 367,100 | |
| 13157 | 706.149,120 | 4.645.588,530 | 386,580 | |
| 13158 | 706.153,890 | 4.645.595,470 | 386,580 | |
| 13159 | 706.156,850 | 4.645.600,170 | 387,680 | |
| 13160 | 706.159,190 | 4.645.596,710 | 387,700 | |
| 13161 | 706.162,530 | 4.645.599,050 | 387,620 | |
| 13162 | 706.158,990 | 4.645.602,430 | 387,710 | |
| 13163 | 706.165,110 | 4.645.603,910 | 387,720 | |
| 13164 | 706.162,290 | 4.645.606,120 | 387,600 | |
| 13165 | 706.169,020 | 4.645.606,520 | 387,550 | |
| 13166 | 706.782,970 | 4.645.586,680 | 375,620 | |
| 13167 | 706.796,380 | 4.645.590,010 | 375,600 | |
| 13168 | 706.807,660 | 4.645.591,930 | 375,560 | |
| 13169 | 706.811,770 | 4.645.592,730 | 375,650 | |
| 13170 | 706.824,850 | 4.645.593,190 | 374,620 | |
| 13171 | 706.843,520 | 4.645.591,110 | 374,110 | |
| 13172 | 706.848,480 | 4.645.589,000 | 374,080 | |
| 13173 | 706.830,890 | 4.645.592,790 | 374,010 | |
| 13174 | 707.529,160 | 4.645.589,810 | 367,040 | |
| 13175 | 707.523,200 | 4.645.595,160 | 366,770 | |
| 13176 | 707.523,250 | 4.645.592,320 | 367,050 | |
| 13177 | 707.529,080 | 4.645.592,680 | 366,780 | |
| 13178 | 707.527,130 | 4.645.602,360 | 366,770 | |
| 13179 | 707.533,010 | 4.645.600,840 | 366,790 | |
| 13180 | 706.166,450 | 4.645.612,440 | 387,510 | |
| 13181 | 706.176,630 | 4.645.616,430 | 387,400 | |
| 13182 | 706.174,650 | 4.645.622,930 | 387,430 | |
| 13183 | 706.186,420 | 4.645.627,360 | 387,610 | |
| 13184 | 707.531,710 | 4.645.610,600 | 366,770 | |
| 13185 | 707.536,860 | 4.645.608,980 | 366,780 | |
| 13186 | 707.539,460 | 4.645.616,520 | 366,730 | |
| 13187 | 707.534,340 | 4.645.617,890 | 366,720 | |
| 13188 | 707.539,410 | 4.645.617,910 | 366,650 | |
| 13189 | 707.534,610 | 4.645.620,780 | 366,340 | |
| 13190 | 707.544,140 | 4.645.627,380 | 366,360 | |
| 13191 | 706.185,140 | 4.645.634,380 | 387,460 | |
| 13192 | 706.210,350 | 4.645.652,840 | 391,340 | |
| 13193 | 706.210,110 | 4.645.659,590 | 391,450 | |
| 13194 | 706.218,650 | 4.645.660,140 | 391,660 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13195 | 707.541,010 | 4.645.635,680 | 366,390 | |
| 13196 | 707.552,000 | 4.645.639,030 | 366,320 | |
| 13197 | 707.544,220 | 4.645.644,880 | 366,360 | |
| 13198 | 707.550,140 | 4.645.643,860 | 366,350 | |
| 13199 | 707.545,380 | 4.645.648,010 | 366,040 | |
| 13200 | 707.550,670 | 4.645.646,830 | 365,980 | |
| 13201 | 707.548,640 | 4.645.655,650 | 365,980 | |
| 13202 | 707.553,120 | 4.645.655,790 | 365,950 | |
| 13203 | 706.218,900 | 4.645.667,200 | 391,760 | |
| 13204 | 706.225,160 | 4.645.668,090 | 391,940 | |
| 13205 | 706.224,890 | 4.645.670,270 | 391,870 | |
| 13206 | 706.237,860 | 4.645.680,660 | 391,880 | |
| 13207 | 706.247,530 | 4.645.681,740 | 391,070 | |
| 13208 | 707.552,180 | 4.645.664,240 | 365,980 | |
| 13209 | 707.553,390 | 4.645.672,500 | 365,980 | |
| 13210 | 707.555,240 | 4.645.674,990 | 365,690 | |
| 13211 | 707.558,890 | 4.645.666,850 | 365,950 | |
| 13212 | 707.559,640 | 4.645.671,970 | 365,940 | |
| 13213 | 707.560,190 | 4.645.674,770 | 365,640 | |
| 13214 | 707.558,400 | 4.645.682,700 | 365,720 | |
| 13215 | 707.566,520 | 4.645.684,550 | 365,710 | |
| 13216 | 706.249,170 | 4.645.687,280 | 391,310 | |
| 13217 | 706.256,880 | 4.645.692,570 | 389,170 | |
| 13218 | 706.258,540 | 4.645.688,330 | 388,920 | |
| 13219 | 706.264,130 | 4.645.691,270 | 388,700 | |
| 13220 | 706.270,110 | 4.645.693,730 | 388,970 | |
| 13221 | 706.261,440 | 4.645.695,710 | 388,800 | |
| 13222 | 706.267,230 | 4.645.697,390 | 389,560 | |
| 13223 | 706.279,140 | 4.645.695,730 | 387,820 | |
| 13224 | 706.274,060 | 4.645.701,490 | 387,590 | |
| 13225 | 706.269,790 | 4.645.703,690 | 387,790 | |
| 13226 | 706.273,790 | 4.645.708,820 | 387,850 | |
| 13227 | 706.296,810 | 4.645.696,780 | 388,610 | |
| 13228 | 706.282,900 | 4.645.702,170 | 387,600 | |
| 13229 | 706.297,610 | 4.645.700,620 | 388,740 | |
| 13230 | 706.313,920 | 4.645.695,290 | 386,190 | |
| 13231 | 706.314,840 | 4.645.701,600 | 386,030 | |
| 13232 | 706.321,850 | 4.645.698,660 | 386,060 | |
| 13233 | 706.321,890 | 4.645.702,430 | 386,080 | |
| 13234 | 707.562,290 | 4.645.692,560 | 365,660 | |
| 13235 | 707.569,400 | 4.645.694,750 | 365,680 | |
| 13236 | 707.562,890 | 4.645.700,840 | 365,700 | |
| 13237 | 707.572,840 | 4.645.701,510 | 365,650 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13238 | 707.565,260 | 4.645.703,500 | 365,420 | |
| 13239 | 707.572,750 | 4.645.704,340 | 365,360 | |
| 13240 | 707.568,900 | 4.645.710,210 | 365,390 | |
| 13241 | 706.269,450 | 4.645.713,730 | 387,020 | |
| 13242 | 706.268,390 | 4.645.716,500 | 387,220 | |
| 13243 | 706.273,410 | 4.645.720,330 | 387,100 | |
| 13244 | 706.271,680 | 4.645.726,740 | 387,030 | |
| 13245 | 706.274,320 | 4.645.730,500 | 387,150 | |
| 13246 | 706.275,060 | 4.645.735,600 | 385,400 | |
| 13247 | 706.914,750 | 4.645.739,300 | 371,480 | |
| 13248 | 707.576,230 | 4.645.711,820 | 365,350 | |
| 13249 | 707.573,430 | 4.645.720,120 | 365,370 | |
| 13250 | 707.579,980 | 4.645.720,390 | 365,400 | |
| 13251 | 707.575,270 | 4.645.730,280 | 365,370 | |
| 13252 | 707.575,360 | 4.645.727,430 | 365,340 | |
| 13253 | 707.583,920 | 4.645.728,580 | 365,340 | |
| 13254 | 707.578,370 | 4.645.734,180 | 364,930 | |
| 13255 | 707.583,790 | 4.645.732,740 | 364,940 | |
| 13256 | 706.275,710 | 4.645.741,790 | 385,260 | |
| 13257 | 706.276,440 | 4.645.752,580 | 385,270 | |
| 13258 | 706.277,960 | 4.645.762,090 | 385,400 | |
| 13259 | 706.895,640 | 4.645.743,050 | 371,480 | |
| 13260 | 706.909,700 | 4.645.742,290 | 371,430 | |
| 13261 | 706.909,060 | 4.645.757,770 | 371,480 | |
| 13262 | 707.583,350 | 4.645.746,890 | 365,020 | |
| 13263 | 707.591,760 | 4.645.740,570 | 365,030 | |
| 13264 | 707.593,970 | 4.645.751,050 | 365,000 | |
| 13265 | 707.587,730 | 4.645.757,420 | 365,060 | |
| 13266 | 707.598,650 | 4.645.761,170 | 364,990 | |
| 13267 | 706.277,970 | 4.645.766,390 | 383,970 | |
| 13268 | 706.278,870 | 4.645.769,390 | 383,820 | |
| 13269 | 706.281,410 | 4.645.782,410 | 383,830 | |
| 13270 | 706.914,680 | 4.645.765,020 | 371,530 | |
| 13271 | 707.589,840 | 4.645.764,800 | 365,050 | |
| 13272 | 707.597,910 | 4.645.766,640 | 364,990 | |
| 13273 | 707.590,930 | 4.645.768,740 | 364,380 | |
| 13274 | 707.597,800 | 4.645.770,710 | 364,260 | |
| 13275 | 707.595,450 | 4.645.776,390 | 364,310 | |
| 13276 | 707.599,210 | 4.645.785,440 | 364,320 | |
| 13277 | 706.281,680 | 4.645.795,890 | 383,860 | |
| 13278 | 706.907,910 | 4.645.790,640 | 371,470 | |
| 13279 | 706.913,870 | 4.645.789,480 | 371,580 | |
| 13280 | 706.914,270 | 4.645.812,570 | 371,800 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13281 | 706.909,010 | 4.645.813,340 | 371,540 | |
| 13282 | 706.325,220 | 4.645.831,010 | 382,240 | |
| 13283 | 706.915,360 | 4.645.829,240 | 371,780 | |
| 13284 | 706.927,190 | 4.645.829,280 | 370,780 | |
| 13285 | 706.909,240 | 4.645.833,260 | 371,500 | |
| 13286 | 706.919,480 | 4.645.829,810 | 370,720 | |
| 13287 | 706.931,850 | 4.645.833,040 | 370,650 | |
| 13288 | 706.915,160 | 4.645.834,960 | 371,810 | |
| 13289 | 706.920,320 | 4.645.833,850 | 370,610 | |
| 13290 | 706.301,360 | 4.645.906,070 | 384,430 | |
| 13291 | 706.310,540 | 4.645.906,390 | 384,300 | |
| 13292 | 706.297,680 | 4.645.919,720 | 384,390 | |
| 13293 | 706.308,200 | 4.645.916,190 | 384,360 | |
| 13294 | 706.297,490 | 4.645.925,450 | 384,330 | |
| 13295 | 706.296,010 | 4.645.930,140 | 385,440 | |
| 13296 | 706.295,870 | 4.645.934,480 | 385,450 | |
| 13297 | 706.293,890 | 4.645.940,940 | 385,370 | |
| 13298 | 706.303,990 | 4.646.013,020 | 388,640 | |
| 13299 | 706.298,390 | 4.646.017,810 | 388,800 | |
| 13300 | 706.307,630 | 4.646.025,480 | 388,930 | |
| 13301 | 706.300,840 | 4.646.034,200 | 388,840 | |
| 13302 | 706.300,590 | 4.646.041,370 | 389,260 | |
| 13303 | 706.304,390 | 4.646.045,300 | 389,410 | |
| 13304 | 706.310,440 | 4.646.035,200 | 389,420 | |
| 13305 | 706.324,100 | 4.646.034,750 | 389,700 | |
| 13306 | 706.308,040 | 4.646.041,130 | 389,430 | |
| 13307 | 706.318,840 | 4.646.039,390 | 389,730 | |
| 13308 | 706.330,380 | 4.646.039,340 | 390,100 | |
| 13309 | 706.325,350 | 4.646.042,970 | 390,170 | |
| 13310 | 706.329,510 | 4.646.045,790 | 390,600 | |
| 13311 | 706.333,530 | 4.646.042,790 | 390,610 | |
| 13312 | 706.336,850 | 4.646.049,850 | 390,800 | |
| 13313 | 706.343,780 | 4.646.047,430 | 390,840 | |
| 13314 | 706.303,690 | 4.646.053,920 | 389,790 | |
| 13315 | 706.299,830 | 4.646.064,360 | 390,120 | |
| 13316 | 706.359,710 | 4.646.056,840 | 391,460 | |
| 13317 | 706.355,850 | 4.646.061,020 | 391,650 | |
| 13318 | 706.379,260 | 4.646.066,350 | 391,910 | |
| 13319 | 706.373,240 | 4.646.069,260 | 392,170 | |
| 13320 | 706.297,840 | 4.646.077,790 | 390,850 | |
| 13321 | 706.295,810 | 4.646.095,450 | 391,610 | |
| 13322 | 706.390,580 | 4.646.078,940 | 392,810 | |
| 13323 | 706.395,930 | 4.646.076,710 | 392,390 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13324 | 706.409,520 | 4.646.083,200 | 392,100 | |
| 13325 | 706.407,330 | 4.646.086,790 | 392,390 | |
| 13326 | 706.420,410 | 4.646.089,590 | 391,910 | |
| 13327 | 706.416,380 | 4.646.092,320 | 392,290 | |
| 13328 | 706.423,900 | 4.646.094,420 | 391,990 | |
| 13329 | 706.293,060 | 4.646.108,860 | 391,980 | |
| 13330 | 706.288,710 | 4.646.122,190 | 391,700 | |
| 13331 | 706.422,000 | 4.646.106,520 | 392,370 | |
| 13332 | 706.418,640 | 4.646.108,410 | 392,460 | |
| 13333 | 706.286,540 | 4.646.131,680 | 391,530 | |
| 13334 | 706.284,090 | 4.646.140,840 | 391,690 | |
| 13335 | 706.282,800 | 4.646.149,480 | 391,650 | |
| 13336 | 706.279,300 | 4.646.163,330 | 391,580 | |
| 13337 | 706.278,140 | 4.646.171,510 | 391,580 | |
| 13338 | 706.276,350 | 4.646.182,050 | 391,350 | |
| 13339 | 706.273,630 | 4.646.189,020 | 391,390 | |
| 13340 | 706.271,230 | 4.646.198,300 | 391,040 | |
| 13341 | 706.269,200 | 4.646.208,110 | 390,790 | |
| 13342 | 706.267,250 | 4.646.218,550 | 390,770 | |
| 13343 | 706.265,790 | 4.646.224,600 | 390,270 | |
| 13344 | 706.263,650 | 4.646.236,600 | 389,990 | |
| 13345 | 706.260,900 | 4.646.249,660 | 389,780 | |
| 13346 | 706.258,440 | 4.646.258,480 | 389,450 | |
| 13347 | 706.257,110 | 4.646.268,550 | 389,280 | |
| 13348 | 706.254,760 | 4.646.276,480 | 389,110 | |
| 13349 | 706.253,460 | 4.646.285,230 | 388,980 | |
| 13350 | 706.251,100 | 4.646.298,400 | 388,680 | |
| 13351 | 706.243,890 | 4.646.307,440 | 388,020 | |
| 13352 | 706.246,140 | 4.646.313,840 | 388,040 | |
| 13353 | 706.244,580 | 4.646.326,770 | 387,980 | |
| 13354 | 706.238,750 | 4.646.331,440 | 388,020 | |
| 13355 | 706.241,170 | 4.646.342,410 | 388,010 | |
| 13356 | 706.235,570 | 4.646.346,140 | 387,980 | |
| 13357 | 706.236,530 | 4.646.358,900 | 387,980 | |
| 13358 | 706.228,810 | 4.646.378,830 | 387,960 | |
| 13359 | 706.231,360 | 4.646.363,230 | 388,010 | |
| 13360 | 706.234,590 | 4.646.372,180 | 387,970 | |
| 13361 | 706.231,470 | 4.646.385,990 | 388,060 | |
| 13362 | 706.225,550 | 4.646.389,120 | 388,080 | |
| 13363 | 706.226,300 | 4.646.392,940 | 387,240 | |
| 13364 | 706.222,270 | 4.646.404,810 | 387,250 | |
| 13365 | 706.229,550 | 4.646.391,290 | 387,300 | |
| 13366 | 706.229,230 | 4.646.399,850 | 387,240 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13367 | 706.225,430 | 4.646.415,790 | 387,230 | |
| 13368 | 706.219,370 | 4.646.420,250 | 387,180 | |
| 13369 | 706.222,330 | 4.646.429,170 | 387,270 | |
| 13370 | 706.216,290 | 4.646.432,880 | 387,270 | |
| 13371 | 706.220,850 | 4.646.441,620 | 387,280 | |
| 13372 | 706.213,700 | 4.646.443,670 | 387,280 | |
| 13373 | 706.214,300 | 4.646.446,650 | 386,940 | |
| 13374 | 706.220,760 | 4.646.444,450 | 386,970 | |
| 13375 | 706.218,230 | 4.646.450,220 | 386,950 | |
| 13376 | 706.211,570 | 4.646.452,310 | 386,940 | |
| 13377 | 706.215,120 | 4.646.463,890 | 386,930 | |
| 13378 | 706.206,630 | 4.646.479,820 | 386,970 | |
| 13379 | 706.208,640 | 4.646.466,650 | 386,970 | |
| 13380 | 706.210,710 | 4.646.478,740 | 386,960 | |
| 13381 | 706.206,480 | 4.646.484,160 | 386,420 | |
| 13382 | 706.210,560 | 4.646.483,030 | 386,420 | |
| 13383 | 706.210,170 | 4.646.489,150 | 386,370 | |
| 13384 | 706.203,670 | 4.646.493,160 | 386,410 | |
| 13385 | 706.200,650 | 4.646.505,640 | 386,450 | |
| 13386 | 706.199,140 | 4.646.515,510 | 386,410 | |
| 13387 | 706.203,080 | 4.646.516,340 | 386,450 | |
| 13388 | 706.207,240 | 4.646.503,300 | 386,480 | |
| 13389 | 706.197,960 | 4.646.522,160 | 387,660 | |
| 13390 | 706.196,470 | 4.646.529,880 | 389,220 | |
| 13391 | 706.201,610 | 4.646.530,420 | 387,270 | |
| 13392 | 706.198,200 | 4.646.536,580 | 389,440 | |
| 13393 | 706.192,710 | 4.646.548,030 | 390,130 | |
| 13394 | 706.196,970 | 4.646.546,420 | 389,820 | |
| 13395 | 706.189,200 | 4.646.560,650 | 390,560 | |
| 13396 | 706.192,860 | 4.646.567,000 | 390,620 | |
| 13397 | 706.179,650 | 4.646.594,100 | 390,800 | |
| 13398 | 706.185,310 | 4.646.577,960 | 390,700 | |
| 13399 | 706.189,050 | 4.646.584,240 | 389,940 | |
| 13400 | 706.173,190 | 4.646.613,470 | 390,260 | |
| 13401 | 706.184,380 | 4.646.603,740 | 389,260 | |
| 13402 | 706.178,630 | 4.646.622,840 | 388,810 | |
| 13403 | 706.168,630 | 4.646.629,470 | 390,110 | |
| 13404 | 706.173,630 | 4.646.633,620 | 389,460 | |
| 13405 | 706.165,340 | 4.646.639,590 | 389,430 | |
| 13406 | 706.170,280 | 4.646.644,970 | 389,000 | |
| 13407 | 706.165,910 | 4.646.657,640 | 387,410 | |
| 13408 | 706.163,520 | 4.646.664,660 | 386,480 | |
| 13409 | 706.161,130 | 4.646.673,150 | 385,570 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13410 | 706.160,200 | 4.646.675,940 | 385,270 | |
| 13411 | 706.159,110 | 4.646.679,200 | 383,570 | |
| 13412 | 706.148,430 | 4.646.708,800 | 383,820 | |
| 13413 | 706.154,990 | 4.646.699,760 | 383,810 | |
| 13414 | 706.121,870 | 4.646.742,000 | 383,770 | |
| 13415 | 706.115,280 | 4.646.755,570 | 385,140 | |
| 13416 | 706.114,060 | 4.646.759,050 | 385,140 | |
| 13417 | 706.119,190 | 4.646.759,870 | 384,080 | |
| 13418 | 706.112,910 | 4.646.763,380 | 385,240 | |
| 13419 | 706.106,820 | 4.646.770,890 | 385,310 | |
| 13420 | 706.102,410 | 4.646.793,390 | 385,610 | |
| 13421 | 706.094,330 | 4.646.824,980 | 386,380 | |
| 13422 | 706.087,690 | 4.646.855,680 | 387,570 | |
| 13423 | 706.080,780 | 4.646.882,980 | 388,450 | |
| 13424 | 706.070,710 | 4.646.928,510 | 388,300 | |
| 13425 | 706.075,040 | 4.646.912,730 | 388,590 | |
| 13426 | 706.067,240 | 4.646.937,890 | 388,390 | |
| 13427 | 706.065,270 | 4.646.942,600 | 387,880 | |
| 13428 | 706.063,590 | 4.646.964,310 | 386,940 | |
| 13429 | 706.059,180 | 4.646.979,480 | 386,290 | |
| 13430 | 705.990,200 | 4.645.115,940 | 383,220 | |
| 13431 | 705.982,580 | 4.645.120,540 | 383,120 | |
| 13432 | 705.996,370 | 4.645.131,850 | 382,810 | |
| 13433 | 705.974,540 | 4.645.135,750 | 383,240 | |
| 13434 | 705.469,980 | 4.647.181,160 | 382,470 | |
| 13435 | 705.457,970 | 4.647.206,480 | 382,460 | |
| 13436 | 705.444,020 | 4.647.235,770 | 382,220 | |
| 13437 | 705.433,280 | 4.647.257,860 | 382,110 | |
| 13438 | 705.418,810 | 4.647.290,600 | 382,100 | |
| 13439 | 705.411,900 | 4.647.305,020 | 382,040 | |
| 13440 | 709.688,300 | 4.646.794,960 | 352,690 | |
| 13441 | 709.677,890 | 4.646.807,240 | 350,910 | |
| 13442 | 709.680,680 | 4.646.805,280 | 352,670 | |
| 13443 | 705.888,143 | 4.645.138,876 | 384,389 | ACEQUIA |
| 13444 | 705.890,468 | 4.645.134,112 | 384,343 | ACEQUIA |
| 13445 | 709.677,650 | 4.646.819,190 | 351,060 | |
| 13446 | 708.149,844 | 4.645.697,660 | 361,966 | |
| 13447 | 709.691,790 | 4.646.797,420 | 351,330 | |
| 13448 | 708.151,099 | 4.645.672,031 | 362,580 | |
| 13449 | 708.155,947 | 4.645.652,605 | 363,177 | |
| 13450 | 709.703,560 | 4.646.802,520 | 349,050 | |
| 13451 | 709.724,340 | 4.646.801,030 | 348,360 | |
| 13452 | 709.736,520 | 4.646.800,060 | 348,640 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13453 | 709.729,000 | 4.646.806,550 | 348,700 | |
| 13454 | 709.734,750 | 4.646.806,160 | 347,450 | |
| 13455 | 713.264,510 | 4.644.530,922 | 338,530 | ACEQUIA |
| 13456 | 713.268,985 | 4.644.538,209 | 338,740 | ACEQUIA |
| 13457 | 709.776,680 | 4.646.807,560 | 347,320 | |
| 13458 | 709.793,870 | 4.646.808,530 | 347,490 | |
| 13459 | 709.798,110 | 4.646.808,670 | 346,020 | |
| 13460 | 709.818,290 | 4.646.811,510 | 346,070 | |
| 13461 | 709.800,310 | 4.646.813,850 | 345,970 | |
| 13462 | 709.821,590 | 4.646.815,700 | 346,020 | |
| 13463 | 709.830,350 | 4.646.816,750 | 346,000 | |
| 13464 | 711.669,212 | 4.646.322,956 | 332,900 | ACEQUIA |
| 13465 | 711.695,216 | 4.646.323,720 | 332,310 | ACEQUIA |
| 13466 | 709.866,480 | 4.646.816,360 | 344,890 | |
| 13467 | 709.859,320 | 4.646.820,090 | 344,920 | |
| 13468 | 710.475,501 | 4.646.824,574 | 341,390 | ACEQUIA |
| 13469 | 710.489,225 | 4.646.822,334 | 341,270 | ACEQUIA |
| 13470 | 709.680,390 | 4.646.826,730 | 350,370 | |
| 13471 | 709.973,117 | 4.646.920,403 | 343,150 | ACEQUIA |
| 13472 | 709.677,330 | 4.646.838,850 | 350,230 | |
| 13473 | 709.683,580 | 4.646.837,930 | 350,310 | |
| 13474 | 708.398,744 | 4.645.216,571 | 367,924 | |
| 13475 | 709.923,050 | 4.646.822,470 | 344,760 | |
| 13476 | 708.409,942 | 4.645.215,663 | 367,222 | |
| 13477 | 709.272,735 | 4.646.401,637 | 351,440 | ACEQUIA |
| 13478 | 709.934,980 | 4.646.828,880 | 344,520 | |
| 13479 | 707.972,098 | 4.646.046,233 | 363,060 | ACEQUIA |
| 13480 | 709.962,340 | 4.646.832,720 | 344,530 | |
| 13481 | 708.406,732 | 4.645.161,132 | 366,989 | |
| 13482 | 708.415,666 | 4.645.173,237 | 366,911 | |
| 13483 | 707.617,641 | 4.645.472,961 | 367,080 | ACEQUIA |
| 13484 | 708.420,034 | 4.645.170,668 | 366,458 | |
| 13485 | 708.406,531 | 4.645.157,411 | 366,393 | |
| 13486 | 709.702,340 | 4.646.873,240 | 350,260 | |
| 13487 | 709.696,180 | 4.646.874,730 | 350,350 | |
| 13488 | 708.082,917 | 4.644.986,956 | 370,760 | ACEQUIA |
| 13489 | 709.720,340 | 4.646.912,580 | 350,330 | |
| 13490 | 708.408,926 | 4.645.141,449 | 366,035 | |
| 13491 | 709.725,860 | 4.646.936,480 | 350,310 | |
| 13492 | 708.407,370 | 4.645.139,455 | 366,672 | |
| 13493 | 709.734,260 | 4.646.953,640 | 350,340 | |
| 13494 | 709.744,260 | 4.646.961,040 | 350,300 | |
| 13495 | 711.149,608 | 4.647.398,518 | 342,560 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13496 | 709.751,710 | 4.646.974,270 | 350,360 | |
| 13497 | 709.747,490 | 4.646.983,620 | 350,300 | |
| 13498 | 711.090,689 | 4.647.406,033 | 342,440 | PT |
| 13499 | 708.413,165 | 4.645.133,212 | 366,263 | |
| 13500 | 711.069,219 | 4.647.419,368 | 342,660 | PIE |
| 13501 | 709.763,830 | 4.647.015,540 | 350,230 | |
| 13502 | 711.060,064 | 4.647.414,359 | 343,420 | CABE |
| 13503 | 709.774,080 | 4.647.021,590 | 350,330 | |
| 13504 | 709.780,200 | 4.647.036,360 | 350,330 | |
| 13505 | 711.033,304 | 4.647.419,963 | 343,330 | PT |
| 13506 | 708.400,358 | 4.645.130,526 | 367,115 | |
| 13507 | 711.007,048 | 4.647.437,063 | 343,450 | PT |
| 13508 | 709.796,950 | 4.647.072,960 | 350,320 | |
| 13509 | 709.794,810 | 4.647.081,490 | 350,350 | |
| 13510 | 709.803,720 | 4.647.088,410 | 350,310 | |
| 13511 | 710.963,116 | 4.647.447,436 | 343,380 | PIE |
| 13512 | 710.962,218 | 4.647.448,069 | 343,750 | PISTA |
| 13513 | 709.769,380 | 4.647.139,800 | 352,080 | |
| 13514 | 709.791,870 | 4.647.127,080 | 351,640 | |
| 13515 | 710.960,385 | 4.647.436,703 | 343,750 | PISTA |
| 13516 | 709.787,580 | 4.647.137,680 | 351,640 | |
| 13517 | 709.036,342 | 4.645.208,349 | 360,080 | ACEQUIA |
| 13518 | 709.826,060 | 4.647.116,930 | 350,300 | |
| 13519 | 709.801,250 | 4.647.122,880 | 351,670 | |
| 13520 | 710.848,446 | 4.647.465,334 | 343,970 | PT |
| 13521 | 709.823,020 | 4.647.122,380 | 350,390 | |
| 13522 | 709.825,970 | 4.647.121,640 | 350,350 | |
| 13523 | 709.803,640 | 4.647.126,980 | 351,730 | |
| 13524 | 709.808,840 | 4.647.125,970 | 350,210 | |
| 13525 | 710.766,163 | 4.647.499,041 | 344,250 | PT |
| 13526 | 708.307,350 | 4.645.008,109 | 369,290 | |
| 13527 | 710.725,405 | 4.647.507,875 | 343,820 | ACEQ |
| 13528 | 710.723,993 | 4.647.497,261 | 343,800 | ACEQ |
| 13529 | 709.829,190 | 4.647.115,450 | 350,090 | |
| 13530 | 708.266,884 | 4.644.988,576 | 369,760 | |
| 13531 | 710.723,311 | 4.647.509,744 | 344,880 | CABE |
| 13532 | 709.838,400 | 4.647.118,960 | 349,540 | |
| 13533 | 710.693,431 | 4.647.505,352 | 344,690 | PT |
| 13534 | 709.830,990 | 4.647.122,670 | 349,850 | |
| 13535 | 708.264,418 | 4.644.999,859 | 369,286 | |
| 13536 | 710.624,187 | 4.647.534,394 | 344,910 | PT |
| 13537 | 709.846,780 | 4.647.119,500 | 349,440 | |
| 13538 | 710.621,129 | 4.647.524,643 | 345,120 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13539 | 709.860,120 | 4.647.121,000 | 349,430 | |
| 13540 | 709.641,405 | 4.645.306,854 | 354,230 | ACEQUIA |
| 13541 | 709.854,910 | 4.647.125,770 | 349,450 | |
| 13542 | 709.872,030 | 4.647.127,640 | 349,490 | |
| 13543 | 710.578,172 | 4.647.537,391 | 345,020 | PT |
| 13544 | 710.560,131 | 4.647.543,416 | 345,050 | PT |
| 13545 | 710.560,880 | 4.647.552,172 | 345,000 | PT |
| 13546 | 705.898,434 | 4.645.116,973 | 385,062 | ACEQUIA |
| 13547 | 710.558,298 | 4.647.542,653 | 345,230 | PT |
| 13548 | 709.954,600 | 4.647.130,730 | 349,460 | |
| 13549 | 709.944,360 | 4.647.136,530 | 349,450 | |
| 13550 | 709.974,320 | 4.647.133,390 | 349,480 | |
| 13551 | 709.964,610 | 4.647.138,830 | 349,440 | |
| 13552 | 709.991,260 | 4.647.134,800 | 349,480 | |
| 13553 | 710.523,025 | 4.647.554,046 | 345,440 | PT |
| 13554 | 709.744,080 | 4.647.154,870 | 353,830 | |
| 13555 | 710.503,000 | 4.647.568,490 | 345,390 | PT |
| 13556 | 709.745,600 | 4.647.159,170 | 353,900 | |
| 13557 | 710.480,097 | 4.647.568,486 | 345,580 | CANALETA |
| 13558 | 710.489,965 | 4.647.575,350 | 344,840 | ACEQ |
| 13559 | 709.759,590 | 4.647.145,530 | 352,770 | |
| 13560 | 709.767,570 | 4.647.147,680 | 352,800 | |
| 13561 | 710.471,201 | 4.647.567,585 | 344,830 | ACEQ |
| 13562 | 710.459,062 | 4.647.574,454 | 345,270 | PT |
| 13563 | 710.463,766 | 4.647.582,671 | 345,260 | PT |
| 13564 | 709.758,730 | 4.647.152,820 | 352,790 | |
| 13565 | 710.452,223 | 4.647.576,932 | 345,320 | PT |
| 13566 | 710.448,547 | 4.647.577,559 | 345,660 | CABE |
| 13567 | 711.294,615 | 4.645.571,863 | 349,620 | ACEQUIA |
| 13568 | 709.494,090 | 4.647.165,170 | 362,140 | |
| 13569 | 709.487,540 | 4.647.176,650 | 361,690 | |
| 13570 | 709.493,140 | 4.647.179,650 | 362,320 | |
| 13571 | 709.483,560 | 4.647.188,570 | 361,670 | |
| 13572 | 709.541,230 | 4.647.178,270 | 362,350 | |
| 13573 | 710.441,945 | 4.647.587,993 | 345,640 | PT |
| 13574 | 709.553,280 | 4.647.178,240 | 361,700 | |
| 13575 | 710.412,299 | 4.647.587,118 | 345,670 | PT |
| 13576 | 711.583,827 | 4.645.809,900 | 338,030 | ACEQUIA |
| 13577 | 710.389,743 | 4.647.602,418 | 345,630 | PT |
| 13578 | 710.376,934 | 4.647.608,325 | 345,690 | PT |
| 13579 | 711.571,429 | 4.645.808,284 | 338,130 | ACEQUIA |
| 13580 | 709.579,910 | 4.647.189,330 | 361,550 | |
| 13581 | 711.627,302 | 4.645.933,909 | 340,940 | ACEQUIA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13582 | 711.644,277 | 4.645.934,214 | 340,630 | ACEQUIA |
| 13583 | 709.689,980 | 4.647.179,910 | 356,130 | |
| 13584 | 709.679,410 | 4.647.182,160 | 356,160 | |
| 13585 | 710.330,753 | 4.647.564,254 | 346,340 | PISTA |
| 13586 | 708.022,229 | 4.644.925,125 | 372,754 | |
| 13587 | 710.334,270 | 4.647.556,280 | 345,300 | ACEQ |
| 13588 | 710.461,521 | 4.645.502,443 | 353,710 | ACEQUIA |
| 13589 | 709.713,110 | 4.647.170,550 | 354,880 | |
| 13590 | 709.702,250 | 4.647.175,590 | 355,630 | |
| 13591 | 710.319,869 | 4.647.541,176 | 346,200 | PT |
| 13592 | 709.704,330 | 4.647.180,510 | 355,290 | |
| 13593 | 710.317,833 | 4.647.524,228 | 346,190 | PT |
| 13594 | 709.700,740 | 4.647.182,210 | 356,170 | |
| 13595 | 709.933,612 | 4.645.470,598 | 356,230 | ACEQUIA |
| 13596 | 709.712,900 | 4.647.184,980 | 354,480 | |
| 13597 | 709.719,360 | 4.647.181,510 | 354,760 | |
| 13598 | 710.027,759 | 4.645.726,719 | 352,390 | ACEQUIA |
| 13599 | 710.290,249 | 4.647.496,308 | 346,300 | PT |
| 13600 | 709.722,400 | 4.647.165,040 | 354,900 | |
| 13601 | 710.291,227 | 4.647.480,887 | 346,350 | CABE |
| 13602 | 710.291,198 | 4.647.479,517 | 346,850 | CABE2 |
| 13603 | 710.283,585 | 4.647.482,539 | 346,880 | CABE2 |
| 13604 | 710.051,535 | 4.645.725,299 | 352,550 | ACEQUIA |
| 13605 | 709.490,350 | 4.647.196,300 | 361,820 | |
| 13606 | 708.303,745 | 4.644.985,268 | 369,113 | |
| 13607 | 709.573,220 | 4.647.193,850 | 361,340 | |
| 13608 | 709.577,510 | 4.647.194,800 | 361,410 | |
| 13609 | 710.265,192 | 4.647.451,500 | 348,230 | CABE2 |
| 13610 | 709.591,590 | 4.647.193,000 | 359,540 | |
| 13611 | 710.264,376 | 4.647.435,786 | 348,110 | PT |
| 13612 | 710.257,398 | 4.647.440,253 | 348,110 | PT |
| 13613 | 709.612,530 | 4.647.198,100 | 359,760 | |
| 13614 | 710.258,693 | 4.647.423,918 | 348,250 | CABE |
| 13615 | 710.255,863 | 4.647.418,566 | 351,150 | CABE2 |
| 13616 | 710.245,988 | 4.647.423,322 | 351,120 | CABE2 |
| 13617 | 709.626,730 | 4.647.199,850 | 359,740 | |
| 13618 | 708.465,150 | 4.644.987,557 | 368,176 | |
| 13619 | 709.637,070 | 4.647.198,340 | 357,800 | |
| 13620 | 710.245,218 | 4.647.392,578 | 351,100 | CABE |
| 13621 | 708.466,751 | 4.644.986,946 | 367,368 | |
| 13622 | 708.465,013 | 4.644.980,504 | 367,684 | |
| 13623 | 709.616,740 | 4.647.205,700 | 359,850 | |
| 13624 | 708.469,229 | 4.644.978,169 | 367,423 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13625 | 709.619,970 | 4.647.211,620 | 359,760 | |
| 13626 | 708.535,897 | 4.644.979,212 | 367,502 | |
| 13627 | 709.655,230 | 4.647.192,080 | 357,920 | |
| 13628 | 709.655,140 | 4.647.197,070 | 357,900 | |
| 13629 | 709.641,950 | 4.647.201,320 | 357,680 | |
| 13630 | 708.555,681 | 4.644.978,315 | 365,409 | |
| 13631 | 710.219,001 | 4.647.337,799 | 354,880 | CABE2 |
| 13632 | 709.718,270 | 4.647.197,830 | 355,560 | |
| 13633 | 709.727,060 | 4.647.193,160 | 354,640 | |
| 13634 | 708.588,912 | 4.644.984,336 | 363,959 | |
| 13635 | 709.482,170 | 4.647.218,510 | 361,600 | |
| 13636 | 710.207,399 | 4.647.298,083 | 354,720 | PT |
| 13637 | 709.486,470 | 4.647.231,340 | 361,820 | |
| 13638 | 709.581,110 | 4.647.241,160 | 359,810 | |
| 13639 | 708.577,489 | 4.644.992,251 | 363,815 | |
| 13640 | 710.173,408 | 4.647.311,499 | 354,760 | PT |
| 13641 | 709.589,310 | 4.647.241,340 | 359,620 | |
| 13642 | 706.286,002 | 4.644.880,931 | 379,900 | ACEQUIA |
| 13643 | 710.152,871 | 4.647.317,697 | 354,910 | PT |
| 13644 | 710.141,560 | 4.647.323,970 | 354,930 | PT |
| 13645 | 709.447,490 | 4.647.259,810 | 361,730 | |
| 13646 | 709.458,010 | 4.647.256,870 | 361,550 | |
| 13647 | 709.457,260 | 4.647.262,740 | 361,760 | |
| 13648 | 709.471,760 | 4.647.261,250 | 361,580 | |
| 13649 | 710.113,509 | 4.647.335,565 | 354,790 | ACEQ |
| 13650 | 709.467,430 | 4.647.264,900 | 361,640 | |
| 13651 | 709.471,750 | 4.647.266,430 | 361,680 | |
| 13652 | 706.050,507 | 4.645.008,283 | 382,090 | ACEQUIA |
| 13653 | 710.085,497 | 4.647.337,254 | 355,070 | PT |
| 13654 | 709.575,830 | 4.647.258,290 | 359,650 | |
| 13655 | 710.060,373 | 4.647.347,291 | 355,280 | PT |
| 13656 | 709.566,870 | 4.647.267,160 | 359,470 | |
| 13657 | 706.408,587 | 4.644.714,423 | 380,850 | ACEQUIA |
| 13658 | 710.040,317 | 4.647.356,060 | 355,330 | PT |
| 13659 | 709.550,780 | 4.647.300,210 | 359,670 | |
| 13660 | 709.556,270 | 4.647.308,330 | 359,680 | |
| 13661 | 706.772,435 | 4.644.463,614 | 381,980 | ACEQUIA |
| 13662 | 709.994,426 | 4.647.375,532 | 355,840 | PT |
| 13663 | 709.542,090 | 4.647.327,900 | 360,660 | |
| 13664 | 709.994,893 | 4.647.404,621 | 355,420 | PT |
| 13665 | 709.991,863 | 4.647.419,071 | 355,560 | CABE |
| 13666 | 709.983,263 | 4.647.417,772 | 355,670 | CABE |
| 13667 | 709.994,334 | 4.647.424,232 | 352,990 | ACEQ |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13668 | 707.596,365 | 4.644.891,806 | 374,700 | ACEQUIA |
| 13669 | 709.987,825 | 4.647.435,322 | 353,220 | PT |
| 13670 | 707.594,145 | 4.644.880,548 | 374,770 | ACEQUIA |
| 13671 | 709.541,820 | 4.647.381,860 | 358,740 | |
| 13672 | 709.980,578 | 4.647.423,554 | 353,090 | ACEQ |
| 13673 | 709.975,654 | 4.647.449,762 | 353,220 | CABE |
| 13674 | 709.983,207 | 4.647.447,779 | 353,140 | CABE |
| 13675 | 709.984,765 | 4.647.450,641 | 352,520 | CABE2 |
| 13676 | 709.973,720 | 4.647.453,475 | 352,470 | CABE2 |
| 13677 | 709.969,303 | 4.647.471,270 | 352,550 | PT |
| 13678 | 709.537,740 | 4.647.423,620 | 357,590 | |
| 13679 | 710.333,468 | 4.647.527,240 | 345,550 | ACEQUIA |
| 13680 | 709.530,630 | 4.647.438,260 | 357,720 | |
| 13681 | 710.606,505 | 4.647.446,118 | 343,670 | ACEQUIA |
| 13682 | 709.974,673 | 4.647.478,372 | 352,540 | CUNETA |
| 13683 | 709.530,740 | 4.647.450,130 | 356,660 | |
| 13684 | 709.535,400 | 4.647.438,450 | 357,650 | |
| 13685 | 709.536,360 | 4.647.435,230 | 357,500 | |
| 13686 | 709.537,150 | 4.647.441,580 | 357,730 | |
| 13687 | 709.536,090 | 4.647.444,450 | 356,680 | |
| 13688 | 709.962,580 | 4.647.484,827 | 353,740 | CABE |
| 13689 | 709.976,247 | 4.647.489,478 | 353,200 | CABE |
| 13690 | 711.214,267 | 4.647.379,232 | 340,650 | ACEQUIA |
| 13691 | 709.491,450 | 4.647.479,290 | 356,610 | |
| 13692 | 709.961,471 | 4.647.494,582 | 353,570 | PT |
| 13693 | 710.213,215 | 4.647.287,478 | 354,690 | PT |
| 13694 | 710.216,411 | 4.647.285,204 | 354,080 | ACEQ |
| 13695 | 710.206,537 | 4.647.288,871 | 354,320 | ACEQ |
| 13696 | 710.205,503 | 4.647.288,039 | 354,940 | CABE |
| 13697 | 710.447,059 | 4.647.580,958 | 344,300 | ACEQUIA |
| 13698 | 710.211,735 | 4.647.282,974 | 353,280 | DESAGUE |
| 13699 | 710.208,452 | 4.647.284,289 | 353,410 | DESAGUE |
| 13700 | 709.517,310 | 4.647.471,270 | 356,790 | |
| 13701 | 709.535,650 | 4.647.458,640 | 356,680 | |
| 13702 | 710.210,373 | 4.647.275,244 | 354,660 | PT |
| 13703 | 709.448,420 | 4.647.503,150 | 356,310 | |
| 13704 | 710.189,388 | 4.647.602,632 | 344,970 | ACEQUIA |
| 13705 | 710.205,106 | 4.647.253,219 | 354,650 | PT |
| 13706 | 710.199,152 | 4.647.238,078 | 354,600 | PT |
| 13707 | 709.462,900 | 4.647.494,360 | 356,280 | |
| 13708 | 710.195,353 | 4.647.227,034 | 354,600 | PT |
| 13709 | 709.457,440 | 4.647.496,530 | 356,280 | |
| 13710 | 709.489,530 | 4.647.484,800 | 357,000 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13711 | 710.195,266 | 4.647.220,508 | 354,620 | PT |
| 13712 | 709.484,070 | 4.647.488,130 | 356,730 | |
| 13713 | 709.432,280 | 4.647.530,250 | 356,250 | |
| 13714 | 710.187,501 | 4.647.218,129 | 355,040 | CARRETERA |
| 13715 | 710.185,620 | 4.647.213,087 | 355,010 | CARRETERA |
| 13716 | 709.432,690 | 4.647.537,580 | 356,140 | |
| 13717 | 710.013,720 | 4.646.832,110 | 344,450 | |
| 13718 | 710.024,230 | 4.646.834,340 | 344,480 | |
| 13719 | 710.191,178 | 4.647.208,138 | 354,070 | ACEQ |
| 13720 | 710.023,910 | 4.646.837,680 | 344,460 | |
| 13721 | 710.189,828 | 4.647.202,560 | 354,160 | PT |
| 13722 | 710.202,564 | 4.647.218,547 | 354,660 | PT |
| 13723 | 710.203,997 | 4.647.223,680 | 354,600 | PT |
| 13724 | 710.217,057 | 4.647.218,855 | 354,660 | PT |
| 13725 | 709.413,626 | 4.647.890,439 | 347,200 | ACEQUIA |
| 13726 | 709.410,789 | 4.647.898,080 | 347,210 | ACEQUIA |
| 13727 | 710.056,940 | 4.646.837,560 | 344,510 | |
| 13728 | 710.055,310 | 4.646.842,040 | 344,530 | |
| 13729 | 710.240,007 | 4.647.212,689 | 354,440 | CABE2 |
| 13730 | 710.072,450 | 4.646.845,620 | 344,530 | |
| 13731 | 710.088,400 | 4.646.846,600 | 344,620 | |
| 13732 | 710.090,210 | 4.646.847,770 | 344,640 | |
| 13733 | 710.274,014 | 4.647.201,436 | 354,140 | PT |
| 13734 | 709.188,888 | 4.647.963,197 | 351,170 | ACEQUIA |
| 13735 | 710.287,236 | 4.647.191,968 | 354,260 | PT |
| 13736 | 709.034,939 | 4.648.008,018 | 349,890 | ACEQUIA |
| 13737 | 710.120,620 | 4.646.860,540 | 344,450 | |
| 13738 | 710.127,390 | 4.646.859,410 | 344,430 | |
| 13739 | 710.132,990 | 4.646.865,300 | 344,540 | |
| 13740 | 710.329,863 | 4.647.183,926 | 354,210 | PT |
| 13741 | 710.136,090 | 4.646.862,030 | 344,520 | |
| 13742 | 710.337,663 | 4.647.176,050 | 354,310 | PT |
| 13743 | 710.339,255 | 4.647.181,604 | 354,080 | PT |
| 13744 | 710.477,968 | 4.647.119,769 | 353,690 | CARRETERA |
| 13745 | 710.490,233 | 4.647.115,778 | 353,580 | CARRETERA |
| 13746 | 708.509,994 | 4.648.163,887 | 353,140 | ACEQUIA |
| 13747 | 710.493,702 | 4.647.106,746 | 352,920 | PT |
| 13748 | 710.490,483 | 4.647.105,180 | 352,930 | CABE |
| 13749 | 708.347,720 | 4.648.219,159 | 354,450 | ACEQUIA |
| 13750 | 710.190,530 | 4.646.877,650 | 344,380 | |
| 13751 | 710.485,725 | 4.647.105,997 | 353,780 | CABE2 |
| 13752 | 710.477,877 | 4.647.109,964 | 353,810 | PT |
| 13753 | 710.478,984 | 4.647.114,657 | 353,880 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13754 | 710.193,520 | 4.646.886,320 | 344,480 | |
| 13755 | 710.012,950 | 4.647.136,580 | 349,460 | |
| 13756 | 710.002,200 | 4.647.143,150 | 349,450 | |
| 13757 | 710.038,660 | 4.647.139,830 | 349,470 | |
| 13758 | 707.999,649 | 4.648.315,344 | 354,060 | ACEQUIA |
| 13759 | 710.049,180 | 4.647.150,050 | 349,490 | |
| 13760 | 710.062,280 | 4.647.142,250 | 349,490 | |
| 13761 | 710.568,197 | 4.647.084,086 | 350,860 | CANALETA |
| 13762 | 710.567,993 | 4.647.087,853 | 350,690 | CANALETA |
| 13763 | 710.110,060 | 4.647.156,350 | 349,570 | |
| 13764 | 707.201,953 | 4.648.504,744 | 363,860 | ACEQUIA |
| 13765 | 710.571,408 | 4.647.084,250 | 351,990 | PISTA |
| 13766 | 710.576,206 | 4.647.083,743 | 352,010 | PISTA |
| 13767 | 710.120,630 | 4.647.160,220 | 350,040 | |
| 13768 | 710.104,440 | 4.647.163,550 | 351,000 | |
| 13769 | 710.110,110 | 4.647.170,030 | 350,940 | |
| 13770 | 706.955,390 | 4.648.301,430 | 359,970 | ACEQUIA |
| 13771 | 710.133,030 | 4.647.164,080 | 350,120 | |
| 13772 | 710.135,670 | 4.647.168,070 | 351,450 | |
| 13773 | 710.584,884 | 4.647.067,427 | 350,630 | PT |
| 13774 | 710.145,130 | 4.647.172,030 | 352,150 | |
| 13775 | 710.143,560 | 4.647.177,430 | 354,350 | |
| 13776 | 710.579,553 | 4.647.079,960 | 350,440 | ACEQ |
| 13777 | 710.151,510 | 4.647.177,920 | 354,670 | |
| 13778 | 707.364,910 | 4.647.884,031 | 361,590 | ACEQUIA |
| 13779 | 710.150,750 | 4.647.183,130 | 354,580 | |
| 13780 | 710.162,070 | 4.647.190,900 | 354,550 | |
| 13781 | 710.576,370 | 4.647.036,963 | 349,640 | PT |
| 13782 | 710.173,400 | 4.647.200,240 | 354,570 | |
| 13783 | 710.183,050 | 4.647.196,690 | 354,570 | |
| 13784 | 710.578,977 | 4.647.024,264 | 349,150 | PT |
| 13785 | 710.570,495 | 4.647.019,407 | 349,310 | PT |
| 13786 | 707.726,246 | 4.647.647,839 | 358,330 | ACEQUIA |
| 13787 | 710.541,269 | 4.646.988,091 | 347,540 | PT |
| 13788 | 707.467,152 | 4.647.566,469 | 360,750 | ACEQUIA |
| 13789 | 707.145,421 | 4.647.120,844 | 376,340 | ACEQUIA |
| 13790 | 710.583,876 | 4.647.101,292 | 352,880 | CANALETA |
| 13791 | 710.575,461 | 4.647.100,981 | 352,740 | CANALETA |
| 13792 | 710.584,029 | 4.647.104,725 | 353,160 | CABE |
| 13793 | 707.474,660 | 4.646.289,911 | 375,390 | ACEQUIA |
| 13794 | 707.480,882 | 4.646.290,497 | 375,450 | ACEQUIA |
| 13795 | 710.600,833 | 4.647.111,514 | 352,930 | |
| 13796 | 708.137,832 | 4.646.311,953 | 369,270 | ACEQUIA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13797 | 710.649,206 | 4.647.115,244 | 352,870 | |
| 13798 | 708.193,928 | 4.646.380,564 | 372,490 | ACEQUIA |
| 13799 | 710.655,859 | 4.647.135,415 | 352,840 | |
| 13800 | 710.666,874 | 4.647.149,034 | 352,870 | CABE |
| 13801 | 710.660,420 | 4.647.153,982 | 352,260 | ACEQ |
| 13802 | 710.668,369 | 4.647.153,351 | 353,380 | CABE2 |
| 13803 | 710.664,755 | 4.647.163,836 | 353,000 | PT |
| 13804 | 710.679,851 | 4.647.114,881 | 352,810 | PT |
| 13805 | 709.096,014 | 4.647.271,805 | 361,710 | ACEQUIA |
| 13806 | 709.223,255 | 4.647.292,531 | 359,620 | ACEQUIA |
| 13807 | 709.228,095 | 4.647.282,487 | 359,700 | ACEQUIA |
| 13808 | 709.431,533 | 4.647.358,847 | 361,900 | ACEQUIA |
| 13809 | 709.424,967 | 4.647.358,552 | 361,830 | ACEQUIA |
| 13810 | 709.060,800 | 4.647.317,949 | 363,430 | ACEQUIA |
| 13811 | 709.067,755 | 4.647.318,066 | 363,140 | ACEQUIA |
| 13812 | 710.616,342 | 4.647.092,388 | 351,940 | PT |
| 13813 | 710.644,755 | 4.647.093,411 | 351,980 | PT |
| 13814 | 709.167,681 | 4.648.445,529 | 347,800 | ACEQUIA |
| 13815 | 710.671,986 | 4.647.087,748 | 352,550 | POSTELUZ |
| 13816 | 709.829,127 | 4.648.809,315 | 342,290 | ACEQUIA |
| 13817 | 710.702,663 | 4.647.090,257 | 352,380 | CABE |
| 13818 | 710.180,871 | 4.648.728,550 | 341,810 | ACEQUIA |
| 13819 | 710.176,972 | 4.648.726,148 | 341,610 | ACEQUIA |
| 13820 | 710.713,537 | 4.647.095,710 | 352,390 | PT |
| 13821 | 710.729,543 | 4.647.090,766 | 352,440 | PT |
| 13822 | 710.735,994 | 4.647.087,289 | 352,570 | PT |
| 13823 | 709.894,848 | 4.648.225,885 | 344,270 | ACEQUIA |
| 13824 | 710.759,505 | 4.647.074,844 | 352,400 | PT |
| 13825 | 705.323,463 | 4.647.271,491 | 380,480 | ACEQUIA |
| 13826 | 710.805,091 | 4.647.064,941 | 352,520 | PT |
| 13827 | 710.806,762 | 4.647.059,336 | 352,170 | PT |
| 13828 | 706.075,810 | 4.646.944,956 | 387,420 | ACEQUIA |
| 13829 | 710.839,877 | 4.647.053,982 | 351,960 | PT |
| 13830 | 706.204,164 | 4.646.700,813 | 380,180 | ACEQUIA |
| 13831 | 710.879,483 | 4.647.035,676 | 351,850 | PT |
| 13832 | 706.426,768 | 4.647.096,413 | 381,130 | ACEQUIA |
| 13833 | 706.847,431 | 4.646.517,618 | 381,370 | ACEQUIA |
| 13834 | 710.928,357 | 4.647.019,430 | 351,820 | PT |
| 13835 | 706.240,502 | 4.646.271,074 | 388,590 | ACEQUIA |
| 13836 | 706.245,047 | 4.646.284,636 | 388,730 | ACEQUIA |
| 13837 | 706.298,313 | 4.645.995,477 | 387,260 | ACEQUIA |
| 13838 | 710.973,759 | 4.647.008,397 | 351,550 | ASPERSOR |
| 13839 | 711.009,221 | 4.647.002,571 | 351,680 | ASPERSOR |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13840 | 706.297,562 | 4.645.828,075 | 382,890 | ACEQUIA |
| 13841 | 706.141,930 | 4.645.613,243 | 386,720 | ACEQUIA |
| 13842 | 704.844,690 | 4.644.708,324 | 430,785 | ACEQUIA |
| 13843 | 710.528,085 | 4.647.959,508 | 341,700 | ACEQUIA |
| 13844 | 710.534,543 | 4.647.961,259 | 341,890 | ACEQUIA |
| 13845 | 710.494,897 | 4.648.060,449 | 344,156 | ACEQUIA |
| 13846 | 710.501,242 | 4.648.063,108 | 344,181 | ACEQUIA |
| 13847 | 710.648,785 | 4.648.156,293 | 343,604 | ACEQUIA |
| 13848 | 711.064,144 | 4.646.966,466 | 351,310 | PT |
| 13849 | 710.343,151 | 4.647.156,574 | 354,477 | ACEQUIA |
| 13850 | 710.341,628 | 4.647.153,169 | 354,389 | ACEQUIA |
| 13851 | 711.073,856 | 4.646.934,670 | 351,300 | PT |
| 13852 | 711.071,141 | 4.646.912,042 | 351,270 | CABE |
| 13853 | 706.146,067 | 4.646.674,707 | 384,060 | ACEQUIA |
| 13854 | 711.070,654 | 4.646.908,217 | 352,080 | CABE2 |
| 13855 | 711.076,194 | 4.646.903,278 | 351,450 | PT |
| 13856 | 711.069,857 | 4.646.905,995 | 351,380 | PT |
| 13857 | 711.078,217 | 4.646.891,912 | 351,390 | PT |
| 13858 | 705.892,293 | 4.645.129,476 | 384,292 | ACEQUIA |
| 13859 | 705.896,025 | 4.645.121,957 | 384,680 | ACEQUIA |
| 13860 | 711.077,860 | 4.646.843,854 | 351,430 | PT |
| 13861 | 706.281,043 | 4.644.893,351 | 382,106 | ACEQUIA |
| 13862 | 711.053,265 | 4.647.002,623 | 351,470 | PT |
| 13863 | 706.694,266 | 4.645.144,120 | 376,745 | ACEQUIA |
| 13864 | 706.704,050 | 4.645.131,181 | 376,880 | ACEQUIA |
| 13865 | 706.743,800 | 4.645.252,238 | 376,269 | ACEQUIA |
| 13866 | 711.130,123 | 4.646.990,334 | 350,610 | PT |
| 13867 | 706.794,720 | 4.645.390,474 | 375,759 | ACEQUIA |
| 13868 | 711.169,730 | 4.646.976,207 | 350,530 | PT |
| 13869 | 711.175,728 | 4.646.981,266 | 350,660 | PT |
| 13870 | 706.852,384 | 4.645.528,787 | 376,470 | ACEQUIA |
| 13871 | 706.743,027 | 4.644.280,975 | 385,906 | ACEQUIA |
| 13872 | 706.747,372 | 4.644.275,838 | 386,496 | ACEQUIA |
| 13873 | 706.806,397 | 4.644.174,966 | 386,812 | ACEQUIA |
| 13874 | 706.804,504 | 4.644.171,786 | 386,916 | ACEQUIA |
| 13875 | 704.888,286 | 4.644.719,541 | 431,426 | ACEQUIA |
| 13876 | 704.903,949 | 4.644.717,274 | 431,388 | ACEQUIA |
| 13877 | 711.187,344 | 4.647.006,383 | 350,330 | PT |
| 13878 | 711.203,103 | 4.647.013,558 | 350,330 | PT |
| 13879 | 711.212,663 | 4.647.034,872 | 350,310 | PT |
| 13880 | 712.855,838 | 4.645.078,657 | 330,110 | ACEQUIA |
| 13881 | 711.242,195 | 4.647.069,158 | 350,380 | PT |
| 13882 | 712.806,188 | 4.645.092,341 | 330,340 | ACEQUIA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13883 | 712.583,064 | 4.644.781,270 | 337,770 | ACEQUIA |
| 13884 | 711.274,180 | 4.647.102,560 | 349,130 | CORONA |
| 13885 | 712.995,884 | 4.644.563,453 | 337,900 | ACEQUIA |
| 13886 | 713.679,971 | 4.644.251,701 | 340,350 | ACEQUIA |
| 13887 | 713.694,511 | 4.644.262,190 | 339,730 | ACEQUIA |
| 13888 | 713.883,877 | 4.644.797,266 | 322,840 | ACEQUIA |
| 13889 | 712.510,043 | 4.645.002,857 | 340,070 | ACEQUIA |
| 13890 | 710.898,511 | 4.646.659,368 | 339,800 | ACEQUIA |
| 13891 | 711.315,414 | 4.647.115,422 | 346,610 | CORONA |
| 13892 | 711.289,449 | 4.647.108,561 | 347,930 | CORONA |
| 13893 | 711.275,784 | 4.647.103,340 | 348,950 | CORONA |
| 13894 | 710.979,601 | 4.646.676,423 | 341,830 | ACEQUIA |
| 13895 | 705.882,828 | 4.645.147,509 | 385,049 | ACEQUIA |
| 13896 | 705.883,438 | 4.645.147,774 | 385,023 | ACEQUIA |
| 13897 | 709.481,500 | 4.646.510,956 | 348,090 | ACEQUIA |
| 13898 | 709.286,761 | 4.646.244,173 | 350,950 | ACEQUIA |
| 13899 | 708.423,038 | 4.646.054,992 | 357,160 | ACEQUIA |
| 13900 | 711.236,267 | 4.646.941,885 | 350,490 | PT |
| 13901 | 707.980,703 | 4.646.037,028 | 362,660 | ACEQUIA |
| 13902 | 707.798,215 | 4.646.052,998 | 363,790 | ACEQUIA |
| 13903 | 707.790,667 | 4.646.027,721 | 363,270 | ACEQUIA |
| 13904 | 707.581,221 | 4.646.000,365 | 364,850 | ACEQUIA |
| 13905 | 711.296,293 | 4.646.865,087 | 350,540 | PT |
| 13906 | 708.085,607 | 4.644.988,504 | 370,810 | ACEQUIA |
| 13907 | 711.312,733 | 4.646.821,728 | 350,530 | PT |
| 13908 | 709.636,945 | 4.645.296,388 | 354,440 | ACEQUIA |
| 13909 | 709.811,516 | 4.645.338,004 | 357,270 | ACEQUIA |
| 13910 | 705.897,964 | 4.645.116,734 | 385,056 | ACEQUIA |
| 13911 | 711.318,661 | 4.646.793,511 | 350,950 | CABE |
| 13912 | 711.310,389 | 4.646.792,742 | 349,490 | ARBOL |
| 13913 | 710.169,896 | 4.645.411,922 | 353,860 | ACEQUIA |
| 13914 | 710.316,005 | 4.645.429,385 | 355,250 | ACEQUIA |
| 13915 | 711.311,686 | 4.646.747,500 | 347,050 | PT |
| 13916 | 711.317,863 | 4.646.735,705 | 347,300 | PT |
| 13917 | 711.320,975 | 4.646.725,636 | 347,080 | PT |
| 13918 | 711.325,151 | 4.646.710,986 | 348,110 | PT |
| 13919 | 710.839,921 | 4.645.511,771 | 349,790 | ACEQUIA |
| 13920 | 710.835,542 | 4.645.506,344 | 349,740 | ACEQUIA |
| 13921 | 711.673,745 | 4.645.468,086 | 340,920 | ACEQUIA |
| 13922 | 711.357,726 | 4.646.684,111 | 347,360 | PT |
| 13923 | 711.363,171 | 4.646.686,557 | 349,480 | PISTA |
| 13924 | 712.570,087 | 4.644.745,913 | 341,500 | ASPERSOR |
| 13925 | 712.581,574 | 4.644.738,012 | 341,518 | ASPERSOR |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13926 | 711.371,822 | 4.646.677,711 | 349,890 | CABE |
| 13927 | 712.582,467 | 4.644.722,732 | 341,528 | ASPERSOR |
| 13928 | 711.391,996 | 4.646.678,831 | 347,950 | PT |
| 13929 | 711.391,175 | 4.646.673,612 | 347,840 | PT |
| 13930 | 712.685,699 | 4.644.655,058 | 342,706 | ASPERSOR |
| 13931 | 710.813,996 | 4.645.498,782 | 350,920 | BALSA |
| 13932 | 711.455,866 | 4.646.660,539 | 345,520 | PIE |
| 13933 | 711.463,439 | 4.646.655,256 | 344,300 | PT |
| 13934 | 706.624,010 | 4.644.832,261 | 378,820 | BALSA |
| 13935 | 706.620,698 | 4.644.817,629 | 378,790 | BALSA |
| 13936 | 711.528,722 | 4.646.640,332 | 345,290 | PT |
| 13937 | 711.548,445 | 4.646.637,324 | 345,610 | CABE |
| 13938 | 706.487,426 | 4.644.833,088 | 379,100 | BALSA |
| 13939 | 710.825,505 | 4.645.509,320 | 350,820 | BALSA |
| 13940 | 711.585,002 | 4.646.620,289 | 344,450 | CABE2 |
| 13941 | 708.737,210 | 4.647.117,722 | 383,210 | BASE |
| 13942 | 705.852,321 | 4.644.767,024 | 391,661 | CA |
| 13943 | 711.622,145 | 4.646.617,545 | 342,470 | PT |
| 13944 | 711.645,979 | 4.646.605,762 | 341,640 | PIE |
| 13945 | 711.669,384 | 4.646.604,809 | 341,790 | PT |
| 13946 | 705.850,443 | 4.645.207,463 | 384,465 | CA |
| 13947 | 705.859,033 | 4.645.203,510 | 384,409 | CA |
| 13948 | 704.843,535 | 4.644.709,912 | 430,695 | CA |
| 13949 | 711.693,096 | 4.646.586,090 | 340,530 | CANALETA |
| 13950 | 711.691,360 | 4.646.586,872 | 341,180 | PISTA |
| 13951 | 705.511,793 | 4.645.198,235 | 391,878 | CA |
| 13952 | 705.560,626 | 4.645.364,842 | 392,343 | CA |
| 13953 | 711.723,814 | 4.646.577,319 | 338,460 | PT |
| 13954 | 705.551,042 | 4.645.210,898 | 391,668 | CA |
| 13955 | 711.761,759 | 4.646.546,225 | 338,760 | CABE2 |
| 13956 | 711.764,081 | 4.646.543,898 | 336,920 | PIE |
| 13957 | 705.543,726 | 4.645.050,768 | 391,900 | CA |
| 13958 | 705.553,118 | 4.645.144,127 | 391,805 | CA |
| 13959 | 711.784,449 | 4.646.532,352 | 336,060 | PIE |
| 13960 | 705.555,259 | 4.645.180,443 | 391,714 | CA |
| 13961 | 705.557,613 | 4.645.227,829 | 391,788 | CA |
| 13962 | 711.829,892 | 4.646.501,871 | 336,190 | CABE |
| 13963 | 705.560,920 | 4.645.290,406 | 391,967 | CA |
| 13964 | 711.863,688 | 4.646.493,006 | 334,940 | PT |
| 13965 | 711.882,269 | 4.646.481,503 | 335,010 | PT |
| 13966 | 711.893,967 | 4.646.473,725 | 335,080 | CABE2 |
| 13967 | 711.896,647 | 4.646.472,044 | 334,930 | PIE |
| 13968 | 711.893,576 | 4.646.464,260 | 334,780 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 13969 | 705.874,487 | 4.645.454,865 | 385,752 | CA |
| 13970 | 705.899,045 | 4.645.456,049 | 384,833 | CA |
| 13971 | 711.893,259 | 4.646.419,794 | 334,750 | CABE2 |
| 13972 | 711.893,898 | 4.646.417,041 | 334,460 | PIE |
| 13973 | 711.901,847 | 4.646.401,842 | 334,470 | PT |
| 13974 | 711.892,054 | 4.646.385,972 | 334,550 | CABE2 |
| 13975 | 705.884,311 | 4.645.477,553 | 387,733 | CA |
| 13976 | 711.899,522 | 4.646.365,851 | 333,960 | PT |
| 13977 | 711.888,855 | 4.646.344,666 | 334,060 | PISTA |
| 13978 | 706.026,231 | 4.645.225,692 | 382,798 | CA |
| 13979 | 711.900,073 | 4.646.341,604 | 334,280 | PISTA |
| 13980 | 706.005,905 | 4.645.213,348 | 382,986 | CA |
| 13981 | 705.182,797 | 4.644.671,224 | 424,186 | CA |
| 13982 | 711.888,256 | 4.646.312,981 | 334,050 | PT |
| 13983 | 711.886,028 | 4.646.290,024 | 334,040 | PT |
| 13984 | 711.357,529 | 4.646.667,704 | 349,810 | PISTA |
| 13985 | 711.343,476 | 4.646.647,948 | 349,870 | PISTA |
| 13986 | 711.336,545 | 4.646.632,795 | 349,390 | PISTA |
| 13987 | 711.329,451 | 4.646.616,191 | 346,960 | PT |
| 13988 | 711.319,270 | 4.646.621,146 | 347,910 | PT |
| 13989 | 705.957,470 | 4.645.196,361 | 382,782 | CA |
| 13990 | 707.898,360 | 4.644.824,980 | 375,660 | |
| 13991 | 711.335,345 | 4.646.631,665 | 348,100 | ACEQ |
| 13992 | 705.913,663 | 4.645.213,189 | 383,445 | CA |
| 13993 | 705.896,726 | 4.645.211,551 | 383,534 | CA |
| 13994 | 711.353,508 | 4.646.676,353 | 351,490 | PT |
| 13995 | 711.265,921 | 4.647.101,847 | 350,000 | PT |
| 13996 | 705.879,858 | 4.645.210,169 | 383,683 | CA |
| 13997 | 707.972,740 | 4.644.892,050 | 373,900 | |
| 13998 | 711.324,181 | 4.647.136,157 | 345,890 | PT |
| 13999 | 711.340,372 | 4.647.116,577 | 345,340 | PT |
| 14000 | 711.358,142 | 4.647.090,268 | 345,030 | PT |
| 14001 | 709.053,440 | 4.644.333,860 | 365,100 | |
| 14002 | 711.355,643 | 4.647.078,818 | 344,820 | CORONA |
| 14003 | 708.950,723 | 4.648.020,561 | 349,480 | PT |
| 14004 | 708.968,803 | 4.648.016,733 | 349,570 | PT |
| 14005 | 709.020,146 | 4.648.003,168 | 349,590 | PT |
| 14006 | 705.911,795 | 4.645.226,324 | 384,159 | CA |
| 14007 | 708.607,400 | 4.644.383,910 | 369,260 | |
| 14008 | 709.048,316 | 4.648.009,976 | 350,830 | CABE |
| 14009 | 709.036,451 | 4.648.016,554 | 349,520 | PT |
| 14010 | 709.021,908 | 4.648.018,174 | 349,570 | PT |
| 14011 | 705.855,519 | 4.645.203,124 | 384,449 | CA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14012 | 709.073,910 | 4.644.408,240 | 365,080 | |
| 14013 | 708.571,030 | 4.644.423,380 | 369,470 | |
| 14014 | 708.564,790 | 4.644.425,610 | 369,470 | |
| 14015 | 708.549,770 | 4.644.432,460 | 369,460 | |
| 14016 | 708.911,990 | 4.648.043,059 | 348,560 | DESAGUE |
| 14017 | 708.905,539 | 4.648.063,762 | 349,730 | PT |
| 14018 | 708.902,719 | 4.648.047,920 | 349,760 | PT |
| 14019 | 705.544,360 | 4.645.090,324 | 391,742 | CA |
| 14020 | 708.871,091 | 4.648.056,555 | 351,010 | PT |
| 14021 | 708.584,930 | 4.644.413,660 | 369,350 | |
| 14022 | 708.862,313 | 4.648.070,371 | 351,350 | CABE |
| 14023 | 705.901,418 | 4.645.480,166 | 385,916 | CA |
| 14024 | 708.832,041 | 4.648.070,313 | 351,210 | PT |
| 14025 | 708.581,680 | 4.644.419,790 | 369,490 | |
| 14026 | 706.215,535 | 4.646.247,361 | 388,979 | CA |
| 14027 | 708.585,700 | 4.644.425,030 | 369,490 | |
| 14028 | 708.781,617 | 4.648.084,829 | 351,340 | PT |
| 14029 | 708.766,508 | 4.648.088,980 | 350,010 | CABE |
| 14030 | 708.768,431 | 4.648.098,393 | 349,740 | PIE |
| 14031 | 705.686,415 | 4.645.449,640 | 389,003 | CA |
| 14032 | 708.622,460 | 4.644.432,300 | 369,500 | |
| 14033 | 708.717,847 | 4.648.113,528 | 351,000 | CABE |
| 14034 | 708.717,674 | 4.648.105,336 | 350,970 | CABE |
| 14035 | 708.703,819 | 4.648.108,740 | 349,930 | PT |
| 14036 | 708.682,669 | 4.648.120,829 | 350,520 | CABE |
| 14037 | 705.886,022 | 4.645.454,655 | 385,288 | CA |
| 14038 | 708.674,429 | 4.648.122,606 | 351,010 | CABE |
| 14039 | 708.664,623 | 4.648.128,017 | 350,900 | PT |
| 14040 | 705.900,959 | 4.645.477,413 | 385,520 | CA |
| 14041 | 708.638,964 | 4.648.129,042 | 353,040 | CABE |
| 14042 | 708.631,472 | 4.648.139,220 | 352,930 | PT |
| 14043 | 708.501,040 | 4.644.458,550 | 369,860 | |
| 14044 | 706.046,184 | 4.645.230,111 | 382,849 | CA |
| 14045 | 708.562,736 | 4.648.159,608 | 353,040 | PT |
| 14046 | 708.535,895 | 4.648.159,011 | 353,070 | PT |
| 14047 | 708.530,460 | 4.644.441,480 | 369,680 | |
| 14048 | 706.121,914 | 4.645.279,024 | 380,486 | CA |
| 14049 | 708.504,294 | 4.648.173,917 | 354,270 | CABE |
| 14050 | 708.531,770 | 4.644.445,160 | 369,940 | |
| 14051 | 708.479,353 | 4.648.183,541 | 354,040 | PT |
| 14052 | 708.479,340 | 4.648.183,553 | 354,010 | PT |
| 14053 | 708.453,960 | 4.648.181,583 | 354,070 | PT |
| 14054 | 708.637,610 | 4.644.438,450 | 369,580 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14055 | 708.416,913 | 4.648.206,468 | 354,100 | PT |
| 14056 | 708.387,104 | 4.648.203,503 | 354,080 | PT |
| 14057 | 708.367,416 | 4.648.206,940 | 354,090 | PT |
| 14058 | 708.658,280 | 4.644.439,120 | 367,240 | |
| 14059 | 708.658,540 | 4.644.441,390 | 367,240 | |
| 14060 | 708.308,342 | 4.648.235,332 | 353,490 | PT |
| 14061 | 708.304,776 | 4.648.227,135 | 353,550 | PT |
| 14062 | 705.503,099 | 4.645.053,864 | 391,976 | CA |
| 14063 | 705.504,256 | 4.645.065,064 | 391,995 | CA |
| 14064 | 705.507,360 | 4.645.125,816 | 392,006 | CA |
| 14065 | 708.682,830 | 4.644.444,400 | 367,000 | |
| 14066 | 708.274,885 | 4.648.261,036 | 353,340 | PT |
| 14067 | 708.675,550 | 4.644.445,500 | 366,880 | |
| 14068 | 708.275,053 | 4.648.294,477 | 353,280 | PT |
| 14069 | 708.266,556 | 4.648.336,382 | 353,270 | PT |
| 14070 | 708.275,739 | 4.648.351,878 | 353,360 | CABE |
| 14071 | 708.699,230 | 4.644.446,550 | 366,950 | |
| 14072 | 708.703,420 | 4.644.450,260 | 366,890 | |
| 14073 | 708.274,332 | 4.648.373,986 | 352,980 | PT |
| 14074 | 708.266,161 | 4.648.398,007 | 350,860 | DESAGUE |
| 14075 | 708.278,476 | 4.648.404,860 | 353,010 | CABE |
| 14076 | 708.272,167 | 4.648.407,357 | 353,220 | CABE |
| 14077 | 708.277,265 | 4.648.402,789 | 351,050 | DESAGUE |
| 14078 | 708.274,475 | 4.648.417,316 | 353,230 | PT |
| 14079 | 705.629,277 | 4.645.219,274 | 390,380 | CA |
| 14080 | 708.293,882 | 4.648.456,116 | 353,570 | PT |
| 14081 | 708.291,320 | 4.648.476,395 | 353,430 | PT |
| 14082 | 708.298,808 | 4.648.475,811 | 353,570 | PT |
| 14083 | 708.782,420 | 4.644.463,150 | 367,050 | |
| 14084 | 708.783,080 | 4.644.464,750 | 367,030 | |
| 14085 | 705.844,383 | 4.645.207,088 | 384,571 | CA |
| 14086 | 708.302,808 | 4.648.506,359 | 354,890 | PIE |
| 14087 | 708.801,260 | 4.644.465,150 | 366,400 | |
| 14088 | 705.848,370 | 4.645.201,977 | 385,277 | CA |
| 14089 | 708.303,009 | 4.648.540,256 | 356,650 | PT |
| 14090 | 705.520,108 | 4.645.270,207 | 391,811 | CA |
| 14091 | 705.515,378 | 4.645.182,432 | 391,725 | CA |
| 14092 | 708.315,504 | 4.648.585,895 | 358,520 | PT |
| 14093 | 705.508,606 | 4.645.057,124 | 391,767 | CA |
| 14094 | 705.508,880 | 4.645.159,397 | 391,996 | CA |
| 14095 | 708.312,241 | 4.648.611,618 | 360,550 | CABE |
| 14096 | 708.319,714 | 4.648.626,158 | 360,440 | PIE |
| 14097 | 708.318,634 | 4.648.646,970 | 362,210 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14098 | 708.324,099 | 4.648.648,821 | 363,810 | CABE |
| 14099 | 708.469,350 | 4.644.467,550 | 369,890 | |
| 14100 | 705.545,910 | 4.645.118,422 | 391,745 | CA |
| 14101 | 708.329,076 | 4.648.659,579 | 365,450 | PT |
| 14102 | 708.329,793 | 4.648.663,447 | 365,970 | PT |
| 14103 | 708.322,887 | 4.648.667,358 | 365,240 | PT |
| 14104 | 708.324,102 | 4.648.678,613 | 365,470 | PT |
| 14105 | 708.312,848 | 4.648.689,637 | 365,300 | PT |
| 14106 | 708.306,072 | 4.648.704,184 | 365,690 | PT |
| 14107 | 705.763,085 | 4.645.199,691 | 386,504 | CA |
| 14108 | 708.290,630 | 4.648.732,723 | 365,990 | PT |
| 14109 | 705.735,949 | 4.645.189,990 | 386,973 | CA |
| 14110 | 708.281,613 | 4.648.756,111 | 365,850 | ASPERSOR |
| 14111 | 708.861,880 | 4.644.476,800 | 366,080 | |
| 14112 | 705.726,861 | 4.645.194,457 | 387,533 | CA |
| 14113 | 708.285,656 | 4.648.739,346 | 365,760 | ASPERSOR |
| 14114 | 706.270,982 | 4.646.007,479 | 387,159 | CA |
| 14115 | 708.886,750 | 4.644.481,360 | 366,020 | |
| 14116 | 708.876,220 | 4.644.483,520 | 366,000 | |
| 14117 | 708.283,104 | 4.648.737,119 | 365,520 | PT |
| 14118 | 708.285,937 | 4.648.733,582 | 365,720 | PT |
| 14119 | 708.278,364 | 4.648.754,449 | 365,790 | PT |
| 14120 | 708.911,460 | 4.644.487,090 | 365,790 | |
| 14121 | 706.520,862 | 4.645.380,326 | 381,023 | CA |
| 14122 | 706.844,346 | 4.644.919,863 | 377,417 | CA |
| 14123 | 709.092,530 | 4.644.472,250 | 365,080 | |
| 14124 | 708.232,248 | 4.648.825,485 | 365,330 | PT |
| 14125 | 707.313,564 | 4.644.249,063 | 382,739 | CA |
| 14126 | 708.375,370 | 4.644.508,950 | 370,950 | |
| 14127 | 708.379,870 | 4.644.510,130 | 370,600 | |
| 14128 | 708.207,942 | 4.648.839,851 | 364,480 | PT |
| 14129 | 708.191,757 | 4.648.843,093 | 364,460 | PT |
| 14130 | 708.163,666 | 4.648.871,483 | 364,520 | PT |
| 14131 | 708.148,759 | 4.648.872,580 | 364,720 | PT |
| 14132 | 708.404,410 | 4.644.495,630 | 370,020 | |
| 14133 | 704.927,483 | 4.644.723,573 | 430,857 | CA |
| 14134 | 707.714,966 | 4.648.395,487 | 354,980 | PISTA |
| 14135 | 707.700,240 | 4.648.386,686 | 353,880 | CUNETA |
| 14136 | 707.701,691 | 4.648.385,862 | 355,000 | PISTA |
| 14137 | 708.389,220 | 4.644.506,990 | 370,870 | |
| 14138 | 705.512,875 | 4.645.222,357 | 391,880 | CA |
| 14139 | 708.426,360 | 4.644.492,470 | 369,520 | |
| 14140 | 708.411,240 | 4.644.496,520 | 370,030 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14141 | 705.554,376 | 4.645.254,044 | 391,962 | CA |
| 14142 | 707.807,013 | 4.648.372,403 | 354,730 | PT |
| 14143 | 707.832,992 | 4.648.366,976 | 354,710 | PT |
| 14144 | 705.547,060 | 4.645.140,264 | 391,715 | CA |
| 14145 | 705.548,132 | 4.645.140,160 | 391,979 | CA |
| 14146 | 707.894,885 | 4.648.341,624 | 354,230 | PT |
| 14147 | 708.969,560 | 4.644.498,330 | 365,460 | |
| 14148 | 705.542,539 | 4.645.050,934 | 391,707 | CA |
| 14149 | 707.980,811 | 4.648.326,288 | 354,230 | PT |
| 14150 | 707.999,567 | 4.648.322,811 | 354,450 | CANALETA |
| 14151 | 708.992,760 | 4.644.501,870 | 365,120 | |
| 14152 | 709.000,040 | 4.644.506,530 | 365,080 | |
| 14153 | 708.063,108 | 4.648.303,166 | 353,800 | PT |
| 14154 | 708.097,118 | 4.648.300,819 | 353,740 | PT |
| 14155 | 704.281,569 | 4.644.438,113 | 435,425 | CA |
| 14156 | 709.041,110 | 4.644.514,830 | 364,820 | |
| 14157 | 708.149,445 | 4.648.284,961 | 352,990 | ACEQ |
| 14158 | 708.150,194 | 4.648.276,839 | 353,620 | CABE |
| 14159 | 709.067,950 | 4.644.516,580 | 364,760 | |
| 14160 | 708.189,968 | 4.648.263,030 | 353,400 | PT |
| 14161 | 705.855,573 | 4.645.460,042 | 386,422 | CA |
| 14162 | 705.886,724 | 4.645.458,875 | 385,045 | CA |
| 14163 | 708.259,342 | 4.648.241,535 | 353,440 | PT |
| 14164 | 710.432,408 | 4.646.176,676 | 343,210 | PT |
| 14165 | 710.417,400 | 4.646.178,740 | 342,530 | PT |
| 14166 | 708.322,370 | 4.644.538,080 | 371,480 | |
| 14167 | 708.319,800 | 4.644.537,960 | 371,800 | |
| 14168 | 705.887,244 | 4.645.458,846 | 385,033 | CA |
| 14169 | 710.379,995 | 4.646.212,486 | 343,530 | PIE |
| 14170 | 710.349,795 | 4.646.226,897 | 343,810 | PT |
| 14171 | 706.066,949 | 4.645.239,649 | 382,662 | CA |
| 14172 | 706.045,758 | 4.645.234,768 | 382,597 | CA |
| 14173 | 708.350,730 | 4.644.522,980 | 371,170 | |
| 14174 | 710.314,414 | 4.646.258,420 | 343,420 | PIE |
| 14175 | 708.348,070 | 4.644.527,340 | 371,110 | |
| 14176 | 710.303,692 | 4.646.269,225 | 345,560 | CARRETERA |
| 14177 | 710.297,917 | 4.646.263,121 | 345,100 | PIE |
| 14178 | 709.074,320 | 4.644.521,050 | 364,710 | |
| 14179 | 710.290,998 | 4.646.264,858 | 345,060 | PT |
| 14180 | 710.277,513 | 4.646.270,816 | 345,070 | PT |
| 14181 | 710.245,470 | 4.646.255,695 | 345,080 | PT |
| 14182 | 706.046,469 | 4.645.247,136 | 382,499 | CA |
| 14183 | 710.224,352 | 4.646.250,369 | 345,040 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14184 | 710.200,049 | 4.646.244,020 | 345,400 | PIE |
| 14185 | 710.171,507 | 4.646.245,637 | 348,360 | CABE |
| 14186 | 710.184,427 | 4.646.241,390 | 348,350 | CABE |
| 14187 | 710.161,481 | 4.646.245,178 | 348,410 | PT |
| 14188 | 710.160,900 | 4.646.237,225 | 348,270 | PT |
| 14189 | 708.262,300 | 4.644.557,340 | 373,050 | |
| 14190 | 705.862,528 | 4.645.220,726 | 385,372 | CA |
| 14191 | 705.853,151 | 4.645.201,349 | 384,970 | CA |
| 14192 | 708.265,610 | 4.644.562,920 | 372,380 | |
| 14193 | 708.248,800 | 4.644.567,870 | 372,950 | |
| 14194 | 710.063,469 | 4.646.255,658 | 349,160 | CABE2 |
| 14195 | 710.051,900 | 4.646.248,946 | 348,930 | PT |
| 14196 | 710.029,609 | 4.646.260,797 | 348,860 | PT |
| 14197 | 710.030,624 | 4.646.250,974 | 348,810 | PT |
| 14198 | 705.558,027 | 4.645.321,519 | 392,010 | CA |
| 14199 | 709.988,232 | 4.646.266,466 | 349,330 | PT |
| 14200 | 709.968,431 | 4.646.260,406 | 349,310 | PIE |
| 14201 | 709.967,010 | 4.646.260,122 | 349,740 | CABE |
| 14202 | 709.963,052 | 4.646.268,401 | 349,170 | PIE |
| 14203 | 709.944,127 | 4.646.263,846 | 349,500 | PT |
| 14204 | 708.125,150 | 4.644.588,150 | 375,260 | |
| 14205 | 708.122,260 | 4.644.585,490 | 375,380 | |
| 14206 | 705.868,855 | 4.645.492,709 | 387,349 | CA |
| 14207 | 709.861,588 | 4.646.276,914 | 349,860 | PT |
| 14208 | 709.861,468 | 4.646.284,418 | 349,860 | PT |
| 14209 | 709.827,251 | 4.646.287,399 | 350,190 | CABE |
| 14210 | 708.132,200 | 4.644.597,000 | 374,730 | |
| 14211 | 709.785,041 | 4.646.287,620 | 350,080 | PT |
| 14212 | 709.770,022 | 4.646.295,770 | 350,520 | CABE |
| 14213 | 708.135,400 | 4.644.596,960 | 374,610 | |
| 14214 | 709.771,262 | 4.646.292,705 | 350,130 | ACEQ |
| 14215 | 708.176,800 | 4.644.599,330 | 373,500 | |
| 14216 | 705.682,354 | 4.645.451,851 | 389,098 | CA |
| 14217 | 708.207,290 | 4.644.585,700 | 373,640 | |
| 14218 | 708.191,080 | 4.644.588,570 | 373,590 | |
| 14219 | 708.197,990 | 4.644.590,180 | 373,560 | |
| 14220 | 708.224,240 | 4.644.573,260 | 373,560 | |
| 14221 | 709.708,760 | 4.646.299,928 | 351,430 | PISTA |
| 14222 | 708.236,980 | 4.644.573,990 | 372,960 | |
| 14223 | 708.217,860 | 4.644.577,560 | 373,570 | |
| 14224 | 709.695,160 | 4.646.309,883 | 351,250 | CANALETA |
| 14225 | 708.228,950 | 4.644.578,080 | 373,080 | |
| 14226 | 709.694,783 | 4.646.320,743 | 349,790 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14227 | 709.699,823 | 4.646.320,819 | 349,710 | PT |
| 14228 | 709.682,024 | 4.646.287,152 | 352,070 | PT |
| 14229 | 706.016,058 | 4.645.221,506 | 382,771 | CA |
| 14230 | 709.656,919 | 4.646.276,891 | 350,980 | CABE |
| 14231 | 709.655,304 | 4.646.281,963 | 350,440 | ACEQ |
| 14232 | 709.157,930 | 4.644.594,000 | 364,710 | |
| 14233 | 705.964,798 | 4.645.209,843 | 383,280 | CA |
| 14234 | 709.163,030 | 4.644.600,840 | 363,570 | |
| 14235 | 705.936,370 | 4.645.213,434 | 383,487 | CA |
| 14236 | 705.963,123 | 4.645.201,266 | 382,758 | CA |
| 14237 | 709.566,082 | 4.646.230,668 | 350,420 | PIE |
| 14238 | 706.035,417 | 4.645.232,578 | 381,652 | CA |
| 14239 | 709.545,580 | 4.646.220,041 | 350,530 | PT |
| 14240 | 706.031,233 | 4.645.239,816 | 382,444 | CA |
| 14241 | 709.519,744 | 4.646.205,203 | 350,440 | PIE |
| 14242 | 709.519,580 | 4.646.199,719 | 350,320 | PIE |
| 14243 | 709.175,420 | 4.644.617,000 | 363,490 | |
| 14244 | 706.047,502 | 4.645.250,633 | 382,480 | CA |
| 14245 | 706.027,841 | 4.645.241,760 | 382,573 | CA |
| 14246 | 709.181,110 | 4.644.615,780 | 364,450 | |
| 14247 | 709.180,340 | 4.644.619,260 | 364,460 | |
| 14248 | 709.186,100 | 4.644.620,770 | 364,420 | |
| 14249 | 709.438,009 | 4.646.160,284 | 351,970 | PT |
| 14250 | 709.419,273 | 4.646.145,103 | 352,830 | CABE |
| 14251 | 709.409,775 | 4.646.143,864 | 352,690 | PT |
| 14252 | 709.410,812 | 4.646.139,072 | 352,360 | PT |
| 14253 | 709.199,880 | 4.644.630,820 | 364,240 | |
| 14254 | 709.355,397 | 4.646.108,882 | 352,360 | PT |
| 14255 | 709.351,764 | 4.646.114,674 | 352,420 | PT |
| 14256 | 709.329,297 | 4.646.094,379 | 352,560 | PT |
| 14257 | 709.326,348 | 4.646.098,990 | 352,630 | PT |
| 14258 | 709.315,338 | 4.646.084,862 | 352,970 | PT |
| 14259 | 709.246,860 | 4.644.665,470 | 364,000 | |
| 14260 | 705.514,033 | 4.645.157,512 | 391,741 | CA |
| 14261 | 705.510,663 | 4.645.094,876 | 391,784 | CA |
| 14262 | 709.275,503 | 4.646.085,407 | 352,850 | PT |
| 14263 | 705.515,889 | 4.645.276,955 | 392,018 | CA |
| 14264 | 705.518,200 | 4.645.317,343 | 392,127 | CA |
| 14265 | 705.890,631 | 4.645.089,481 | 385,199 | CA |
| 14266 | 709.248,545 | 4.646.104,878 | 350,900 | DESAGUE |
| 14267 | 709.245,930 | 4.646.109,876 | 351,470 | PISTA |
| 14268 | 709.249,378 | 4.646.110,494 | 351,360 | PISTA |
| 14269 | 709.251,128 | 4.646.116,909 | 352,450 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14270 | 709.245,992 | 4.646.120,632 | 352,560 | PT |
| 14271 | 709.284,810 | 4.644.696,850 | 362,930 | |
| 14272 | 709.242,129 | 4.646.123,517 | 352,210 | PIE |
| 14273 | 709.247,171 | 4.646.127,158 | 352,200 | PIE |
| 14274 | 709.331,205 | 4.646.425,311 | 351,880 | PT |
| 14275 | 705.138,470 | 4.644.702,519 | 426,092 | CA |
| 14276 | 705.605,706 | 4.645.221,266 | 390,412 | CA |
| 14277 | 709.322,073 | 4.646.466,683 | 352,330 | PT |
| 14278 | 709.305,680 | 4.644.712,410 | 362,630 | |
| 14279 | 709.303,103 | 4.646.510,238 | 352,090 | PT |
| 14280 | 709.271,934 | 4.646.548,950 | 352,110 | PT |
| 14281 | 709.280,665 | 4.646.556,660 | 352,250 | CABE |
| 14282 | 709.281,003 | 4.646.558,919 | 350,820 | ACEQ |
| 14283 | 709.270,168 | 4.646.562,564 | 352,500 | CABE |
| 14284 | 705.764,404 | 4.645.475,385 | 388,585 | CA |
| 14285 | 709.318,340 | 4.644.722,200 | 362,480 | |
| 14286 | 709.324,610 | 4.644.722,920 | 362,570 | |
| 14287 | 709.321,030 | 4.644.724,820 | 362,590 | |
| 14288 | 705.909,914 | 4.645.458,151 | 384,547 | CA |
| 14289 | 709.249,308 | 4.646.627,120 | 353,410 | PT |
| 14290 | 709.239,761 | 4.646.635,614 | 353,340 | PT |
| 14291 | 713.728,809 | 4.644.945,123 | 326,580 | CABEZA |
| 14292 | 709.332,540 | 4.644.731,900 | 362,490 | |
| 14293 | 709.506,505 | 4.646.524,877 | 349,290 | PT |
| 14294 | 709.514,951 | 4.646.551,669 | 349,190 | PT |
| 14295 | 709.517,309 | 4.646.579,928 | 349,290 | PT |
| 14296 | 709.533,649 | 4.646.602,975 | 349,310 | PT |
| 14297 | 709.542,623 | 4.646.626,241 | 349,320 | PT |
| 14298 | 709.542,338 | 4.646.652,151 | 349,250 | PT |
| 14299 | 707.746,151 | 4.646.778,640 | 377,770 | PT |
| 14300 | 707.746,573 | 4.646.772,441 | 378,060 | ASPERSOR |
| 14301 | 712.830,011 | 4.645.089,704 | 331,280 | CABEZA |
| 14302 | 707.738,203 | 4.646.764,674 | 377,230 | PT |
| 14303 | 707.733,291 | 4.646.760,293 | 377,280 | ASPERSOR |
| 14304 | 707.715,809 | 4.646.754,274 | 377,050 | PT |
| 14305 | 707.706,178 | 4.646.734,181 | 376,970 | PT |
| 14306 | 707.689,609 | 4.646.728,075 | 375,950 | ASPERSOR |
| 14307 | 713.331,269 | 4.644.221,309 | 339,860 | CABEZA |
| 14308 | 713.295,008 | 4.644.207,270 | 340,500 | CABEZA |
| 14309 | 707.649,414 | 4.646.691,860 | 375,800 | ASPERSOR |
| 14310 | 707.636,026 | 4.646.679,823 | 375,740 | ASPERSOR |
| 14311 | 707.622,628 | 4.646.667,758 | 375,640 | ASPERSOR |
| 14312 | 713.745,383 | 4.644.232,386 | 338,350 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14313 | 707.600,461 | 4.646.647,729 | 375,190 | ASPERSOR |
| 14314 | 707.600,973 | 4.646.646,504 | 374,860 | PIE |
| 14315 | 707.600,213 | 4.646.639,295 | 374,810 | PT |
| 14316 | 707.596,220 | 4.646.642,362 | 374,750 | PT |
| 14317 | 707.562,852 | 4.646.613,756 | 374,750 | PT |
| 14318 | 709.460,800 | 4.644.812,810 | 361,810 | |
| 14319 | 709.463,790 | 4.644.811,500 | 361,820 | |
| 14320 | 707.539,112 | 4.646.590,916 | 374,790 | PT |
| 14321 | 707.500,740 | 4.646.590,086 | 374,770 | PT |
| 14322 | 711.527,446 | 4.646.504,927 | 339,500 | CABEZA |
| 14323 | 709.472,160 | 4.644.814,630 | 361,800 | |
| 14324 | 707.473,315 | 4.646.582,087 | 374,960 | CABE |
| 14325 | 707.468,004 | 4.646.585,928 | 374,300 | PT |
| 14326 | 707.460,535 | 4.646.578,934 | 374,520 | PT |
| 14327 | 707.436,913 | 4.646.578,292 | 374,310 | PIE |
| 14328 | 707.435,885 | 4.646.577,813 | 374,770 | CABE |
| 14329 | 707.427,998 | 4.646.579,914 | 374,110 | ACEQ |
| 14330 | 707.423,154 | 4.646.579,761 | 375,010 | CABE2 |
| 14331 | 709.450,330 | 4.644.842,040 | 360,440 | |
| 14332 | 707.406,564 | 4.646.581,032 | 374,990 | PT |
| 14333 | 707.389,792 | 4.646.572,174 | 374,740 | PT |
| 14334 | 707.386,399 | 4.646.572,326 | 374,460 | PT |
| 14335 | 711.683,778 | 4.646.385,169 | 333,990 | CABEZA |
| 14336 | 707.359,427 | 4.646.569,298 | 374,320 | PT |
| 14337 | 709.485,510 | 4.644.822,150 | 361,780 | |
| 14338 | 707.442,882 | 4.646.361,867 | 382,390 | PT |
| 14339 | 709.491,730 | 4.644.825,460 | 361,830 | |
| 14340 | 707.466,492 | 4.646.329,976 | 378,650 | PT |
| 14341 | 711.148,024 | 4.646.875,481 | 350,770 | CABEZA |
| 14342 | 709.506,440 | 4.644.831,470 | 361,730 | |
| 14343 | 711.115,709 | 4.646.858,017 | 351,490 | CABEZA |
| 14344 | 707.478,345 | 4.646.290,795 | 375,430 | CANALETA |
| 14345 | 711.070,136 | 4.646.812,216 | 351,410 | CABEZA |
| 14346 | 709.518,860 | 4.644.839,760 | 361,650 | |
| 14347 | 709.523,440 | 4.644.842,440 | 361,630 | |
| 14348 | 707.498,132 | 4.646.266,765 | 372,940 | ACEQ |
| 14349 | 711.022,687 | 4.646.733,614 | 346,460 | CABEZA |
| 14350 | 711.011,590 | 4.646.740,652 | 346,370 | CABEZA |
| 14351 | 707.508,373 | 4.646.244,873 | 372,810 | CABE |
| 14352 | 707.511,890 | 4.646.239,609 | 371,930 | PIE |
| 14353 | 707.512,809 | 4.646.222,118 | 371,790 | PT |
| 14354 | 707.520,107 | 4.646.211,810 | 371,870 | CABE |
| 14355 | 710.965,570 | 4.646.673,246 | 342,080 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14356 | 709.435,460 | 4.644.870,250 | 360,510 | |
| 14357 | 707.531,414 | 4.646.191,394 | 371,090 | CABE |
| 14358 | 707.537,225 | 4.646.192,183 | 371,080 | CABE |
| 14359 | 707.533,199 | 4.646.181,493 | 369,760 | PT |
| 14360 | 707.537,949 | 4.646.170,769 | 368,870 | CABE |
| 14361 | 707.548,658 | 4.646.169,332 | 369,950 | PIE |
| 14362 | 709.966,556 | 4.646.921,094 | 345,150 | CABEZA |
| 14363 | 709.545,440 | 4.644.852,180 | 361,520 | |
| 14364 | 707.559,816 | 4.646.148,302 | 368,980 | CABE |
| 14365 | 707.561,990 | 4.646.145,917 | 367,750 | PIE |
| 14366 | 709.787,985 | 4.646.865,030 | 347,880 | CABEZA |
| 14367 | 709.671,469 | 4.646.822,342 | 351,820 | CABEZA |
| 14368 | 709.547,160 | 4.644.855,530 | 360,610 | |
| 14369 | 709.671,771 | 4.646.820,490 | 351,920 | CABEZA |
| 14370 | 707.584,865 | 4.646.082,012 | 366,330 | PIE |
| 14371 | 707.588,762 | 4.646.088,718 | 367,090 | CABE |
| 14372 | 707.590,459 | 4.646.067,749 | 366,130 | PT |
| 14373 | 709.573,961 | 4.646.746,264 | 352,280 | CABEZA |
| 14374 | 707.605,415 | 4.646.060,336 | 365,540 | PIE |
| 14375 | 709.574,073 | 4.646.714,481 | 351,410 | CABEZA |
| 14376 | 707.613,668 | 4.646.026,807 | 365,460 | CABE |
| 14377 | 709.557,310 | 4.646.664,975 | 350,360 | CABEZA |
| 14378 | 709.423,700 | 4.644.897,630 | 360,170 | |
| 14379 | 709.432,480 | 4.644.883,540 | 360,210 | |
| 14380 | 709.428,810 | 4.644.892,350 | 360,190 | |
| 14381 | 709.583,630 | 4.644.878,970 | 360,600 | |
| 14382 | 709.584,750 | 4.644.883,000 | 360,550 | |
| 14383 | 709.597,140 | 4.644.889,170 | 360,530 | |
| 14384 | 709.685,784 | 4.646.321,403 | 350,650 | CABEZA |
| 14385 | 710.413,202 | 4.646.198,759 | 343,590 | CABEZA |
| 14386 | 710.429,873 | 4.646.159,562 | 343,300 | CABEZA |
| 14387 | 710.451,633 | 4.646.174,214 | 343,030 | CABEZA |
| 14388 | 709.615,940 | 4.644.905,610 | 360,480 | |
| 14389 | 707.613,596 | 4.645.960,290 | 362,430 | CABE |
| 14390 | 707.613,449 | 4.645.951,391 | 362,160 | PT |
| 14391 | 710.547,031 | 4.646.176,450 | 342,080 | CABEZA |
| 14392 | 707.608,917 | 4.645.917,862 | 362,300 | PT |
| 14393 | 709.419,350 | 4.644.909,490 | 360,130 | |
| 14394 | 707.607,997 | 4.645.899,885 | 362,400 | PT |
| 14395 | 709.417,790 | 4.644.919,730 | 359,860 | |
| 14396 | 707.612,977 | 4.645.880,831 | 362,350 | ASPERSOR**** |
| 14397 | 707.615,292 | 4.645.861,063 | 362,320 | PT |
| 14398 | 707.604,185 | 4.645.862,511 | 362,450 | ASPERSOR**** |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14399 | 707.627,277 | 4.646.022,465 | 364,550 | PT |
| 14400 | 709.617,940 | 4.644.907,580 | 360,440 | |
| 14401 | 709.103,728 | 4.646.106,875 | 353,220 | CABEZA |
| 14402 | 709.631,050 | 4.644.913,440 | 360,400 | |
| 14403 | 709.636,710 | 4.644.917,860 | 360,340 | |
| 14404 | 709.635,600 | 4.644.920,470 | 360,330 | |
| 14405 | 709.643,490 | 4.644.923,200 | 360,370 | |
| 14406 | 708.427,069 | 4.646.040,516 | 358,080 | CABEZA |
| 14407 | 708.320,646 | 4.646.056,863 | 358,880 | CABEZA |
| 14408 | 708.206,744 | 4.646.055,821 | 361,040 | CABEZA |
| 14409 | 708.183,309 | 4.646.044,066 | 360,800 | CABEZA |
| 14410 | 707.788,287 | 4.646.026,983 | 364,820 | CABE |
| 14411 | 707.784,832 | 4.646.018,963 | 364,750 | CABE |
| 14412 | 707.791,236 | 4.646.027,615 | 363,460 | ACEQ |
| 14413 | 709.399,710 | 4.644.954,630 | 359,800 | |
| 14414 | 709.407,540 | 4.644.935,180 | 359,840 | |
| 14415 | 709.407,850 | 4.644.941,420 | 359,810 | |
| 14416 | 707.836,500 | 4.646.020,466 | 364,650 | PT |
| 14417 | 707.863,494 | 4.646.030,504 | 364,660 | PT |
| 14418 | 707.607,832 | 4.645.733,942 | 365,500 | CABEZA |
| 14419 | 707.919,709 | 4.646.031,960 | 364,940 | CABE |
| 14420 | 707.922,838 | 4.646.034,780 | 365,520 | CABE |
| 14421 | 707.925,092 | 4.646.038,233 | 365,380 | PT |
| 14422 | 707.609,333 | 4.645.668,453 | 365,970 | CABEZA |
| 14423 | 707.926,792 | 4.646.021,273 | 364,730 | PISTA |
| 14424 | 707.940,141 | 4.646.021,580 | 364,070 | PT |
| 14425 | 709.682,520 | 4.644.952,930 | 360,080 | |
| 14426 | 709.683,720 | 4.644.950,480 | 360,250 | |
| 14427 | 707.629,343 | 4.645.536,751 | 367,140 | CABEZA |
| 14428 | 708.002,384 | 4.646.021,429 | 364,150 | PT |
| 14429 | 708.018,292 | 4.646.021,631 | 364,200 | PT |
| 14430 | 707.626,834 | 4.645.406,764 | 367,950 | CABEZA |
| 14431 | 708.045,528 | 4.646.021,067 | 365,730 | PT |
| 14432 | 708.045,245 | 4.646.025,576 | 366,840 | ARBOL |
| 14433 | 707.622,997 | 4.645.247,998 | 367,670 | CABEZA |
| 14434 | 708.404,670 | 4.644.987,830 | 368,310 | |
| 14435 | 708.127,885 | 4.646.024,822 | 366,130 | PISTA |
| 14436 | 708.128,582 | 4.646.018,371 | 365,720 | PISTA |
| 14437 | 708.156,617 | 4.646.023,927 | 364,660 | PT |
| 14438 | 708.466,760 | 4.644.985,530 | 367,440 | |
| 14439 | 708.479,260 | 4.644.985,320 | 367,260 | |
| 14440 | 708.176,041 | 4.646.029,657 | 363,070 | PT |
| 14441 | 708.189,824 | 4.646.033,537 | 360,060 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14442 | 708.183,783 | 4.646.039,753 | 360,790 | CABE |
| 14443 | 708.193,542 | 4.646.035,427 | 360,430 | CABE |
| 14444 | 708.541,530 | 4.644.984,790 | 366,770 | |
| 14445 | 708.565,480 | 4.644.987,350 | 365,050 | |
| 14446 | 707.969,074 | 4.646.076,891 | 364,810 | PT |
| 14447 | 707.971,077 | 4.646.092,861 | 364,690 | PT |
| 14448 | 707.977,582 | 4.646.087,990 | 364,660 | PT |
| 14449 | 709.396,410 | 4.644.966,910 | 359,530 | |
| 14450 | 708.003,388 | 4.646.113,244 | 366,070 | CABE |
| 14451 | 708.006,075 | 4.646.125,649 | 365,930 | PT |
| 14452 | 708.010,278 | 4.646.121,131 | 365,990 | PT |
| 14453 | 709.396,550 | 4.644.969,940 | 359,510 | |
| 14454 | 708.413,217 | 4.645.095,135 | 368,010 | CABEZA |
| 14455 | 708.478,059 | 4.645.109,818 | 365,630 | CABEZA |
| 14456 | 708.062,655 | 4.646.172,997 | 367,310 | PT |
| 14457 | 708.074,335 | 4.646.193,838 | 367,190 | PT |
| 14458 | 708.079,867 | 4.646.189,851 | 367,300 | PT |
| 14459 | 709.393,260 | 4.644.980,390 | 359,710 | |
| 14460 | 708.102,677 | 4.646.212,549 | 367,440 | PIE |
| 14461 | 708.101,388 | 4.646.223,238 | 369,160 | CABE |
| 14462 | 708.114,031 | 4.646.232,216 | 368,850 | PT |
| 14463 | 708.659,664 | 4.645.141,597 | 361,560 | CABEZA |
| 14464 | 709.699,930 | 4.644.962,090 | 360,140 | |
| 14465 | 708.718,514 | 4.645.505,247 | 357,160 | CABEZA |
| 14466 | 708.149,768 | 4.646.292,493 | 369,160 | PIE |
| 14467 | 708.660,385 | 4.645.530,274 | 357,660 | CABEZA |
| 14468 | 708.159,738 | 4.646.301,314 | 370,360 | PT |
| 14469 | 708.160,633 | 4.646.318,107 | 370,320 | PT |
| 14470 | 708.177,818 | 4.646.348,000 | 370,350 | PT |
| 14471 | 709.247,926 | 4.645.240,593 | 359,740 | CABEZA |
| 14472 | 709.244,109 | 4.645.229,898 | 359,720 | CABEZA |
| 14473 | 709.246,083 | 4.645.228,479 | 359,880 | CABEZA |
| 14474 | 709.017,161 | 4.645.204,650 | 360,070 | CABEZA |
| 14475 | 708.156,460 | 4.644.990,850 | 370,610 | |
| 14476 | 708.251,718 | 4.646.453,661 | 372,840 | PT |
| 14477 | 708.961,633 | 4.645.196,553 | 359,870 | CABEZA |
| 14478 | 708.274,050 | 4.646.471,976 | 372,980 | PT |
| 14479 | 708.276,705 | 4.646.466,976 | 372,980 | PT |
| 14480 | 709.199,254 | 4.648.273,223 | 348,100 | PT |
| 14481 | 709.200,493 | 4.648.255,625 | 348,080 | PT |
| 14482 | 709.202,706 | 4.648.218,600 | 348,090 | PT |
| 14483 | 709.201,596 | 4.648.164,211 | 348,360 | CABE |
| 14484 | 708.284,980 | 4.644.993,830 | 369,280 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14485 | 709.194,231 | 4.648.165,979 | 348,250 | CABE |
| 14486 | 709.203,440 | 4.648.158,751 | 348,710 | CABE |
| 14487 | 709.206,617 | 4.648.093,039 | 348,340 | PT |
| 14488 | 708.313,040 | 4.645.000,610 | 369,230 | |
| 14489 | 708.310,880 | 4.645.006,050 | 369,230 | |
| 14490 | 709.207,586 | 4.648.029,368 | 350,390 | CABE |
| 14491 | 709.213,574 | 4.648.003,561 | 350,040 | PT |
| 14492 | 709.220,354 | 4.647.976,183 | 350,020 | PT |
| 14493 | 708.366,950 | 4.644.990,840 | 368,800 | |
| 14494 | 708.394,930 | 4.644.988,590 | 368,330 | |
| 14495 | 709.041,143 | 4.644.634,062 | 364,460 | CABEZA |
| 14496 | 709.209,365 | 4.647.941,347 | 351,180 | CABE2 |
| 14497 | 709.090,069 | 4.644.544,094 | 364,770 | CABEZA |
| 14498 | 709.208,472 | 4.647.934,962 | 351,350 | CARRETERA |
| 14499 | 709.096,072 | 4.644.545,016 | 365,030 | CABEZA |
| 14500 | 708.650,780 | 4.645.003,910 | 362,230 | |
| 14501 | 709.216,048 | 4.647.919,623 | 351,290 | CABE |
| 14502 | 709.075,544 | 4.644.326,934 | 364,980 | CABEZA |
| 14503 | 709.214,475 | 4.647.917,061 | 350,870 | PIE |
| 14504 | 709.386,890 | 4.644.990,650 | 359,690 | |
| 14505 | 709.382,240 | 4.644.994,580 | 359,700 | |
| 14506 | 709.482,283 | 4.645.425,500 | 357,880 | CABEZA |
| 14507 | 709.378,430 | 4.645.003,430 | 359,750 | |
| 14508 | 709.466,941 | 4.645.388,197 | 358,270 | CABEZA |
| 14509 | 709.374,950 | 4.645.011,020 | 359,750 | |
| 14510 | 709.765,610 | 4.644.989,160 | 359,870 | |
| 14511 | 709.193,835 | 4.648.150,195 | 348,400 | PT |
| 14512 | 709.192,304 | 4.648.181,399 | 348,080 | PT |
| 14513 | 709.190,934 | 4.648.219,940 | 348,090 | PT |
| 14514 | 709.198,526 | 4.648.289,073 | 348,050 | PT |
| 14515 | 709.780,000 | 4.644.995,860 | 359,490 | |
| 14516 | 709.443,223 | 4.645.272,267 | 358,870 | CABEZA |
| 14517 | 709.197,513 | 4.648.378,884 | 348,180 | PT |
| 14518 | 709.197,307 | 4.648.405,905 | 348,200 | PT |
| 14519 | 709.182,889 | 4.648.422,492 | 348,180 | PT |
| 14520 | 709.198,164 | 4.648.423,614 | 348,190 | PT |
| 14521 | 709.186,103 | 4.648.431,176 | 348,420 | PISTA |
| 14522 | 709.187,009 | 4.648.436,411 | 348,430 | PISTA |
| 14523 | 709.197,751 | 4.648.435,804 | 348,180 | CANALETA |
| 14524 | 709.196,437 | 4.648.428,511 | 348,330 | PISTA |
| 14525 | 708.700,910 | 4.645.031,510 | 360,380 | |
| 14526 | 709.254,259 | 4.648.399,983 | 348,110 | CABE |
| 14527 | 709.704,124 | 4.645.324,645 | 356,830 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14528 | 709.254,694 | 4.648.393,276 | 348,010 | CABE |
| 14529 | 709.742,095 | 4.645.318,985 | 358,230 | CABEZA |
| 14530 | 709.279,094 | 4.648.388,041 | 347,690 | PT |
| 14531 | 709.766,543 | 4.645.321,190 | 357,860 | CABEZA |
| 14532 | 709.312,955 | 4.648.386,163 | 347,560 | PIE |
| 14533 | 709.309,160 | 4.648.377,680 | 347,870 | CABE |
| 14534 | 709.812,824 | 4.645.338,355 | 357,650 | CABEZA |
| 14535 | 709.347,044 | 4.648.376,286 | 347,390 | PIE |
| 14536 | 708.720,870 | 4.645.048,310 | 359,940 | |
| 14537 | 709.345,611 | 4.648.375,030 | 347,430 | PIE |
| 14538 | 708.736,440 | 4.645.062,050 | 360,010 | |
| 14539 | 709.367,994 | 4.648.363,395 | 347,190 | PT |
| 14540 | 709.360,210 | 4.645.050,420 | 359,810 | |
| 14541 | 710.166,967 | 4.645.403,508 | 355,610 | CABEZA |
| 14542 | 709.419,371 | 4.648.356,114 | 347,000 | PT |
| 14543 | 709.357,170 | 4.645.059,080 | 359,800 | |
| 14544 | 709.353,250 | 4.645.063,090 | 359,830 | |
| 14545 | 709.435,269 | 4.648.360,106 | 347,080 | PISTA |
| 14546 | 708.364,870 | 4.645.074,070 | 369,150 | |
| 14547 | 710.642,474 | 4.645.477,946 | 353,040 | CABEZA |
| 14548 | 708.751,600 | 4.645.082,080 | 360,030 | |
| 14549 | 709.465,401 | 4.648.340,877 | 346,690 | PIE |
| 14550 | 709.465,530 | 4.648.334,368 | 346,480 | PIE |
| 14551 | 709.340,690 | 4.645.096,860 | 359,830 | |
| 14552 | 709.348,360 | 4.645.072,970 | 359,830 | |
| 14553 | 709.503,955 | 4.648.330,408 | 346,460 | PIE |
| 14554 | 709.537,946 | 4.648.311,970 | 346,190 | PT |
| 14555 | 711.103,635 | 4.645.555,440 | 350,390 | CABEZA |
| 14556 | 709.579,005 | 4.648.301,318 | 345,910 | PIE |
| 14557 | 708.395,900 | 4.645.118,190 | 367,410 | |
| 14558 | 711.678,783 | 4.645.476,305 | 342,850 | CABEZA |
| 14559 | 709.612,290 | 4.648.291,246 | 345,650 | PIE |
| 14560 | 711.321,050 | 4.645.654,597 | 349,430 | CABEZA |
| 14561 | 709.656,854 | 4.648.279,219 | 345,810 | CABE |
| 14562 | 708.790,520 | 4.645.105,590 | 359,750 | |
| 14563 | 709.679,162 | 4.648.279,942 | 345,480 | PT |
| 14564 | 709.694,113 | 4.648.265,583 | 345,400 | PT |
| 14565 | 709.698,142 | 4.648.265,349 | 345,220 | PT |
| 14566 | 711.355,640 | 4.645.770,546 | 344,900 | CABEZA |
| 14567 | 708.769,670 | 4.645.113,570 | 359,020 | |
| 14568 | 711.415,225 | 4.645.770,753 | 342,920 | CABEZA |
| 14569 | 709.732,587 | 4.648.265,007 | 345,620 | PISTA |
| 14570 | 709.723,006 | 4.648.284,026 | 345,010 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14571 | 709.778,895 | 4.648.266,124 | 345,180 | PT |
| 14572 | 711.570,650 | 4.645.786,614 | 340,930 | CABEZA |
| 14573 | 709.765,729 | 4.648.260,112 | 345,590 | PISTA |
| 14574 | 709.765,312 | 4.648.255,306 | 345,670 | PISTA |
| 14575 | 709.772,869 | 4.648.250,458 | 345,130 | PIE |
| 14576 | 709.773,483 | 4.648.249,397 | 345,210 | CABE |
| 14577 | 710.434,494 | 4.645.942,659 | 351,450 | CABEZA |
| 14578 | 709.794,901 | 4.648.237,329 | 344,780 | PT |
| 14579 | 710.440,088 | 4.645.739,588 | 351,900 | CABEZA |
| 14580 | 709.812,064 | 4.648.231,260 | 344,720 | PIE |
| 14581 | 710.439,228 | 4.645.733,899 | 352,270 | CABEZA |
| 14582 | 710.452,109 | 4.645.632,190 | 353,510 | CABEZA |
| 14583 | 709.852,852 | 4.648.219,884 | 344,510 | PIE |
| 14584 | 709.922,839 | 4.645.472,937 | 356,580 | CABEZA |
| 14585 | 709.893,425 | 4.648.213,321 | 344,970 | CABE |
| 14586 | 709.900,236 | 4.648.211,859 | 344,510 | PIE |
| 14587 | 709.933,309 | 4.645.469,307 | 356,710 | CABEZA |
| 14588 | 709.931,086 | 4.648.193,737 | 344,450 | PT |
| 14589 | 709.298,390 | 4.645.161,060 | 360,450 | |
| 14590 | 709.302,450 | 4.645.158,630 | 360,470 | |
| 14591 | 709.999,420 | 4.648.180,279 | 344,480 | PT |
| 14592 | 709.995,909 | 4.645.792,732 | 350,540 | CABEZA |
| 14593 | 710.042,720 | 4.648.154,269 | 344,410 | PT |
| 14594 | 710.066,962 | 4.648.158,361 | 344,500 | PT |
| 14595 | 709.563,779 | 4.645.531,977 | 356,470 | CABEZA |
| 14596 | 709.305,760 | 4.645.164,030 | 360,410 | |
| 14597 | 710.108,474 | 4.648.155,004 | 343,940 | PISTA |
| 14598 | 710.089,451 | 4.648.155,592 | 343,870 | PISTA |
| 14599 | 707.565,868 | 4.644.952,442 | 374,100 | CABEZA |
| 14600 | 709.298,180 | 4.645.169,620 | 360,030 | |
| 14601 | 709.301,640 | 4.645.169,040 | 360,090 | |
| 14602 | 710.128,944 | 4.648.132,291 | 344,630 | PT |
| 14603 | 710.158,601 | 4.648.131,427 | 344,770 | PT |
| 14604 | 707.375,104 | 4.644.913,076 | 373,770 | CABEZA |
| 14605 | 710.209,803 | 4.648.107,640 | 344,690 | PT |
| 14606 | 710.240,030 | 4.648.098,835 | 344,680 | PT |
| 14607 | 710.265,549 | 4.648.092,316 | 344,830 | PT |
| 14608 | 707.275,820 | 4.644.897,452 | 374,300 | CABEZA |
| 14609 | 707.259,358 | 4.644.906,229 | 374,330 | CABEZA |
| 14610 | 710.368,287 | 4.648.069,784 | 344,870 | PISTA |
| 14611 | 710.363,337 | 4.648.062,768 | 344,710 | PISTA |
| 14612 | 707.234,019 | 4.644.894,163 | 374,540 | CABEZA |
| 14613 | 709.314,780 | 4.645.198,200 | 359,570 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14614 | 710.395,551 | 4.648.061,147 | 343,840 | PT |
| 14615 | 710.421,700 | 4.648.044,103 | 343,750 | PT |
| 14616 | 709.314,250 | 4.645.202,340 | 359,470 | |
| 14617 | 709.326,770 | 4.645.178,800 | 359,900 | |
| 14618 | 710.500,928 | 4.648.049,842 | 344,300 | CANALETA |
| 14619 | 710.518,917 | 4.648.052,757 | 343,600 | PT |
| 14620 | 707.003,027 | 4.644.870,039 | 376,680 | CABEZA |
| 14621 | 709.338,310 | 4.645.196,110 | 359,610 | |
| 14622 | 709.344,280 | 4.645.204,220 | 359,660 | |
| 14623 | 706.792,428 | 4.644.839,431 | 377,760 | CABEZA |
| 14624 | 706.788,607 | 4.644.837,098 | 378,160 | CABEZA |
| 14625 | 708.397,310 | 4.645.230,970 | 367,740 | |
| 14626 | 709.343,530 | 4.645.208,540 | 359,690 | |
| 14627 | 710.600,792 | 4.648.113,221 | 343,470 | PT |
| 14628 | 710.634,502 | 4.648.125,463 | 343,420 | PT |
| 14629 | 710.655,521 | 4.648.148,775 | 343,400 | PT |
| 14630 | 710.660,999 | 4.648.141,825 | 343,380 | PT |
| 14631 | 709.357,870 | 4.645.230,780 | 359,350 | |
| 14632 | 710.701,199 | 4.648.164,485 | 342,320 | PIE |
| 14633 | 706.294,947 | 4.644.866,224 | 381,650 | CABEZA |
| 14634 | 708.385,780 | 4.645.241,010 | 367,760 | |
| 14635 | 709.362,710 | 4.645.240,720 | 359,310 | |
| 14636 | 710.727,636 | 4.648.201,236 | 343,660 | PISTA |
| 14637 | 706.186,760 | 4.644.897,512 | 383,120 | CABEZA |
| 14638 | 706.161,418 | 4.644.923,728 | 382,980 | CABEZA |
| 14639 | 710.730,139 | 4.648.218,535 | 343,220 | PT |
| 14640 | 710.684,652 | 4.648.602,524 | 341,380 | PT |
| 14641 | 708.329,480 | 4.645.312,250 | 367,250 | |
| 14642 | 706.145,297 | 4.644.935,523 | 383,150 | CABEZA |
| 14643 | 706.142,144 | 4.644.930,872 | 383,150 | CABEZA |
| 14644 | 710.574,546 | 4.648.671,467 | 341,130 | PT |
| 14645 | 706.162,042 | 4.645.182,401 | 382,510 | CABEZA |
| 14646 | 706.204,305 | 4.645.170,880 | 382,150 | CABEZA |
| 14647 | 706.212,205 | 4.645.179,471 | 382,230 | CABEZA |
| 14648 | 708.272,090 | 4.645.379,690 | 367,350 | |
| 14649 | 710.504,137 | 4.648.708,100 | 341,640 | PT |
| 14650 | 710.488,619 | 4.648.736,723 | 341,690 | PT |
| 14651 | 708.236,020 | 4.645.425,120 | 368,390 | |
| 14652 | 710.412,909 | 4.648.808,075 | 341,780 | PT |
| 14653 | 706.409,272 | 4.644.715,006 | 381,160 | CABEZA |
| 14654 | 706.430,752 | 4.644.697,308 | 381,760 | CABEZA |
| 14655 | 706.471,417 | 4.644.685,157 | 381,580 | CABEZA |
| 14656 | 708.202,520 | 4.645.459,670 | 365,970 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14657 | 710.361,249 | 4.648.853,944 | 342,580 | PISTA |
| 14658 | 708.188,380 | 4.645.498,730 | 365,730 | |
| 14659 | 710.336,537 | 4.648.834,091 | 342,050 | PT |
| 14660 | 706.682,045 | 4.644.512,392 | 382,670 | CABEZA |
| 14661 | 706.716,336 | 4.644.502,938 | 382,660 | CABEZA |
| 14662 | 706.774,449 | 4.644.469,339 | 382,710 | CABEZA |
| 14663 | 710.234,722 | 4.648.773,812 | 342,120 | PT |
| 14664 | 708.172,950 | 4.645.572,210 | 364,820 | |
| 14665 | 710.226,065 | 4.648.765,351 | 342,550 | CABE |
| 14666 | 709.407,952 | 4.648.666,281 | 345,460 | CANALETA |
| 14667 | 709.410,338 | 4.648.678,183 | 345,460 | PT |
| 14668 | 707.029,807 | 4.644.444,901 | 383,510 | CABEZA |
| 14669 | 709.410,573 | 4.648.657,023 | 345,900 | PISTA |
| 14670 | 708.154,480 | 4.645.632,760 | 363,620 | |
| 14671 | 708.152,510 | 4.645.647,990 | 363,260 | |
| 14672 | 708.148,980 | 4.645.659,720 | 362,910 | |
| 14673 | 709.407,127 | 4.648.632,392 | 345,530 | CABE |
| 14674 | 709.394,408 | 4.648.635,765 | 345,540 | CABE |
| 14675 | 709.381,486 | 4.648.608,343 | 345,400 | PIE |
| 14676 | 707.299,073 | 4.644.156,930 | 383,300 | CABEZA |
| 14677 | 709.346,661 | 4.648.599,837 | 345,720 | PT |
| 14678 | 707.322,204 | 4.644.133,110 | 381,720 | CABEZA |
| 14679 | 707.360,167 | 4.644.170,747 | 383,060 | CABEZA |
| 14680 | 707.372,905 | 4.644.174,756 | 382,890 | CABEZA |
| 14681 | 707.193,186 | 4.644.426,058 | 382,180 | CABEZA |
| 14682 | 707.199,797 | 4.644.416,806 | 382,060 | CABEZA |
| 14683 | 707.776,328 | 4.644.801,352 | 374,550 | CABEZA |
| 14684 | 707.774,717 | 4.644.792,416 | 374,430 | CABEZA |
| 14685 | 709.287,826 | 4.648.527,940 | 346,530 | CABE |
| 14686 | 708.849,791 | 4.647.998,219 | 350,490 | CABEZA |
| 14687 | 708.867,803 | 4.648.002,215 | 350,300 | CABEZA |
| 14688 | 708.892,788 | 4.647.996,366 | 351,030 | CABEZA |
| 14689 | 709.239,919 | 4.648.511,233 | 346,500 | PIE |
| 14690 | 709.223,106 | 4.648.478,361 | 346,750 | PIE |
| 14691 | 709.221,966 | 4.648.476,071 | 346,920 | CABE |
| 14692 | 709.203,781 | 4.647.892,482 | 351,870 | CABEZA |
| 14693 | 709.203,304 | 4.647.900,817 | 351,740 | CABEZA |
| 14694 | 709.915,584 | 4.647.679,567 | 348,680 | CABEZA |
| 14695 | 709.944,161 | 4.647.663,343 | 348,610 | CABEZA |
| 14696 | 710.162,693 | 4.647.580,886 | 347,220 | CABEZA |
| 14697 | 706.959,566 | 4.648.293,215 | 360,960 | PT |
| 14698 | 710.254,561 | 4.647.557,979 | 346,810 | CABEZA |
| 14699 | 710.252,064 | 4.647.550,576 | 347,110 | CABEZA |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14700 | 706.926,021 | 4.648.279,141 | 361,750 | PIE |
| 14701 | 710.330,905 | 4.647.528,556 | 346,410 | CABEZA |
| 14702 | 710.335,725 | 4.647.533,750 | 346,200 | CABEZA |
| 14703 | 710.334,704 | 4.647.526,966 | 346,240 | CABEZA |
| 14704 | 706.831,747 | 4.648.226,824 | 361,820 | PIE |
| 14705 | 706.821,293 | 4.648.234,829 | 362,130 | CABE |
| 14706 | 710.516,838 | 4.647.478,537 | 345,800 | CABEZA |
| 14707 | 710.516,567 | 4.647.471,715 | 345,780 | CABEZA |
| 14708 | 710.605,701 | 4.647.447,427 | 345,530 | CABEZA |
| 14709 | 710.611,303 | 4.647.449,759 | 345,430 | CABEZA |
| 14710 | 710.612,516 | 4.647.444,637 | 345,330 | CABEZA |
| 14711 | 706.775,186 | 4.648.215,368 | 364,140 | CABE |
| 14712 | 706.779,089 | 4.648.216,019 | 363,290 | PIE |
| 14713 | 706.763,462 | 4.648.216,267 | 362,300 | ACEQ |
| 14714 | 706.777,130 | 4.648.220,461 | 363,050 | PISTA |
| 14715 | 711.371,636 | 4.647.358,951 | 342,030 | CABEZA |
| 14716 | 711.375,166 | 4.647.341,938 | 341,330 | CABEZA |
| 14717 | 711.382,415 | 4.647.346,352 | 341,110 | CABEZA |
| 14718 | 706.910,332 | 4.648.371,900 | 360,730 | CABE |
| 14719 | 706.918,726 | 4.648.364,026 | 360,610 | CABE |
| 14720 | 706.924,223 | 4.648.421,216 | 359,010 | PT |
| 14721 | 706.877,743 | 4.648.459,549 | 357,990 | PIE |
| 14722 | 711.057,105 | 4.647.401,546 | 343,570 | CABEZA |
| 14723 | 706.848,205 | 4.648.504,665 | 358,040 | PT |
| 14724 | 710.720,463 | 4.647.490,421 | 344,870 | CABEZA |
| 14725 | 710.721,678 | 4.647.496,223 | 344,880 | CABEZA |
| 14726 | 710.689,873 | 4.647.504,740 | 344,750 | CABEZA |
| 14727 | 706.909,822 | 4.648.364,855 | 358,700 | ACEQ |
| 14728 | 706.916,835 | 4.648.355,565 | 360,980 | PISTA |
| 14729 | 706.909,518 | 4.648.362,416 | 360,970 | PISTA |
| 14730 | 706.911,956 | 4.648.341,075 | 361,030 | PT |
| 14731 | 707.020,980 | 4.648.235,831 | 360,490 | PT |
| 14732 | 707.049,694 | 4.648.223,420 | 360,800 | PT |
| 14733 | 710.474,681 | 4.647.570,509 | 345,610 | CABEZA |
| 14734 | 710.446,072 | 4.647.581,048 | 345,770 | CABEZA |
| 14735 | 707.087,545 | 4.648.192,054 | 361,510 | ASPERSOR |
| 14736 | 710.354,822 | 4.647.612,186 | 346,030 | CABEZA |
| 14737 | 707.119,522 | 4.648.146,313 | 361,740 | PT |
| 14738 | 710.165,181 | 4.647.552,163 | 347,270 | CABEZA |
| 14739 | 707.146,875 | 4.648.120,640 | 361,640 | PT |
| 14740 | 707.174,462 | 4.648.097,430 | 361,500 | PT |
| 14741 | 710.155,125 | 4.647.520,418 | 348,750 | CABEZA |
| 14742 | 707.209,415 | 4.648.076,916 | 361,680 | PIE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14743 | 707.205,139 | 4.648.066,866 | 361,790 | CABE |
| 14744 | 710.116,371 | 4.647.467,325 | 352,500 | CABEZA |
| 14745 | 710.124,200 | 4.647.465,271 | 352,390 | CABEZA |
| 14746 | 710.104,976 | 4.647.448,461 | 355,100 | CABEZA |
| 14747 | 710.111,507 | 4.647.448,816 | 355,010 | CABEZA |
| 14748 | 707.248,765 | 4.648.023,061 | 362,490 | CABE2 |
| 14749 | 707.258,669 | 4.648.026,211 | 361,690 | CABE |
| 14750 | 710.197,562 | 4.647.662,639 | 345,560 | CABEZA |
| 14751 | 710.190,555 | 4.647.654,948 | 345,630 | CABEZA |
| 14752 | 710.154,388 | 4.647.672,792 | 345,240 | CABEZA |
| 14753 | 710.154,873 | 4.647.665,346 | 345,220 | CABEZA |
| 14754 | 710.114,127 | 4.647.676,023 | 344,640 | CABEZA |
| 14755 | 710.114,073 | 4.647.687,027 | 344,620 | CABEZA |
| 14756 | 709.977,656 | 4.647.719,590 | 344,900 | CABEZA |
| 14757 | 707.518,680 | 4.648.145,145 | 364,140 | PIE |
| 14758 | 709.786,533 | 4.647.778,679 | 345,770 | CABEZA |
| 14759 | 709.791,765 | 4.647.784,946 | 345,770 | CABEZA |
| 14760 | 709.522,139 | 4.647.857,513 | 347,180 | CABEZA |
| 14761 | 707.508,020 | 4.648.127,348 | 364,020 | PT |
| 14762 | 707.501,045 | 4.648.127,368 | 364,050 | PT |
| 14763 | 707.506,860 | 4.648.111,562 | 364,090 | PT |
| 14764 | 709.483,713 | 4.647.868,952 | 347,620 | CABEZA |
| 14765 | 709.483,142 | 4.647.877,309 | 347,670 | CABEZA |
| 14766 | 707.492,905 | 4.648.033,728 | 364,280 | PT |
| 14767 | 709.412,595 | 4.647.899,538 | 347,800 | CABEZA |
| 14768 | 707.487,448 | 4.647.957,474 | 364,330 | PT |
| 14769 | 709.408,567 | 4.647.889,186 | 348,820 | CABEZA |
| 14770 | 709.294,755 | 4.647.924,995 | 349,130 | CABEZA |
| 14771 | 709.293,998 | 4.647.932,868 | 348,980 | CABEZA |
| 14772 | 707.495,032 | 4.647.933,076 | 364,800 | CABE |
| 14773 | 707.485,373 | 4.647.923,213 | 364,600 | PT |
| 14774 | 709.185,046 | 4.647.965,235 | 351,340 | CABEZA |
| 14775 | 709.184,964 | 4.647.956,334 | 351,340 | CABEZA |
| 14776 | 709.044,709 | 4.648.007,043 | 351,370 | CABEZA |
| 14777 | 707.468,536 | 4.647.818,428 | 364,620 | PT |
| 14778 | 707.476,171 | 4.647.813,589 | 364,630 | PT |
| 14779 | 707.455,643 | 4.647.799,924 | 363,980 | PIE |
| 14780 | 708.908,675 | 4.648.036,690 | 350,280 | CABEZA |
| 14781 | 708.910,831 | 4.648.045,123 | 350,340 | CABEZA |
| 14782 | 707.430,989 | 4.647.789,018 | 362,590 | PISTA |
| 14783 | 708.688,418 | 4.648.108,469 | 351,240 | CABEZA |
| 14784 | 708.682,142 | 4.648.106,428 | 350,930 | CABEZA |
| 14785 | 707.454,481 | 4.647.777,041 | 363,890 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14786 | 707.449,818 | 4.647.762,059 | 363,920 | PT |
| 14787 | 707.441,003 | 4.647.762,835 | 364,100 | PT |
| 14788 | 708.510,092 | 4.648.169,495 | 353,350 | CABEZA |
| 14789 | 707.430,738 | 4.647.727,565 | 362,620 | PT |
| 14790 | 707.430,746 | 4.647.697,395 | 362,940 | CABE |
| 14791 | 708.505,653 | 4.648.170,324 | 354,360 | CABEZA |
| 14792 | 707.419,770 | 4.647.685,853 | 361,290 | PT |
| 14793 | 707.424,601 | 4.647.674,217 | 361,380 | PT |
| 14794 | 707.412,307 | 4.647.665,837 | 361,560 | PT |
| 14795 | 708.146,110 | 4.648.272,525 | 353,840 | CABEZA |
| 14796 | 708.003,688 | 4.648.322,677 | 354,380 | CABEZA |
| 14797 | 708.001,443 | 4.648.314,889 | 354,280 | CABEZA |
| 14798 | 707.995,283 | 4.648.315,687 | 354,520 | CABEZA |
| 14799 | 707.998,990 | 4.648.325,396 | 354,460 | CABEZA |
| 14800 | 707.859,719 | 4.648.334,837 | 355,010 | CABEZA |
| 14801 | 707.368,328 | 4.647.530,575 | 361,890 | CABE |
| 14802 | 707.395,519 | 4.647.511,328 | 361,600 | PT |
| 14803 | 707.418,625 | 4.647.525,952 | 361,590 | PT |
| 14804 | 707.700,076 | 4.648.392,815 | 355,690 | CABEZA |
| 14805 | 707.692,179 | 4.648.383,054 | 355,720 | CABEZA |
| 14806 | 707.790,734 | 4.648.405,076 | 354,910 | CABEZA |
| 14807 | 707.798,768 | 4.648.402,930 | 354,890 | CABEZA |
| 14808 | 707.485,329 | 4.647.537,184 | 361,480 | PT |
| 14809 | 707.511,550 | 4.647.530,540 | 361,500 | PT |
| 14810 | 707.819,702 | 4.648.508,773 | 355,270 | CABEZA |
| 14811 | 707.565,750 | 4.647.534,133 | 359,780 | PIE |
| 14812 | 707.572,650 | 4.647.546,543 | 359,770 | PIE |
| 14813 | 707.594,214 | 4.647.541,398 | 359,690 | PT |
| 14814 | 707.202,352 | 4.648.515,742 | 364,440 | CABEZA |
| 14815 | 707.647,173 | 4.647.547,733 | 359,720 | PT |
| 14816 | 707.667,696 | 4.647.549,682 | 359,610 | PT |
| 14817 | 707.669,644 | 4.647.556,915 | 359,770 | PT |
| 14818 | 707.369,025 | 4.647.515,586 | 361,480 | PT |
| 14819 | 707.364,537 | 4.647.503,408 | 361,490 | PT |
| 14820 | 707.348,028 | 4.647.499,590 | 361,620 | CABE |
| 14821 | 707.049,794 | 4.648.201,309 | 361,380 | CABEZA |
| 14822 | 707.342,346 | 4.647.497,587 | 359,920 | DESAGUE |
| 14823 | 707.198,555 | 4.648.060,781 | 361,560 | CABEZA |
| 14824 | 707.207,751 | 4.648.069,734 | 361,720 | CABEZA |
| 14825 | 707.245,346 | 4.648.024,172 | 362,030 | CABEZA |
| 14826 | 707.308,530 | 4.647.481,137 | 361,380 | PT |
| 14827 | 707.256,300 | 4.648.020,541 | 361,240 | CABEZA |
| 14828 | 707.278,944 | 4.647.475,436 | 361,880 | ASPERSOR**** |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14829 | 707.299,271 | 4.647.489,397 | 361,750 | ASPERSOR |
| 14830 | 707.363,736 | 4.647.884,470 | 362,250 | CABEZA |
| 14831 | 707.353,535 | 4.647.481,119 | 360,030 | ASPERSOR |
| 14832 | 707.369,811 | 4.647.889,931 | 362,510 | CABEZA |
| 14833 | 707.415,202 | 4.647.853,855 | 362,860 | CABEZA |
| 14834 | 707.192,901 | 4.647.473,172 | 362,280 | PT |
| 14835 | 707.163,102 | 4.647.480,496 | 362,380 | PT |
| 14836 | 707.162,858 | 4.647.471,266 | 362,280 | PT |
| 14837 | 708.189,693 | 4.647.851,801 | 356,690 | CABEZA |
| 14838 | 707.124,582 | 4.647.477,215 | 361,080 | PIE |
| 14839 | 708.017,805 | 4.647.813,456 | 357,450 | CABEZA |
| 14840 | 708.027,974 | 4.647.821,610 | 357,460 | CABEZA |
| 14841 | 707.125,041 | 4.647.461,720 | 362,670 | PT |
| 14842 | 707.107,985 | 4.647.432,059 | 362,850 | PIE |
| 14843 | 707.734,703 | 4.647.645,947 | 358,750 | CABEZA |
| 14844 | 707.106,570 | 4.647.427,952 | 363,270 | CABE |
| 14845 | 707.112,066 | 4.647.408,276 | 363,170 | PT |
| 14846 | 707.101,075 | 4.647.398,316 | 364,040 | CABE |
| 14847 | 707.656,834 | 4.647.563,254 | 359,860 | CABEZA |
| 14848 | 707.101,706 | 4.647.370,100 | 364,040 | PIE |
| 14849 | 707.095,670 | 4.647.369,255 | 365,180 | CABE |
| 14850 | 707.671,429 | 4.647.555,059 | 359,650 | CABEZA |
| 14851 | 707.099,006 | 4.647.354,551 | 365,070 | PT |
| 14852 | 707.089,944 | 4.647.338,967 | 366,690 | CABE |
| 14853 | 707.094,580 | 4.647.337,206 | 366,520 | CABE |
| 14854 | 707.469,801 | 4.647.565,175 | 361,720 | CABEZA |
| 14855 | 707.460,673 | 4.647.556,793 | 361,580 | CABEZA |
| 14856 | 707.083,776 | 4.647.276,633 | 368,570 | PT |
| 14857 | 707.377,793 | 4.647.563,993 | 361,870 | CABEZA |
| 14858 | 707.079,529 | 4.647.263,256 | 368,560 | PIE |
| 14859 | 707.071,891 | 4.647.260,051 | 369,900 | CABE |
| 14860 | 706.990,063 | 4.647.653,792 | 367,340 | CABEZA |
| 14861 | 706.995,784 | 4.647.653,504 | 367,320 | CABEZA |
| 14862 | 707.066,852 | 4.647.230,466 | 371,370 | CABE |
| 14863 | 707.065,245 | 4.647.221,954 | 370,490 | ACEQ |
| 14864 | 707.215,345 | 4.647.017,478 | 368,990 | CABEZA |
| 14865 | 707.053,629 | 4.647.223,889 | 372,240 | PISTA |
| 14866 | 707.368,625 | 4.646.543,402 | 376,010 | CABEZA |
| 14867 | 707.419,768 | 4.646.422,492 | 381,140 | CABEZA |
| 14868 | 707.410,976 | 4.646.426,586 | 381,050 | CABEZA |
| 14869 | 707.489,552 | 4.646.269,841 | 374,780 | CABEZA |
| 14870 | 707.482,249 | 4.646.268,468 | 374,540 | CABEZA |
| 14871 | 707.135,790 | 4.647.128,504 | 375,920 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14872 | 707.151,528 | 4.647.123,926 | 376,310 | CANALETA |
| 14873 | 707.150,833 | 4.647.117,600 | 374,190 | PIE |
| 14874 | 707.519,899 | 4.646.212,175 | 371,890 | CABEZA |
| 14875 | 707.524,495 | 4.646.191,348 | 371,050 | CABEZA |
| 14876 | 707.516,136 | 4.646.189,938 | 371,020 | CABEZA |
| 14877 | 707.223,814 | 4.646.989,649 | 369,190 | PT |
| 14878 | 707.550,823 | 4.646.139,581 | 368,700 | CABEZA |
| 14879 | 707.239,168 | 4.646.964,135 | 369,910 | CABE |
| 14880 | 707.252,503 | 4.646.955,302 | 369,800 | PT |
| 14881 | 707.578,589 | 4.646.077,625 | 367,040 | CABEZA |
| 14882 | 707.248,559 | 4.646.938,235 | 370,870 | CABE |
| 14883 | 707.260,839 | 4.646.921,453 | 370,530 | PT |
| 14884 | 707.585,238 | 4.646.039,570 | 366,310 | CABEZA |
| 14885 | 707.987,230 | 4.646.126,242 | 366,130 | CABEZA |
| 14886 | 707.995,185 | 4.646.119,506 | 366,120 | CABEZA |
| 14887 | 707.278,440 | 4.646.828,930 | 372,930 | PT |
| 14888 | 707.274,156 | 4.646.808,088 | 373,340 | PT |
| 14889 | 708.088,179 | 4.646.240,808 | 369,110 | CABEZA |
| 14890 | 708.082,175 | 4.646.250,652 | 369,140 | CABEZA |
| 14891 | 708.133,004 | 4.646.318,203 | 370,420 | CABEZA |
| 14892 | 707.284,359 | 4.646.744,514 | 374,440 | PISTA |
| 14893 | 707.290,017 | 4.646.732,406 | 373,900 | ASPERSOR |
| 14894 | 708.135,582 | 4.646.321,730 | 370,820 | CABEZA |
| 14895 | 708.317,188 | 4.646.509,424 | 373,320 | CABEZA |
| 14896 | 707.303,342 | 4.646.719,748 | 373,270 | PT |
| 14897 | 708.363,493 | 4.646.562,808 | 372,350 | CABEZA |
| 14898 | 708.391,551 | 4.646.590,031 | 368,850 | CABEZA |
| 14899 | 707.322,800 | 4.646.673,011 | 373,590 | ASPERSOR |
| 14900 | 707.315,402 | 4.646.641,377 | 374,110 | ASPERSOR |
| 14901 | 708.834,936 | 4.647.038,047 | 367,030 | CABEZA |
| 14902 | 707.352,939 | 4.646.627,160 | 373,880 | ASPERSOR |
| 14903 | 707.347,225 | 4.646.646,456 | 373,620 | ASPERSOR |
| 14904 | 707.183,271 | 4.646.497,214 | 377,560 | PT |
| 14905 | 707.201,187 | 4.646.492,751 | 377,830 | PT |
| 14906 | 709.045,150 | 4.647.272,083 | 363,890 | CABEZA |
| 14907 | 709.054,104 | 4.647.284,317 | 363,940 | CABEZA |
| 14908 | 709.062,057 | 4.647.295,777 | 363,970 | CABEZA |
| 14909 | 709.214,212 | 4.647.765,170 | 355,340 | CABEZA |
| 14910 | 707.309,654 | 4.646.474,515 | 378,330 | PT |
| 14911 | 709.827,874 | 4.648.808,833 | 343,420 | CABEZA |
| 14912 | 709.824,317 | 4.648.814,490 | 343,460 | CABEZA |
| 14913 | 707.389,970 | 4.646.467,018 | 378,690 | PT |
| 14914 | 707.398,782 | 4.646.465,098 | 378,750 | PT |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14915 | 707.208,642 | 4.646.498,677 | 376,600 | PT |
| 14916 | 710.226,665 | 4.648.764,970 | 342,390 | CABEZA |
| 14917 | 709.554,544 | 4.648.332,683 | 347,100 | CABEZA |
| 14918 | 707.122,161 | 4.647.480,018 | 362,170 | PISTA |
| 14919 | 707.127,916 | 4.647.486,278 | 362,900 | PISTA |
| 14920 | 705.631,705 | 4.647.483,725 | 378,500 | CABEZA |
| 14921 | 705.572,552 | 4.647.447,143 | 380,520 | CABEZA |
| 14922 | 705.578,605 | 4.647.440,088 | 380,550 | CABEZA |
| 14923 | 707.097,208 | 4.647.528,571 | 363,160 | ASPERSOR |
| 14924 | 707.090,212 | 4.647.544,366 | 363,580 | ASPERSOR |
| 14925 | 705.320,296 | 4.647.272,401 | 382,320 | CABEZA |
| 14926 | 705.328,825 | 4.647.262,818 | 382,360 | CABEZA |
| 14927 | 705.393,455 | 4.647.303,436 | 382,170 | CABEZA |
| 14928 | 705.399,145 | 4.647.307,541 | 382,090 | CABEZA |
| 14929 | 705.930,606 | 4.647.244,013 | 377,540 | CABEZA |
| 14930 | 707.037,170 | 4.647.649,896 | 365,710 | ASPERSOR |
| 14931 | 705.941,788 | 4.647.241,941 | 377,570 | CABEZA |
| 14932 | 707.019,017 | 4.647.649,939 | 365,660 | ASPERSOR |
| 14933 | 707.030,994 | 4.647.653,808 | 367,250 | CABE |
| 14934 | 707.023,238 | 4.647.663,439 | 367,100 | PT |
| 14935 | 707.012,046 | 4.647.673,141 | 367,010 | PT |
| 14936 | 705.981,692 | 4.647.179,721 | 379,440 | CABEZA |
| 14937 | 706.976,757 | 4.647.701,111 | 367,030 | PT |
| 14938 | 706.957,769 | 4.647.715,415 | 366,980 | PT |
| 14939 | 706.940,884 | 4.647.730,151 | 366,950 | PT |
| 14940 | 711.198,347 | 4.647.376,079 | 342,620 | PT |
| 14941 | 709.727,550 | 4.646.928,050 | 350,340 | |
| 14942 | 711.178,263 | 4.647.390,505 | 342,300 | PT |
| 14943 | 709.741,160 | 4.646.971,380 | 350,320 | |
| 14944 | 711.120,406 | 4.647.407,254 | 342,560 | PT |
| 14945 | 711.091,133 | 4.647.414,689 | 342,480 | PT |
| 14946 | 711.063,171 | 4.647.414,897 | 342,550 | PIE |
| 14947 | 708.938,737 | 4.645.704,468 | 355,720 | ACEQUIA |
| 14948 | 708.402,819 | 4.645.134,832 | 366,549 | |
| 14949 | 709.789,560 | 4.647.057,450 | 350,340 | |
| 14950 | 710.985,740 | 4.647.443,230 | 343,450 | PT |
| 14951 | 708.383,594 | 4.645.099,951 | 368,835 | |
| 14952 | 709.249,238 | 4.645.239,842 | 359,390 | ACEQUIA |
| 14953 | 710.956,658 | 4.647.438,178 | 343,930 | PISTA |
| 14954 | 709.812,090 | 4.647.118,010 | 350,190 | |
| 14955 | 708.366,704 | 4.645.085,324 | 369,232 | |
| 14956 | 710.849,580 | 4.647.477,154 | 344,010 | PT |
| 14957 | 708.346,871 | 4.645.047,760 | 369,287 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 14958 | 710.763,597 | 4.647.488,128 | 344,150 | PT |
| 14959 | 710.726,849 | 4.647.506,995 | 344,380 | CABE |
| 14960 | 708.295,498 | 4.644.983,944 | 369,489 | |
| 14961 | 709.832,290 | 4.647.117,190 | 348,610 | |
| 14962 | 709.095,562 | 4.644.556,045 | 364,020 | ACEQUIA |
| 14963 | 710.654,444 | 4.647.525,466 | 344,730 | PT |
| 14964 | 709.113,207 | 4.644.511,775 | 365,380 | ACEQUIA |
| 14965 | 704.858,468 | 4.644.712,327 | 430,973 | ACEQUIA |
| 14966 | 709.877,870 | 4.647.123,530 | 349,460 | |
| 14967 | 709.815,942 | 4.645.328,412 | 357,320 | ACEQUIA |
| 14968 | 705.898,365 | 4.645.116,912 | 384,797 | ACEQUIA |
| 14969 | 710.559,291 | 4.647.552,684 | 345,200 | PT |
| 14970 | 710.538,132 | 4.647.550,232 | 345,170 | PT |
| 14971 | 710.523,697 | 4.647.561,458 | 345,490 | PT |
| 14972 | 709.487,570 | 4.647.163,860 | 361,670 | |
| 14973 | 710.316,352 | 4.645.436,345 | 355,220 | ACEQUIA |
| 14974 | 710.544,253 | 4.645.472,166 | 353,940 | ACEQUIA |
| 14975 | 710.489,619 | 4.647.577,228 | 345,540 | CABE |
| 14976 | 710.469,756 | 4.647.568,329 | 345,580 | CABE |
| 14977 | 708.163,565 | 4.644.988,498 | 370,619 | |
| 14978 | 708.135,618 | 4.644.977,494 | 370,603 | |
| 14979 | 709.982,210 | 4.647.141,280 | 349,490 | |
| 14980 | 708.088,362 | 4.644.956,990 | 370,640 | |
| 14981 | 710.445,601 | 4.647.576,370 | 345,720 | CABE |
| 14982 | 710.441,464 | 4.647.578,402 | 345,630 | PT |
| 14983 | 709.539,590 | 4.647.184,860 | 361,900 | |
| 14984 | 709.547,940 | 4.647.181,090 | 361,390 | |
| 14985 | 710.372,227 | 4.647.598,943 | 345,680 | PT |
| 14986 | 709.583,330 | 4.647.190,740 | 359,530 | |
| 14987 | 710.336,429 | 4.647.556,914 | 346,160 | CABE2 |
| 14988 | 710.337,776 | 4.647.563,158 | 346,290 | PISTA |
| 14989 | 710.330,412 | 4.647.558,815 | 346,350 | PISTA |
| 14990 | 710.332,182 | 4.647.556,816 | 346,290 | CABE |
| 14991 | 709.698,410 | 4.647.177,010 | 356,090 | |
| 14992 | 710.325,734 | 4.647.536,891 | 346,210 | PT |
| 14993 | 710.299,876 | 4.647.511,992 | 346,180 | PT |
| 14994 | 710.308,483 | 4.647.507,265 | 346,360 | PT |
| 14995 | 710.299,707 | 4.647.510,831 | 346,410 | PT |
| 14996 | 710.035,305 | 4.645.731,063 | 352,420 | ACEQUIA |
| 14997 | 707.897,111 | 4.644.815,714 | 375,535 | |
| 14998 | 709.722,970 | 4.647.187,560 | 354,700 | |
| 14999 | 709.483,510 | 4.647.201,440 | 361,650 | |
| 15000 | 709.581,640 | 4.647.196,020 | 359,530 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 15001 | 709.603,690 | 4.647.194,610 | 359,560 | |
| 15002 | 708.404,953 | 4.644.981,052 | 368,641 | |
| 15003 | 709.601,330 | 4.647.202,310 | 359,620 | |
| 15004 | 710.243,421 | 4.647.411,214 | 351,020 | PT |
| 15005 | 709.632,240 | 4.647.200,460 | 358,000 | |
| 15006 | 710.237,368 | 4.647.386,208 | 354,790 | CABE2 |
| 15007 | 710.244,895 | 4.647.380,456 | 354,730 | CABE2 |
| 15008 | 709.628,930 | 4.647.206,400 | 358,130 | |
| 15009 | 710.236,483 | 4.647.355,277 | 354,750 | PT |
| 15010 | 710.230,273 | 4.647.337,047 | 354,440 | ACEQ |
| 15011 | 709.668,690 | 4.647.194,050 | 357,700 | |
| 15012 | 710.214,356 | 4.647.316,817 | 354,750 | PT |
| 15013 | 710.223,461 | 4.647.313,683 | 354,760 | PT |
| 15014 | 709.479,210 | 4.647.243,600 | 361,630 | |
| 15015 | 710.192,535 | 4.647.304,983 | 354,740 | PT |
| 15016 | 709.603,140 | 4.647.230,090 | 359,600 | |
| 15017 | 710.155,757 | 4.647.311,446 | 354,810 | PT |
| 15018 | 706.151,441 | 4.644.939,761 | 382,240 | ACEQUIA |
| 15019 | 710.113,376 | 4.647.334,374 | 355,220 | CABE |
| 15020 | 710.113,218 | 4.647.336,842 | 355,220 | CABE2 |
| 15021 | 710.093,647 | 4.647.336,444 | 355,260 | CABE2 |
| 15022 | 710.093,781 | 4.647.334,046 | 355,370 | CABE2 |
| 15023 | 706.393,208 | 4.644.745,347 | 380,610 | ACEQUIA |
| 15024 | 710.047,614 | 4.647.359,418 | 355,580 | PT |
| 15025 | 706.774,894 | 4.644.468,653 | 381,560 | ACEQUIA |
| 15026 | 710.001,934 | 4.647.382,294 | 355,570 | PT |
| 15027 | 706.773,855 | 4.644.459,445 | 381,950 | ACEQUIA |
| 15028 | 706.913,100 | 4.644.449,658 | 382,240 | ACEQUIA |
| 15029 | 709.545,440 | 4.647.346,760 | 360,690 | |
| 15030 | 709.994,280 | 4.647.425,884 | 353,480 | CABE2 |
| 15031 | 709.536,760 | 4.647.379,420 | 359,090 | |
| 15032 | 709.531,930 | 4.647.411,830 | 357,720 | |
| 15033 | 710.101,993 | 4.647.601,687 | 347,480 | ACEQUIA |
| 15034 | 710.333,721 | 4.647.533,998 | 345,530 | ACEQUIA |
| 15035 | 709.531,220 | 4.647.434,330 | 357,510 | |
| 15036 | 709.530,230 | 4.647.441,080 | 357,630 | |
| 15037 | 709.530,930 | 4.647.443,720 | 356,730 | |
| 15038 | 710.918,740 | 4.647.357,638 | 345,070 | ACEQUIA |
| 15039 | 709.964,940 | 4.647.477,077 | 353,330 | CARRETERA |
| 15040 | 709.498,820 | 4.647.475,200 | 356,640 | |
| 15041 | 709.505,730 | 4.647.475,430 | 356,670 | |
| 15042 | 710.483,178 | 4.647.570,166 | 345,620 | ACEQUIA |
| 15043 | 709.531,580 | 4.647.463,260 | 356,760 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 15044 | 709.522,370 | 4.647.464,230 | 356,650 | |
| 15045 | 709.524,620 | 4.647.467,340 | 356,670 | |
| 15046 | 710.212,217 | 4.647.279,390 | 354,920 | CABE2 |
| 15047 | 709.535,060 | 4.647.461,390 | 356,750 | |
| 15048 | 710.196,900 | 4.647.255,497 | 354,670 | PT |
| 15049 | 710.192,660 | 4.647.240,055 | 354,760 | PT |
| 15050 | 710.121,102 | 4.647.455,626 | 351,750 | ACEQUIA |
| 15051 | 710.106,302 | 4.647.454,577 | 351,710 | ACEQUIA |
| 15052 | 710.195,205 | 4.647.218,535 | 354,860 | CANALETA |
| 15053 | 709.430,110 | 4.647.533,650 | 356,240 | |
| 15054 | 710.194,269 | 4.647.216,039 | 354,840 | CARRETERA |
| 15055 | 710.184,996 | 4.647.210,964 | 354,130 | ACEQ |
| 15056 | 709.486,910 | 4.647.867,941 | 346,700 | ACEQUIA |
| 15057 | 709.486,706 | 4.647.875,786 | 346,930 | ACEQUIA |
| 15058 | 710.032,250 | 4.646.839,260 | 344,730 | |
| 15059 | 710.043,270 | 4.646.841,530 | 344,520 | |
| 15060 | 710.071,320 | 4.646.841,250 | 344,580 | |
| 15061 | 709.292,418 | 4.647.932,397 | 348,450 | ACEQUIA |
| 15062 | 710.084,510 | 4.646.850,520 | 344,620 | |
| 15063 | 710.288,760 | 4.647.197,071 | 354,120 | PT |
| 15064 | 710.298,203 | 4.647.187,969 | 354,310 | PT |
| 15065 | 710.319,043 | 4.647.186,410 | 354,050 | PT |
| 15066 | 710.135,740 | 4.646.865,550 | 344,640 | |
| 15067 | 708.678,979 | 4.648.116,621 | 349,790 | ACEQUIA |
| 15068 | 710.154,500 | 4.646.867,070 | 344,340 | |
| 15069 | 710.154,390 | 4.646.871,490 | 344,310 | |
| 15070 | 710.492,535 | 4.647.111,897 | 353,130 | CABE |
| 15071 | 708.344,820 | 4.648.213,498 | 354,360 | ACEQUIA |
| 15072 | 710.184,230 | 4.646.880,490 | 344,300 | |
| 15073 | 710.531,654 | 4.647.100,580 | 352,870 | PT |
| 15074 | 708.002,503 | 4.648.323,131 | 353,820 | ACEQUIA |
| 15075 | 710.029,880 | 4.647.146,160 | 349,480 | |
| 15076 | 710.567,373 | 4.647.087,000 | 351,220 | CANALETA |
| 15077 | 710.570,102 | 4.647.086,043 | 352,070 | CABE |
| 15078 | 710.571,320 | 4.647.090,051 | 352,660 | PISTA |
| 15079 | 710.577,746 | 4.647.090,047 | 352,820 | PISTA |
| 15080 | 706.947,674 | 4.648.298,117 | 360,020 | ACEQUIA |
| 15081 | 710.577,801 | 4.647.054,473 | 350,720 | PISTA |
| 15082 | 710.579,616 | 4.647.068,519 | 350,600 | PT |
| 15083 | 707.246,573 | 4.648.019,362 | 361,040 | ACEQUIA |
| 15084 | 710.146,530 | 4.647.180,430 | 354,510 | |
| 15085 | 710.157,710 | 4.647.178,960 | 354,520 | |
| 15086 | 710.170,370 | 4.647.189,340 | 354,570 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 15087 | 710.578,021 | 4.647.027,020 | 349,470 | PT |
| 15088 | 715.841,394 | 4.644.518,289 | 319,070 | |
| 15089 | 715.826,429 | 4.644.518,014 | 319,060 | |
| 15090 | 715.813,138 | 4.644.518,388 | 319,060 | |
| 15091 | 715.847,173 | 4.644.408,880 | 315,300 | DESAGÜE |
| 15092 | 715.761,378 | 4.644.394,291 | 315,440 | DESAGÜE |
| 15093 | 715.568,421 | 4.644.482,020 | 315,890 | DESAGÜE |
| 15094 | 715.401,964 | 4.644.498,923 | 316,420 | DESAGÜE |
| 15095 | 715.218,130 | 4.644.461,939 | 317,420 | DESAGÜE |
| 15096 | 715.092,457 | 4.644.385,876 | 317,890 | DESAGÜE |
| 15097 | 714.979,815 | 4.644.345,653 | 318,070 | DESAGÜE |
| 15098 | 714.863,288 | 4.644.389,548 | 319,170 | DESAGÜE |
| 15099 | 714.860,199 | 4.644.385,399 | 322,830 | CABEZA |
| 15100 | 714.840,760 | 4.644.394,941 | 322,470 | CABEZA |
| 15101 | 714.816,729 | 4.644.407,330 | 322,200 | CABEZA |
| 15102 | 714.807,196 | 4.644.412,293 | 322,240 | CABEZA |
| 15103 | 714.808,644 | 4.644.416,741 | 319,080 | CABEZA |
| 15104 | 714.794,276 | 4.644.418,657 | 322,270 | CABEZA |
| 15105 | 714.777,096 | 4.644.427,610 | 322,400 | CABEZA |
| 15106 | 714.780,935 | 4.644.431,001 | 319,050 | DESAGÜE |
| 15107 | 714.758,256 | 4.644.437,126 | 322,490 | CABEZA |
| 15108 | 714.737,703 | 4.644.446,237 | 322,500 | PUENTE |
| 15109 | 714.731,356 | 4.644.449,204 | 322,630 | PUENTE |
| 15110 | 714.729,115 | 4.644.444,779 | 322,600 | PUENTE |
| 15111 | 714.737,576 | 4.644.440,830 | 322,620 | PUENTE |
| 15112 | 714.732,043 | 4.644.439,629 | 319,710 | DESAGÜE |
| 15113 | 714.737,169 | 4.644.451,493 | 319,180 | DESAGÜE |
| 15114 | 714.737,204 | 4.644.452,176 | 319,200 | DESAGÜE |
| 15115 | 714.739,311 | 4.644.438,467 | 322,600 | CABEZA |
| 15116 | 714.751,040 | 4.644.432,948 | 322,630 | CABEZA |
| 15117 | 714.765,215 | 4.644.425,682 | 322,550 | CABEZA |
| 15118 | 714.789,683 | 4.644.412,564 | 322,400 | CABEZA |
| 15119 | 714.825,739 | 4.644.393,941 | 322,450 | CABEZA |
| 15120 | 714.840,990 | 4.644.387,771 | 322,440 | CABEZA |
| 15121 | 714.859,130 | 4.644.377,997 | 322,620 | CABEZA |
| 15122 | 714.714,175 | 4.644.451,971 | 322,740 | CABEZA |
| 15123 | 714.714,802 | 4.644.457,965 | 322,690 | CABEZA |
| 15124 | 714.694,295 | 4.644.467,787 | 322,770 | CABEZA |
| 15125 | 714.690,518 | 4.644.463,849 | 322,750 | CABEZA |
| 15126 | 714.664,471 | 4.644.477,255 | 322,730 | CABEZA |
| 15127 | 714.666,380 | 4.644.482,579 | 322,720 | CABEZA |
| 15128 | 714.642,437 | 4.644.495,106 | 322,390 | CABEZA |
| 15129 | 714.644,764 | 4.644.500,050 | 320,050 | DESAGÜE |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 15130 | 714.639,545 | 4.644.489,710 | 322,510 | CABEZA |
| 15131 | 714.727,156 | 4.644.443,707 | 322,530 | CABEZA |
| 15132 | 714.725,238 | 4.644.435,326 | 322,450 | CABEZA |
| 15133 | 714.724,024 | 4.644.424,885 | 322,520 | CABEZA |
| 15134 | 714.722,724 | 4.644.403,698 | 322,440 | CABEZA |
| 15135 | 714.721,571 | 4.644.381,945 | 322,360 | CABEZA |
| 15136 | 714.721,039 | 4.644.362,140 | 322,460 | CABEZA |
| 15137 | 714.720,343 | 4.644.347,820 | 322,420 | CABEZA |
| 15138 | 714.715,599 | 4.644.348,024 | 322,690 | CABEZA |
| 15139 | 714.716,479 | 4.644.362,568 | 322,640 | CABEZA |
| 15140 | 714.717,136 | 4.644.379,145 | 322,500 | CABEZA |
| 15141 | 714.717,967 | 4.644.399,361 | 322,530 | CABEZA |
| 15142 | 714.718,899 | 4.644.423,982 | 322,480 | CABEZA |
| 15143 | 714.719,805 | 4.644.442,320 | 322,670 | CABEZA |
| 15144 | 714.737,901 | 4.644.438,484 | 322,640 | CABEZA |
| 15145 | 714.735,115 | 4.644.422,754 | 322,440 | CABEZA |
| 15146 | 714.733,074 | 4.644.406,669 | 322,400 | CABEZA |
| 15147 | 714.732,269 | 4.644.394,363 | 322,140 | CABEZA |
| 15148 | 714.730,620 | 4.644.377,112 | 322,290 | CABEZA |
| 15149 | 714.729,045 | 4.644.362,363 | 322,190 | CABEZA |
| 15150 | 714.728,384 | 4.644.350,005 | 322,360 | CABEZA |
| 15151 | 714.726,077 | 4.644.349,644 | 320,760 | DESAGÜE |
| 15152 | 714.731,913 | 4.644.347,845 | 321,810 | |
| 15153 | 714.732,585 | 4.644.364,638 | 321,870 | |
| 15154 | 714.735,621 | 4.644.392,258 | 321,850 | |
| 15155 | 714.738,060 | 4.644.409,585 | 321,870 | |
| 15156 | 714.742,073 | 4.644.429,447 | 321,880 | |
| 15157 | 714.813,024 | 4.644.401,425 | 322,400 | CABEZA |
| 15158 | 714.829,525 | 4.644.392,858 | 322,480 | CABEZA |
| 15159 | 715.848,202 | 4.644.414,641 | 318,230 | BOMBEO |
| 15160 | 715.838,082 | 4.644.430,813 | 318,460 | |
| 15161 | 715.839,232 | 4.644.439,207 | 318,410 | |
| 15162 | 715.839,825 | 4.644.450,406 | 318,420 | |
| 15163 | 715.843,965 | 4.644.470,207 | 318,760 | |
| 15164 | 715.844,095 | 4.644.479,681 | 318,800 | |
| 15165 | 715.846,224 | 4.644.496,497 | 319,120 | |
| 15166 | 715.844,912 | 4.644.506,486 | 319,110 | |
| 15167 | 714.840,827 | 4.644.394,873 | 322,534 | |
| 15168 | 714.807,035 | 4.644.412,273 | 322,395 | |
| 15169 | 714.807,448 | 4.644.413,193 | 321,741 | |
| 15170 | 714.777,880 | 4.644.427,206 | 322,490 | |
| 15171 | 714.778,275 | 4.644.427,896 | 321,870 | |
| 15172 | 714.750,642 | 4.644.441,603 | 322,528 | |

| NUMERO | X | Y | Z | CODIGO |
|---|---|---|---|---|
| 15173 | 714.751,146 | 4.644.442,647 | 321,734 | |
| 15174 | 714.738,031 | 4.644.446,215 | 322,536 | |
| 15175 | 714.732,385 | 4.644.442,529 | 322,322 | |
| 15176 | 715.848,858 | 4.644.406,637 | 318,489 | |

# APÉNDICE 2.- DEFINICIÓN GEOMETRICA DE LA RED

## DATOS GEOMETRICOS DE LA RED

Para la correcta ejecución de los trazados de tuberías detallamos a continuación los diferentes ramales. Definiremos en primer lugar el trazado en planta mediante un listado de todos sus puntos singulares y a continuación se definirá en alzado.

**R-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 705938,4 | 4645138,92 | 113,825484 | 0 | 529,846 |
| 529,846 | 706455,8 | 4645024,75 | 97,865388 | 0 | 130,199 |
| 660,045 | 706585,926 | 4645029,12 | 97,83403 | 0 | 196,051 |
| 856,096 | 706781,864 | 4645035,79 | 99,406235 | 0 | 263,628 |
| 1119,724 | 707045,481 | 4645038,25 | 53,325694 | 0 | 549,403 |
| 1669,127 | 707453,723 | 4645405,92 | 23,70603 | 0 | 423,559 |
| 2092,687 | 707607,825 | 4645800,45 | 3,351166 | 0 | 218,413 |
| 2311,1 | 707619,317 | 4646018,56 | 97,993651 | 0 | 291,75 |
| 2602,851 | 707910,922 | 4646027,75 | 50,240569 | 0 | 316,861 |
| 2919,711 | 708135,822 | 4646250,96 | 24,51366 | 0 | 92,925 |
| 3012,636 | 708170,726 | 4646337,08 | 24,513658 | 300 | 140,598 |
| 3153,234 | 708251,603 | 4646450,51 | 54,349389 | 0 | 127,132 |
| 3280,366 | 708347,426 | 4646534,06 | 38,605929 | 0 | 191,614 |
| 3471,98 | 708456,633 | 4646691,51 | 38,608781 | -275,184 | 0,366 |
| 3472,346 | 708456,842 | 4646691,81 | 38,528283 | 0 | 58,059 |
| 3530,406 | 708489,873 | 4646739,56 | 36,169742 | 0 | 231,489 |
| 3761,894 | 708614,432 | 4646934,68 | 93,05692 | 0 | 94,405 |
| 3856,299 | 708708,276 | 4646944,96 | 92,41714 | 0 | 39,793 |
| 3896,092 | 708747,786 | 4646949,68 | 63,201861 | 0 | 28,28 |
| 3924,372 | 708771,472 | 4646965,14 | 63,201827 | 299,998 | 51,989 |
| 3976,361 | 708817,252 | 4646989,64 | 74,234372 | 0 | 45,76 |
| 4022,122 | 708859,316 | 4647007,66 | 34,54868 | 0 | 145,293 |
| 4167,415 | 708934,351 | 4647132,07 | 34,548649 | 299,996 | 23,463 |
| 4190,878 | 708947,234 | 4647151,68 | 39,527646 | 0 | 192,64 |
| 4383,517 | 709059,305 | 4647308,36 | 394,42512 | 0 | 101,53 |
| 4485,047 | 709050,426 | 4647409,5 | 30,660881 | 0 | 315,413 |
| 4800,46 | 709196,53 | 4647689,03 | 58,527434 | 0 | 25,109 |
| 4825,569 | 709216,497 | 4647704,26 | 397,608922 | 0 | 78,07 |
| 4903,639 | 709213,565 | 4647782,27 | 395,823226 | 0 | 124,204 |
| 5027,843 | 709205,422 | 4647906,21 | 18,319472 | 0 | 47,147 |
| 5074,99 | 709218,803 | 4647951,42 | 386,260261 | 0 | 73,103 |
| 5148,093 | 709203,148 | 4648022,83 | 397,543821 | 0 | 149,01 |
| 5297,103 | 709197,4 | 4648171,72 | 398,361225 | 0 | 247,229 |
| 5544,331 | 709191,037 | 4648418,87 | 6,651334 | 0 | 47,239 |
| 5591,57 | 709195,963 | 4648465,85 | 56,111336 | 0 | 293,026 |
| 5884,596 | 709422,07 | 4648652,24 | 364,776057 | 0 | 24,754 |
| 5909,35 | 709409,062 | 4648673,3 | 64,677815 | 0 | 33,714 |
| 5943,063 | 709437,718 | 4648691,06 | 69,33264 | 0 | 267,205 |
| 6210,268 | 709674,514 | 4648814,86 | 69,332637 | 150 | 125,901 |
| 6336,169 | 709796,523 | 4648822,43 | 122,766814 | 0 | 70,907 |
| 6407,076 | 709862,943 | 4648797,61 | 122,844779 | 0 | 282,029 |
| 6689,105 | 710127,008 | 4648698,56 | 64,53266 | 0 | 61,21 |
| 6750,315 | 710178,962 | 4648730,92 | 61,53769 | 0 | 214,007 |
| 6964,322 | 710355,085 | 4648852,5 | 144,663669 | 0 | 84,931 |
| 7049,254 | 710419,958 | 4648797,68 | 144,66371 | 100 | 6,966 |
| 7056,22 | 710425,139 | 4648793,03 | 149,098529 | 0 | 119,685 |
| 7175,905 | 710510,959 | 4648709,6 | 149,098552 | -100 | 20,112 |
| 7196,017 | 710526,669 | 4648697,1 | 136,294805 | 0 | 176,933 |
| 7372,95 | 710675,618 | 4648601,61 | 136,294805 | | |

**R-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 379,334 | 0 | 0 | -0,005 |
| 230 | 378,184 | 0 | 0 | 0,003 |
| 280 | 378,334 | 0 | 0 | -0,00500118 |
| 679,106 | 376,338 | 0 | 0 | -0,03099954 |
| 707,429 | 375,46 | 0 | 0 | -0,00863739 |
| 838,024 | 374,332 | 0 | 0 | -0,02092291 |
| 905,701 | 372,916 | 0 | 0 | -0,00499792 |
| 1201,024 | 371,44 | 0 | 0 | -0,02866428 |
| 1247,179 | 370,117 | 0 | 0 | -0,01029172 |
| 1634,189 | 366,134 | 0 | 0 | -0,0049994 |
| 1775,606 | 365,427 | 0 | 0 | -0,01218284 |
| 2055,508 | 362,017 | 0 | 0 | -0,04211647 |
| 2116,553 | 359,446 | 0 | 0 | 0,00958297 |
| 2254,193 | 360,765 | 0 | 0 | 0,00373221 |
| 2481,672 | 361,614 | 0 | 0 | 0,00655454 |
| 2726,693 | 363,22 | 0 | 0 | 0,02784468 |
| 2764,474 | 364,272 | 0 | 0 | 0,01357396 |
| 2855,015 | 365,501 | 0 | 0 | 0,01984047 |
| 2884,601 | 366,088 | 0 | 0 | 0,01671309 |
| 3037,535 | 368,644 | 0 | 0 | 0,03539823 |
| 3082,057 | 370,22 | 0 | 0 | 0,00300091 |
| 3242,675 | 370,702 | 0 | 0 | -0,02587276 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 3312,053 | 368,907 | 0 | 0 | -0,1031106 |
| 3331,149 | 366,938 | 0 | 0 | -0,04182307 |
| 3436,378 | 362,537 | 0 | 0 | -0,01747331 |
| 3580,369 | 360,021 | 0 | 0 | 0,02686353 |
| 3772,786 | 365,19 | 0 | 0 | -0,00500333 |
| 3921,287 | 364,447 | 0 | 0 | -0,02655501 |
| 4021,833 | 361,777 | 0 | 0 | -0,00500065 |
| 4275 | 360,511 | 0 | 0 | 0,003 |
| 4440 | 361,006 | 0 | 0 | -0,02385985 |
| 4761,251 | 353,341 | 0 | 0 | -0,00499972 |
| 4867,257 | 352,811 | 0 | 0 | -0,02000555 |
| 5130,484 | 347,545 | 0 | 0 | -0,00499987 |
| 6599,721 | 340,199 | 0 | 0 | 0,00299845 |
| 6808,162 | 340,824 | 0 | 0 | -0,00500011 |
| 7372,95 | 338 | 0 | 0 | |

**R-1-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706585,926 | 4645029,12 | 0,674945 | 0 | 36,624 |
| 36,624 | 706586,315 | 4645065,74 | 362,293201 | 0 | 63,594 |
| 100,218 | 706550,813 | 4645118,5 | 362,293201 | | |

**R-1-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 376,433 | 0 | 0 | 0,0030035 |
| 100,218 | 376,734 | 0 | 0 | |

**R-1-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706455,8 | 4645024,75 | 158,566484 | 0 | 221,912 |
| 221,912 | 706590,246 | 4644848,2 | 177,700087 | 0 | 264,057 |
| 485,968 | 706680,861 | 4644600,18 | 177,700087 | | |

**R-1-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 377,084 | 0 | 0 | -0,005 |
| 224,994 | 375,959 | 0 | 0 | 0,0069998 |
| 400 | 377,184 | 0 | 0 | 0,0317095 |
| 485,968 | 379,91 | 0 | 0 | |

**R-1-2-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706590,246 | 4644848,2 | 55,027521 | 0 | 8,966 |
| 8,966 | 706597,066 | 4644854,02 | 55,027521 | | |

**R-1-2-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 375,974 | 0 | 0 | 0,0030114 |
| 8,966 | 376,001 | 0 | 0 | |

**R-1-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706781,864 | 4645035,79 | 360,987456 | 0 | 106,147 |
| 106,147 | 706720,812 | 4645122,62 | 5,140269 | 0 | 124,72 |
| 230,866 | 706730,871 | 4645246,93 | 42,776973 | 0 | 37,127 |
| 267,993 | 706753,983 | 4645275,99 | 23,380769 | 0 | 273,981 |
| 541,974 | 706852,359 | 4645531,7 | 12,955435 | 0 | 49,473 |
| 591,448 | 706862,358 | 4645580,15 | 0,362943 | 0 | 158,016 |
| 749,464 | 706863,259 | 4645738,16 | 351,849733 | 0 | 273,004 |
| 1022,468 | 706675,905 | 4645936,73 | 351,849733 | | |

**R-1-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 373,954 | 0 | 0 | 0,003 |
| 100 | 374,254 | 0 | 0 | -0,005 |
| 390 | 372,804 | 0 | 0 | 0,0079467 |
| 540 | 373,996 | 0 | 0 | -0,044614 |
| 610 | 370,873 | 0 | 0 | -0,005 |
| 850 | 369,673 | 0 | 0 | 0,0880667 |
| 880 | 372,315 | 0 | 0 | 0,015 |
| 990 | 373,965 | 0 | 0 | 0,0830664 |
| 1022,468 | 376,662 | 0 | 0 | |

**R-1-3-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706730,871 | 4645246,93 | 352,503252 | 0 | 42,885 |
| 42,885 | 706701,763 | 4645278,42 | 352,502965 | -100 | 10,278 |
| 53,163 | 706694,411 | 4645285,6 | 345,960022 | 0 | 119,827 |
| 172,99 | 706604,477 | 4645364,79 | 345,960022 | | |

**R-1-3-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 373,6 | 0 | 0 | 0,0363333 |
| 90 | 376,87 | 0 | 0 | 0,0030004 |
| 172,99 | 377,119 | 0 | 0 | |

**R-1-3-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706863,26 | 4645738,2 | 100,90029 | 0 | 49,685 |
| 49,685 | 706912,94 | 4645737,5 | 399,35124 | 0 | 95,182 |
| 144,868 | 706911,97 | 4645832,6 | 100,46468 | 0 | 16,611 |
| 161,479 | 706928,58 | 4645832,5 | 100,46468 | | |

**R-1-3-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 370,176 | 0 | 0 | -0,004998 |
| 161,479 | 369,369 | 0 | 0 | |

**R-1-3-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706862,36 | 4645580,2 | 322,13308 | 0 | 10,768 |
| 10,768 | 706852,23 | 4645583,8 | 322,13307 | -100 | 66,077 |
| 76,845 | 706787,36 | 4645584,9 | 280,06742 | 0 | 143,87 |
| 220,714 | 706650,49 | 4645540,6 | 280,06741 | 99,999 | 27,502 |
| 248,216 | 706623,49 | 4645535,8 | 297,57554 | 0 | 61,343 |
| 309,559 | 706562,2 | 4645533,5 | 297,57554 | | |

**R-1-3-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 371,701 | 0 | 0 | 0,0240172 |
| 47,341 | 372,838 | 0 | 0 | 0,0181869 |
| 230 | 376,16 | 0 | 0 | 0,0514461 |
| 309,559 | 380,253 | 0 | 0 | |

**R-1-4, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706781,86 | 4645035,8 | 160,13116 | 0 | 20,93 |
| 20,93 | 706794,13 | 4645018,8 | 160,13116 | | |

**R-1-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 373,954 | 0 | 0 | 0,00301 |
| 20,93 | 374,017 | 0 | 0 | |

**R-1-5, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707619,317 | 4646018,56 | 370,615474 | 0 | 496,309 |
| 496,309 | 707398,283 | 4646462,93 | 372,92459 | 0 | 89,906 |
| 586,215 | 707361,189 | 4646544,83 | 394,160383 | 0 | 28,112 |
| 614,327 | 707358,614 | 4646572,82 | 375,217707 | 0 | 152,062 |
| 766,389 | 707300,903 | 4646713,51 | 375,217735 | 300 | 62,755 |
| 829,144 | 707283,31 | 4646773,63 | 388,534803 | 0 | 144,738 |
| 973,882 | 707257,384 | 4646916,02 | 388,534812 | -300 | 73,937 |
| 1047,819 | 707235,355 | 4646986,41 | 372,844988 | 0 | 92,226 |
| 1140,044 | 707197,198 | 4647070,37 | 291,784435 | 0 | 16,016 |
| 1156,061 | 707181,315 | 4647068,31 | 372,12934 | 0 | 50,335 |
| 1206,396 | 707159,976 | 4647113,9 | 340,668925 | 0 | 142,76 |
| 1349,156 | 707045,369 | 4647199,02 | 369,498614 | 0 | 14,087 |
| 1363,243 | 707038,875 | 4647211,52 | 67,097989 | 0 | 34,269 |
| 1397,512 | 707068,668 | 4647228,45 | 13,755454 | 0 | 252,133 |
| 1649,645 | 707122,724 | 4647474,72 | 96,421863 | 0 | 209,357 |
| 1859,002 | 707331,75 | 4647486,48 | 61,826253 | 0 | 53,496 |
| 1912,498 | 707375,914 | 4647516,67 | 17,422519 | 0 | 276,231 |
| 2188,729 | 707450,57 | 4647782,62 | 310,806492 | 0 | 28,17 |
| 2216,899 | 707422,805 | 4647787,38 | 363,545929 | 0 | 7,105 |
| 2224,004 | 707418,956 | 4647793,35 | 387,387476 | 0 | 16,367 |
| 2240,37 | 707415,734 | 4647809,4 | 387,38748 | -150 | 64,384 |
| 2304,754 | 707390,107 | 4647867,92 | 360,062223 | 0 | 109,182 |
| 2413,936 | 707326,018 | 4647956,32 | 360,062134 | -150 | 27,845 |
| 2441,781 | 707307,68 | 4647977,22 | 348,244382 | 0 | 287,411 |
| 2729,192 | 707098,923 | 4648174,77 | 348,244104 | -150,023 | 6,487 |
| 2735,679 | 707094,117 | 4648179,12 | 345,491133 | 0 | 171,154 |
| 2906,834 | 706964,831 | 4648291,28 | 348,075027 | 0 | 78,017 |
| 2984,85 | 706908,022 | 4648344,75 | 15,551891 | 0 | 72,139 |
| 3056,99 | 706925,47 | 4648414,75 | 77,869341 | 0 | 168,715 |
| 3225,705 | 707084,094 | 4648472,23 | 76,756578 | 0 | 70,405 |
| 3296,11 | 707149,858 | 4648497,36 | 397,850075 | 0 | 16,718 |
| 3312,828 | 707149,293 | 4648514,07 | 397,850075 | | |

**R-1-5, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 360,977 | 0 | 0 | 0,0999922 |
| 25,772 | 363,554 | 0 | 0 | 0,0214079 |
| 148,764 | 366,187 | 0 | 0 | 0,0437239 |
| 267,189 | 371,365 | 0 | 0 | 0,069014 |
| 400,075 | 380,536 | 0 | 0 | -0,036793 |
| 614,327 | 372,653 | 0 | 0 | -0,004998 |
| 850 | 371,475 | 0 | 0 | -0,0216 |
| 1074,909 | 366,617 | 0 | 0 | -0,149972 |
| 1085,771 | 364,988 | 0 | 0 | 0,0029971 |
| 1095,447 | 365,017 | 0 | 0 | 0,1499871 |
| 1110,995 | 367,349 | 0 | 0 | 0,025385 |
| 1156,061 | 368,493 | 0 | 0 | 0,0629582 |
| 1206,396 | 371,662 | 0 | 0 | 0,0813019 |
| 1230,024 | 373,583 | 0 | 0 | 0,0029967 |
| 1349,156 | 373,94 | 0 | 0 | -0,095459 |
| 1397,512 | 369,324 | 0 | 0 | -0,060975 |
| 1447,352 | 366,285 | 0 | 0 | -0,030802 |
| 1602,504 | 361,506 | 0 | 0 | -0,005407 |
| 1859,002 | 360,119 | 0 | 0 | -0,0477 |
| 1882 | 359,022 | 0 | 0 | 0,0274444 |
| 1912,498 | 359,859 | 0 | 0 | 0,0030004 |
| 2089,144 | 360,389 | 0 | 0 | 0,0168499 |
| 2188,729 | 362,067 | 0 | 0 | -0,042847 |
| 2216,899 | 360,86 | 0 | 0 | -0,004997 |
| 2411,8 | 359,886 | 0 | 0 | -0,006176 |
| 2581,8 | 358,836 | 0 | 0 | 0,0029997 |
| 2906,834 | 359,811 | 0 | 0 | -0,072737 |
| 2927,8 | 358,286 | 0 | 0 | 0,0262051 |
| 2984,85 | 359,781 | 0 | 0 | -0,068298 |
| 2998,789 | 358,829 | 0 | 0 | -0,005 |
| 3056,99 | 358,538 | 0 | 0 | 0,019916 |
| 3097,008 | 359,335 | 0 | 0 | 0,0114377 |
| 3225,705 | 360,807 | 0 | 0 | 0,0074148 |
| 3312,828 | 361,453 | 0 | 0 | |

**R-1-5-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707398,283 | 4646462,93 | 311,038295 | 0 | 214,786 |
| 214,786 | 707186,718 | 4646499,99 | 311,038295 | | |

**R-1-5-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 376,995 | 0 | 0 | -0,01019733 |
| 187,5 | 375,083 | 0 | 0 | 0,05871143 |
| 214,786 | 376,685 | 0 | 0 | |

**R-1-5-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707358,614 | 4646572,82 | 94,111741 | 0 | 136,17 |
| 136,17 | 707494,202 | 4646585,4 | 94,111749 | -150 | 98,091 |
| 234,262 | 707582,202 | 4646624,64 | 52,480501 | 0 | 221,904 |
| 456,166 | 707745,105 | 4646775,32 | 348,429405 | 0 | 3,165 |
| 459,33 | 707742,813 | 4646777,5 | 348,429405 | | |

**R-1-5-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 372,653 | 0 | 0 | 0,00330667 |
| 150 | 373,149 | 0 | 0 | -0,00499567 |
| 265,5 | 372,572 | 0 | 0 | 0,00930131 |
| 380 | 373,637 | 0 | 0 | 0,03585025 |
| 459,33 | 376,481 | 0 | 0 | |

**R-1-5-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707122,72 | 4647474,7 | 1,887726 | 0 | 21,47 |
| 21,47 | 707123,36 | 4647496,2 | 365,8247 | 0 | 167,776 |
| 189,246 | 707037,56 | 4647640,4 | 365,82476 | -100 | 37,063 |
| 226,309 | 707013,2 | 4647668 | 342,22969 | 0 | 115,682 |
| 341,991 | 706922,05 | 4647739,2 | 342,22969 | | |

**R-1-5-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 361,251 | 0 | 0 | -0,070522 |
| 13,868 | 360,273 | 0 | 0 | 0,0226401 |
| 239,795 | 365,388 | 0 | 0 | 0,0029943 |
| 341,991 | 365,694 | 0 | 0 | |

**R-1-5-4, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707375,91 | 4647516,7 | 91,523749 | 0 | 290,437 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 290,437 | 707663,78 | 4647555,2 | 39,647431 | 0 | 173,368 |
| 463,805 | 707764,91 | 4647696 | 39,647466 | 100 | 52,933 |
| 516,738 | 707805,48 | 4647729,1 | 73,34593 | 0 | 183,65 |
| 700,389 | 707973,26 | 4647803,7 | 73,345911 | 100 | 19,258 |
| 719,647 | 707991,5 | 4647809,8 | 85,606132 | 0 | 275,338 |
| 994,985 | 708259,83 | 4647871,6 | 184,37621 | 0 | 187,017 |
| 1182,002 | 708305,27 | 4647690,1 | 76,84554 | 0 | 90,029 |
| 1272,031 | 708389,41 | 4647722,2 | 76,84554 | | |

**R-1-5-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 359,589 | 0 | 0 | -0,005158 |
| 290,437 | 358,091 | 0 | 0 | -0,023664 |
| 315,581 | 357,496 | 0 | 0 | -0,005 |
| 720 | 355,474 | 0 | 0 | -0,011704 |
| 784,251 | 354,722 | 0 | 0 | -0,005002 |
| 900 | 354,143 | 0 | 0 | -0,013516 |
| 947,723 | 353,498 | 0 | 0 | -0,005015 |
| 994,985 | 353,261 | 0 | 0 | -0,023728 |
| 1022 | 352,62 | 0 | 0 | 0,0351496 |
| 1182,002 | 358,244 | 0 | 0 | 0,0158393 |
| 1272,031 | 359,67 | 0 | 0 | |

**R-1-5-4-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707663,78 | 4647555,2 | 167,72012 | 0 | 57,051 |
| 57,051 | 707691,48 | 4647505,4 | 167,72012 | | |

**R-1-5-4-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 358,091 | 0 | 0 | -0,528647 |
| 5,847 | 355 | 0 | 0 | 0,0029676 |
| 20 | 355,042 | 0 | 0 | 0,302852 |
| 39,039 | 360,808 | 0 | 0 | 0,1254164 |
| 57,051 | 363,067 | 0 | 0 | |

**R-1-5-5, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706964,83 | 4648291,3 | 274,39558 | 0 | 207,941 |
| 207,941 | 706773,48 | 4648209,9 | 366,1494 | 0 | 17,32 |
| 225,26 | 706764,7 | 4648224,8 | 366,1494 | | |

**R-1-5-5, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 359,811 | 0 | 0 | -0,03 |
| 20 | 359,211 | 0 | 0 | 0,00875 |
| 180 | 360,611 | 0 | 0 | 0,0155546 |
| 225,26 | 361,315 | 0 | 0 | |

**R-1-5-6, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707450,57 | 4647782,6 | 36,796441 | 0 | 57,976 |
| 57,976 | 707482,25 | 4647831,2 | 4,806699 | 0 | 300,574 |
| 358,55 | 707504,92 | 4648130,9 | 62,506401 | 0 | 37,254 |
| 395,805 | 707535,9 | 4648151,6 | 62,506401 | | |

**R-1-5-6, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 362,067 | 0 | 0 | 0,0066875 |
| 160 | 363,137 | 0 | 0 | -0,010256 |
| 249,798 | 362,216 | 0 | 0 | 0,0038217 |
| 395,805 | 362,774 | 0 | 0 | |

**R-1-5-7, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706925,47 | 4648414,8 | 353,80865 | 0 | 163,258 |
| 163,258 | 706817,14 | 4648536,9 | 353,80865 | | |

**R-1-5-7, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 358,538 | 0 | 0 | -0,026072 |
| 64,36 | 356,86 | 0 | 0 | -0,004995 |
| 163,258 | 356,366 | 0 | 0 | |

**R-1-6, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707045,48 | 4645038,2 | 156,8595 | 0 | 28,293 |
| 28,293 | 707063,22 | 4645016,2 | 114,31814 | 0 | 397,125 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 425,418 | 707450,34 | 4644927,6 | 63,037538 | 0 | 24,776 |
| 450,194 | 707471,06 | 4644941,2 | 127,94466 | 0 | 424,421 |
| 874,615 | 707855,24 | 4644760,9 | 130,45639 | 0 | 325,434 |
| 1200,049 | 708144,14 | 4644611 | 126,09395 | 0 | 468,491 |
| 1668,54 | 708573,83 | 4644424,3 | 88,020926 | 0 | 545,555 |
| 2214,095 | 709109,75 | 4644526,4 | 38,435636 | 0 | 97,148 |
| 2311,243 | 709164,9 | 4644606,4 | 59,236636 | 0 | 205,806 |
| 2517,049 | 709329,94 | 4644729,3 | 65,740174 | 0 | 155,336 |
| 2672,385 | 709463,32 | 4644808,9 | 68,618344 | 0 | 77,308 |
| 2749,693 | 709531,43 | 4644845,5 | 68,618345 | -300 | 44,515 |
| 2794,208 | 709568,94 | 4644869,4 | 59,171943 | 0 | 101,932 |
| 2896,14 | 709650,62 | 4644930,4 | 59,17194 | 300 | 62,678 |
| 2958,818 | 709704,38 | 4644962,4 | 72,472584 | 0 | 109,511 |
| 3068,329 | 709803,81 | 4645008,3 | 68,911026 | 0 | 33,689 |
| 3102,019 | 709833,56 | 4645024,1 | 68,680038 | 0 | 48,311 |
| 3150,33 | 709876,14 | 4645046,9 | 68,680037 | 300 | 53,387 |
| 3203,716 | 709925,19 | 4645067,8 | 80,009012 | 0 | 151,771 |
| 3355,487 | 710069,54 | 4645114,7 | 80,009036 | 300 | 37,356 |
| 3392,844 | 710105,69 | 4645124 | 87,936298 | 0 | 23,845 |
| 3416,689 | 710129,11 | 4645128,5 | 95,988587 | 0 | 37,347 |
| 3454,035 | 710166,39 | 4645130,8 | 95,988585 | -400 | 121,614 |
| 3575,65 | 710284,74 | 4645156,7 | 76,633068 | 0 | 36,845 |
| 3612,494 | 710319,13 | 4645169,9 | 76,633056 | -400 | 59,095 |
| 3671,589 | 710372,53 | 4645195,1 | 67,227827 | 0 | 197,964 |
| 3869,553 | 710544,83 | 4645292,6 | 67,227838 | -399,999 | 58,401 |
| 3927,954 | 710593,39 | 4645324,9 | 57,93303 | 0 | 132,417 |
| 4060,371 | 710697,94 | 4645406,2 | 98,408782 | 0 | 30,8 |
| 4091,171 | 710728,73 | 4645407 | 57,473677 | 0 | 387,109 |
| 4478,281 | 711032,63 | 4645646,8 | 76,213107 | 0 | 152,051 |
| 4630,332 | 711174,19 | 4645702,3 | 127,49792 | 0 | 547,813 |
| 5178,145 | 711671,69 | 4645472,9 | 162,15945 | 0 | 29,233 |
| 5207,378 | 711688,06 | 4645448,7 | 131,94004 | 0 | 465,595 |
| 5672,974 | 712096,28 | 4645224,8 | 131,93968 | 244,322 | 0,425 |
| 5673,399 | 712096,65 | 4645224,6 | 132,04825 | 0 | 474,335 |
| 6147,734 | 712512,14 | 4644995,8 | 183,1839 | 0 | 213,128 |
| 6360,862 | 712567,78 | 4644790 | 144,06159 | 0 | 23,487 |
| 6384,349 | 712585,87 | 4644775 | 182,61518 | 0 | 56,437 |
| 6440,785 | 712601,09 | 4644720,7 | 135,61775 | 0 | 21,044 |
| 6461,83 | 712618,92 | 4644709,5 | 135,61776 | 250 | 31,39 |
| 6493,22 | 712644,41 | 4644691,2 | 143,61119 | 0 | 54,712 |
| 6547,932 | 712686,78 | 4644656,6 | 143,61127 | -249,932 | 3,426 |
| 6551,357 | 712689,45 | 4644654,5 | 142,73886 | 0 | 64,058 |
| 6615,415 | 712739,61 | 4644614,6 | 116,58781 | 0 | 180,549 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 6795,965 | 712914,06 | 4644568,1 | 116,58777 | -250 | 16,206 |
| 6812,171 | 712929,84 | 4644564,4 | 112,46094 | 0 | 83,016 |
| 6895,187 | 713011,27 | 4644548,3 | 78,730813 | 0 | 3,15 |
| 6898,337 | 713014,25 | 4644549,3 | 78,730813 | 250 | 107,795 |
| 7006,133 | 713120,46 | 4644562 | 106,18069 | 0 | 142,898 |
| 7149,031 | 713262,69 | 4644548,1 | 128,07701 | 0 | 27,211 |
| 7176,242 | 713287,3 | 4644536,5 | 163,36302 | 0 | 122,823 |
| 7299,065 | 713354,14 | 4644433,5 | 245,90898 | 0 | 80,727 |
| 7379,792 | 713300,84 | 4644372,8 | 162,2231 | 0 | 59,384 |
| 7439,176 | 713334,05 | 4644323,6 | 162,22311 | -150 | 157,551 |
| 7596,728 | 713469,34 | 4644257,9 | 95,356276 | 0 | 126,717 |
| 7723,445 | 713595,72 | 4644267,1 | 95,356288 | 150 | 43,716 |
| 7767,161 | 713639,16 | 4644263,9 | 113,90984 | 0 | 59,538 |
| 7826,699 | 713697,29 | 4644251 | 183,50299 | 0 | 116,18 |
| 7942,879 | 713727,06 | 4644138,7 | 84,266956 | 0 | 121,986 |
| 8064,865 | 713845,34 | 4644168,6 | 84,266896 | 99,999 | 31,885 |
| 8096,75 | 713876,96 | 4644171,4 | 104,56543 | 0 | 133,968 |
| 8230,717 | 714010,59 | 4644161,8 | 104,5655 | -99,999 | 17,113 |
| 8247,83 | 714027,68 | 4644162 | 93,671018 | 0 | 241,965 |
| 8489,795 | 714268,45 | 4644186 | 93,671246 | -99,985 | 6,419 |
| 8496,214 | 714274,81 | 4644186,9 | 89,58428 | 0 | 238,242 |
| 8734,456 | 714509,87 | 4644225,7 | 89,58428 | | |

**R-1-6, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 371,846 | 0 | 0 | -0,139918 |
| 15,066 | 369,738 | 0 | 0 | 0,0322895 |
| 50 | 370,866 | 0 | 0 | -0,003474 |
| 140,379 | 370,552 | 0 | 0 | -0,004999 |
| 230 | 370,104 | 0 | 0 | 0,003 |
| 360 | 370,494 | 0 | 0 | 0,0553868 |
| 371,519 | 371,132 | 0 | 0 | 0,0029987 |
| 720 | 372,177 | 0 | 0 | -0,005 |
| 874,615 | 371,404 | 0 | 0 | -0,019145 |
| 900 | 370,918 | 0 | 0 | -0,005 |
| 1070 | 370,068 | 0 | 0 | 0,0039091 |
| 1290 | 370,928 | 0 | 0 | -0,016325 |
| 1490 | 367,663 | 0 | 0 | -0,005 |
| 1720 | 366,513 | 0 | 0 | -0,04335 |
| 1760 | 364,779 | 0 | 0 | -0,005 |
| 2730 | 359,929 | 0 | 0 | -0,02084 |
| 2780 | 358,887 | 0 | 0 | -0,005 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 3230 | 356,637 | 0 | 0 | -0,009583 |
| 3470 | 354,337 | 0 | 0 | -0,005 |
| 4090 | 351,237 | 0 | 0 | -0,014588 |
| 4260 | 348,757 | 0 | 0 | -0,005 |
| 4590 | 347,107 | 0 | 0 | -0,079067 |
| 4620 | 344,735 | 0 | 0 | 0,003 |
| 4700 | 344,975 | 0 | 0 | 0,0205 |
| 4810 | 347,23 | 0 | 0 | -0,01 |
| 4920 | 346,13 | 0 | 0 | -0,03 |
| 5131,77 | 339,777 | 0 | 0 | -0,004994 |
| 5183,035 | 339,521 | 0 | 0 | 0,2088975 |
| 5192,341 | 341,465 | 0 | 0 | 0,0632528 |
| 5309,901 | 348,901 | 0 | 0 | 0,0825987 |
| 5450 | 360,473 | 0 | 0 | 0,003 |
| 5650 | 361,073 | 0 | 0 | -0,045346 |
| 6020 | 344,295 | 0 | 0 | -0,044257 |
| 6160 | 338,099 | 0 | 0 | -0,004997 |
| 6381,127 | 336,994 | 0 | 0 | 0,0261851 |
| 6480 | 339,583 | 0 | 0 | 0,003 |
| 6590 | 339,913 | 0 | 0 | -0,044 |
| 6630 | 338,153 | 0 | 0 | -0,005 |
| 7140 | 335,603 | 0 | 0 | 0,003 |
| 7300 | 336,083 | 0 | 0 | 0,0338391 |
| 7374,736 | 338,612 | 0 | 0 | -0,011448 |
| 7520 | 336,949 | 0 | 0 | 0,008 |
| 7800 | 339,189 | 0 | 0 | -0,039125 |
| 7840 | 337,624 | 0 | 0 | -0,012953 |
| 7990 | 335,681 | 0 | 0 | -0,028621 |
| 8054,533 | 333,834 | 0 | 0 | -0,002998 |
| 8199,277 | 333,4 | 0 | 0 | 0,0151274 |
| 8357,93 | 335,8 | 0 | 0 | -0,005001 |
| 8734,456 | 333,917 | 0 | 0 | |

**R-1-6-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707855,243 | 4644760,85 | 38,425508 | 0 | 41,175 |
| 41,175 | 707878,614 | 4644794,75 | 38,425495 | 249,999 | 59,062 |
| 100,237 | 707917,544 | 4644838,99 | 53,46554 | 0 | 89,488 |
| 189,725 | 707984,171 | 4644898,73 | 53,465509 | 249,999 | 61,753 |
| 251,478 | 708034,747 | 4644933,88 | 69,19074 | 0 | 47,15 |
| 298,627 | 708076,482 | 4644955,82 | 75,890385 | 0 | 118,163 |
| 416,79 | 708186,272 | 4644999,51 | 105,267096 | 0 | 115,501 |
| 532,291 | 708301,378 | 4644989,96 | 102,78782 | 0 | 218,321 |
| 750,612 | 708519,49 | 4644980,41 | 102,787782 | -150 | 31,917 |
| 782,529 | 708551,284 | 4644982,4 | 89,241832 | 0 | 80,912 |
| 863,442 | 708631,044 | 4644996,01 | 89,241852 | -150 | 83,472 |
| 946,914 | 708705,339 | 4645031,64 | 53,815145 | 0 | 31,655 |
| 978,569 | 708729,023 | 4645052,65 | 53,815145 | -150 | 55,265 |
| 1033,834 | 708762,764 | 4645096,02 | 30,359879 | 0 | 17,622 |
| 1051,457 | 708770,853 | 4645111,68 | 108,71217 | 0 | 19,719 |
| 1071,176 | 708790,388 | 4645108,99 | 17,853078 | 0 | 71,334 |
| 1142,51 | 708810,132 | 4645177,53 | 17,853158 | -149,995 | 13,274 |
| 1155,784 | 708813,237 | 4645190,44 | 12,219258 | 0 | 54,374 |
| 1210,158 | 708823,61 | 4645243,81 | 13,103811 | 0 | 101,441 |
| 1311,599 | 708844,342 | 4645343,11 | 14,236165 | 0 | 148,712 |
| 1460,311 | 708877,321 | 4645488,12 | 13,444577 | 0 | 81,113 |
| 1541,424 | 708894,324 | 4645567,43 | 15,442199 | 0 | 286,038 |
| 1827,462 | 708963,028 | 4645845,1 | 12,545773 | 0 | 20,789 |
| 1848,25 | 708967,099 | 4645865,48 | 12,545773 | | |

**R-1-6-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 371,404 | 0 | 0 | 0,017 |
| 100 | 373,104 | 0 | 0 | -0,005 |
| 150 | 372,854 | 0 | 0 | -0,027118 |
| 281,905 | 369,277 | 0 | 0 | -0,009908 |
| 770 | 364,441 | 0 | 0 | -0,056906 |
| 840,678 | 360,419 | 0 | 0 | -0,013944 |
| 1170 | 355,827 | 0 | 0 | -0,004999 |
| 1665,875 | 353,348 | 0 | 0 | 0,0069966 |
| 1848,25 | 354,624 | 0 | 0 | |

**R-1-6-1-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708301,38 | 4644990 | 43,654897 | 0 | 118,955 |
| 118,955 | 708376,71 | 4645082 | 43,654904 | -150 | 30,391 |
| 149,346 | 708393,44 | 4645107,3 | 30,756735 | 0 | 41,312 |
| 190,658 | 708412,64 | 4645143,9 | 390,02001 | 0 | 75,478 |
| 266,136 | 708400,85 | 4645218,5 | 356,4278 | 0 | 274,578 |
| 540,714 | 708227,26 | 4645431,2 | 356,42783 | 150 | 65,015 |
| 605,729 | 708198,17 | 4645488,8 | 384,02114 | 0 | 62,333 |
| 668,062 | 708182,69 | 4645549,2 | 384,02123 | -149,995 | 17,548 |
| 685,61 | 708177,35 | 4645565,9 | 376,57349 | 0 | 25,346 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 710,957 | 708168,23 | 4645589,5 | 376,5734 | 149,997 | 24,239 |
| 735,196 | 708161,37 | 4645612,7 | 386,86101 | 0 | 58,737 |
| 793,933 | 708149,34 | 4645670,2 | 386,86093 | 149,998 | 20,605 |
| 814,538 | 708146,51 | 4645690,6 | 395,60602 | 0 | 8,309 |
| 822,847 | 708145,94 | 4645698,9 | 85,048034 | 0 | 35,982 |
| 858,83 | 708180,93 | 4645707,3 | 85,048034 | | |

**R-1-6-1-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 366,796 | 0 | 0 | 0,003 |
| 130 | 367,186 | 0 | 0 | -0,044 |
| 190 | 364,546 | 0 | 0 | 0,003 |
| 540 | 365,596 | 0 | 0 | -0,017944 |
| 858,83 | 359,875 | 0 | 0 | |

**R-1-6-1-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708877,32 | 4645488,1 | 310,01891 | 0 | 27,989 |
| 27,989 | 708849,68 | 4645492,5 | 310,01891 | | |

**R-1-6-1-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 354,376 | 0 | 0 | 0,0030012 |
| 27,989 | 354,46 | 0 | 0 | |

**R-1-6-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708144,14 | 4644611 | 239,60306 | 0 | 32,198 |
| 32,198 | 708125,38 | 4644584,9 | 239,60306 | | |

**R-1-6-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 370,576 | 0 | 0 | 0,1103795 |
| 32,198 | 374,13 | 0 | 0 | |

**R-1-6-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709463,32 | 4644808,9 | 374,16613 | 0 | 382,15 |
| 382,15 | 709312,47 | 4645160,1 | 37,204583 | 0 | 578,997 |
| 961,147 | 709631,9 | 4645643 | 381,04215 | 0 | 24,47 |
| 985,617 | 709624,72 | 4645666,4 | 381,04215 | | |

**R-1-6-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 360,217 | 0 | 0 | -0,02832 |
| 50 | 358,801 | 0 | 0 | -0,005 |
| 820 | 354,951 | 0 | 0 | -0,027958 |
| 940 | 351,596 | 0 | 0 | 0,0132407 |
| 985,617 | 352,2 | 0 | 0 | |

**R-1-6-3-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709312,47 | 4645160,1 | 326,78604 | 0 | 19,515 |
| 19,515 | 709294,66 | 4645168 | 36,261426 | 0 | 113,864 |
| 133,38 | 709356,06 | 4645263,9 | 36,261426 | | |

**R-1-6-3-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 357,14 | 0 | 0 | 0,002999 |
| 133,38 | 357,54 | 0 | 0 | |

**R-1-6-4, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708573,83 | 4644424,3 | 152,58032 | 0 | 51,944 |
| 51,944 | 708609,04 | 4644386,2 | 152,58032 | | |

**R-1-6-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 366,77 | 0 | 0 | 0,0030032 |
| 51,944 | 366,926 | 0 | 0 | |

**R-1-6-5, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709803,81 | 4645008,3 | 16,924522 | 0 | 478,304 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 478,304 | 709929,48 | 4645469,8 | 18,34412 | 0 | 34,175 |
| 512,48 | 709939,19 | 4645502,6 | 15,840534 | 0 | 107,982 |
| 620,462 | 709965,78 | 4645607,2 | 15,840551 | 150 | 53,399 |
| 673,861 | 709987,77 | 4645655,6 | 38,503685 | 0 | 32,428 |
| 706,289 | 710006,21 | 4645682,2 | 38,504284 | -149,653 | 1,447 |
| 707,736 | 710007,03 | 4645683,4 | 37,889734 | 0 | 45,409 |
| 753,145 | 710032,48 | 4645721 | 130,90046 | 0 | 24,948 |
| 778,093 | 710054,55 | 4645709,4 | 37,166693 | 0 | 43,665 |
| 821,758 | 710078,62 | 4645745,8 | 102,13477 | 0 | 52,182 |
| 873,939 | 710130,77 | 4645744,1 | 102,13481 | 150 | 19,744 |
| 893,683 | 710150,4 | 4645742,1 | 110,51421 | 0 | 167,344 |
| 1061,027 | 710315,47 | 4645714,6 | 81,688017 | 0 | 129,851 |
| 1190,878 | 710439,99 | 4645751,4 | 81,688017 | | |

**R-1-6-5, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 357,445 | 0 | 0 | -0,005679 |
| 623,194 | 353,906 | 0 | 0 | -0,018648 |
| 765,57 | 351,251 | 0 | 0 | 0,009001 |
| 900 | 352,461 | 0 | 0 | -0,008 |
| 1190,878 | 350,134 | 0 | 0 | |

**R-1-6-5-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710032,48 | 4645721 | 395,42051 | 0 | 46,343 |
| 46,343 | 710029,15 | 4645767,3 | 395,42052 | 150 | 71,264 |
| 117,607 | 710040,79 | 4645836,9 | 25,665975 | 0 | 18,846 |
| 136,453 | 710048,18 | 4645854,2 | 372,59346 | 0 | 15,543 |
| 151,996 | 710041,7 | 4645868,3 | 312,96262 | 0 | 15,29 |
| 167,286 | 710026,72 | 4645871,4 | 243,40073 | 0 | 20,299 |
| 187,585 | 710013,93 | 4645855,7 | 243,40073 | | |

**R-1-6-5-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,483 | 0 | 0 | -0,048 |
| 80 | 347,643 | 0 | 0 | -0,010003 |
| 154,975 | 346,893 | 0 | 0 | 0,0600123 |
| 187,585 | 348,85 | 0 | 0 | |

**R-1-6-5-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709939,19 | 4645502,6 | 109,51587 | 0 | 18,436 |
| 18,436 | 709957,42 | 4645499,8 | 109,51587 | | |

**R-1-6-5-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 354,535 | 0 | 0 | 0,0029833 |
| 18,436 | 354,59 | 0 | 0 | |

**R-1-6-6, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709109,75 | 4644526,4 | 217,68029 | 0 | 200,515 |
| 200,515 | 709054,78 | 4644333,6 | 217,68029 | | |

**R-1-6-6, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 362,509 | 0 | 0 | 0,0030023 |
| 200,515 | 363,111 | 0 | 0 | |

**R-1-6-7, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710697,94 | 4645406,2 | 346,69196 | 0 | 92,221 |
| 92,221 | 710629,43 | 4645467,9 | 355,71084 | 0 | 20,658 |
| 112,879 | 710616,19 | 4645483,8 | 355,71084 | | |

**R-1-6-7, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,385 | 0 | 0 | -0,004997 |
| 112,879 | 350,821 | 0 | 0 | |

**R-1-6-7-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710629,43 | 4645467,9 | 254,45312 | 0 | 17,133 |
| 17,133 | 710616,49 | 4645456,7 | 254,45312 | | |

**R-1-6-7-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 350,924 | 0 | 0 | 0,0029767 |
| 17,133 | 350,975 | 0 | 0 | |

**R-1-6-8, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 712567,78 | 4644790 | 239,50898 | 0 | 94,735 |
| 94,735 | 712512,69 | 4644713 | 239,50898 | | |

**R-1-6-8, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 337,095 | 0 | 0 | 0,0621523 |
| 94,735 | 342,983 | 0 | 0 | |

**R-1-6-9, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711174,19 | 4645702,3 | 75,831146 | 0 | 157,349 |
| 157,349 | 711320,34 | 4645760,6 | 75,831167 | 150 | 38,816 |
| 196,165 | 711357,84 | 4645770,2 | 92,305042 | 0 | 103,384 |
| 299,549 | 711460,47 | 4645782,6 | 8,102288 | 0 | 16,375 |
| 315,923 | 711462,55 | 4645798,9 | 7,148209 | 0 | 146,331 |
| 462,254 | 711478,94 | 4645944,3 | 99,231703 | 0 | 89,043 |
| 551,297 | 711567,98 | 4645945,3 | 99,232424 | 99,943 | 0,513 |
| 551,81 | 711568,49 | 4645945,4 | 99,558087 | 0 | 72,488 |
| 624,297 | 711640,98 | 4645945,9 | 99,558087 | | |

**R-1-6-9, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 344,766 | 0 | 0 | -0,035 |
| 30 | 343,716 | 0 | 0 | -0,005 |
| 180 | 342,966 | 0 | 0 | -0,049027 |
| 221,875 | 340,913 | 0 | 0 | -0,007 |
| 321,875 | 340,213 | 0 | 0 | -0,005 |
| 624,297 | 338,701 | 0 | 0 | |

**R-1-6-9-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711478,94 | 4645944,3 | 325,95377 | 0 | 72,986 |
| 72,986 | 711411,94 | 4645973,2 | 325,95377 | | |

**R-1-6-9-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 339,511 | 0 | 0 | 0,0030006 |
| 72,986 | 339,73 | 0 | 0 | |

**R-1-6-9-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711460,47 | 4645782,6 | 94,381513 | 0 | 63,754 |
| 63,754 | 711523,97 | 4645788,2 | 94,381513 | | |

**R-1-6-9-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 340,369 | 0 | 0 | -0,019999 |
| 63,754 | 339,094 | 0 | 0 | |

**R-1-6-10, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 712739,61 | 4644614,6 | 248,55761 | 0 | 16,073 |
| 16,073 | 712728,5 | 4644603 | 248,55761 | | |

**R-1-6-10, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 338,795 | 0 | 0 | 0,0029864 |
| 16,073 | 338,843 | 0 | 0 | |

**R-1-6-11, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711671,69 | 4645472,9 | 48,04611 | 0 | 28,72 |
| 28,72 | 711691,37 | 4645493,8 | 48,04611 | | |

**R-1-6-11, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 339,545 | 0 | 0 | 0,0029944 |
| 28,72 | 339,631 | 0 | 0 | |

**R-1-6-12, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 713300,84 | 4644372,8 | 236,04643 | 0 | 177,626 |
| 177,626 | 713205,56 | 4644222,9 | 236,04623 | 149,99 | 11,426 |
| 189,052 | 713199,07 | 4644213,5 | 240,89592 | 0 | 203,827 |
| 392,879 | 713076,95 | 4644050,3 | 281,33784 | 0 | 54,976 |
| 447,855 | 713024,32 | 4644034,4 | 326,3792 | 0 | 88,463 |
| 536,319 | 712943,34 | 4644070,1 | 326,37917 | -150 | 53,475 |
| 589,793 | 712891,63 | 4644082,5 | 303,68389 | 0 | 66,771 |
| 656,564 | 712824,97 | 4644086,4 | 350,49606 | 0 | 38,25 |
| 694,814 | 712798,13 | 4644113,6 | 301,82757 | 0 | 35,82 |
| 730,634 | 712762,33 | 4644114,7 | 301,82757 | | |

**R-1-6-12, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 338,554 | 0 | 0 | 0,1000042 |
| 23,819 | 340,936 | 0 | 0 | 0,0029995 |
| 392,879 | 342,043 | 0 | 0 | -0,005002 |
| 447,855 | 341,768 | 0 | 0 | 0,0035073 |
| 656,564 | 342,5 | 0 | 0 | 0,0250719 |
| 694,814 | 343,459 | 0 | 0 | -0,041764 |
| 730,634 | 341,963 | 0 | 0 | |

**R-1-6-13, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 712512,14 | 4644995,8 | 66,484478 | 0 | 177,026 |
| 177,026 | 712665,19 | 4645084,7 | 66,484413 | -150 | 23,772 |
| 200,798 | 712684,72 | 4645098,2 | 56,395285 | 0 | 41,754 |
| 242,552 | 712717,05 | 4645124,6 | 56,395197 | 149,998 | 22,14 |
| 264,692 | 712735,17 | 4645137,3 | 65,791671 | 0 | 59,741 |
| 324,433 | 712786,49 | 4645167,9 | 68,221979 | 0 | 96,339 |
| 420,773 | 712871,08 | 4645214 | 35,760264 | 0 | 71,689 |
| 492,462 | 712909,26 | 4645274,7 | 136,41545 | 0 | 30,702 |
| 523,164 | 712935,08 | 4645258,1 | 139,42758 | 0 | 318,264 |
| 841,428 | 713194,23 | 4645073,3 | 54,283832 | 0 | 39,488 |
| 880,917 | 713223,97 | 4645099,3 | 106,8209 | 0 | 14,564 |
| 895,481 | 713238,45 | 4645097,8 | 52,816978 | 0 | 161,889 |
| 1057,37 | 713357,87 | 4645207,1 | 120,31895 | 0 | 138,716 |
| 1196,086 | 713489,58 | 4645163,5 | 120,31888 | 99,999 | 42,591 |
| 1238,677 | 713526,01 | 4645142,1 | 147,43345 | 0 | 32,183 |
| 1270,86 | 713549,66 | 4645120,3 | 147,43345 | | |

**R-1-6-13, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 338,642 | 0 | 0 | -0,030867 |
| 78,855 | 336,208 | 0 | 0 | -0,005 |
| 216,058 | 335,522 | 0 | 0 | -0,072065 |
| 309,724 | 328,772 | 0 | 0 | -0,006887 |
| 523,164 | 327,302 | 0 | 0 | -0,004999 |
| 841,428 | 325,711 | 0 | 0 | 0,0453038 |
| 880,917 | 327,5 | 0 | 0 | -0,07086 |
| 895,481 | 326,468 | 0 | 0 | -0,005003 |
| 1057,37 | 325,658 | 0 | 0 | 0,0030006 |
| 1245 | 326,221 | 0 | 0 | -0,0622 |
| 1260 | 325,288 | 0 | 0 | -0,005064 |
| 1270,86 | 325,233 | 0 | 0 | |

**R-1-6-13-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 712935,08 | 4645258,1 | 38,831402 | 0 | 46,531 |
| 46,531 | 712961,73 | 4645296,2 | 38,831402 | | |

**R-1-6-13-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 327,302 | 0 | 0 | 0,0030088 |
| 46,531 | 327,442 | 0 | 0 | |

**R-1-7, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708708,28 | 4646945 | 387,81285 | 0 | 91,9 |
| 91,9 | 708690,79 | 4647035,2 | 387,81285 | | |

**R-1-7, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 364,772 | 0 | 0 | 0,1700029 |
| 27,476 | 369,443 | 0 | 0 | 0,2218273 |
| 91,9 | 383,734 | 0 | 0 | |

**R-1-8, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707453,72 | 4645405,9 | 111,38837 | 0 | 98,798 |
| 98,798 | 707550,94 | 4645388,3 | 15,654625 | 0 | 18,25 |
| 117,048 | 707555,39 | 4645406 | 15,654625 | | |

**R-1-8, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 365,959 | 0 | 0 | 0,011004 |
| 117,048 | 367,247 | 0 | 0 | |

**R-1-9, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709050,43 | 4647409,5 | 314,65623 | 0 | 13,493 |
| 13,493 | 709037,3 | 4647412,6 | 314,65623 | | |

**R-1-9, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 359,931 | 0 | 0 | 0,0495072 |
| 13,493 | 360,599 | 0 | 0 | |

**R-1-10, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707910,92 | 4646027,8 | 102,79517 | 0 | 121,126 |
| 121,126 | 708031,93 | 4646022,4 | 102,79525 | -299,987 | 17,96 |
| 139,087 | 708049,89 | 4646022,2 | 98,983852 | 0 | 100,221 |
| 239,308 | 708150,1 | 4646023,8 | 76,517959 | 0 | 0,218 |
| 239,526 | 708150,3 | 4646023,9 | 76,517959 | 300 | 101,307 |
| 340,833 | 708249,12 | 4646043,9 | 98,015913 | 0 | 167,367 |
| 508,2 | 708416,4 | 4646049,1 | 97,974991 | 0 | 354,991 |
| 863,191 | 708771,21 | 4646060,4 | 88,465638 | 0 | 178,037 |
| 1041,228 | 708946,34 | 4646092,5 | 88,465733 | 300,015 | 16,487 |
| 1057,715 | 708962,63 | 4646095 | 91,964237 | 0 | 283,029 |
| 1340,744 | 709243,4 | 4646130,6 | 19,168363 | 0 | 309,665 |
| 1650,409 | 709335,24 | 4646426,4 | 68,120674 | 0 | 185,564 |
| 1835,973 | 709498,02 | 4646515,5 | 21,654636 | 0 | 252,26 |
| 2088,233 | 709582,18 | 4646753,3 | 32,041019 | 0 | 47,646 |
| 2135,88 | 709605,16 | 4646795 | 71,043338 | 0 | 80,353 |
| 2216,232 | 709677,35 | 4646830,3 | 28,663616 | 0 | 319,941 |
| 2536,173 | 709816,58 | 4647118,4 | 92,615663 | 0 | 236,005 |
| 2772,178 | 710051 | 4647145,7 | 92,615671 | -250 | 138,912 |
| 2911,09 | 710177,63 | 4647198,3 | 57,241978 | 0 | 10,639 |
| 2921,73 | 710185,96 | 4647204,9 | 119,33231 | 0 | 393,174 |
| 3314,904 | 710561,15 | 4647087,3 | 96,480151 | 0 | 20,189 |
| 3335,093 | 710581,31 | 4647088,5 | 97,264936 | 0 | 128,81 |
| 3463,903 | 710710 | 4647094 | 119,86803 | 0 | 248,074 |
| 3711,977 | 710946,09 | 4647017,8 | 119,86808 | -149,998 | 23,773 |
| 3735,75 | 710969,19 | 4647012,3 | 109,77824 | 0 | 94,53 |
| 3830,281 | 711062,61 | 4646997,9 | 109,30746 | 0 | 108,731 |
| 3939,012 | 711170,18 | 4646982 | 123,90515 | 0 | 21,857 |
| 3960,869 | 711190,52 | 4646974 | 123,90514 | 150 | 98,683 |
| 4059,552 | 711264,36 | 4646911,3 | 165,78772 | 0 | 102,439 |
| 4161,992 | 711316,8 | 4646823,3 | 202,85087 | 0 | 55,479 |
| 4217,471 | 711314,32 | 4646767,8 | 202,85089 | -150 | 62,372 |
| 4279,843 | 711324,38 | 4646706,7 | 176,37952 | 0 | 6,206 |
| 4286,049 | 711326,63 | 4646701 | 127,88378 | 0 | 37,512 |
| 4323,561 | 711360,6 | 4646685 | 116,84163 | 0 | 335,732 |
| 4659,293 | 711684,65 | 4646597,3 | 134,80208 | 0 | 252,764 |
| 4912,057 | 711900,57 | 4646465,9 | 203,25712 | 0 | 172,218 |
| 5084,275 | 711891,77 | 4646293,9 | 203,25712 | | |

**R-1-10, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 362,408 | 0 | 0 | -0,018 |
| 70 | 361,148 | 0 | 0 | 0,026 |
| 200 | 364,528 | 0 | 0 | -0,05055 |
| 250,01 | 362 | 0 | 0 | -0,106777 |
| 290 | 357,73 | 0 | 0 | -0,015 |
| 330 | 357,13 | 0 | 0 | -0,010908 |
| 700 | 353,094 | 0 | 0 | -0,005 |
| 1330 | 349,944 | 0 | 0 | -0,012 |
| 1410 | 348,984 | 0 | 0 | 0,003 |
| 1510 | 349,284 | 0 | 0 | -0,01 |
| 1610 | 348,284 | 0 | 0 | 0,03584 |
| 1660 | 350,076 | 0 | 0 | -0,012885 |
| 1790 | 348,401 | 0 | 0 | -0,063915 |
| 1819,508 | 346,515 | 0 | 0 | 0,016531 |
| 1895,305 | 347,768 | 0 | 0 | 0,0056338 |
| 1897,435 | 347,78 | 0 | 0 | -0,004999 |
| 1998,065 | 347,277 | 0 | 0 | 0,0239969 |
| 2140 | 350,683 | 0 | 0 | -0,021613 |
| 2220 | 348,954 | 0 | 0 | -0,005 |
| 2560 | 347,254 | 0 | 0 | 0,003 |
| 2830 | 348,064 | 0 | 0 | 0,06756 |
| 2880 | 351,442 | 0 | 0 | 0,003 |
| 3200 | 352,402 | 0 | 0 | -0,015217 |
| 3260 | 351,489 | 0 | 0 | -0,005 |
| 3300 | 351,289 | 0 | 0 | -0,092978 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 3321,661 | 349,275 | 0 | 0 | 0,0143788 |
| 3420 | 350,689 | 0 | 0 | -0,005 |
| 3560 | 349,989 | 0 | 0 | 0,003 |
| 3750 | 350,559 | 0 | 0 | -0,009573 |
| 3860 | 349,506 | 0 | 0 | -0,005 |
| 4180 | 347,906 | 0 | 0 | -0,055 |
| 4240 | 344,606 | 0 | 0 | 0,04276 |
| 4290 | 346,744 | 0 | 0 | -0,028908 |
| 4430,273 | 342,689 | 0 | 0 | -0,014347 |
| 4620 | 339,967 | 0 | 0 | -0,05495 |
| 4680 | 336,67 | 0 | 0 | -0,018 |
| 4890 | 332,89 | 0 | 0 | -0,004998 |
| 5084,275 | 331,919 | 0 | 0 | |

**R-1-10-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709335,24 | 4646426,4 | 373,43565 | 0 | 238,933 |
| 238,933 | 709238,41 | 4646644,8 | 373,43565 | | |

**R-1-10-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 349,732 | 0 | 0 | 0,0030008 |
| 238,933 | 350,449 | 0 | 0 | |

**R-1-10-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709243,4 | 4646130,6 | 179,13028 | 0 | 35,587 |
| 35,587 | 709254,86 | 4646096,9 | 120,42174 | 0 | 48,784 |
| 84,371 | 709301,16 | 4646081,6 | 67,585239 | 0 | 401,43 |
| 485,801 | 709651,67 | 4646277,2 | 72,365908 | 0 | 55,885 |
| 541,686 | 709702,37 | 4646300,7 | 92,651711 | 0 | 21,388 |
| 563,074 | 709723,61 | 4646303,2 | 112,26199 | 0 | 52,439 |
| 615,513 | 709775,08 | 4646293,2 | 112,26105 | -100,066 | 4,818 |
| 620,331 | 709779,83 | 4646292,4 | 109,19474 | 0 | 356,735 |
| 977,065 | 710132,85 | 4646241 | 109,19483 | -99,999 | 36,162 |
| 1013,228 | 710168,8 | 4646242,3 | 86,173073 | 0 | 128,528 |
| 1141,756 | 710294,3 | 4646270 | 139,01569 | 0 | 168,989 |
| 1310,745 | 710432,54 | 4646172,8 | 97,008209 | 0 | 254,183 |
| 1564,928 | 710686,44 | 4646184,8 | 100,85343 | 0 | 68,361 |
| 1633,289 | 710754,79 | 4646183,8 | 104,02271 | 0 | 290,715 |
| 1924,004 | 711044,93 | 4646165,5 | 104,02271 | | |

**R-1-10-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 349,815 | 0 | 0 | 0,003 |
| 180 | 350,355 | 0 | 0 | -0,008917 |
| 420 | 348,215 | 0 | 0 | 0,003 |
| 600 | 348,755 | 0 | 0 | -0,008857 |
| 1023,937 | 345 | 0 | 0 | -0,062969 |
| 1050,204 | 343,346 | 0 | 0 | -0,00963 |
| 1250 | 341,422 | 0 | 0 | -0,00803 |
| 1719,761 | 337,65 | 0 | 0 | -0,005014 |
| 1924,004 | 336,626 | 0 | 0 | |

**R-1-10-2-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709702,37 | 4646300,7 | 382,07157 | 0 | 16,988 |
| 16,988 | 709697,65 | 4646317,1 | 382,07157 | | |

**R-1-10-2-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 348,58 | 0 | 0 | 0,0030021 |
| 16,988 | 348,631 | 0 | 0 | |

**R-1-10-2-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710754,79 | 4646183,8 | 205,01554 | 0 | 23,474 |
| 23,474 | 710752,95 | 4646160,4 | 205,01554 | | |

**R-1-10-2-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 338,344 | 0 | 0 | 0,0030246 |
| 23,474 | 338,415 | 0 | 0 | |

**R-1-10-2-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710294,3 | 4646270 | 388,9061 | 0 | 17,96 |
| 17,96 | 710291,19 | 4646287,7 | 388,9061 | | |

**R-1-10-2-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 342,337 | 0 | 0 | 0,0030067 |

| | | | | |
|---|---|---|---|---|
| 17,96 | 342,391 | 0 | 0 | |

**R-1-10-3, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709816,58 | 4647118,4 | 331,7989 | 0 | 120,169 |
| 120,169 | 709711,09 | 4647175,9 | 320,55924 | 0 | 90,354 |
| 210,523 | 709625,41 | 4647204,6 | 347,02883 | 0 | 83,855 |
| 294,378 | 709563,41 | 4647261,1 | 384,56769 | 0 | 90,904 |
| 385,282 | 709541,59 | 4647349,3 | 384,56764 | 99,999 | 17,158 |
| 402,441 | 709538,92 | 4647366,2 | 395,491 | 0 | 95,633 |
| 498,073 | 709532,15 | 4647461,6 | 329,12776 | 0 | 57,848 |
| 555,921 | 709480,25 | 4647487,2 | 332,5167 | 0 | 32,514 |
| 588,435 | 709451,89 | 4647503,1 | 29,516724 | 0 | 18,065 |
| 606,5 | 709459,97 | 4647519,2 | 330,22429 | 0 | 116,604 |
| 723,104 | 709356,26 | 4647572,5 | 330,22429 | | |

**R-1-10-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 347,373 | 0 | 0 | 0,0429174 |
| 230 | 357,244 | 0 | 0 | 0,003 |
| 390 | 357,724 | 0 | 0 | -0,024273 |
| 500 | 355,054 | 0 | 0 | -0,004998 |
| 723,104 | 353,939 | 0 | 0 | |

**R-1-10-3-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709625,41 | 4647204,6 | 282,86459 | 0 | 139,132 |
| 139,132 | 709491,29 | 4647167,6 | 392,5841 | 0 | 98,882 |
| 238,013 | 709479,79 | 4647265,8 | 284,97851 | 0 | 45,86 |
| 283,873 | 709435,21 | 4647255,1 | 284,97851 | | |

**R-1-10-3-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 356,408 | 0 | 0 | 0,03615 |
| 80 | 359,3 | 0 | 0 | 0,0030019 |
| 283,873 | 359,912 | 0 | 0 | |

**R-1-10-3-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709711,09 | 4647175,9 | 32,284914 | 0 | 22,283 |
| 22,283 | 709721,92 | 4647195,4 | 32,284914 | | |

**R-1-10-3-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 352,53 | 0 | 0 | 0,0030068 |
| 22,283 | 352,597 | 0 | 0 | |

**R-1-10-4, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709677,35 | 4646830,3 | 178,31942 | 0 | 32,485 |
| 32,485 | 709688,2 | 4646799,7 | 93,101247 | 0 | 364,276 |
| 396,761 | 710050,34 | 4646839,1 | 93,101222 | -100 | 18,671 |
| 415,433 | 710068,6 | 4646842,8 | 81,214754 | 0 | 131,807 |
| 547,24 | 710194,71 | 4646881,1 | 81,214754 | | |

**R-1-10-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 349,035 | 0 | 0 | -0,034256 |
| 160 | 343,554 | 0 | 0 | -0,004999 |
| 547,24 | 341,618 | 0 | 0 | |

**R-1-10-5, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710185,96 | 4647204,9 | 319,74918 | 0 | 109,774 |
| 109,774 | 710081,43 | 4647238,4 | 319,74918 | | |

**R-1-10-5, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,567 | 0 | 0 | 0,0252154 |
| 109,774 | 354,335 | 0 | 0 | |

**R-1-10-6, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710581,305 | 4647088,46 | 196,863059 | 0 | 19,312 |
| 19,312 | 710582,256 | 4647069,17 | 196,862959 | 99,999 | 36,369 |
| 55,681 | 710577,475 | 4647033,32 | 220,016327 | 0 | 34,712 |
| 90,393 | 710566,74 | 4647000,31 | 268,483466 | 0 | 24,844 |
| 115,238 | 710544,879 | 4646988,51 | 268,483466 | | |

**R-1-10-6, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,114 | 0 | 0 | -0,37985555 |
| 5,123 | 349,168 | 0 | 0 | -0,02717159 |
| 115,238 | 346,176 | 0 | 0 | |

**R-1-10-7, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710185,96 | 4647204,9 | 19,90202 | 0 | 20,44 |
| 20,44 | 710192,25 | 4647224,4 | 17,561637 | 0 | 72,161 |
| 92,601 | 710211,9 | 4647293,8 | 322,67635 | 0 | 102,692 |
| 195,293 | 710115,66 | 4647329,6 | 325,08124 | 0 | 127,296 |
| 322,59 | 709998,11 | 4647378,5 | 382,70675 | 0 | 118,582 |
| 441,172 | 709966,3 | 4647492,7 | 382,70675 | | |

**R-1-10-7, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,567 | 0 | 0 | 0,0311 |
| 30 | 352,5 | 0 | 0 | 0,003 |
| 320 | 353,37 | 0 | 0 | -0,029542 |
| 398,533 | 351,05 | 0 | 0 | -0,003002 |
| 441,172 | 350,922 | 0 | 0 | |

**R-1-10-7-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710192,25 | 4647224,4 | 119,49925 | 0 | 149,089 |
| 149,089 | 710334,4 | 4647179,4 | 119,49925 | | |

**R-1-10-7-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 352,203 | 0 | 0 | 0,0029982 |
| 149,089 | 352,65 | 0 | 0 | |

**R-1-10-7-4, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710211,9 | 4647293,8 | 19,137545 | 0 | 125,769 |
| 125,769 | 710249,14 | 4647413,9 | 19,13755 | 100 | 25,431 |
| 151,201 | 710259,67 | 4647437 | 35,327697 | 0 | 135,997 |
| 287,198 | 710331,32 | 4647552,6 | 35,327697 | | |

**R-1-10-7-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 352,688 | 0 | 0 | -0,005 |
| 80 | 352,288 | 0 | 0 | -0,094957 |
| 142,607 | 346,343 | 0 | 0 | -0,022416 |
| 230 | 344,384 | 0 | 0 | -0,005 |
| 287,198 | 344,098 | 0 | 0 | |

**R-1-10-8, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711062,61 | 4646997,9 | 192,36363 | 0 | 177,635 |
| 177,635 | 711083,87 | 4646821,5 | 241,3613 | 0 | 238,916 |
| 416,551 | 710939,34 | 4646631,3 | 239,30654 | 0 | 21,154 |
| 437,705 | 710927,09 | 4646614 | 239,30654 | | |

**R-1-10-8, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 349,79 | 0 | 0 | -0,005 |
| 190 | 348,84 | 0 | 0 | -0,053045 |
| 390 | 338,231 | 0 | 0 | -0,00501 |
| 437,705 | 337,992 | 0 | 0 | |

**R-1-10-8-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710939,34 | 4646631,3 | 147,24673 | 0 | 9,375 |
| 9,375 | 710946,25 | 4646624,9 | 147,24673 | | |

**R-1-10-8-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 338,098 | 0 | 0 | 0,0029867 |
| 9,375 | 338,126 | 0 | 0 | |

**R-1-10-9, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710581,31 | 4647088,5 | 396,05939 | 0 | 19,757 |
| 19,757 | 710580,08 | 4647108,2 | 97,280296 | 0 | 73,297 |
| 93,055 | 710653,31 | 4647111,3 | 100,2158 | 0 | 44,542 |
| 137,597 | 710697,86 | 4647111,2 | 100,21572 | 99,999 | 31,757 |
| 169,354 | 710729,06 | 4647106,1 | 120,43267 | 0 | 24,817 |
| 194,17 | 710752,61 | 4647098,2 | 120,43267 | | |

**R-1-10-9, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,114 | 0 | 0 | 0,003 |
| 120 | 351,474 | 0 | 0 | -0,011743 |
| 194,17 | 350,603 | 0 | 0 | |

**R-1-10-9-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710653,31 | 4647111,3 | 16,197467 | 0 | 48,73 |
| 48,73 | 710665,58 | 4647158,5 | 16,197467 | | |

**R-1-10-9-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,393 | 0 | 0 | 0,0029961 |
| 48,73 | 351,539 | 0 | 0 | |

**R-1-10-10, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711360,6 | 4646685 | 230,45632 | 0 | 72,585 |
| 72,585 | 711327,18 | 4646620,6 | 230,45632 | | |

**R-1-10-10, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 345,774 | 0 | 0 | 0,0030034 |
| 72,585 | 345,992 | 0 | 0 | |

**R-1-10-11, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711170,18 | 4646982 | 45,664872 | 0 | 42,394 |
| 42,394 | 711198,05 | 4647014 | 43,982861 | 0 | 117,91 |
| 160,303 | 711273,19 | 4647104,9 | 73,020764 | 0 | 61,436 |
| 221,739 | 711329,19 | 4647130,1 | 160,09026 | 0 | 18,717 |
| 240,456 | 711340,17 | 4647115 | 160,09021 | 100 | 40,686 |
| 281,142 | 711356,77 | 4647078,1 | 185,99159 | 0 | 8,129 |
| 289,271 | 711358,54 | 4647070,2 | 185,99159 | | |

**R-1-10-11, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 349,11 | 0 | 0 | -0,015533 |
| 180 | 346,314 | 0 | 0 | -0,069248 |
| 230,745 | 342,8 | 0 | 0 | 0,0143539 |
| 263,001 | 343,263 | 0 | 0 | 0,0030072 |
| 289,271 | 343,342 | 0 | 0 | |

**R-1-10-13, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 711900,57 | 4646465,9 | 128,1468 | 0 | 44,081 |
| 44,081 | 711940,42 | 4646447 | 128,1468 | | |

**R-1-10-13, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 332,78 | 0 | 0 | 0,0225494 |
| 44,081 | 333,774 | 0 | 0 | |

**R-1-11, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709218,81 | 4647951,4 | 319,69151 | 0 | 327,722 |
| 327,722 | 708906,64 | 4648051,2 | 318,69988 | 0 | 663,958 |
| 991,681 | 708271,12 | 4648243,4 | 399,63777 | 0 | 122,705 |
| 1114,386 | 708270,42 | 4648366,1 | 399,63777 | 150 | 42,912 |
| 1157,297 | 708276,28 | 4648408,5 | 17,849984 | 0 | 64,397 |
| 1221,695 | 708294,1 | 4648470,4 | 17,849806 | -150 | 20,068 |
| 1241,763 | 708298,35 | 4648490 | 9,332786 | 0 | 68,577 |
| 1310,339 | 708308,36 | 4648557,8 | 9,33299 | -149,996 | 4,688 |
| 1315,028 | 708308,98 | 4648562,4 | 7,34299 | 0 | 64,363 |
| 1379,391 | 708316,38 | 4648626,4 | 7,343011 | 150 | 38,073 |
| 1417,464 | 708325,49 | 4648663,2 | 23,501776 | 0 | 2,205 |
| 1419,669 | 708326,29 | 4648665,3 | 373,47829 | 0 | 60,113 |
| 1479,782 | 708301,96 | 4648720,3 | 373,4784 | -149,997 | 28,239 |
| 1508,02 | 708288,18 | 4648744,9 | 361,49338 | 0 | 56,774 |
| 1564,794 | 708255,9 | 4648791,6 | 361,49335 | -150 | 55,863 |
| 1620,658 | 708216,4 | 4648830,6 | 337,78431 | 0 | 76,138 |
| 1696,796 | 708153,28 | 4648873,2 | 337,78431 | | |

**R-1-11, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 348,655 | 0 | 0 | 0,003 |
| 160 | 349,135 | 0 | 0 | -0,018139 |
| 313,651 | 346,348 | 0 | 0 | 0,0605336 |
| 340 | 347,943 | 0 | 0 | 0,003 |
| 490 | 348,393 | 0 | 0 | 0,007787 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 593,249 | 349,197 | 0 | 0 | 0,0135029 |
| 834,975 | 352,461 | 0 | 0 | -0,008796 |
| 1160 | 349,602 | 0 | 0 | 0,0347638 |
| 1241,953 | 352,451 | 0 | 0 | 0,0434372 |
| 1370 | 358,013 | 0 | 0 | 0,09486 |
| 1420 | 362,756 | 0 | 0 | 0,011 |
| 1510 | 363,746 | 0 | 0 | -0,008876 |
| 1696,796 | 362,088 | 0 | 0 | |

**R-1-11-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708271,12 | 4648243,4 | 319,20366 | 0 | 277,752 |
| 277,752 | 708005,91 | 4648325,9 | 312,92805 | 0 | 315,52 |
| 593,271 | 707696,87 | 4648389,6 | 312,92805 | | |

**R-1-11-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 351,565 | 0 | 0 | 0,0030003 |
| 593,271 | 353,345 | 0 | 0 | |

**R-1-11-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708906,64 | 4648051,2 | 15,350028 | 0 | 6,447 |
| 6,447 | 708908,18 | 4648057,4 | 15,350028 | | |

**R-1-11-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 347,2 | 0 | 0 | 0,0029471 |
| 6,447 | 347,219 | 0 | 0 | |

**R-1-12, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 708489,87 | 4646739,6 | 153,15429 | 0 | 23,339 |
| 23,339 | 708505,54 | 4646722,3 | 127,20038 | 0 | 118,5 |
| 141,839 | 708613,39 | 4646673,2 | 195,44196 | 0 | 17,564 |
| 159,403 | 708614,64 | 4646655,6 | 195,44196 | | |

**R-1-12, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 360,894 | 0 | 0 | -0,005 |
| 159,403 | 360,097 | 0 | 0 | |

**R-1-14, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709218,81 | 4647951,4 | 118,39882 | 0 | 727,635 |
| 727,635 | 709916,27 | 4647744 | 118,97008 | 0 | 251,441 |
| 979,075 | 710156,63 | 4647670,2 | 118,77514 | 0 | 296,7 |
| 1275,776 | 710440,52 | 4647584 | 118,81363 | 0 | 180,081 |
| 1455,856 | 710612,79 | 4647531,5 | 115,80349 | 0 | 625,759 |
| 2081,615 | 711219,37 | 4647377,8 | 108,54714 | 0 | 149,554 |
| 2231,169 | 711367,58 | 4647357,8 | 155,54333 | 0 | 23,359 |
| 2254,528 | 711382,6 | 4647339,9 | 155,54333 | | |

**R-1-14, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 348,655 | 0 | 0 | -0,018886 |
| 140 | 346,011 | 0 | 0 | -0,005 |
| 940 | 342,011 | 0 | 0 | 0,0194649 |
| 1020,247 | 343,573 | 0 | 0 | 0,1216524 |
| 1040 | 345,976 | 0 | 0 | -0,074004 |
| 1055,391 | 344,837 | 0 | 0 | -0,005 |
| 1810 | 341,064 | 0 | 0 | 0,003 |
| 1870 | 341,244 | 0 | 0 | -0,008968 |
| 2076,391 | 339,393 | 0 | 0 | 0,0029977 |
| 2254,528 | 339,927 | 0 | 0 | |

**R-1-14-1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710156,63 | 4647670,2 | 83,942159 | 0 | 138,489 |
| 138,489 | 710290,73 | 4647704,8 | 77,332604 | 0 | 458,438 |
| 596,927 | 710720,42 | 4647864,6 | 83,668115 | 0 | 169,282 |
| 766,21 | 710884,16 | 4647907,5 | 84,709222 | 0 | 268,367 |
| 1034,576 | 711144,82 | 4647971,4 | 178,66752 | 0 | 18,042 |
| 1052,618 | 711150,76 | 4647954,3 | 178,66752 | | |

**R-1-14-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 342,772 | 0 | 0 | 0,003 |
| 200 | 343,372 | 0 | 0 | -0,0457 |
| 230 | 342,001 | 0 | 0 | -0,005 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 1052,618 | 337,888 | 0 | 0 | |

**R-1-14-1-2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710720,42 | 4647864,6 | 186,51344 | 0 | 21,416 |
| 21,416 | 710724,92 | 4647843,6 | 186,51344 | | |

**R-1-14-1-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 340,166 | 0 | 0 | 0,0029884 |
| 21,416 | 340,23 | 0 | 0 | |

**R-1-16 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709191,04 | 4648418,9 | 118,04185 | 0 | 255,651 |
| 255,651 | 709436,5 | 4648347,4 | 118,26726 | 0 | 302,627 |
| 558,278 | 709726,75 | 4648261,7 | 117,31428 | 0 | 43,666 |
| 601,944 | 709768,81 | 4648250 | 119,38147 | 0 | 339,552 |
| 941,497 | 710092,75 | 4648148,2 | 118,40832 | 0 | 277,876 |
| 1219,372 | 710359,09 | 4648069 | 118,33818 | 0 | 81,801 |
| 1301,173 | 710437,52 | 4648045,7 | 118,33819 | -100 | 85,782 |
| 1386,955 | 710519,87 | 4648057,4 | 63,727704 | 0 | 74,898 |
| 1461,853 | 710582,94 | 4648097,8 | 64,21797 | 0 | 182,187 |
| 1644,04 | 710737,1 | 4648194,9 | 369,64097 | 0 | 23,534 |
| 1667,573 | 710726,3 | 4648215,8 | 369,64097 | | |

**R-1-16, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 345,476 | 0 | 0 | 0,0030015 |
| 139,598 | 345,895 | 0 | 0 | -0,005001 |
| 941,497 | 341,885 | 0 | 0 | 0,0036167 |
| 1219,372 | 342,89 | 0 | 0 | -0,006752 |
| 1560 | 340,59 | 0 | 0 | 0,0040393 |
| 1647,639 | 340,944 | 0 | 0 | 0,0030099 |
| 1667,573 | 341,004 | 0 | 0 | |

**R-1-16-1 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709436,5 | 4648347,4 | 17,760891 | 0 | 20,499 |
| 20,499 | 709442,14 | 4648367,1 | 17,760891 | | |

**R-1-16-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 345,315 | 0 | 0 | 0,0239036 |
| 20,499 | 345,805 | 0 | 0 | |

**R-1-16-3 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709726,75 | 4648261,7 | 16,214742 | 0 | 17,924 |
| 17,924 | 709731,27 | 4648279,1 | 16,214742 | | |

**R-1-16-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 343,801 | 0 | 0 | -0,005021 |
| 17,924 | 343,711 | 0 | 0 | |

**R-1-16-5 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 709768,81 | 4648250 | 17,822159 | 0 | 15,608 |
| 15,608 | 709773,13 | 4648265 | 17,822159 | | |

**R-1-16-5, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 343,578 | 0 | 0 | -0,004997 |
| 15,608 | 343,5 | 0 | 0 | |

**R-1-16-7 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710092,75 | 4648148,2 | 19,855054 | 0 | 19,734 |
| 19,734 | 710098,81 | 4648167 | 19,855054 | | |

**R-1-16-7, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 341,885 | 0 | 0 | 0,0483936 |
| 19,734 | 342,84 | 0 | 0 | |

**R-1-16-9 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710582,94 | 4648097,8 | 362,56659 | 0 | 18,873 |

| | | | | | |
|---|---|---|---|---|---|
| 18,873 | 710572,47 | 4648113,5 | 362,56659 | | |

**R-1-16-9, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 341,253 | 0 | 0 | 0,0841647 |
| 18,844 | 342,839 | 0 | 0 | |

**R-1-18 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 710178,96 | 4648730,9 | 164,34157 | 0 | 21,443 |
| 21,443 | 710190,36 | 4648712,8 | 164,34157 | | |

**R-1-18, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 340,651 | 0 | 0 | 0,0029592 |
| 9,124 | 340,678 | 0 | 0 | 0,0944882 |
| 21,443 | 341,842 | 0 | 0 | |

**R-2 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 705924,81 | 4645139,4 | 113,80309 | 0 | 195,586 |
| 195,586 | 706115,81 | 4645097,3 | 163,54327 | 0 | 116,711 |
| 312,297 | 706179,06 | 4644999,2 | 163,54328 | -249,999 | 36,233 |
| 348,53 | 706200,82 | 4644970,3 | 154,31656 | 0 | 132,619 |
| 481,149 | 706288,03 | 4644870,4 | 154,31648 | 249,992 | 19,224 |
| 500,373 | 706300,1 | 4644855,4 | 159,21186 | 0 | 122,985 |
| 623,357 | 706373,62 | 4644756,8 | 125,97962 | 0 | 15,282 |
| 638,64 | 706387,65 | 4644750,7 | 125,97961 | 250 | 62,855 |
| 701,495 | 706441,61 | 4644718,8 | 141,98555 | 0 | 380,778 |
| 1082,272 | 706742,54 | 4644485,5 | 110,72257 | 0 | 41,213 |
| 1123,485 | 706783,17 | 4644478,6 | 212,01864 | 0 | 252,73 |
| 1376,215 | 706735,74 | 4644230,4 | 171,73544 | 0 | 141,982 |
| 1518,197 | 706796,73 | 4644102,2 | 122,13397 | 0 | 227,096 |
| 1745,292 | 707010,23 | 4644024,8 | 177,70452 | 0 | 294,848 |
| 2040,141 | 707111,4 | 4643747,8 | 177,70448 | 100 | 37,035 |
| 2077,176 | 707117,45 | 4643711,5 | 201,28162 | 0 | 16,686 |
| 2093,862 | 707117,11 | 4643694,8 | 201,28162 | | |

**R-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 380,989 | 0 | 0 | 0,0033769 |
| 147,177 | 381,486 | 0 | 0 | -0,008019 |
| 180,223 | 381,221 | 0 | 0 | -0,004991 |
| 280 | 380,723 | 0 | 0 | -0,005 |
| 380 | 380,223 | 0 | 0 | -0,014475 |
| 500 | 378,486 | 0 | 0 | 0,0377898 |
| 512,596 | 378,962 | 0 | 0 | 0,0153997 |
| 580 | 380 | 0 | 0 | 0,003 |
| 620 | 380,12 | 0 | 0 | -0,037191 |
| 643,769 | 379,236 | 0 | 0 | -0,004982 |
| 665,848 | 379,126 | 0 | 0 | 0,0029978 |
| 775,595 | 379,455 | 0 | 0 | 0,003 |
| 875,595 | 379,755 | 0 | 0 | 0,003 |
| 975,595 | 380,055 | 0 | 0 | 0,0029997 |
| 1082,272 | 380,375 | 0 | 0 | -0,004998 |
| 1123,485 | 380,169 | 0 | 0 | 0,0189692 |
| 1157,382 | 380,812 | 0 | 0 | 0,0157922 |
| 1309,736 | 383,218 | 0 | 0 | 0,0094022 |
| 1518,197 | 385,178 | 0 | 0 | -0,021009 |
| 1850 | 378,207 | 0 | 0 | 0,0041018 |
| 2049,179 | 379,024 | 0 | 0 | 0,0205895 |
| 2093,862 | 379,944 | 0 | 0 | |

**R-2-1 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706783,17 | 4644478,6 | 115,84929 | 0 | 148,542 |
| 148,542 | 706927,13 | 4644442 | 114,70988 | 0 | 227,241 |
| 375,783 | 707148,33 | 4644390 | 62,324213 | 0 | 88,433 |
| 464,216 | 707221,73 | 4644439,3 | 158,92913 | 0 | 169,536 |
| 633,752 | 707323,67 | 4644303,9 | 168,88248 | 0 | 21,032 |
| 654,785 | 707333,55 | 4644285,3 | 168,88256 | 100 | 21,307 |
| 676,092 | 707341,48 | 4644265,6 | 182,44695 | 0 | 105,27 |
| 781,362 | 707370,14 | 4644164,3 | 182,44695 | | |

**R-2-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 380,169 | 0 | 0 | 0,0068645 |
| 186,904 | 381,452 | 0 | 0 | 0,0109362 |
| 275,783 | 382,424 | 0 | 0 | -0,025918 |
| 320 | 381,278 | 0 | 0 | -0,005817 |
| 380 | 380,929 | 0 | 0 | -0,015033 |
| 464,216 | 379,663 | 0 | 0 | 0,0060243 |
| 600 | 380,481 | 0 | 0 | 0,0283539 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 633,752 | 381,438 | 0 | 0 | -0,011578 |
| 781,362 | 379,729 | 0 | 0 | |

**R-2-1-2 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706927,13 | 4644442 | 216,58897 | 0 | 35,305 |
| 35,305 | 706918,04 | 4644407,9 | 216,58897 | | |

**R-2-1-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 381,189 | 0 | 0 | 0,0450078 |
| 35,305 | 382,778 | 0 | 0 | |

**R-2-1-4 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707147,89 | 4644319,6 | 0,402964 | 0 | 70,341 |
| 70,341 | 707148,33 | 4644390 | 0,402964 | | |

**R-2-1-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 382,424 | 0 | 0 | -0,038001 |
| 70,341 | 379,751 | 0 | 0 | |

**R-2-2 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706735,74 | 4644230,4 | 241,4745 | 0 | 173,964 |
| 173,964 | 706630,25 | 4644092,1 | 241,4745 | | |

**R-2-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 383,871 | 0 | 0 | 0,02 |
| 120 | 386,271 | 0 | 0 | 0,0656734 |
| 173,964 | 389,815 | 0 | 0 | |

**R-2-3 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 707010,23 | 4644024,8 | 112,38549 | 0 | 213,332 |
| 213,332 | 707219,54 | 4643983,6 | 112,38549 | | |

**R-2-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 380,518 | 0 | 0 | -0,01775 |
| 40 | 379,808 | 0 | 0 | -0,013148 |
| 141,005 | 378,48 | 0 | 0 | -0,005005 |
| 213,332 | 378,118 | 0 | 0 | |

**R-2-4 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706796,73 | 4644102,2 | 218,07463 | 0 | 258,283 |
| 258,283 | 706724,38 | 4643854,2 | 218,07463 | | |

**R-2-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 385,178 | 0 | 0 | -0,01 |
| 100 | 384,178 | 0 | 0 | -0,004997 |
| 258,283 | 383,387 | 0 | 0 | |

**R-3 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 705924,81 | 4645139,4 | 68,554955 | 0 | 109,228 |
| 109,228 | 706020,98 | 4645191,1 | 377,97433 | 0 | 51,622 |
| 160,85 | 706003,47 | 4645239,7 | 35,135513 | 0 | 135,947 |
| 296,797 | 706074,75 | 4645355,5 | 33,649207 | 0 | 58,047 |
| 354,844 | 706104,03 | 4645405,6 | 33,649206 | -300 | 117,646 |
| 472,49 | 706142,18 | 4645516,1 | 8,683975 | 0 | 73,023 |
| 545,514 | 706152,11 | 4645588,4 | 39,501249 | 0 | 21,748 |
| 567,262 | 706164,75 | 4645606,1 | 41,231215 | 0 | 8,871 |
| 576,133 | 706170,11 | 4645613,2 | 41,231231 | 300 | 89,107 |
| 665,24 | 706233,56 | 4645675,3 | 60,14032 | 0 | 9,559 |
| 674,8 | 706241,3 | 4645680,9 | 66,017637 | 0 | 34,157 |
| 708,957 | 706270,71 | 4645698,3 | 5,242481 | 0 | 122,925 |
| 831,882 | 706280,82 | 4645820,8 | 86,996566 | 0 | 43,071 |
| 874,953 | 706322,99 | 4645829,5 | 385,36545 | 0 | 146,764 |
| 1021,717 | 706289,55 | 4645972,4 | 17,236404 | 0 | 58,739 |
| 1080,456 | 706305,26 | 4646029 | 386,59764 | 0 | 537,547 |
| 1618,003 | 706192,93 | 4646554,7 | 386,59766 | -299,997 | 21,357 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 1639,36 | 706187,73 | 4646575,4 | 382,0656 | 0 | 117,725 |
| 1757,085 | 706155 | 4646688,5 | 368,13835 | 0 | 91,854 |
| 1848,939 | 706110,92 | 4646769,1 | 385,34081 | 0 | 290,838 |
| 2139,777 | 706044,54 | 4647052,3 | 385,34078 | -150 | 45,698 |
| 2185,475 | 706027,55 | 4647094,5 | 365,94606 | 0 | 102,703 |
| 2288,178 | 705975,2 | 4647182,8 | 365,94617 | 150 | 15,719 |
| 2303,897 | 705967,9 | 4647196,8 | 372,61748 | 0 | 54,179 |
| 2358,076 | 705945,31 | 4647246 | 370,94588 | 0 | 367,246 |
| 2725,321 | 705783,47 | 4647575,7 | 271,23014 | 0 | 56,908 |
| 2782,23 | 705732,27 | 4647550,8 | 261,48718 | 0 | 410,297 |
| 3192,527 | 705394,79 | 4647317,5 | 172,70976 | 0 | 262,539 |
| 3455,066 | 705503,92 | 4647078,7 | 274,65262 | 0 | 33,627 |
| 3488,692 | 705472,92 | 4647065,6 | 274,65262 | | |

**R-3, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 380,989 | 0 | 0 | -0,005 |
| 100 | 380,489 | 0 | 0 | -0,041301 |
| 142,929 | 378,716 | 0 | 0 | 0,0408136 |
| 180 | 380,229 | 0 | 0 | 0,003 |
| 410 | 380,919 | 0 | 0 | 0,0122431 |
| 451,983 | 381,433 | 0 | 0 | 0,0239966 |
| 508,116 | 382,78 | 0 | 0 | 0,0390077 |
| 588,613 | 385,92 | 0 | 0 | 0,0029509 |
| 599,796 | 385,953 | 0 | 0 | 0,0832246 |
| 651,151 | 390,227 | 0 | 0 | -0,06622 |
| 747,028 | 383,878 | 0 | 0 | -0,051862 |
| 780 | 382,168 | 0 | 0 | -0,018504 |
| 874,953 | 380,411 | 0 | 0 | 0,0239909 |
| 1021,717 | 383,932 | 0 | 0 | 0,041002 |
| 1171,856 | 390,088 | 0 | 0 | -0,017966 |
| 1452,05 | 385,054 | 0 | 0 | -0,003 |
| 1578,366 | 384,675 | 0 | 0 | 0,111361 |
| 1613,495 | 388,587 | 0 | 0 | -0,017458 |
| 1703,481 | 387,016 | 0 | 0 | -0,108108 |
| 1757,085 | 381,221 | 0 | 0 | 0,0154182 |
| 1819,933 | 382,19 | 0 | 0 | 0,024551 |
| 2009,538 | 386,845 | 0 | 0 | -0,041686 |
| 2103,119 | 382,944 | 0 | 0 | 0,0158049 |
| 2160 | 383,843 | 0 | 0 | -0,304642 |
| 2173,442 | 379,748 | 0 | 0 | -0,029442 |
| 2211,891 | 378,616 | 0 | 0 | -0,02232 |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 2284,56 | 376,994 | 0 | 0 | -0,026767 |
| 2320,686 | 376,027 | 0 | 0 | -0,023127 |
| 2357,872 | 375,167 | 0 | 0 | -0,005 |
| 2782,23 | 373,045 | 0 | 0 | 0,0204805 |
| 2902,784 | 375,514 | 0 | 0 | 0,0292511 |
| 2971,978 | 377,538 | 0 | 0 | 0,0029996 |
| 3150 | 378,072 | 0 | 0 | 0,03705 |
| 3170 | 378,813 | 0 | 0 | 0,0082447 |
| 3203,476 | 379,089 | 0 | 0 | 0,01188 |
| 3303,476 | 380,277 | 0 | 0 | 0,0179606 |
| 3405,978 | 382,118 | 0 | 0 | 0,0322233 |
| 3456,097 | 383,733 | 0 | 0 | 0,1193053 |
| 3485,115 | 387,195 | 0 | 0 | |

**R-3-2 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706020,98 | 4645191,1 | 90,143503 | 0 | 83,843 |
| 83,843 | 706103,82 | 4645204,1 | 90,143503 | | |

**R-3-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 380,108 | 0 | 0 | 0,0100664 |
| 83,843 | 380,952 | 0 | 0 | |

**R-3-4 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706270,71 | 4645698,3 | 97,375601 | 0 | 49,21 |
| 49,21 | 706319,88 | 4645700,3 | 97,375601 | | |

**R-3-4, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 386,399 | 0 | 0 | -0,011486 |
| 20,285 | 386,166 | 0 | 0 | -0,051678 |
| 43,951 | 384,943 | 0 | 0 | -0,008937 |
| 49,21 | 384,896 | 0 | 0 | |

**R-3-6 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706305,26 | 4646029 | 67,865029 | 0 | 132,378 |
| 132,378 | 706421,13 | 4646093 | 390,61386 | 0 | 12,681 |
| 145,059 | 706419,27 | 4646105,6 | 390,61386 | | |

**R-3-6, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 386,341 | 0 | 0 | 0,0476845 |
| 92,378 | 390,746 | 0 | 0 | 0,0029992 |
| 145,059 | 390,904 | 0 | 0 | |

**R-3-8 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706155 | 4646688,5 | 76,59185 | 0 | 310,315 |
| 310,315 | 706444,574 | 4646800,05 | 397,137364 | 0 | 400,51 |
| 710,825 | 706426,57 | 4647200,15 | 397,137391 | 150 | 88,087 |
| 798,913 | 706447,939 | 4647284,31 | 34,522848 | 0 | 579,092 |
| 1378,005 | 706746,805 | 4647780,32 | 34,522862 | 150 | 107,533 |
| 1485,538 | 706829,294 | 4647845,68 | 80,161381 | 0 | 67,179 |
| 1552,717 | 706893,237 | 4647866,28 | 80,161381 | | |

**R-3-8, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 381,221 | 0 | 0 | -0,04858362 |
| 52,034 | 378,693 | 0 | 0 | -0,01699715 |
| 200 | 376,178 | 0 | 0 | -0,005 |
| 340 | 375,478 | 0 | 0 | 0,05234545 |
| 450 | 381,236 | 0 | 0 | -0,01658185 |
| 553,366 | 379,522 | 0 | 0 | 0,00300059 |
| 720 | 380,022 | 0 | 0 | -0,06685 |
| 900 | 367,989 | 0 | 0 | -0,02381091 |
| 934,312 | 367,172 | 0 | 0 | -0,04791634 |
| 991,015 | 364,455 | 0 | 0 | 0,11314195 |
| 1010 | 366,603 | 0 | 0 | 0,018 |
| 1110 | 368,403 | 0 | 0 | 0,003 |
| 1210 | 368,703 | 0 | 0 | 0,04 |
| 1330 | 373,503 | 0 | 0 | -0,005 |
| 1360 | 373,353 | 0 | 0 | -0,05486639 |
| 1443,676 | 368,762 | 0 | 0 | -0,01816748 |
| 1552,717 | 366,781 | 0 | 0 | |

**R-3-8-2 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706444,57 | 4646800 | 97,511053 | 0 | 82,473 |
| 82,473 | 706526,98 | 4646803,3 | 98,216833 | 0 | 115,293 |
| 197,766 | 706642,23 | 4646806,5 | 185,36383 | 0 | 29,973 |
| 227,739 | 706649,06 | 4646777,3 | 197,47796 | 0 | 107,114 |
| 334,853 | 706653,3 | 4646670,3 | 197,478 | -100 | 52,031 |
| 386,884 | 706668,5 | 4646621,1 | 164,35429 | 0 | 47,662 |
| 434,545 | 706693,81 | 4646580,8 | 164,35417 | -100 | 52,628 |
| 487,174 | 706731,96 | 4646545,4 | 130,85 | 0 | 3,944 |
| 491,117 | 706735,44 | 4646543,5 | 130,85006 | -99,999 | 28,048 |
| 519,165 | 706761,76 | 4646534,1 | 112,99433 | 0 | 72,883 |
| 592,048 | 706833,13 | 4646519,3 | 114,93185 | 0 | 73,58 |
| 665,628 | 706904,69 | 4646502,2 | 114,93185 | | |

**R-3-8-2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 375,369 | 0 | 0 | -0,005 |
| 190 | 374,419 | 0 | 0 | -0,133977 |
| 214,967 | 371,074 | 0 | 0 | 0,066127 |
| 271,419 | 374,807 | 0 | 0 | 0,02974 |
| 500 | 381,605 | 0 | 0 | -0,015 |
| 590 | 380,255 | 0 | 0 | -0,100033 |
| 620 | 377,254 | 0 | 0 | -0,014991 |
| 665,628 | 376,57 | 0 | 0 | |

**R-3-8-2-1 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 706833,13 | 4646519,3 | 44,415867 | 0 | 24,451 |
| 24,451 | 706848,84 | 4646538,1 | 44,415886 | -100 | 34,536 |
| 58,987 | 706866,06 | 4646567,8 | 22,429686 | 0 | 7,126 |
| 66,112 | 706868,52 | 4646574,5 | 22,429686 | | |

**R-3-8-2-1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 380,374 | 0 | 0 | 0,0029949 |
| 66,112 | 380,572 | 0 | 0 | |

**R-3-10 puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 0 | 705394,79 | 4647317,5 | 258,95685 | 0 | 91,739 |

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| 91,739 | 705321,47 | 4647262,3 | 258,95685 | | |

**R-3-10, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 0 | 378,999 | 0 | 0 | 0,0029968 |
| 84,091 | 379,251 | 0 | 0 | 0,054767 |
| 91,559 | 379,66 | 0 | 0 | |

**IMPULSIÓN 1, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| - | 705.931,415 | 4.645.157,657 | 177,288 | - | 20,000 |
| 20,000 | 705.938,400 | 4.645.138,917 | 278,119 | - | 240,766 |
| 260,766 | 705.711,716 | 4.645.057,783 | 301,873 | - | 235,262 |
| 496,028 | 705.476,556 | 4.645.064,704 | 216,372 | - | 158,533 |
| 654,561 | 705.436,233 | 4.644.911,385 | 260,990 | - | 121,348 |
| 775,909 | 705.336,964 | 4.644.841,593 | 287,346 | - | 108,252 |
| 884,161 | 705.230,843 | 4.644.820,218 | 254,918 | - | 13,591 |
| 897,752 | 705.220,519 | 4.644.811,378 | 254,918 | | |

**IMPULSION 1, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| - | 378,600 | - | - | 3,67% |
| 70,000 | 381,168 | 703,764 | 8,134 | 1,36% |
| 140,000 | 382,118 | 700,000 | 12,050 | 4,80% |
| 160,000 | 383,078 | - | - | 6,80% |
| 200,000 | 385,798 | 700,000 | 18,722 | 1,45% |
| 405,001 | 388,772 | - | - | -39,72% |
| 415,000 | 384,800 | - | - | 0,50% |
| 470,000 | 385,075 | - | - | 76,36% |
| 475,000 | 388,893 | - | - | 0,50% |
| 590,000 | 389,468 | 700,000 | 16,380 | 5,18% |
| 650,000 | 392,576 | - | - | 16,04% |
| 740,000 | 407,009 | 699,317 | 26,179 | 23,52% |
| 793,040 | 419,486 | - | - | 0,30% |
| 897,752 | 419,800 | - | - | |

**IMPULSION 2, puntos singulares en planta;**

| P.K. | Coord. X | Coord. Y | Azimut | Radio | Longitud |
|---|---|---|---|---|---|
| - | 705.912,925 | 4.645.171,477 | 177,439 | - | 34,242 |
| 34,242 | 705.924,807 | 4.645.139,362 | 278,126 | - | 227,241 |
| 261,483 | 705.710,849 | 4.645.062,811 | 301,873 | - | 238,221 |
| 499,704 | 705.472,731 | 4.645.069,819 | 216,372 | - | 160,679 |
| 660,383 | 705.431,862 | 4.644.914,424 | 260,990 | - | 118,470 |
| 778,853 | 705.334,947 | 4.644.846,287 | 287,346 | - | 120,565 |
| 899,419 | 705.216,756 | 4.644.822,481 | 287,346 | - 400,000 | 62,090 |
| 961,509 | 705.157,082 | 4.644.805,555 | 277,464 | - | 230,036 |
| 1.191,545 | 704.941,308 | 4.644.725,815 | 277,464 | 399,998 | 44,585 |
| 1.236,130 | 704.898,714 | 4.644.712,720 | 284,560 | - | 5,622 |
| 1.241,752 | 704.893,256 | 4.644.711,370 | 284,560 | - 399,999 | 49,507 |
| 1.291,259 | 704.846,056 | 4.644.696,541 | 276,681 | - | 252,683 |
| 1.543,941 | 704.610,136 | 4.644.606,041 | 276,681 | - 400,000 | 77,142 |
| 1.621,084 | 704.541,212 | 4.644.571,659 | 264,403 | - | 225,570 |
| 1.846,654 | 704.349,995 | 4.644.452,002 | 299,967 | - | 122,048 |
| 1.968,703 | 704.227,946 | 4.644.451,939 | 299,967 | | |

**IMPULSION 2, definición del alzado;**

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| - | 380,818 | - | - | 0,50% |
| 70,000 | 381,168 | 400,000 | 1,714 | 1,36% |
| 140,000 | 382,118 | 400,000 | 4,886 | 3,80% |
| 200,000 | 384,398 | 400,000 | 3,582 | 2,01% |
| 330,000 | 387,010 | 400,000 | 5,997 | 5,01% |
| 370,000 | 389,013 | 400,000 | 5,995 | 2,01% |
| 410,000 | 389,817 | - | - | -43,17% |
| 420,000 | 385,500 | - | - | 0,50% |
| 470,000 | 385,750 | - | - | 18,87% |
| 490,000 | 389,523 | - | - | 0,55% |
| 590,000 | 390,068 | 400,000 | 8,223 | 4,66% |
| 650,000 | 392,862 | 400,000 | 23,267 | 16,29% |
| 690,000 | 399,378 | 400,000 | 2,344 | 17,46% |
| 740,000 | 408,109 | 400,000 | 9,672 | 22,30% |
| 795,000 | 420,373 | - | - | 0,50% |
| 930,000 | 421,048 | 400,000 | 11,200 | 6,10% |
| 980,000 | 424,098 | 400,000 | 9,400 | 1,40% |
| 1.230,000 | 427,598 | 400,000 | 6,300 | -1,75% |
| 1.270,000 | 426,898 | 400,000 | 2,500 | -0,50% |
| 1.420,000 | 426,148 | - | - | -24,89% |
| 1.430,000 | 423,659 | - | - | 0,89% |
| 1.630,000 | 425,429 | 400,000 | 4,630 | 3,20% |
| 1.730,000 | 428,629 | 400,000 | 3,400 | 1,50% |
| 1.830,000 | 430,129 | 400,000 | 6,000 | 4,50% |
| 1.890,000 | 432,829 | 400,000 | 8,000 | 0,50% |

| P.K. | Cota | Kv | Tangente | Pendiente |
|---|---|---|---|---|
| 1.950,000 | 433,129 | - | - | 38,61% |
| 1.963,703 | 438,420 | - | - | 0,50% |
| 1.968,703 | 438,445 | - | - | |

# ANEJO Nº 6.- PARÁMETROS BÁSICOS DE RIEGO Y DOTACIONES

**ANEJO 6.- PARAMETOS BÁSICOS DE RIEGO Y DOTACIONES ..... 1**

**1 INTRODUCCIÓN Y OBJETO DEL PRESENTE ANEJO ..... 1**

**2 NECESIDADES HÍDRICAS DE LA ALTERNATIVA ..... 1**

**3 PARÁMETROS BÁSICOS DE RIEGO ..... 1**

**3.1 AGRUPACIONES DE RIEGO ..... 1**

**3.2 DOTACIONES Y GRADO DE LIBERTAD ..... 1**

**3.3 EFICIENCIA DE APLICACIÓN DEL SISTEMA DE RIEGO ..... 2**

**3.4 PRESIÓN DE CONSIGNA DE LOS HIDRANTES ..... 2**

**3.5 GARANTÍA DE SUMINISTRO ..... 2**

**3.6 CAUDAL UNITARIO POR HIDRANTE ..... 2**

# ANEJO 6.- PARAMETOS BÁSICOS DE RIEGO Y DOTACIONES

## 1 INTRODUCCIÓN Y OBJETO DEL PRESENTE ANEJO

En este anejo, una vez conocidas las parcelas objeto de la transformación en el Anejo nº2, "Relación de parcelas y superficies", así como se han establecido los requerimientos hídricos de la alternativa de cultivos planteada en el Anejo nº 3, "Estudio Agronómico", se definen los parámetros básicos de riego que serán posteriormente utilizados para el dimensionamiento de las redes de riego.

Se ha establecido un sistema de riego a la demanda con reducción de caudales utilizando el modelo R.Clement. Las redes de distribución que se proyectan sirven para que el usuario pueda organizar el riego en parcela libremente, dentro de unas limitaciones, garantizando una alta calidad de funcionamiento a nivel de toma.

## 2 NECESIDADES HÍDRICAS DE LA ALTERNATIVA

Las necesidades hídricas se han determinado en el Anejo nº 3, "Estudio Agronómico", siendo estas las siguientes:

- Superficie considerada. 2.714,53 ha
- Mes de máximas necesidades: Julio. Necesidades brutas: 1.796 $m^3$/ha y mes.
- Caudal continuo ficticio por hectárea se considerará de 0,67 l/s y ha.
- Volumen medio de agua consumido al año: 7.088 $m^3$/ha y año.

## 3 PARÁMETROS BÁSICOS DE RIEGO

### 3.1 AGRUPACIONES DE RIEGO

Para conformar las agrupaciones de riego se ha partido de la relación de parcelas y superficies, que se recogen en el anejo nº2 "Relación de propietarios, parcelas y superficies".

A partir de estas parcelas en algunos casos se trazan agrupaciones de hidrantes en las que se engloban diferentes propietarios para en un posterior amueblamiento facilitar la instalación de los sistemas planteados.

La superficie a modernizar será abastecida a partir del Canal de Monegros mediante una impulsión a dos balsas elevadas desde las que se distribuirá el agua sendas redes de distribución. Para realizar la elevación se emplea un bombeo solar y un bombeo eléctrico, que se suplementan.

### 3.2 DOTACIONES Y GRADO DE LIBERTAD

Utilizamos la formula general de cálculo de dotaciones en función de la superficie, necesidades, rendimiento del sistema y grado de libertad deseado.

$$Q_{dot} = \frac{q_{fc} \cdot S_p}{10^3 \cdot r} \cdot GL$$

A partir de la fórmula anterior se busca un grado de libertad mínimo de 1,5, partiendo de los siguientes datos:

- duración de la jornada efectiva: 20 horas
- número máximo de sectores de riego o posturas: 10

Además, se establece una dotación mínima de 18 l/s en hidrantes con superficie comprendida entre 6 y 10 ha y de 15 l/s en hidrantes con superficie inferior a 6 ha, dado que las parcelas pequeñas necesitan un caudal mínimo para poder establecer un correcto funcionamiento de los sectores de riego.

Por último, se ha incrementado ligeramente la dotación de algunos hidrantes compartidos, al comprobar que las tomas de dichos hidrantes debían regar simultáneamente por requerir cada uno de ellos de 10 posturas.

### 3.3 EFICIENCIA DE APLICACIÓN DEL SISTEMA DE RIEGO

El caudal consumido por la instalación de riego es siempre superior al unitario del aspersor por el efecto de los aspersores sectoriales en las márgenes y solapamiento de aspersores para ajustarse a la geometría de la parcela. Si bien es difícil establecer un valor exacto del caudal consumido o instalado en el diseño del riego por aspersión por este efecto ya depende tamaño y geometría de la parcela podemos establecer a grandes rasgos los siguientes valores que determinarán la eficiencia de aplicación de la instalación:

**Tabla 1.** Eficiencia de la instalación

| Superficie | Caudal instalado | Eficiencia instalación |
|---|---|---|
| <5 | 18,5 | 0,881 |
| 5-10 | 18,0 | 0,905 |
| 10-15 | 17,5 | 0,931 |
| 15-60 | 17,0 | 0,958 |
| >60 | 16,5 | 0,980 |

Mediante este coeficiente se ajusta la pluviometría teórica del sistema en un marco ideal (16,29 l/s) con la real de la instalación.

### 3.4 PRESIÓN DE CONSIGNA DE LOS HIDRANTES

Para determinar la presión de consigna en cada hidrante se considerarán las siguientes presiones y pérdidas de carga:

Presión de 30 m.c.a. en el emisor.

Pérdida de carga de 10 mca (*)

(*) Se incluyen las pérdidas de carga en el hidrante, en la secundaria, en la terciaria y en la caña del aspersor.

De esta forma, la presión de consigna se determinará a partir de la siguiente expresión:

Δz agrupación + 30 m.c.a. emisor + 10 m.c.a. pérdidas de carga.

Por tanto, la presión de consigna en los hidrantes será de 40 m.c.a. más la diferencia de cota entre la ubicación prevista del hidrante y la cota máxima de la zona regable de la parcela.

En algunas zonas, se ha ajustado la presión requerida por los emisores por exigencia de la topografía sin necesidad de aumentar la altura de bombeo y reducir los costes energéticos, considerando para dichas zonas la posibilidad de instalar emisores de baja presión o sistemas de riego por pivot o goteros.

### 3.5 GARANTÍA DE SUMINISTRO

La garantía de suministro que aplicaremos para el dimensionado de las diferentes alternativas planteadas será la siguiente:

**Tabla 2.** Garantía de suministro

| nº hidrantes | Garantía de Suministro |
|---|---|
| 1-4 | 100% |
| 5-10 | 95% |
| 11-20 | 92% |
| ≥21 | 90% |

En el cálculo de caudales se considerará un rendimiento de la red del 80%.

### 3.6 CAUDAL UNITARIO POR HIDRANTE

En las tablas que se incluyen a continuación, se indican los caudales y superficies de diseño para cada uno de los hidrantes que componen la red de riego. También se incluye una tabla con los caudales de las tomas en los hidrantes compartidos.

**Tabla 1.** Caudales de la red de riego

| Piso | Hidrante | Superficie hidrante (ha) | Dotación (l/s) | Consumo teorico l/ha | Nº Posturas aspersión | Duración MAIZ (horas) | Grado de libertad real |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 5,7467 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 2 | 3,3023 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 3 | 8,0991 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 4 | 1,3307 | 15 | 18,5 | 2 | 2,7 | 7,5 |
| 1 | 5 | 13,6925 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 6 | 4,2555 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 1 | 7 | 9,3035 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 8 | 3,6138 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 9 | 23,1691 | 40 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 10 | 2,0379 | 15 | 18,5 | 3 | 4,0 | 5,0 |
| 1 | 11 | 5,0861 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 12 | 20,5275 | 36 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 13 | 5,9214 | 15 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 14 | 39,1439 | 67 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 15 | 11,7745 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 16 | 9,3611 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 17 | 29,1653 | 50 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 18 | 18,6253 | 32 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 19 | 17,9321 | 31 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 20 | 7,0807 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 21 | 7,5717 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 22 | 21,2750 | 37 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 23 | 4,4553 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 1 | 24 | 13,6271 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 25 | 48,3535 | 83 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 26 | 6,9559 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 27 | 11,2809 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 28 | 9,4021 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 29 | 5,1647 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 30 | 15,6754 | 27 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 31 | 2,8475 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 1 | 32 | 9,7958 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 33 | 4,7292 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 1 | 34 | 9,6253 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 35 | 7,2139 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 36 | 6,0994 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 37 | 10,5114 | 19 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 38 | 9,9390 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 39 | 9,9835 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 40 | 7,3151 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 41 | 10,0397 | 18 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 42 | 8,4362 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 43 | 5,1756 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 44 | 2,0653 | 15 | 18,5 | 3 | 4,0 | 5,0 |
| 1 | 45 | 10,0200 | 18 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 46 | 7,6421 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 47 | 17,1537 | 30 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 48 | 10,3861 | 19 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 49 | 9,9381 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 50 | 5,6461 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 51 | 5,0193 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 52 | 10,9901 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 53 | 2,5302 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 1 | 54 | 7,6300 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 60 | 557,3886 | 860 | 16,5 | 11 | 14,7 | 1,4 |
| 1 | 61 | 11,6554 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 62 | 13,7903 | 25 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 63 | 10,4736 | 19 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 64 | 9,6409 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 65 | 10,7084 | 19 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 66 | 11,7005 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 67 | 26,2999 | 45 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 68 | 34,2357 | 59 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 69 | 6,0644 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 70 | 20,4362 | 35 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 71 | 13,3456 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 80 | 37,9783 | 65 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 81 | 29,7636 | 51 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 82 | 25,8153 | 45 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 83 | 13,4148 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 84 | 24,8692 | 43 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 85 | 37,2570 | 64 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 86 | 25,0526 | 43 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 87 | 9,5741 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 88 | 11,3054 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 89 | 13,3377 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 90 | 22,1144 | 38 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 91 | 9,0752 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 92 | 3,4302 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 93 | 5,1325 | 15 | 18,0 | 7 | 9,3 | 2,1 |

| Piso | Hidrante | Superficie hidrante (ha) | Dotación (l/s) | Consumo teorico l/ha | Nº Posturas aspersión | Duración MAIZ (horas) | Grado de libertad real |
|---|---|---|---|---|---|---|---|
| 1 | 94 | 4,6577 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 1 | 95 | 3,7206 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 100 | 18,5167 | 32 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 101 | 11,4335 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 102 | 21,4740 | 37 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 103 | 12,2518 | 22 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 104 | 12,9878 | 23 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 105 | 4,2768 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 1 | 106 | 10,8321 | 19 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 107 | 9,2981 | 22 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 108 | 8,9983 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 109 | 9,6854 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 110 | 6,7648 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 111 | 14,9080 | 27 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 112 | 7,5571 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 113 | 6,5084 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 114 | 9,8699 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 115 | 9,0456 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 116 | 3,1925 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 1 | 117 | 8,5843 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 118 | 3,0823 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 1 | 119 | 2,4976 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 1 | 120 | 11,4178 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 121 | 17,3976 | 30 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 122 | 8,7557 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 123 | 2,6836 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 1 | 124 | 7,7947 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 125 | 7,4889 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 126 | 6,1029 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 127 | 1,4620 | 15 | 18,5 | 2 | 2,7 | 7,5 |
| 1 | 128 | 2,3767 | 15 | 18,5 | 3 | 4,0 | 5,0 |
| 1 | 129 | 18,9047 | 33 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 130 | 6,6925 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 131 | 11,0194 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 132 | 25,5104 | 44 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 133 | 7,0911 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 134 | 8,6159 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 135 | 2,4285 | 15 | 18,5 | 3 | 4,0 | 5,0 |
| 1 | 136 | 11,7716 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 137 | 10,0773 | 18 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 138 | 10,9518 | 20 | 17,5 | 10 | 13,3 | 1,5 |

| Piso | Hidrante | Superficie hidrante (ha) | Dotación (l/s) | Consumo teorico l/ha | Nº Posturas aspersión | Duración MAIZ (horas) | Grado de libertad real |
|---|---|---|---|---|---|---|---|
| 1 | 139 | 5,9359 | 15 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 140 | 10,8978 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 141 | 11,9446 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 142 | 8,7143 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 1 | 143 | 14,0415 | 25 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 144 | 14,0949 | 25 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 145 | 11,0763 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 146 | 3,6979 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 147 | 15,2609 | 27 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 150 | 17,9247 | 31 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 151 | 9,7691 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 152 | 26,2503 | 45 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 153 | 10,0509 | 18 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 154 | 4,7786 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 1 | 155 | 11,9097 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 156 | 3,3904 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 157 | 6,1967 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 158 | 13,7013 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 159 | 6,0812 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 160 | 12,4067 | 22 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 161 | 9,4315 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 162 | 11,5912 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 163 | 9,5215 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 164 | 19,6958 | 34 | 17,0 | 10 | 13,3 | 1,5 |
| 1 | 165 | 9,4579 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 166 | 9,4861 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 167 | 5,9777 | 15 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 169 | 9,7698 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 1 | 170 | 6,5279 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 171 | 7,9637 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 172 | 11,2569 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 173 | 7,6499 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 174 | 5,2981 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 175 | 3,8930 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 1 | 176 | 6,1156 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 177 | 11,4225 | 20 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 178 | 7,5678 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 1 | 179 | 5,0314 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 180 | 10,2861 | 19 | 17,5 | 10 | 13,3 | 1,5 |
| 1 | 181 | 5,6940 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 1 | 182 | 1,9848 | 15 | 18,5 | 3 | 4,0 | 5,0 |

| Piso | Hidrante | Superficie hidrante (ha) | Dotación (l/s) | Consumo teorico l/ha | Nº Posturas aspersión | Duración MAIZ (horas) | Grado de libertad real |
|---|---|---|---|---|---|---|---|
| 2 | 201 | 6,3360 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 2 | 202 | 5,5832 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 2 | 203 | 2,9144 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 2 | 204 | 8,6905 | 18 | 18,0 | 9 | 12,0 | 1,7 |
| 2 | 205 | 2,4463 | 15 | 18,5 | 4 | 5,3 | 3,8 |
| 2 | 206 | 1,5806 | 15 | 18,5 | 2 | 2,7 | 7,5 |
| 2 | 207 | 1,8563 | 15 | 18,5 | 3 | 4,0 | 5,0 |
| 2 | 208 | 23,6848 | 41 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 209 | 11,7365 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 2 | 210 | 7,2307 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 2 | 211 | 7,4112 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 2 | 212 | 16,7606 | 29 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 213 | 7,8902 | 18 | 18,0 | 8 | 10,7 | 1,9 |
| 2 | 214 | 32,4010 | 56 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 215 | 33,8796 | 58 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 216 | 38,1955 | 66 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 217 | 5,2239 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 2 | 218 | 11,6127 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 2 | 219 | 4,4747 | 15 | 18,5 | 6 | 8,0 | 2,5 |
| 2 | 220 | 13,3642 | 24 | 17,5 | 10 | 13,3 | 1,5 |
| 2 | 221 | 3,9831 | 15 | 18,5 | 5 | 6,7 | 3,0 |
| 2 | 222 | 24,1372 | 42 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 223 | 5,7233 | 15 | 18,0 | 7 | 9,3 | 2,1 |
| 2 | 224 | 14,2432 | 25 | 17,5 | 10 | 13,3 | 1,5 |
| 2 | 225 | 6,9973 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 2 | 226 | 6,9760 | 18 | 18,0 | 7 | 9,3 | 2,1 |
| 2 | 227 | 11,7676 | 21 | 17,5 | 10 | 13,3 | 1,5 |
| 2 | 228 | 9,8415 | 18 | 18,0 | 10 | 13,3 | 1,5 |
| 2 | 229 | 16,4461 | 29 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 230 | 24,4890 | 42 | 17,0 | 10 | 13,3 | 1,5 |
| 2 | 231 | 6,6922 | 18 | 18,0 | 7 | 9,3 | 2,1 |

**Tabla 2.** Caudales de las tomas en hidrantes compartidos

| Piso | Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Caudal toma (l/s) | DN toma (mm) |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 7.535 | 15 | 100 | 15,0 | 80 |
| 1 | 1 | 2 | 4.003 | 15 | 100 | 10,0 | 80 |
| 1 | 1 | 3 | 33.361 | 15 | 100 | 15,0 | 80 |
| 1 | 1 | 4 | 9.560 | 15 | 100 | 15,0 | 80 |
| 1 | 1 | 5 | 3.008 | 15 | 100 | 10,0 | 80 |
| 1 | 6 | 1 | 2.108 | 15 | 100 | 5,0 | 50 |
| 1 | 6 | 2 | 852 | 15 | 100 | 5,0 | 50 |
| 1 | 6 | 3 | 1.344 | 15 | 100 | 5,0 | 50 |
| 1 | 6 | 4 | 23.704 | 15 | 100 | 15,0 | 80 |
| 1 | 6 | 5 | 1.075 | 15 | 100 | 5,0 | 50 |
| 1 | 6 | 6 | 13.472 | 15 | 100 | 15,0 | 80 |
| 1 | 10 | 1 | 8.515 | 15 | 100 | 15,0 | 80 |
| 1 | 10 | 2 | 6.920 | 15 | 100 | 15,0 | 80 |
| 1 | 10 | 3 | 1.840 | 15 | 100 | 5,0 | 50 |
| 1 | 10 | 4 | 1.481 | 15 | 100 | 5,0 | 50 |
| 1 | 10 | 5 | 644 | 15 | 100 | 5,0 | 50 |
| 1 | 10 | 6 | 979 | 15 | 100 | 5,0 | 50 |
| 1 | 11 | 1 | 30.918 | 15 | 100 | 15,0 | 80 |
| 1 | 11 | 2 | 19.943 | 15 | 100 | 15,0 | 80 |
| 1 | 20 | 1 | 43.623 | 18 | 100 | 18,0 | 100 |
| 1 | 20 | 2 | 27.184 | 18 | 100 | 15,0 | 80 |
| 1 | 21 | 1 | 35.180 | 18 | 100 | 15,0 | 80 |
| 1 | 21 | 2 | 36.778 | 18 | 100 | 15,0 | 80 |
| 1 | 21 | 3 | 3.759 | 18 | 100 | 10,0 | 80 |
| 1 | 29 | 1 | 19.216 | 15 | 100 | 15,0 | 80 |
| 1 | 29 | 2 | 32.431 | 15 | 100 | 15,0 | 80 |
| 1 | 31 | 1 | 11.501 | 15 | 100 | 15,0 | 80 |
| 1 | 31 | 2 | 16.974 | 15 | 100 | 15,0 | 80 |
| 1 | 33 | 1 | 9.194 | 15 | 100 | 15,0 | 80 |
| 1 | 33 | 2 | 38.098 | 15 | 100 | 15,0 | 80 |
| 1 | 36 | 1 | 41.201 | 18 | 100 | 18,0 | 100 |
| 1 | 36 | 2 | 19.793 | 18 | 100 | 15,0 | 80 |
| 1 | 40 | 1 | 54.903 | 18 | 100 | 18,0 | 100 |
| 1 | 40 | 2 | 18.248 | 18 | 100 | 15,0 | 80 |
| 1 | 44 | 1 | 11.916 | 15 | 100 | 15,0 | 80 |
| 1 | 44 | 2 | 8.737 | 15 | 100 | 15,0 | 80 |
| 1 | 46 | 1 | 14.720 | 18 | 100 | 15,0 | 80 |
| 1 | 46 | 2 | 61.701 | 18 | 100 | 18,0 | 100 |
| 1 | 92 | 1 | 6.046 | 15 | 100 | 15,0 | 80 |
| 1 | 92 | 2 | 18.972 | 15 | 100 | 15,0 | 80 |

| Piso | Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Caudal toma (l/s) | DN toma (mm) |
|---|---|---|---|---|---|---|---|
| 1 | 92 | 3 | 9.284 | 15 | 100 | 15,0 | 80 |
| 1 | 93 | 1 | 22.203 | 15 | 100 | 15,0 | 80 |
| 1 | 93 | 2 | 29.122 | 15 | 100 | 15,0 | 80 |
| 1 | 94 | 1 | 17.034 | 15 | 100 | 15,0 | 80 |
| 1 | 94 | 2 | 7.573 | 15 | 100 | 15,0 | 80 |
| 1 | 94 | 3 | 4.325 | 15 | 100 | 10,0 | 80 |
| 1 | 94 | 4 | 5.395 | 15 | 100 | 15,0 | 80 |
| 1 | 94 | 5 | 12.250 | 15 | 100 | 15,0 | 80 |
| 1 | 95 | 1 | 6.117 | 15 | 100 | 15,0 | 80 |
| 1 | 95 | 2 | 9.004 | 15 | 100 | 15,0 | 80 |
| 1 | 95 | 3 | 14.561 | 15 | 100 | 15,0 | 80 |
| 1 | 95 | 4 | 7.524 | 15 | 100 | 15,0 | 80 |
| 1 | 112 | 1 | 62.712 | 18 | 100 | 18,0 | 100 |
| 1 | 112 | 2 | 12.859 | 18 | 100 | 15,0 | 80 |
| 1 | 118 | 1 | 2.160 | 15 | 100 | 5,0 | 50 |
| 1 | 118 | 2 | 2.265 | 15 | 100 | 5,0 | 50 |
| 1 | 118 | 3 | 15.760 | 15 | 100 | 15,0 | 80 |
| 1 | 118 | 4 | 2.145 | 15 | 100 | 5,0 | 50 |
| 1 | 118 | 5 | 2.745 | 15 | 100 | 5,0 | 50 |
| 1 | 118 | 6 | 2.143 | 15 | 100 | 5,0 | 50 |
| 1 | 118 | 7 | 1.670 | 15 | 100 | 5,0 | 50 |
| 1 | 118 | 8 | 1.935 | 15 | 100 | 5,0 | 50 |
| 1 | 119 | 1 | 4.248 | 15 | 100 | 10,0 | 80 |
| 1 | 119 | 2 | 2.307 | 15 | 100 | 5,0 | 50 |
| 1 | 119 | 3 | 2.158 | 15 | 100 | 5,0 | 50 |
| 1 | 119 | 4 | 4.064 | 15 | 100 | 10,0 | 80 |
| 1 | 119 | 5 | 4.084 | 15 | 100 | 10,0 | 80 |
| 1 | 119 | 6 | 5.601 | 15 | 100 | 15,0 | 80 |
| 1 | 119 | 7 | 2.514 | 15 | 100 | 5,0 | 50 |
| 1 | 123 | 1 | 3.376 | 15 | 100 | 10,0 | 80 |
| 1 | 123 | 2 | 6.941 | 15 | 100 | 15,0 | 80 |
| 1 | 123 | 3 | 5.344 | 15 | 100 | 15,0 | 80 |
| 1 | 123 | 4 | 2.044 | 15 | 100 | 5,0 | 50 |
| 1 | 123 | 5 | 2.091 | 15 | 100 | 5,0 | 50 |
| 1 | 123 | 6 | 1.952 | 15 | 100 | 5,0 | 50 |
| 1 | 123 | 7 | 2.324 | 15 | 100 | 5,0 | 50 |
| 1 | 123 | 8 | 2.764 | 15 | 100 | 10,0 | 80 |
| 1 | 125 | 1 | 24.896 | 18 | 100 | 15,0 | 80 |
| 1 | 125 | 2 | 49.993 | 18 | 100 | 18,0 | 100 |
| 1 | 126 | 1 | 31.618 | 18 | 100 | 18,0 | 100 |
| 1 | 126 | 2 | 23.012 | 18 | 100 | 15,0 | 80 |
| 1 | 126 | 3 | 6.399 | 18 | 100 | 15,0 | 80 |

| Piso | Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Caudal toma (l/s) | DN toma (mm) |
|---|---|---|---|---|---|---|---|
| 1 | 127 | 1 | 1.341 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 2 | 2.356 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 3 | 1.889 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 4 | 1.509 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 5 | 1.965 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 6 | 2.018 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 7 | 1.862 | 15 | 100 | 5,0 | 50 |
| 1 | 127 | 8 | 1.680 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 1 | 2.400 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 2 | 2.556 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 3 | 4.202 | 15 | 100 | 10,0 | 80 |
| 1 | 128 | 4 | 1.500 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 5 | 2.600 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 6 | 1.330 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 7 | 2.225 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 8 | 2.153 | 15 | 100 | 5,0 | 50 |
| 1 | 128 | 9 | 4.801 | 15 | 100 | 10,0 | 80 |
| 1 | 146 | 1 | 36.979 | 15 | 100 | 15,0 | 80 |
| 1 | 159 | 1 | 21.303 | 18 | 100 | 15,0 | 80 |
| 1 | 159 | 2 | 14.228 | 18 | 100 | 15,0 | 80 |
| 1 | 159 | 3 | 25.281 | 18 | 100 | 15,0 | 80 |
| 1 | 179 | 1 | 32.813 | 15 | 100 | 15,0 | 80 |
| 1 | 179 | 2 | 17.501 | 15 | 100 | 15,0 | 80 |
| 2 | 201 | 1 | 45.644 | 18 | 100 | 15,0 | 80 |
| 2 | 201 | 2 | 17.716 | 18 | 100 | 15,0 | 80 |
| 2 | 203 | 1 | 1.258 | 15 | 100 | 5,0 | 50 |
| 2 | 203 | 2 | 11.700 | 15 | 100 | 15,0 | 80 |
| 2 | 203 | 3 | 14.669 | 15 | 100 | 15,0 | 80 |
| 2 | 203 | 4 | 1.517 | 15 | 100 | 5,0 | 50 |
| 2 | 205 | 1 | 21.306 | 15 | 100 | 15,0 | 80 |
| 2 | 205 | 2 | 1.464 | 15 | 100 | 5,0 | 50 |
| 2 | 205 | 3 | 1.693 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 1 | 8.978 | 15 | 100 | 15,0 | 80 |
| 2 | 206 | 2 | 1.300 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 3 | 1.000 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 4 | 758 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 5 | 500 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 6 | 700 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 7 | 1.220 | 15 | 100 | 5,0 | 50 |
| 2 | 206 | 8 | 1.350 | 15 | 100 | 5,0 | 50 |
| 2 | 207 | 1 | 3.819 | 15 | 100 | 10,0 | 80 |
| 2 | 207 | 2 | 14.744 | 15 | 100 | 15,0 | 80 |

| Piso | Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Caudal toma (l/s) | DN toma (mm) |
|---|---|---|---|---|---|---|---|
| 2 | 219 | 1 | 14.302 | 15 | 100 | 15,0 | 80 |
| 2 | 219 | 2 | 30.445 | 15 | 100 | 15,0 | 80 |
| 2 | 227 | 1 | 90.756 | 21 | 100 | 18,0 | 100 |
| 2 | 227 | 2 | 20.162 | 21 | 100 | 15,0 | 80 |

# ANEJO Nº 7.- ESTUDIO GEOTÉCNICO

# *ESTUDIO GEOTÉCNICO PARA EL PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TTMM DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA).*

**PETICIONARIO**: CINCRAL, S.L.

**INFORME**: 0673

**FECHA INFORME**: MAYO 2021

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# 1. ANTECEDENTES

La empresa CINGRAL, S.L. encarga a IGEOSUMA, S.L. la realización de un estudio geotécnico para el proyecto de “Modernización integral del regadío de la Comunidad de Regantes de Santa Ana, en los TTMM de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta (Huesca)”.

En el proyecto se contempla la construcción de cuatro balsas de almacenamiento de agua, una estación de bombeo y la colocación de una red de tuberías en todo el ámbito de la zona regable.

La investigación geológica-geotécnica y los ensayos de campo se han individualizado para cada uno de los tipos de actuación, realizándose una campaña de investigación geotécnica específica para cada una de las actuaciones antes indicadas.

El estudio ha consistido en la recopilación bibliográfica, en el reconocimiento geológico por técnicos cualificados de la zona en la que se ubicarán los elementos de obra antes indicados y en la valoración geotécnica del terreno, basada en los datos geológicos tomados durante el reconocimiento y en los obtenidos a partir los ensayos geotécnicos de campo y ensayos de laboratorio ejecutados.

Durante la realización de las calicatas sobre un diseño inicial (febrero de 2021) de la balsa pie de canal (V4) se detectó, en una parte de la misma, que el terreno planteaba una problemática geotécnica muy significativa debido a la existencia de suelos blandos fruto de la saturación de los mismos debido a la presencia de un nivel de agua próximo a superficie.

Esta problemática obligó a un replanteo de la forma de esta balsa de pie de canal V4 y una nueva campaña de calicatas, y paralelamente se realizaron calicatas adicionales en emplazamientos alternativos señalados por el peticionario. Finalmente, en el proyecto se consideró la realización de dos balsas de pie de canal, la V4 y la V10.

También fruto de la modificación en la forma y tamaño de la balsa elevada 1, fue necesario aumentar la campaña de reconocimiento de la misma, sobre la prevista para el diseño inicial de febrero de 2021.

Los ensayos geotécnicos han consistido en la realización de:

- 8 sondeos (de entre 8 a 8,4 m de profundidad y con un total de 65,7 metros perforados). Se distribuyeron de la siguiente manera: 1 en la balsa elevada-2 (BE2-S1), 2 en la balsa elevada-1 (BE1-S1 y BE1-S2), 2 en la balsa de pie de canal V4 (BP-S1 y BP-S2), 2 en la balsa de pie de canal V10 (BPV10-S1 y BPV10-S2) y 1 en la estación de bombeo situada al pie de la balsa V4 (EB-S1).

Durante la ejecución de los sondeos se han realizado ensayos de resistencia dinámica S.P.T. y se han tomado muestras inalteradas y testigos parafinados.

- 8 ensayos de penetración dinámica tipo DPSH, distribuidos de la siguiente forma: 2 en la balsa elevada-1 (BE1-P1 y BE1-P2), 2 en la estación de bombeo (EB-P1 y EB-P2) y cuatro en algunos de los cruces de la red de tuberías bajo infraestructuras (RR-P1 a RR-P4).

- 79 calicatas de reconocimiento: 5 en la balsa elevada 2 (BE2-C1 a C5); 8 en la balsa elevada 1 (BE1-C1 a BE1-C8); 27 en la balsa de pie de canal V4 (BP-C1 a BP-C27), de ellas solo las calicatas 1, 2, 3, 9, 10, 11, 13 y 27 quedaron en la zona de la balsa V4 en su diseño final; 4 en la balsa de pie de canal V10 (BPV10-C1 a BPV10-C4); 25 en la red de tuberías-riego (RR-C1 a RR-C25) y 10 calicatas en posiciones de balsas que fueron descartadas, concretamente 4 en la balsa V7 (BPV7-C1 a BPV7-C4), 3 en la balsa alternativa 1 (BPALT1-C1 a BPALT1-C3) y 3 en la balsa alternativa 2 (BPALT2-C1 a BPALT2-C3).

Durante la ejecución de las calicatas fueron tomadas muestras de los diferentes terrenos reconocidos.

En el anejo I (CROQUIS DE SITUACIÓN ENSAYOS) se recoge la ubicación de los ensayos geotécnicos realizados para cada uno de las zonas estudiadas.

En las tablas adjuntas en la página siguiente, se resumen las coordenadas de todos los ensayos realizados.

Sobre las muestras tomadas en los sondeos y las calicatas, y para cada uno de los tipos o grupos de materiales reconocidos, se realizaron los correspondientes ensayos de laboratorio cuyos resultados se reflejan y resumen en el capítulo 4.2 del presente informe, y se adjuntan en el anejo V de “BOLETINES DE ENSAYOS DE LABORATORIO”.

Los objetivos de los trabajos y del presente informe son:

- Para las balsas, definir la aptitud de los terrenos existentes para su construcción (capacidad portante, permeabilidad, etc.) así como la posibilidad de aprovechamiento de los materiales que se excavan, su ripabilidad, estabilidad, la presencia o no de nivel freático y detectar la problemática geotécnica que pudiera existir y que condicione la excavación, cimentación y puesta en obra de los materiales.

- Para la estación de bombeo, definir las características portantes del terreno, tipo de cimentación, estabilidad de las excavaciones, agresividad y otros aspectos geotécnicos condicionantes, y en general detectar cualquier problemática geotécnica que pudiera existir para su construcción.

- En la red de tuberías se busca definir la consistencia de los materiales para su excavación, la presencia o no de nivel freático que condicione la puesta en obra de las conducciones, valorar la necesidad o no de entibación a la vista de las características del suelo y su comportamiento en corte vertical, y definir si los materiales excavados son aptos para el posterior relleno de las zanjas.

| UNIDAD DE OBRA | TIPO ENSAYO | REFERENCIA ENSAYO | COORDENADAS UTM (ETRS 89) Huso 30 T | | COTA, Z (m); (De plano topográfico) |
|---|---|---|---|---|---|
| | | | X (m) | Y (m) | |
| BALSA ELEVADA 2 | CALICATA | BE2_C1 | 704152 | 4644508 | 444,5 |
| | | BE2_C2 | 704124 | 4644456 | 446,5 |
| | | BE2_C3 | 704155 | 4644386 | 445 |
| | | BE2_C4 | 704204 | 4644434 | 441 |
| | | BE2_C5 | 704159 | 4644440 | 443,5 |
| | SONDEO | BE2_S1 | 704209 | 4644485 | 440,5 |
| BALSA ELEVADA 1 | CALICATA | BE1_C1 | 705179 | 4644784 | 426 |
| | | BE1_C2 | 705074 | 4644768 | 428 |
| | | BE1_C3 | 705031 | 4644641 | 427,5 |
| | | BE1_C4 | 705127 | 4644621 | 425,5 |
| | | BE1_C5 | 705090 | 4644704 | 427 |
| | | BE1_C6 | 705221 | 4644678 | 423 |
| | | BE1_C7 | 704925 | 4644573 | 427 |
| | | BE1_C8 | 704890 | 4644675 | 428 |
| | SONDEO | BE1_S1 | 704972 | 4644718 | 429,5 |
| | | BE1_S2 | 705165 | 4644689 | 425 |
| | DPSH | BE1_P1 | 705241 | 4644740 | 422,5 |
| | | BE1_P2 | 705030 | 4644591 | 423 |
| ESTACIÓN DE BOMBEO | SONDEO | EB-S1 | 705924 | 4645181 | 383,3 |
| | DPSH | EB-P1 | 705924 | 4645157 | 383 |
| | | EB-P2 | 705897 | 4645202 | 383,8 |
| BALSA PIE CANAL V4 | CALICATA (Sombreadas las calicatas incluidas en el diseño final) | BP_C1 | 705741 | 4645179 | 388 |
| | | BP_C2 | 705617 | 4645168 | 390 |
| | | BP_C3 | 705616 | 4645074 | 390 |
| | | BP_C4 | 705724 | 4644891 | 388,5 |
| | | BP_C5 | 705818 | 4644910 | 388 |
| | | BP_C6 | 705760 | 4644977 | 387,5 |
| | | BP_C7 | 705874 | 4645009 | 386 |
| | | BP_C8 | 705777 | 4645061 | 387,5 |
| | | BP_C9 | 705784 | 4645141 | 387 |
| | | BP_C10 | 705705 | 4645111 | 388,5 |
| | | BP_C11 | 705871 | 4645193 | 384,5 |
| | | BP_C12 | 706076 | 4645186 | 383 |
| | | BP_C13 | 705849 | 4645109 | 385,5 |
| | | BP_C14 | 705995 | 4645177 | 383 |
| | | BP_C15 | 705989 | 4645124 | 383,3 |
| | | BP_C16 | 705886 | 4645080 | 385 |
| | | BP_C17 | 705840 | 4645050 | 386 |
| | | BP_C18 | 705800 | 4645028 | 387 |
| | | BP_C19 | 705742 | 4645010 | 387,7 |
| | | BP_C20 | 705682 | 4644954 | 389 |
| | | BP_C21 | 705661 | 4644959 | 389 |
| | | BP_C22 | 705704 | 4644992 | 388,5 |
| | | BP_C23 | 705728 | 4645026 | 388 |
| | | BP_C24 | 705773 | 4645041 | 387,5 |
| | | BP_C25 | 705828 | 4645074 | 386,5 |
| | | BP_C26 | 705929 | 4645115 | 384,5 |
| | | BP_C27 | 705769 | 4645088 | 387 |
| | SONDEO | BP_S1 | 705615 | 4645122 | 390 |
| | | BP_S2 | 705886 | 4645155 | 384 |
| BALSA PIE DE CANAL V10 | CALICATA | BPV10_C1 | 705661 | 4645275 | 389 |
| | | BPV10_C2 | 705845 | 4645478 | 387 |
| | | BPV10_C3 | 705768 | 4645376 | 387,5 |
| | | BPV10_C4 | 705708 | 4645473 | 390 |
| | SONDEO | BPV10_S1 | 705818 | 4645428 | 387,3 |
| | | BPV10_S2 | 705665 | 4645391 | 389 |

| UNIDAD DE OBRA | TIPO ENSAYO | REFERENCIA ENSAYO | COORDENADAS UTM (ETRS 89) Huso 30 T | |
|---|---|---|---|---|
| | | | X (m) | Y (m) |
| RED DE RIEGO | CALICATA | RR_C-1 | 706722 | 4643839 |
| | | RR_C-2 | 707196 | 4644421 |
| | | RR_C-3 | 706873 | 4644518 |
| | | RR_C-4 | 705984 | 4645007 |
| | | RR_C-5 | 706319 | 4645833 |
| | | RR_C-6 | 706447 | 4646804 |
| | | RR_C-7 | 705745 | 4647570 |
| | | RR_C-8 | 706908 | 4644852 |
| | | RR_C-9 | 707471 | 4644940 |
| | | RR_C-10 | 707599 | 4645960 |
| | | RR_C-11 | 707133 | 4647505 |
| | | RR_C-12 | 707184 | 4648518 |
| | | RR_C-13 | 708826 | 4645177 |
| | | RR_C-14 | 710449 | 4645457 |
| | | RR_C-15 | 711637 | 4645924 |
| | | RR_C-16 | 712522 | 4644988 |
| | | RR_C-17 | 711123 | 4647970 |
| | | RR_C-18 | 709485 | 4646526 |
| | | RR_C-19 | 710324 | 4646269 |
| | | RR_C-20 | 711309 | 4646546 |
| | | RR_C-21 | 708823 | 4646998 |
| | | RR_C-22 | 709210 | 4647955 |
| | | RR_C-23 | 707979 | 4648314 |
| | | RR_C-24 | 710119 | 4648704 |
| | | RR_C-25 | 710216 | 4647643 |
| | DPSH | RR_P1 | 707220 | 4644433 |
| | | RR_P2 | 706281 | 4645826 |
| | | RR_P3 | 706436 | 4646802 |
| | | RR_P4 | 705777 | 4647571 |

| UNIDAD DE OBRA | TIPO ENSAYO | REFERENCIA ENSAYO | COORDENADAS UTM (ETRS 89) Huso 30 T | | COTA, Z (m); (De plano topográfico) |
|---|---|---|---|---|---|
| | | | X (m) | Y (m) | |
| BALSA PIE DE CANAL V7 (Descartada) | CALICATA | BPV7_C1 | 705756 | 4645591 | 388 |
| | | BPV7_C2 | 705902 | 4645530 | 385 |
| | | BPV7_C3 | 705946 | 4645635 | 385 |
| | | BPV7_C4 | 705837 | 4645763 | 388,5 |
| BALSA PIE DE CANAL ALTERNATIVA 1 (Descartada) | CALICATA | BPALT1_C1 | 706822 | 4643884 | 384,2 |
| | | BPALT1_C2 | 706840 | 4644143 | 387 |
| | | BPALT1_C3 | 706664 | 4644055 | 389 |
| BALSA PIE DE CANAL ALTERNATIVA 2 (Descartada) | CALICATA | BPALT2_C1 | 706864 | 4643720 | 382,5 |
| | | BPALT2_C2 | 706834 | 4643475 | 384,5 |
| | | BPALT2_C3 | 706627 | 4643526 | 386,5 |

## 2. SITUACIÓN GEOGRÁFICA

La zona de estudio se encuadra entre las localidades de Tardienta, Senés de Alcubierre y Torres de Barbués-Almuniente. En la figura adjunta (tomada de Google Earth) se refleja la situación de la zona de actuación (en rojo) y se muestran las principales vías de acceso.

Desde el punto de vista topográfico la zona de estudio se ubica en una zona que se caracteriza por presentar relieves suaves o de poca altitud y áreas más o menos planas.

## 3. SITUACIÓN GEOLÓGICA

### 3.1.- ENCUADRE GEOLÓGICO GENERAL

La zona de estudio, en lo que respecta a los planos geológicos de España serie Magna (Escala 1:50000), se dispone mayoritariamente dentro de la hoja nº 324 (Grañén) y el extremo oeste de la misma alcanza la hoja nº323 (Zuera).

Geológicamente la zona estudiada se sitúa en la parte septentrional de la Depresión del Ebro, cuenca de antepaís meridional de la Cadena Pirenaica. Las primeras estribaciones de esta cordillera son las Sierras Exteriores que se localizan a unos 30 kilómetros al norte y noreste de la zona de actuación.

Esta cuenca se encuentra limitada por los relieves pirenaicos, ibéricos y costero-catalanes. Estos relieves conforman la Depresión en un perímetro triangular que tiene sus vértices en Logroño, Valderrobles (Teruel) y Vic (Barcelona), conectando únicamente con otra cuenca terciaria, la del Duero, por la franja deprimida situada entre la Sierra de la Demanda y la Sierra de Cantabria (La Bureba). Ver figura adjunta.

Corresponde a los últimos estadios de evolución de la cuenca de antepaís meridional del orógeno pirenaico relacionada también con las otras cordilleras que la circundan: los Catalánides, por el SE y la Cordillera Ibérica por el SO. De esta forma, desde el Oligoceno, hasta la actualidad, ha actuado como centro de depósito de materiales continentales procedentes del desmantelamiento de las cordilleras citadas.

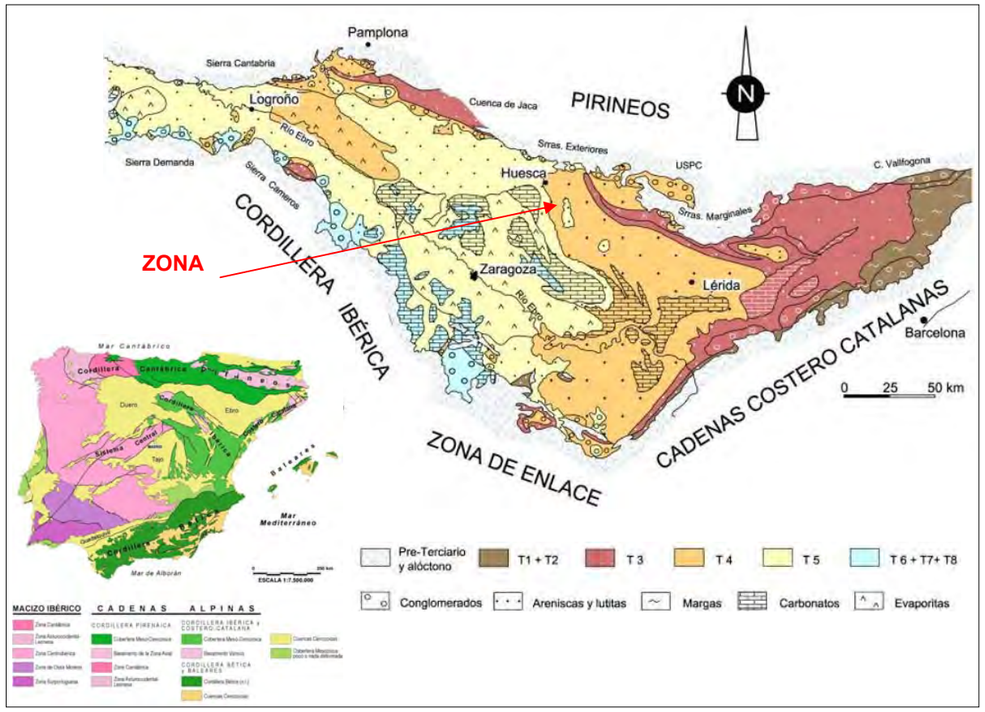



Figura.- Situación Geológica general dentro de la Depresión terciaria del Ebro de la Zona de Estudio
*(Fuente: Vera, J.A. Editor 2004, Geología en España SGE-IGME).*

Los materiales que configuran la zona estudiada y alrededores tienen una edad comprendida entre el Oligoceno superior y el Mioceno inferior, estando parcialmente recubiertos por sedimentos cuaternarios.

Esta zona presenta una geología muy sencilla, debido a que la deformación sufrida en los Pirineos, Cordillera Ibérica y Catalánides apenas se ha transmitido a este sector de la cuenca, lo que provoca que las capas de los sedimentos terciarios presenten unos buzamientos prácticamente horizontales.

Sobre estos materiales terciarios se implanta durante el Cuaternario la red fluvial actual, que da lugar a depósitos aluviales y coluviales compuestos fundamentalmente por materiales granulares. Consisten principalmente en varios niveles de terrazas, correspondientes a los ríos principales como el Flumen. También se encuentran depósitos poligénicos (aluvio-coluviales) que recubren los fondos de valle, laderas o constituyen glacis. Estos depósitos cuaternarios ocupan una importante extensión dentro de la zona de estudio.

### 3.2.- ESTRATIGRAFÍA

Consultadas las dos hojas geológicas en las que se sitúa la zona de estudio (323 y 324) se reconoce que aunque existe un buen solape entre ambas, no existe una misma nomenclatura entre las unidades solapadas.

A la vista de ello se ha optado por utilizar el mapa geológico continuo que refleja la página web del IGME y que unifica la subdivisión de las unidades cartográficas de las hojas MAGNA. A partir de él se ha elaborado la figura adjunta en la que se identifican los diferentes recubrimientos cuaternarios y las diversas unidades litoestratigráficas del sustrato rocoso Terciario, que se extienden en el ámbito de la actuación proyectada. En dicha figura, se marcan las unidades cartográficas determinadas en el entorno y su equivalencia con las leyendas de las hojas MAGNA.

*MATERIALES DEL TERCIARIO*

Los materiales que configuran la zona estudiada tienen una edad miocena y las unidades cartográficas en las que se han agrupado son las siguientes:

**. Unidad cartográfica 131.**

Es equivalente a la UC 2 de la hoja 324 y no aparece en la hoja 323. Se incluye en Fm. de Sariñena (QUIRANTES, 1970-71a). El espesor aflorante en la Hoja es de aproximadamente 600 m. Tiene una edad Ageniense (Mioceno).

Está formada por lutitas, limos y areniscas finas entre las que se intercalan paleocanales arenosos aislados, con espesores de 2-5 metros y una continuidad lateral de decenas de metros (máximo 100 m). Tienen en general una base erosiva laxa e internamente muestran superficies de acreción lateral y barras con estratificación cruzada y en surco. Las facies de llanura aluvial son muy abundantes y consisten en lutitas y arenas finas, arcillas limolíticas grises con capas de calizas. Los niveles carbonáticos están formados por calizas mudstone-wackestone de color gris-azulado, con continuidad lateral kilométrica y espesor centimétrico (2-15 cm). Contienen restos de gasterópodos, carófitas, ostrácodos y bivalvos. A techo muestran bioturbación por raíces. Dentro de esta unidad, se encuentra un nivel volcanoclástico.

Se interpreta como una facies de llanura aluvial distal de un sistema fluvial. Las intercalaciones de calizas lacustres en su parte superior se depositaron en depresiones extensas y poco profundas en la zona marginal del sistema fluvial.

**. Unidad cartográfica 142**

Es equivalente a la UC 3 de la hoja 324 y a la UC 4 de la hoja 323. Para este caso se ha considerado la descripción asociada a la UC 4 de la hoja 323.

Está formado por una alternancia de margas grises y yesos tabulares y nodulares. Tiene una edad Ageniense-Aragoniense (Mioceno) y se incluye dentro de la Unidad Bujaraloz-Sariñena.

Las margas son yesíferas y en ocasiones laminadas. Los yesos se disponen en niveles tabulares de espesor centimétrico a decimétrico (máximo de 150 cm). Poseen un aspecto micronodular y texturas alabastrinas. Los yesos también pueden aparecer entre las margas como nódulos centimétricos de textura alabastrina.

Se interpreta como un depósito de playa lake.

**Unidad cartográfica 143**

Es equivalente a la UC 3 de la hoja 323.

Está formado por una alternancia de arcillas grisáceas con yesos nodulares y niveles tabulares de yeso nodular con algunos paleocanales de areniscas. Tiene una edad Ageniense-Aragoniense y se incluye dentro de la Unidad Bujaraloz-Sariñena.

Los niveles de areniscas aparecen intercalados ente las arcillas, son de espesores de hasta 0,5-0,6 m, y poseen abundante yeso como cemento. Los yesos son nodulares y lenticulares, se encuentran entre las arcillas y las areniscas, y en algunos casos definen niveles continuos de aspecto tabular.

Representa un ambiente de tránsito entre un medio aluvial distal y el margen de lago salino (playa lake).

**Unidad cartográfica 147**

En la hoja 324, al igual que la UC 142, es también equivalente a la UC3. Se ha considerado la descripción asociada a esta unidad UC-3 de esta hoja.

En el mapa previo de Grañén de QUIRANTES (1970-71a), parte de la unidad fue incluida en la Fm. de Alcubierre. En cambio en la Hoja de Zuera, esta unidad fue incluida por QUIRANTES (1970-71b) en la Fm. de Retuerta. Su espesor aflorante es aproximadamente de 275 m.

Está formada por yesos, lutitas, calizas laminadas y areniscas de edad. Tiene una edad Ageniense-Aragoniense (Mioceno).

Las lutitas son de colores amarillos o grises y tienen intercalaciones de capas centimétricas a decimétricas de calizas y yesos nodulares y alabastrinos en ciclos métricos estratodecrecientes. Algunas litofacies menos abundantes son yesos laminares asociados a capas milimétricas de gypsarenitas. Las calizas son limolitas carbonáticas laminadas de color amarillo u ocre, a veces con laminaciones estromatolíticas.

Los tramos más lutíticos intercalan capas tabulares de arenas de grano medio a fino con ripples y limos. Localmente se observan canales de coloración gris-azulada, con escala métrica, cantos blandos en la base y relleno masivo. Ocasionalmente contienen restos de vertebrados.

Las facies de esta unidad corresponden a la zona terminal (llanura lutítico-evaporítica) de un sistema fluvial.

*MATERIALES DEL CUATERNARIO*

Los depósitos cuaternarios afloran ampliamente en la zona de estudio y corresponden a formaciones superficiales de génesis fluvial y poligénica, diferenciándose las siguientes unidades cartográficas:

**. Unidad cartográfica 206**

Es equivalente a la UC 6 de la hoja 324. Se trata de depósitos de Terrazas aluviales y está formado por gravas con arenas.

**. Unidad cartográfica 228**

Es equivalente a la UC 7 de la hoja 324 y a las unidades UC 25 y UC 28 de la hoja 323.

Corresponde con depósitos de glacis subactuales y glacis colgados. Está formado por gravas subangulosas de calizas con matriz areno-limosa, a veces arcillosa. Pueden presentar algunos cantos de yesos, y en los glacis más antiguos, cierto encostramiento por carbonatos. Entre las gravas aparecen intercalaciones de limos, arenas y arcillas.

**. Unidad cartográfica 224**

Es equivalente a la UC 10 de la hoja 324 y de la UC 32 de la hoja 323.

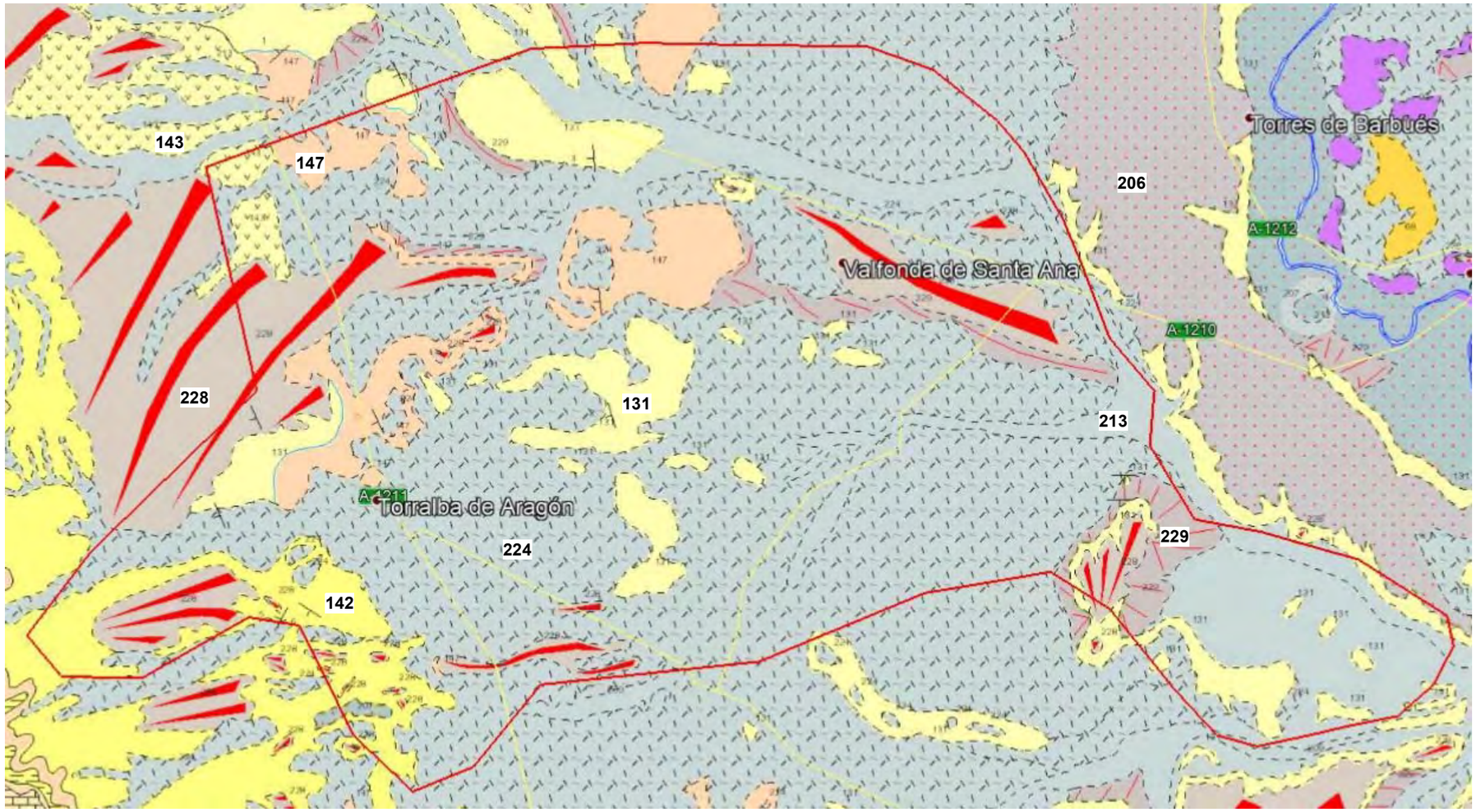
Son depósitos de tipo aluvio-coluvial. Están formados dominantemente por limos arcillosos algo arenosos con alguna delgada intercalación de gravas (hiladas) y/o con cantos dispersos procedentes de la erosión de terrazas y glacis.

**. Unidad cartográfica 229**

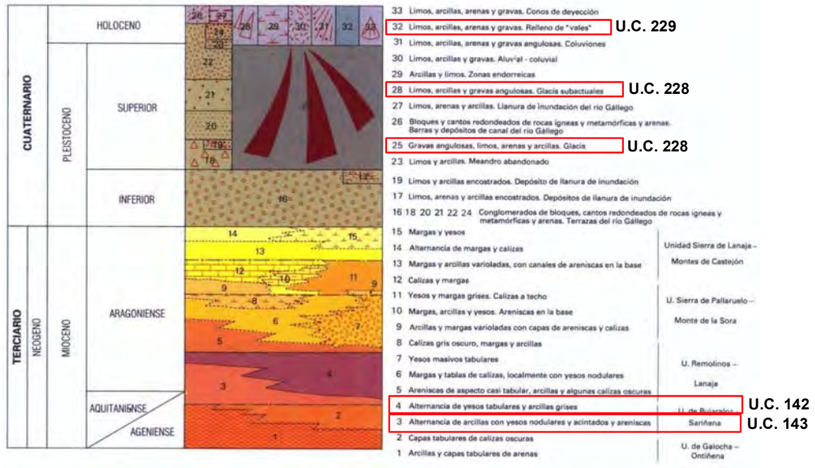
Es equivalente a la UC 11 de la hoja 324. Son depósitos coluviales que se disponen tapizando las laderas de los relieves más prominentes. Están formados por una mezcla heterogénea de gravas-cantos, arenas y limos.

**. Unidad cartográfica 213**

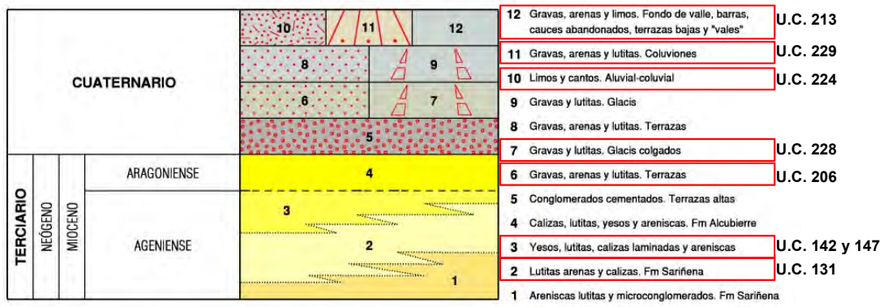
Es equivalente a la UC 12 de la hoja 324. Son depósitos de tipo aluvial de relleno de “vales”. Están formados por una mezcla variable de limos, arenas y gravas.




LEYENDA HOJA 323 "ZUERA"




LEYENDA HOJA 324 "GRAÑEN"



### 3.3.- TECTÓNICA – ESTRUCTURA GEOLÓGICA

Tal y como ya hemos indicado anteriormente los materiales que encontramos en la zona de estudio aparecen como dos conjuntos litológicos bien diferenciados que son los materiales terciarios de relleno de la Depresión del Ebro y los depósitos cuaternarios que los recubren.

La cuenca terciaria del Ebro constituye la cuenca de antepaís meridional de la Cordillera Pirenaica. Dicha cuenca está flanqueada por el SO y SE por las Cordilleras Ibérica y Costero Catalana, de menor importancia relativa en su evolución. Consecuentemente, los mapas de isobatas de la base del Terciario de la cuenca indican un incremento progresivo de profundidad hacia el margen pirenaico (RIBA *et al*., 1986). El substrato pre-terciario se encuentra inclinado hacia el N o NNE, hallándose a profundidades de 2.600 -3.000 m.

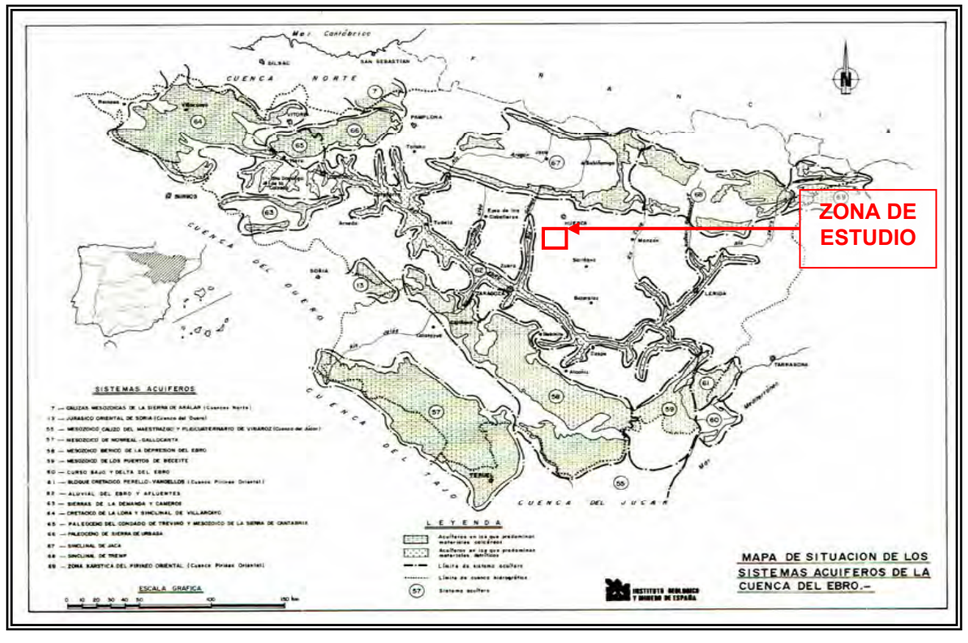
En el área estudiada, la estructura en superficie de los materiales terciarios es simple, de tipo monoclinal (con buzamientos hacia el SW que no sobrepasan los 2-5°) o con capas horizontales.

Así mismo, estas unidades terciarias generalmente presentan una red de diaclasamiento de tipo medio a baja, en donde puede reconocerse el sistema N-S (engloba direcciones NNW-SSE a NNE-SSW) y el sistema de dirección E-W, conjugada de la anterior, que incluiría un abanico de direcciones desde ENE-WSW hasta ESE-WNW.

### 3.4. HIDROGEOLOGÍA

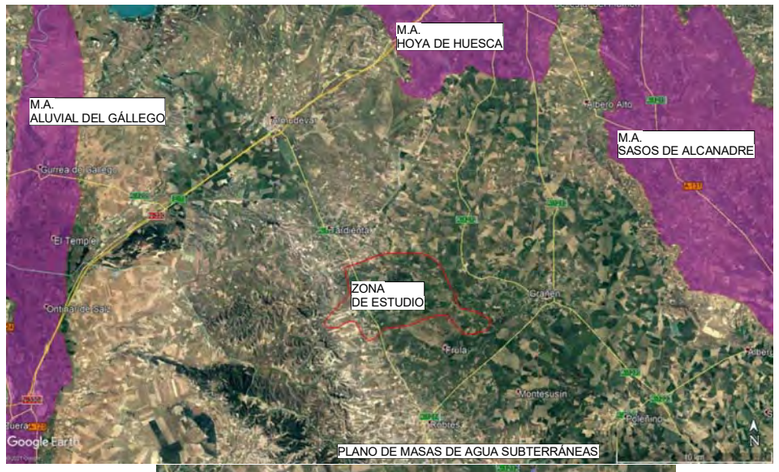
Hidrogeológicamente la zona de estudio queda encuadrada en el dominio hidrogeológico de la Depresión del Ebro (según división de la Confederación Hidrográfica del Ebro, abreviadamente CHE) o Cuenca del Ebro, según división del IGME (Instituto Geominero de España).

Concretando ese encuadre hidrogeológico y según el Instituto Geominero de España la zona investigada quedaría fuera de los sistemas acuíferos regionales, como queda reflejado en la figura siguiente.




Según la CHE, la zona concreta de estudio quedaría fuera de cualquier unidad acuífera regional o masa de agua subterránea definida en el dominio de la Depresión del Ebro, según reflejamos en la figura adjunta. También en dicha figura se ha incluido el inventario de puntos de agua subterránea que dispone la CHE en el entorno de la zona de estudio, observándose que no hay ninguno dentro del ámbito de la actuación.

PLANO DE UNIDADES HIDROGEOLÓGICAS




PLANO DE MASAS DE AGUA SUBTERRÁNEAS

INVENTARIO PUNTOS DE AGUA SUBTERRÁNEAS

En suma, en la zona de estudio se descarta la presencia de acuíferos regionales.

Las formaciones terciarias detectadas en la zona de estudio y alrededores se caracterizan por presentar una baja permeabilidad, y aunque los niveles carbonatados o detríticos más gruesos (arenas y areniscas) presentes dentro de alguna de estas formaciones pueden tener cierta permeabilidad que facilita alguna acumulación local de agua, ésta es, en general, de muy reducida magnitud debido sobre todo en nuestro caso a que quedan intercalados dentro de las argilitas claramente impermeables y tienen una baja continuidad lateral. No obstante y como se ha observado en algunos de los sondeos y calicatas, existen acumulaciones locales de agua dentro de estas formaciones, en relación con las discontinuidades existentes en las mismas, que generan rezumes de variable entidad.

Los recubrimientos cuaternarios están formados principalmente por materiales arcillosos, limosos y arenosos que presentan a grandes rasgos una baja permeabilidad, siendo susceptibles de poseer niveles de acumulación locales de agua con un funcionamiento de acuífero de tipo libre, si bien estos recubrimientos presentan en general un escaso interés hidrogeológico debido al escaso espesor que presentan. La acumulación de agua en estos niveles se debe principalmente a la diferente permeabilidad entre estos recubrimientos y el sustrato rocoso, que determina básicamente su acumulación inmediatamente por encima del contacto.

La alimentación de estos niveles locales de agua en los recubrimientos cuaternarios asi como en las formaciones terciarias está relacionada con las precipitaciones, escorrentía y riego tanto el excedente del mismo como el procedente de fugas de acequias, canales o el conducido por las zanjas de drenaje (azarbes) existentes.

Dado este esquema hidrogeológico es esperable una variabilidad destacable tanto en la presencia o no de agua como en la profundidad de aparición de la misma como pudo comprobarse en los sondeos y calicatas realizadas. Además es esperable que la profundidad de aparición del nivel freático en el área de estudio varíe según la pluviometría y sobre todo por la época de riego.

### 3.5. SISMICIDAD

Para el establecimiento del riesgo sísmico de la zona hemos utilizado los métodos probabilísticos basados en el registro geológico de la actividad sísmica tanto la conocida a escala humana (con o sin registro instrumental) como la inferida a través del estudio paleosísmico, que se plasma en los siguientes planos:

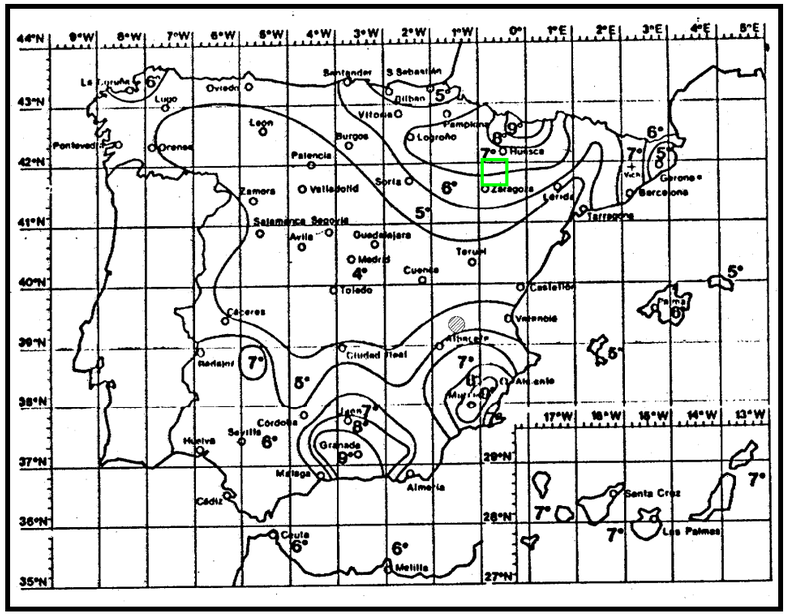
- De sismicidad histórica (abreviadamente SH) que marcan los terremotos históricos con registro o bien que delimitan las zonas donde se han producido los terremotos más fuertes (intensidad > VIII).

- De peligrosidad sísmica, obtenidos por métodos probabilísticos para diferentes periodos de retorno. Concretamente el I.G.N. (1991) ha realizado estos planos para periodos de retorno de cien, quinientos y mil años (equivalen a probabilidades anuales de superación de 0’01, 0’002 y 0’001 respectivamente).

- De zonas sismorresistentes, elaborados para su aplicación en la edificación.

La definición de las características sismotectónicas y de riesgo sísmico de la zona, que indicamos más adelante, se han basado en la revisión y consulta de los datos de estos mapas y por tanto tienen el grado de certidumbre asociado a éstos, que claramente manifiestan el estado de conocimiento y de registro sísmico actual. En este sentido las conclusiones que extraemos son las siguientes:

- Mapas de isolíneas de igual intensidad epicentral, que están basados en los sismos acaecidos y registrados en la península hasta 1991. Según el mapa que se adjunta en la figura siguiente, la zona de estudio se situaría dentro de las franjas de magnitud epicentral de 6-7 en la escala M.S.K. Estas magnitudes de terremoto podrían producir daños graves (daños clase 3) y en algunas incluso destrucción (daños clase 4) en construcciones tipo A (con muros de mampostería en seco o con barro, de adobes, de tapial), muchas construcciones tipo B (Con muros de fábrica de ladrillo, de bloques de mortero, de mampostería con mortero, de sillarejo, de sillería y de entramados de madera) sufren daños moderados (daños clase 2) y algunas construcciones tipo C (con estructura metálica o de hormigón armado) experimentan daños ligeros.




*Mapa de isolíneas de igual intensidad epicentral*

- Mapa de peligrosidad sísmica, que tiene un carácter interpretativo y en él se representa la probabilidad de recurrencia de un seísmo de magnitud determinada.

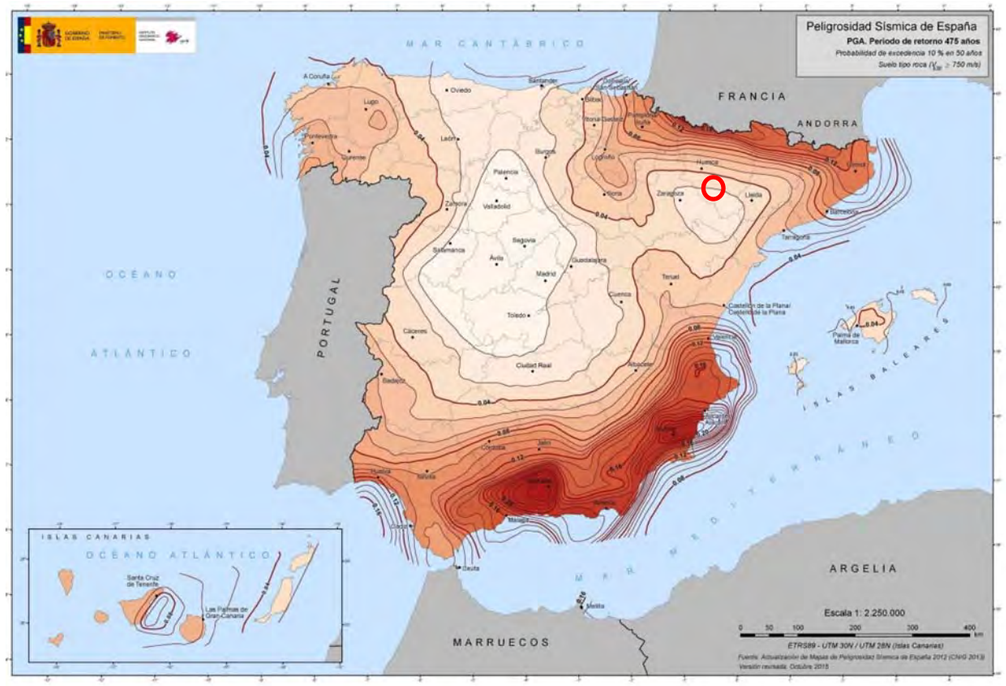
Utilizando los mapas realizados por el instituto geográfico nacional en 1991, la zona de estudio se sitúa en la zona delimitada por la línea de intensidad IV-V (escala M.S.K.) para un periodo de retorno de 500 años (ver figura adjunta). Estas magnitudes de terremoto se percibirían en el interior de los edificios por las personas o incluso producirían daños ligeros y de carácter no catastrófico.

*Mapa de intensidad de movimientos sísmicos para periodo de retorno de 500 años*

- Mapas de zonas sismorresistentes, elaborados para su aplicación a la edificación. Según la actual normativa española NCSE-02, la zona de estudio se sitúa en la franja delimitada superiormente por la isolínea de aceleración sísmica básica de 0,04 g.

Concretamente y según esta norma los términos municipales oscenses de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta, dentro de los que se desarrolla la actuación, posee una aceleración sísmica básica ($a_b$) inferior a 0,04 g (g=9,8 m/s$^2$).

En la *"Actualización de Mapas de Peligrosidad Sísmica de España 2012"* (IGN) la aceleración sísmica PGA para un periodo de recurrencia de 475 años para esos términos municipales siendo inferior a 0,04·g.




*Mapa de distribución de la aceleración sísmica básica según la norma NCSE-02 (Parte general y edificación)*

En síntesis, y con el conocimiento geológico-sismológico que se posee a fecha de hoy, puede decirse que en la zona de estudio la exposición al riesgo sísmico es muy baja (Riesgo blanco) propia de un área tectónicamente bastante estable. La norma sismorresistente NCSE-02 (Parte general y edificación) asigna una aceleración sísmica básica inferior a 0,04 g (siendo g la aceleración de la gravedad), lo que implica un riesgo asociado a movimientos sísmicos bajo que no hace necesario considerar esfuerzos sísmicos en el cálculo estructural de las cimentaciones, salvo mejor criterio del proyectista. Adicionalmente los sismos históricos y los planos interpretativos de recurrencia e intensidad de sismo esperable, indican una baja actividad sísmica para la cual es esperable intensidades sísmicas en general de grado inferior a V (escala MKS) y que por tanto pueden llegar a generarse ligeros daños (clase 1) en construcciones tipo A (con muros de mampostería, adobes o tapial). No se prevén terremotos de carácter catastrófico o que produzcan daños elevados, correspondientes a valores de intensidad epicentral superiores a VII según escala M.K.S.

# 4. TRABAJOS REALIZADOS

## 4.1. TRABAJOS DE CAMPO

### 4.1.1. Sondeos

Se han realizado 8 sondeos, acumulando 65,7 m perforados en el conjunto del trabajo. La distribución de los mismos por unidad de obra es la siguiente:

. 1 sondeo en la balsa elevada 2, denominado como BE2-S1.
. 2 sondeos en la basa elevada 1, denominados como BE1-S1 y BE1-S2.
. 2 sondeos en la balsa de pie de canal V4, denominados como BP-S1 y BP-S2.
. 2 sondeos en la balsa de pie de canal v10, denominados como BPV10-S1 y BPV10-S2.
. 1 sondeo en la estación de bombeo, denominado como EB-S1.

La ubicación de los mismos se refleja en los planos del anejo I. Sus coordenadas UTM se resumen en la tabla del capítulo 1, donde se incluye la cota asignada a partir de la topografía facilitada.

Los trabajos se realizaron en tres fases:

. En la primera fase, entre el 19 y 22 de febrero del 2021, se realizaron los sondeos BE2-S1 y BE1-S2. Ante la problemática de suelos blandos y nivel de agua detectada en la balsa de pie de canal inicial (V4) durante la realización de las calicatas y la posibilidad de modificación de la misma, se pararon los trabajos de sondeos.

. En la segunda fase, entre el 22 y 24 de marzo del 2021, se realizaron los sondeos sobre los diseños finales de la balsa de pie de canal V4 (BP-S1 y BP-S2) y sobre una segunda balsa de pie de canal complementaria denominada como V10 (BPV10-S1 y BPV10-S2). Adicionalmente se realizó el sondeo restante de la balsa elevada 1 (BE1-S1).

. En la tercera fase, el 3 de Mayo del 2021, se realizó el sondeo de la estación de bombeo (EB-S1).

Para la realización de los sondeos se emplearon dos sondas de rotación montadas en camión. En la primera y tercera fase se empleó una sonda modelo ROLATEC RL-800, mientras que en la segunda fase se utilizó una sonda TECOINSA TP-60.

Ambas tienen un diámetro máximo de perforación de 113 mm. Los sondeos se han llevado a cabo siguiendo la práctica habitual en este tipo de trabajos, perforándose con corona de widia y batería sencilla de 116 y 101 mm de diámetro en los suelos y con batería doble y adición de agua en la roca, con diámetros de 101 y 86 mm.

Paralelamente a la perforación de los sondeos se realizaron los ensayos SPT, toma de muestra inalterada (MI) y testigos plastificados (TP).

Las muestras se colocaron en cajas, debidamente etiquetadas, para su posterior traslado y estudio en el laboratorio.

En la balsa elevada 2 no se detectó nivel de agua. En el resto de las balsas, ante la posible presencia de agua en el terreno, en especial en las balsas de pie de canal V4 y V10, se colocó tubería de PVC ranurada para realizar medidas del nivel freático. Dado que la perforación de la roca fue realizada adicionando agua, que enmascara la detección de agua en el terreno, posteriormente a la finalización y colocación de la tubería de PVC, se ejecutaron achiques de los sondeos mediante bomba sumergida para observar si existía una recuperación posterior.

En la tabla adjunta se recoge de forma resumida, la longitud, número de muestras inalteradas (MI) y ensayos SPT, cajas utilizadas, longitud de tubería piezométrica colocada, etc. para cada uno de los sondeos.

| UNIDAD DE OBRA | SONDEO | Prof. (m) | Nº SPT | Nº MI | Nº TP | Nº Cajas | Pruebas de Achique-Recuperación | PVC (m) |
|---|---|---|---|---|---|---|---|---|
| BALSA ELEVADA 2 | BE2-S1 | 8,30 | 1 | 1 | 2 | 3 | | |
| BALSA ELEVADA 1 | BE1-S1 | 8,40 | 2 | 1 | 4 | 3 | 1 | 8,0 |
| | BE1-S2 | 8,30 | 2 | 2 | 2 | 3 | 1 | 8,0 |
| ESTACIÓN DE BOMBEO | EB-S1 | 8,30 | 3 | 2 | 2 | 4 | | |
| BALSA PIE DE CANAL V4 | BP-S1 | 8,20 | 1 | 1 | 4 | 3 | 1 | 8,0 |
| | BP-S2 | 8,20 | 1 | 1 | 3 | 3 | 1 | 8,0 |
| BALSA PIE DE CANAL V10 | BPV10-S1 | 8,00 | 2 | 2 | 3 | 3 | 1 | 8,0 |
| | BPV10-S2 | 8,00 | 3 | 2 | 2 | 3 | 1 | 8,0 |
| TOTAL | TOTAL | 65,70 | 15 | 12 | 22 | 25 | 6 | 48,0 |

Basándonos en las muestras y testigos extraídos en los sondeos se han realizado los perfiles litológicos correspondientes que se incluyen en el anejo II junto con su reportaje fotográfico.

De forma resumida y general, los perfiles obtenidos permiten diferenciar tres tipos de materiales o unidades geológicas:

- Nivel o Unidad I, corresponde con la tierra de labor y los suelos vegetales.

- Nivel o Unidad II, geológicamente incluido dentro de los recubrimientos cuaternarios. Mayoritariamente está formada por limos arcillosos a limos con arcillas y arenas, marrón ocres con áreas y rizocreciones blanquecinas de sulfatos. En la balsa elevada 1, se detectan además una mezcla de limos (con arcillas y arenas) y de gravas heterométricas (de tamaño fino a medio), subangulosas y de naturaleza calcárea.

- Nivel o Unidad III correspondiente al sustrato Terciario. Está formado principalmente por arcillas-argilitas grisáceas a marrones con un variable contenido en yesos, entre los que se intercalan niveles-estratos de espesor variable (en general centimétrico) de yesos alabastrinos, calizas tableadas y areniscas. La parte superior de esta unidad se encuentra alterada (subnivel III-A).

Los espesores y profundidad de aparición de cada uno de estos niveles, asi como su composición concreta se reflejan en el anejo II, y resumimos en la tabla adjunta.

| | | | | | UG-I: TIERRA DE LABOR / SUELO VEGETAL | UG-II: RECUBRIMIENTO CUATERNARIO | | | UG-III: SUSTRATO TERCIARIO | | | | NIVEL DE AGUA | SUELOS BLANDOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UNIDAD DE OBRA | REF. | COTA TERRENO (m) | Prof. alcanzada (m) | Cota fondo sondeo (m) | ESPESOR (m) | ESPESOR (m) | COTA APARICIÓN (m) | Observaciones | PROF. (m) APARICIÓN | COTA APARICIÓN NIVEL II | ESPESOR (m) SUBNIVEL II-A (ALTERACIÓN) | COTA APARICIÓN SUBNIVEL NIVEL II-B | Prof (m) 29/03/2021 | |
| BALSA ELEVADA 2 | BE2_S1 | 440,5 | 8,30 | 432,20 | 0,40 | 0,60 | 440,10 | Limos con arenas y arcillas | 1,00 | 439,50 | 1,05 | 438,45 | NO | |
| BALSA ELEVADA 1 | BE1_S1 | 429,5 | 8,40 | 421,10 | 0,50 | 1,60 | 429,00 | 0,5 m de gravas, debajo Arcillas limosas | 2,10 | 427,40 | 0,45 | 426,95 | 6,80 | |
| | BE1_S2 | 425,0 | 8,30 | 416,70 | 0,40 | 1,70 | 424,60 | 0,7 de gravas, debajo limos arcillosos | 2,10 | 422,90 | 1,00 | 421,90 | 5,24 | |
| ESTACIÓN BOMBEO | EB_S1 | 383,3 | 8,30 | 375,00 | 0,30 | 2,60 | 383,00 | Limos arcillosos y arcillas con cantos | 2,90 | 380,40 | 1,80 | 378,60 | 2,10 | Por debajo de 1,8m y hasta 2,9m |
| BALSA PIE DE CANAL V4 | BP_S1 | 390,0 | 8,20 | 381,80 | 0,4 | 0,90 | 389,60 | Limos con arcillas y arenas | 1,30 | 388,70 | 0,60 | 388,10 | 4,84 | |
| | BP_S2 | 384,0 | 8,20 | 375,80 | 0,4 | 0,90 | 383,60 | Limos arcillosos | 1,30 | 382,70 | 1,40 | 381,30 | 3,40 | |
| BALSA PIE DE CANAL V10 | BPV10_S1 | 387,3 | 8,00 | 379,30 | 0,4 | 1,90 | 386,90 | Limos arcillosos | 2,30 | 385,00 | 0,80 | 384,20 | 3,32 | Por debajo de 1,2m y hasta 2,2m |
| | BPV10_S2 | 389,0 | 8,00 | 381,00 | 0,5 | 2,60 | 388,50 | Limos arcillosos | 3,10 | 385,90 | 1,30 | 384,60 | 7,15 | |

## 4.1.2.- Ensayo penetración dinámica estándar (S.P.T.)

La resistencia a la penetración estándar (SPT) se define como el número de golpes necesario para que el golpeo de una maza de 63’5 (± 0’5) Kg. de masa transmitida a la cabeza del varillaje, y cayendo desde una altura de 760 (±10) mm consiga que un toma muestras estandarizado penetre 300 mm en el terreno después del descenso inicial debido al propio peso del equipo y tras la denominada penetración de asiento (los primeros 150 mm que no se contabilizan en cálculos posteriores). Es decir, en su conjunto la penetración debe tener una longitud de 450 mm, salvo que antes se alcance el rechazo a la penetración, el cual se obtendrá cuando se alcancen 50 golpes en la penetración de asiento o en cualquiera de los dos intervalos de 150 mm, en cuyo caso se anotará la penetración alcanzada en cada ensayo.

Se utiliza habitualmente para realizar el ensayo un toma muestras de tipo bipartido. Este toma muestras tiene 51 mm de diámetro exterior y 35 mm de interior, permitiendo que el terreno se aloje en su interior para la adecuada caracterización del mismo. La muestra así obtenida con el toma muestras bipartido se colocará en recipientes identificados por etiquetas.

En los suelos con presencia de gravas la zapata puede ser sustituida a veces por una zapata cónica de acero macizo de 51 mm de diámetro y 60º de ángulo cónico. En estos casos deberá indicarse obligatoriamente esta sustitución en el registro del ensayo. En nuestro caso todos los ensayos se realizaron con zapata abierta.

El dispositivo de golpeo utilizado en el ensayo es el denominado martillo de seguridad, que es un dispositivo automático que garantiza que la energía transferida al varillaje sea la misma en todos los golpes y ensayos, con una frecuencia de golpeo uniforme, que debe ser inferior a los treinta impactos por minuto y sin que exista interrupción durante la realización del ensayo.

El ensayo debe realizarse sin interrupción y con una frecuencia de golpeo inferior a 30 golpes por minuto.

Los índices N que se obtienen directamente del ensayo SPT deben corregirse de tal manera que queden normalizados a una presión efectiva de referencia, común e igual a 98 kPa. Para ello puede utilizarse la expresión siguiente:

N corregido = f x N

siendo f el factor de corrección dado por la fórmula siguiente:

$$f = \sqrt{\frac{98}{p'}}$$

donde p´ es la presión efectiva a la cota de ensayo en kPa

En la tabla siguiente (Guía de cimentaciones de obras de carretera) se recogen los factores de corrección. Para los valores intermedios de la presión vertical efectiva se puede interpolar linealmente entre los datos indicados en la tabla.

| PRESIÓN VERTICAL EFECTIVA(*) AL NIVEL DEL ENSAYO (kPa) | FACTOR DE CORRECCIÓN, f $N_{corregido} = f \cdot N$ |
|---|---|
| 0 | 2,0 |
| 25 | 1,5 |
| 50 | 1,2 |
| 100 | 1,0 |
| 200 | 0,8 |
| 400 o mayor | 0,5 |

(*) Se refiere al momento en el que se realiza el ensayo.

Cuando existan datos relativos al porcentaje de la energía total del golpeo que se transmite al tomamuestras, se realizará una segunda  corrección, para obtener N60, mediante la expresión siguiente:

N60 =N corregido x η/60donde:

η = Porcentaje de la energía total del golpeo que se transmite al tomamuestras (rendimiento). Para los martillos accionados mecánicamente con los que se ha realizado la campaña, este factor toma un valor de 75% según diversos autores (VENTAYOL y FERNANDEZ TADEO, 2011), si bien para ensayos a menos de 10 metros de profundidad, la relación η/60 puede establecerse en 1,1, y en 1,3 para profundidades superiores.

Del lado de la seguridad, para los ensayos SPT a profundidades menores de 6 m no se han aplicado las correcciones anteriores ya que incrementarían sensiblemente el valor de SPT.

A los SPT que han dado rechazo se les asigna un valor de 100 si el rechazo se produce en el segundo intervalo de hinca o la suma del segundo intervalo más 50 cuando el rechazo se produce en el tercer tramo de hinca.

En cualquier caso, el valor del índice N del SPT que se utilice para los cálculos de las cimentaciones y asientos, después de corregido, no debe ser nunca superior a 50.

Se han realizado un total de 15 ensayos SPT, con los resultados que se recogen en el siguiente cuadro.

| Sondeo | Profundidad (m) | | Ensayo SPT Nº de golpes / 15 cm $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{SPT}$ | $N_{60}$ | Litología dominante | NIVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| BE2-S1 | 1,60 | 2,20 | 13 | 17 | 27 | 65 | 44 | **44** | Arcillas limosas. Sustrato Terciario alterado | III-A |
| BE1-S1 | 1,00 | 1,45 | 6 | 6 | 8 | | 14 | **14** | Arcillas limosas. | II |
| | 2,60 | 3,05 | 14 | 33 | 38 | | 71 | **71** | Argilitas marrón grisáceas. Sustrato Terciario más sano | III-B |
| BE1-S2 | 1,20 | 1,80 | 7 | 12 | 10 | 10 | 22 | **22** | Limos arcillosos grisáceos | II |
| | 3,35 | 3,70 | 14 | 38 | R | | Rzo | 88 | Argilitas. Sustrato Terciario alterado más sano | III-B |
| EB-S1 | 1,80 | 2,40 | 0 | 0 | 3 | 5 | 3 | **3** | Arcillas limosas | II |
| | 3,00 | 3,10 | R | | | | Rzo | **Rzo** | Yesos. Sustrato alterado | III-A |
| | 4,85 | 5,25 | 12 | 36 | R | | Rzo | **86** | Argilitas grisáceas. Sustrato Terciario más sano | III-B |
| BP-S1 | 1,42 | 1,87 | 25 | 17 | 53 | | 70 | **70** | Argilitas. Sustrato Terciario alterado más sano | III-B |
| BP-S2 | 1,80 | 2,25 | 10 | 31 | 25 | | 56 | **56** | Arcillas marrones. Sustrato alterado alterado | III-A |
| BPV10-S1 | 1,80 | 2,25 | 2 | 4 | 3 | | 7 | **7** | Limos arcillosos marrones | II |
| | 3,20 | 3,65 | 29 | 19 | 27 | | 46 | **46** | Argilitas grisáceas. Sustrato Terciario más sano | III-B |
| BPV10-S2 | 1,80 | 2,25 | 5 | 8 | 9 | | 17 | **17** | Limos arcillosos marrones | II |
| | 3,40 | 3,85 | 8 | 13 | 15 | | 28 | **28** | Arcillas grisáceas. Sustrato alterado | III-A |
| | 4,60 | 5,05 | 30 | 32 | 30 | | 62 | **62** | Argilitas grisáceas. Sustrato Terciario más sano | III-B |

### 4.1.3. Toma de muestras en sondeos

Se han tomado también un total de 12 muestras inalteradas, con las profundidades y con la secuencia de golpeo que se recoge en la tabla siguiente, en el que se incluye además un valor estimado de golpeo al SPT a partir de una reducción al 60% del golpeo de la muestra inalterada, que habitualmente se considera en la bibliografía.

| Sondeo | Profundidad (m) | Toma de Muestra Inalterada Nº de golpes / 15 cm $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{MI}$ | $N_{SPT}$ (60% $N_{MI}$) | Litología dominante | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| BE2-S1 | 1,00-1,60 | 17 | 12 | 23 | 23 | 35 | 21 | Arcillas limosas. Sustrato Terciario alterado | III-A |
| BE1-S1 | 2,00-2,60 | 15 | 25 | 33 | 50 | 58 | 35 | Arcillas marrón grisáceas. Sustrato Terciario alterado | III-A |
| BE1-S2 | 1,90-2,30 | 19 | 26 | R | | Rzo | Rzo | Arcillas grisáceas. Sustrato Terciario alterado a sano | III-A / III-B |
| | 3,00-3,35 | 22 | 55 | R | | Rzo | Rzo | Arcillas grisáceas. Sustrato Terciario más sano | III-B |
| EB-S1 | 1,2-1,8 | 4 | 7 | 9 | 10 | 16 | 10 | Limos arcillosos | II |
| | 4,5-4,85 | 18 | 41 | R | | Rzo | Rzo | Arcillas / Argilitas | III-A / III-B |
| BP-S1 | 1,20-1,42 | 17 | R | | | Rzo | Rzo | Yesos. Sustrato Terciario más sano | III-B |
| BP-S2 | 1,20-1,80 | 17 | 41 | 31 | 36 | 72 | 43 | Arcillas marrones. Sustrato Terciario alterado | III-A |
| BPV10-S1 | 1,20-1,80 | 5 | 4 | 5 | 4 | 9 | 5 | Limos arcillosos | II |
| | 2,80-3,19 | 7 | 39 | R | | Rzo | Rzo | Arcillas / Argilitas | III-A / III-B |
| BPV10-S2 | 1,20-1,80 | 8 | 7 | 9 | 12 | 16 | 10 | Limos arcillosos | II |
| | 2,8-3,40 | 8 | 8 | 14 | 18 | 22 | 13 | Limos arcillosos / arcillas grisácea | II / III-A |

En los materiales del sustrato Terciario más sano (nivel III-B), extraídos mediante rotación con batería doble y agua, se han tomado un total de 22 testigos que se han plastificado para su conservación. Su distribución se recoge en la tabla siguiente.

| Sondeo | Profundidad (m) | Litología dominante | Nivel |
|---|---|---|---|
| BE2-S1 | 4,90-5,1 | Argilitas grises | III-B |
| | 7,40-7,80 | Argilitas grises | III-B |
| BE1-S1 | 3,20-3,40 | Argilitas marrones a grisáceas | III-B |
| | 4,70-5,00 | Argilitas marrones a grisáceas | III-B |
| | 6,10-6,40 | Yesos / Argilitas grisáceas | III-B |
| | 7,80-8,00 | Argilitas grisáceas a marrón grisáceas | III-B |
| BE1-S2 | 5,00-5,30 | Argilitas marrones a grisáceas | III-B |
| | 6,00-6,30 | Argilitas grisáceas con abundantes yesos | III-B |
| EB-S1 | 6,00-6,35 | Argilitas grisáceas | III-B |
| | 7,60-7,80 | Argilitas grisáceas | III-B |
| BP-S1 | 2,80-3,00 | Argilitas marrones a grisáceas | III-B |
| | 3,60-3,80 | Argilitas marrones a grisáceas | III-B |
| | 5,00-5,20 | Argilitas marrones a grisáceas | III-B |
| | 7,30-7,50 | Argilitas grisáceas con abundantes yesos | III-B |
| BP-S2 | 3,40-3,60 | Argilitas marrones a marrón grisáceas | III-B |
| | 5,30-5,60 | Argilitas marrones a marrón grisáceas | III-B |
| | 7,20-7,50 | Argilitas grisáceas | III-B |
| BPV10-S1 | 4,20-4,50 | Argilitas marrones a marrón grisáceas | III-B |
| | 5,50-5,80 | Argilitas marrones a marrón grisáceas | III-B |
| | 6,60-7,20 | Argilitas grisáceas | III-B |
| BPV10-S2 | 6,20-6,50 | Argilitas grisáceas | III-B |
| | 7,20-7,40 | Yesos alabastrinos con arcillas grises | III-B |

### 4.1.4. Índice RQD

Dada la naturaleza rocosa del terreno se realizó en los tramos perforados con agua y para cada una de las maniobras de perforación realizadas la medición del índice RQD (Rock Quality Determinación)

El índice RQD se calcula con la expresión siguiente:

$$RQD(\%) = \frac{\sum Longitud_testigos_más_de_10_cm}{Longitud_total} \times 100$$

Los resultados obtenidos se incluyen en las columnas de los sondeos del anejo II y se resumen en la siguiente tabla, donde se incluye además los valores ponderados por sondeo, por unidad de obra y general para el conjunto del sustrato terciario sano (III-B).

| Sondeo | Profundidad Inicio (m) | Profundidad Final (m) | RQD % | VALORES RQD (%) PONDERADOS | | |
|---|---|---|---|---|---|---|
| | | | | POR SONDEO | POR UNIDAD DE OBRA | GENERAL |
| BE2-S1 | 2,70 | 5,70 | 61 | 66,00 | 66,00 | 77,00 |
| | 5,70 | 8,30 | 71 | | | |
| BE1-S1 | 3,05 | 3,70 | 72 | 72,00 | 80,00 | |
| | 3,70 | 5,70 | 89 | | | |
| | 5,70 | 7,30 | 63 | | | |
| | 7,30 | 8,40 | 56 | | | |
| BE1-S2 | 4,50 | 7,40 | 87 | 90,00 | | |
| | 7,40 | 8,30 | 100 | | | |
| EB-S1 | 4,70 | 8,30 | 96 | 96,00 | 96,00 | |
| BP-S1 | 2,50 | 4,40 | 80 | 76,00 | 75,00 | |
| | 4,40 | 5,40 | 69 | | | |
| | 5,40 | 6,80 | 79 | | | |
| | 6,80 | 8,20 | 71 | | | |
| BP-S2 | 3,00 | 4,00 | 46 | 75,00 | | |
| | 4,00 | 6,00 | 85 | | | |
| | 6,00 | 8,20 | 78 | | | |
| BPV10-S1 | 3,80 | 5,20 | 59 | 75,00 | 78,00 | |
| | 5,20 | 6,40 | 82 | | | |
| | 6,40 | 8,00 | 85 | | | |
| BPV10-S2 | 5,20 | 6,80 | 80 | 82,00 | | |
| | 6,80 | 8,00 | 85 | | | |

En función de estos datos se puede valorar la calidad del macizo rocoso de acuerdo a la tabla siguiente.

| RQD % | Calidad macizo |
|---|---|
| <25 | Muy mala |
| 25-50 | Mala |
| 50-75 | Media |
| 75-90 | Buena |
| 90-100 | Muy buena |

Según los datos obtenidos los valores de RQD no difieren mucho ni por sondeo ni por unidad de obra, y en general son propios de un macizo rocoso de calidad media a buena, con un RQD=77%.

### 4.1.5.- Nivel de agua en sondeos

En la balsa elevada 2 no se detectó nivel de agua, por lo que no se consideró necesario la colocación de PVC y la realización de pruebas de achique.

En el resto de balsas, tras la colocación del PVC se realizó, en alguno de los sondeos, un vaciado parcial del agua de su interior, mediante las bombas de los equipos de perforación. Tras dicho achique se realizó la medición del nivel de agua, que reflejamos en la tabla adjunta.

En la estación de bombeo se colocó PVC se midió el nivel de agua.

Posteriormente, el 29 de marzo de 2021 en el caso de los sondeos de las balsas y el 3 de Mayo del 2021 en el sondeo de la estación de bombeo, se procedió a realizar una medición general del nivel de agua en todos los sondeos con PVC, que incluimos también en la tabla adjunta.

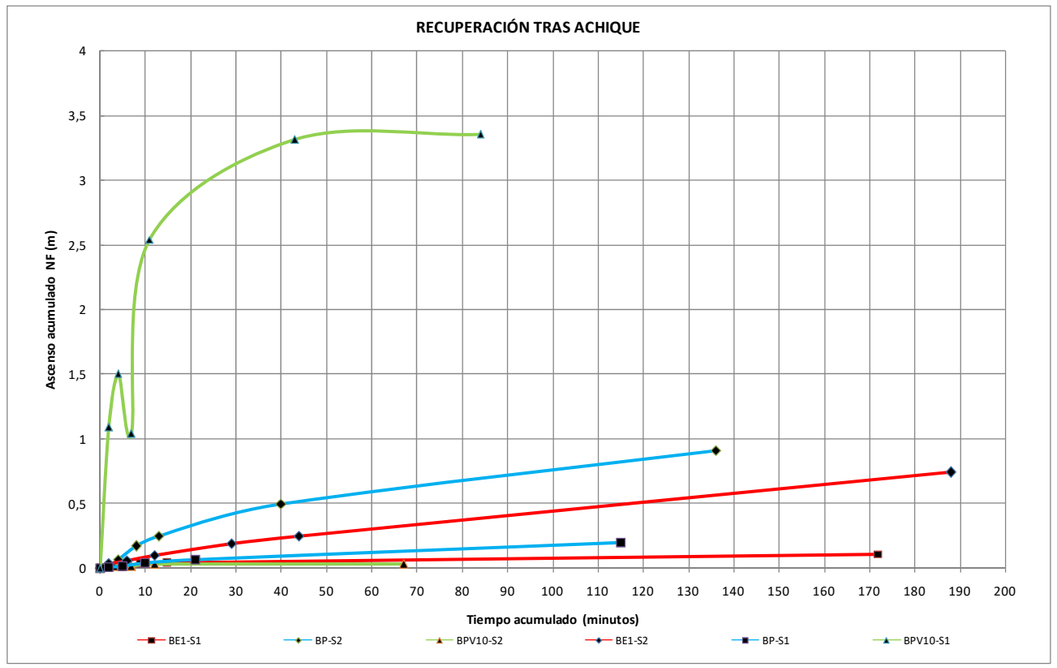
| ACTUACIÓN | SONDEO | COTA BOCA (m) | Prof. (m) | FIN SONDEO | PROF. NIVEL AGUA (m) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 19-02-21 | 22/02/2021 (*) | 24-03-21 | 24/03/2021 (*) | 29-03-21 | 03-05-21 |
| BALSA ELEVADA 2 | BE2-S1 | 440,5 | 8,3 | 19-02-21 | NO | | | | | |
| BALSA ELEVADA 1 | BE1-S1 | 429,5 | 8,4 | 22-03-21 | | | | 6,00 | 6,80 | |
| | BE1-S2 | 425,0 | 8,3 | 22-02-21 | | 4,50 | 5,10 | | 5,24 | |
| ESTACIÓN BOMBEO | EB-S1 | 383,3 | 8,3 | 03-05-21 | | | | | | 2,10 |
| BALSA PIE DE CANAL V4 | BP-S1 | 390,0 | 8,2 | 23-03-21 | | | | 6,70 | 4,84 | |
| | BP-S2 | 384,0 | 8,2 | 23-03-21 | | | 3,90 | | 3,40 | |
| BALSA PIE DE CANAL V10 | BPV10-S1 | 387,3 | 8,0 | 24-03-21 | | | 3,80 | | 3,32 | |
| | BPV10-S2 | 389,0 | 8,0 | 24-03-21 | | | | 7,40 | 7,15 | |

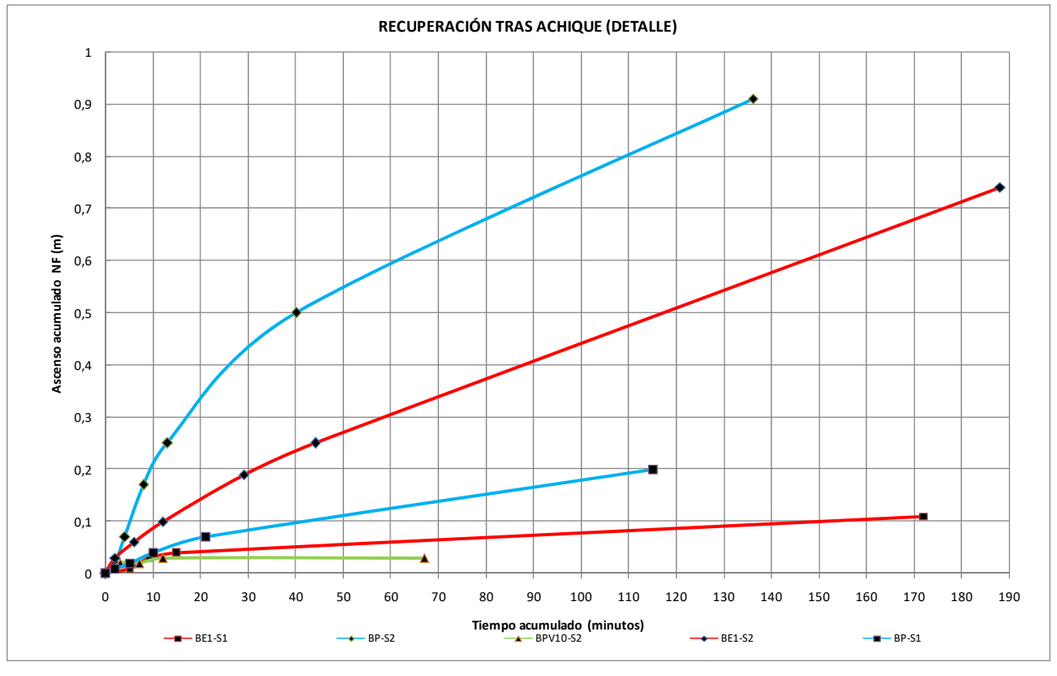
(*) Previamente se había vaciado el sondeo al finalizarse el mismo

Dado que la perforación de la roca fue realizada adicionando agua, que enmascara la detección de agua en el terreno, se ejecutaron achiques de los sondeos mediante bomba sumergida para observar si existía una recuperación posterior. Señalar que en todos los casos, con tiempos de bombeo reducidos (entre 1 y 3 minutos) se conseguía prácticamente el vaciado total de los sondeos.

Los resultados obtenidos se resumen en la tabla adjunta. Adicionalmente en los gráficos adjuntos se detalla la evolución temporal del nivel del agua tras el achique.

| | | ACHIQUE | | RECUPERACIÓN | | |
|---|---|---|---|---|---|---|
| SONDEO | Prof. Nivel de agua previa al achique (m) 29/03/2021 | Tiempo hasta vaciado (minutos) | Descenso producido del nivel de agua (m) | Tiempo de medición (minutos) | Prof. Nivel de agua a finalización de la medición (m) | Ascenso nivel agua (m) |
| BE1-S1 | 6,8 | 1 | 7,90 | 172 | 7,79 | 0,11 |
| BE1-S2 | 5,24 | 2 | 8,34 | 188 | 7,60 | 0,74 |
| BP-S1 | 4,84 | 3 | 7,20 | 115 | 7,00 | 0,20 |
| BP-S2 | 3,4 | 3 | 6,32 | 136 | 5,41 | 0,91 |
| BPV10-S1 | 3,32 | 3 | 6,74 | 84 | 3,39 | 3,35 |
| BPV10-S2 | 7,15 | < 1 | 7,26 | 67 | 7,23 | 0,03 |



A la vista del seguimiento realizado y los resultados de los achiques podemos señalar lo siguiente:

. Balsa Elevada 1.

El seguimiento temporal observado indica una profundización del nivel de agua en la medición del 29/03/2021 respecto a las anteriores, lo que nos indicaría la ausencia de aporte de agua desde el terreno.

La recuperación tras achique, por el contrario indica la existencia de un cierto aporte de agua desde el terreno, aunque por su ritmo lento, indicaría que dicho aporte sería de una magnitud muy reducida.

A la vista de ambos resultados, no resulta evidente establecer la existencia de agua en el terreno hasta la profundidad alcanzada, no obstante consideramos que de aparecer se limitaría a rezumes locales de muy escaso caudal que asociaríamos al sustrato Terciario, ya que ni en los sondeos ni en las calicatas se ha detectado agua o humedades significativas en el recubrimiento cuaternario existente por encima.

. Balsa de Pie de canal V4

El seguimiento temporal observado indica una elevación del nivel de agua en la medición del 29/03/2021 respecto a las anteriores, lo que nos indicaría la existencia de aporte de agua desde el terreno.

La recuperación tras achique es evidente en ambos sondeos, aunque es lenta y a un ritmo mayor en el sondeo BP-S1 que en el BP-S2, lo que indicaría también la existencia de aporte de agua desde el terreno.

Según estos resultados, hasta la profundidad alcanzada puede concluirse que existe agua en el terreno.

En los sondeos y en las calicatas no se ha detectado agua ni humedades significativas en el recubrimiento cuaternario, por el contrario en algunas calicatas si que se ha observado humedades en las discontinuidades del sustrato Terciario y localmente afloramientos de agua de escasa entidad en el mismo.

En este sentido, la presencia de agua en el terreno estaría asociada al Sustrato Terciario, y se manifestaría como rezumes en el mismo.

La procedencia de esta agua, consideramos está asociada a fugas del canal que discurre por encima de la zona de estudio. Dichas fugas consideramos son patentes por la observación del funcionamiento de un azarbe-drenaje próximo que cruza bajo el canal, ya que aguas arriba aparece seco y aguas abajo si que hay agua circulante (ver fotografías). Este azarbe a su vez, al llevar agua, también es un elemento que por infiltración de la misma alimentaría el agua en el interior del terreno.

. Balsa de Pie de canal V10

El seguimiento temporal observado indica una elevación del nivel de agua en la medición del 29/03/2021 respecto a las anteriores, lo que nos indicaría la existencia de aporte de agua desde el terreno.

La recuperación tras achique es evidente en el sondeo BPV10-S1 y además es a un ritmo rápido. Por el contrario en el sondeo BPV10-S2 puede decirse que no hay recuperación del nivel de agua, al menos en el periodo de control de 1 hora.

Según estos resultados y a pesar del resultado del S2, consideramos que hasta la profundidad alcanzada puede concluirse que existe agua en el terreno aunque de una distribución y entidad variable.

En el sondeo S1 y calicata C3, situadas en la parte baja de la zona de estudio se ha reconocido la presencia de humedades significativas y suelos algo blandos en la base del recubrimiento cuaternario, pero en ningún caso un rezume evidente de agua.

Adicionalmente en el resto de las calicatas se ha detectado cierta humedad en las discontinuidades y estratificación del sustrato Terciario.

A la vista de ello la presencia de agua en el terreno estaría asociada principalmente al sustrato Terciario, y en menor medida también al recubrimiento cuaternario, en las zonas topográficamente más bajas y con mayor espesor de suelos. Consideramos que no determina un nivel freático como tal, y corresponderían con flujos-rezumes que podrían ser de una magnitud no desdeñable en esas zonas más bajas.

Al igual que para la balsa de pie de canal inicial, consideramos que el agua en el terreno está asociada a fugas del canal que discurre próximo y por encima de la zona de estudio. Y de forma indirecta se alimentaría de las aguas infiltradas desde el azarbe próximo.

. Estación de Bombeo – Arqueta seccionamiento.

Según el sondeo realizado (EB-S1) para esta zona se determina la presencia de un nivel de agua situado sobre los 2,1 m de profundidad (cota aproximada 381,2) que satura la base de los suelos arcillo-limosos del recubrimiento cuaternario. En el sondeo cercano (BP-S2), donde no se detectan espesores altos de la UG-II también se detecta agua pero dentro del sustrato Terciario (UG-III). En este caso se dispone a una cota del orden de la 380,6.

A la vista de ello, en esta zona existe una clara presencia de agua en el terreno, aproximadamente sobre la cota 381, que se dispone sobre la UG-II si ésta se extiende hasta dicha cota o bien sobre la UG-III si dicha cota es alcanzada por esta unidad.

No se considera un nivel freático regional, y consideramos está claramente alimentado por las fugas del canal e indirectamente por las aguas infiltradas desde el azarbe próximo.

En una muestra de agua tomada en el sondeo S-1 de la balsa de pie de canal V10, se determinó un contenido en sulfatos de 1838 mg de SO4/l que según EHE, las calificaría como agresivas (ambiente Qb).

### 4.1.6. Calicatas mecánicas

Para el presente informe se realizaron un total de 77 calicatas mecánicas con retroexcavadora mixta KOMATSU WB 97S, con la siguiente distribución por unidades de obra:

. 5 en la Balsa Elevada 2, denominadas como BE2-C1 a BE2-C5.
. 8 en la Balsa Elevada 1, denominadas como BE1-C1 a BE1-C6.
. 27 en la Balsa de Pie de Canal V4, denominadas como BP-C1 a BP-C27.
. 4 en la Balsa de Pie de canal V7, denominadas como BPV7-C1 a BPV7-C4. Posteriormente fue descartada.
. 4 en la Balsa de Pie de canal V10, denominadas como BPV10-C1 a BPV10-C4.
. 3 en la Balsa de Pie de canal Alternativa 1, denominadas como BPALT1-C1 a BPALT1-C3. Posteriormente descartada.
. 3 en la Balsa de Pie de canal Alternativa 2, denominadas como BPALT2-C1 a BPALT2-C3. Posteriormente descartada.
. 25 en la red de riego denominadas como RR-C1 a RR-C25.

En las calicatas se ha observado el perfil litológico, la existencia o no de nivel freático, la presencia de suelos blandos-saturados, la estabilidad de las excavaciones, la dificultad de excavación y ha permitido además la toma de las muestras de terreno para su ensayo en laboratorio.

Las calicatas se realizaron en diferentes fases del año 2021:

. Entre el 16 y 18 de Febrero se realizaron las calicatas de la balsa elevada 1, parte de las calicatas de la balsa elevada 2 (de la BE1-C1 a C5), parte de las calicatas de la balsa pie de canal inicial (de la BP-C1 a BP-C13) y la totalidad de las calicatas de la red de riego.

. El 2 de Marzo se realizaron otra parte de las calicatas de la balsa de pie de canal inicial (de la BP-C14 a C-26) y la totalidad de las calicatas de las balsas de pie de canal Alternativa 1 y 2.

. El 18 de Marzo se realizó la última calicata de la balsa de pie de canal inicial (BP-C27) y la totalidad de las calicatas de las balsas de pie de canal v7 y v10.

. El 3 de Mayo, se realizaron dos calicatas en la balsa elevada 1 (BE1-C7 y BE1-C8) en una zona que por la ampliación de la balsa había quedado sin investigar.

La ejecución de un elevado número de calicatas en la zona de la balsa de pie de canal inicial, fue debido a la necesidad de un estudio detallado del nivel de agua y de la presencia de suelos blandos que condicionaban desde el punto de vista geotécnico muy apreciablemente el diseño de esta unidad de obra. Esta problemática también supuso la necesidad de realizar calicatas en posibles nuevos emplazamientos de la balsa de pie de canal inicial.

Las coordenadas UTM de las mismas se resumen en las tablas incluidas en el capítulo 1, donde se incluye también su cota, para el caso de las calicatas realizadas en las balsas, obtenida a partir de la topografía facilitada. Su posición se refleja en los planos del anejo I.

Los perfiles litológicos así como datos relacionados de tomas de muestra, excavabilidad, estabilidad y presencia de agua se reflejan en los boletines incluidos en el anejo III del presente informe.

Según los perfiles obtenidos, podemos agrupar los materiales en los mismos niveles litológicos o niveles geotécnicos, que se han reconocido en los sondeos. En las tablas adjuntas y solo para el caso de las calicatas que se disponen en las unidades de obra definitivas, se resumen los espesores, cotas etc.

| | | | | | UG-I: TIERRA DE LABOR / SUELO VEGETAL | UG-II: RECUBRIMIENTO CUATERNARIO | | | UG-III: SUSTRATO TERCIARIO | | | | NIVEL DE AGUA | SUELOS BLANDOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UNIDAD DE OBRA | REF. | COTA TERRENO (m) | Prof. alcanzada (m) | Cota fondo Calicata (m) | ESPESOR (m) | ESPESOR (m) | COTA APARICIÓN (m) | Observaciones | PROF. (m) APARICIÓN | COTA APARICIÓN NIVEL II | ESPESOR (m) SUBNIVEL II-A (ALTERACIÓN) | COTA APARICIÓN SUBNIVEL NIVEL II-B | Prof. (m) | |
| BALSA ELEVADA 2 | BE2_C1 | 444,5 | 1,85 | 442,65 | 0,30 | 0,40 | 444,20 | Limos arcillosos | 0,70 | 443,80 | 0,80 | 443,00 | | |
| | BE2_C2 | 446,5 | 1,90 | 444,60 | 0,40 | 0,30 | 446,10 | Arcillas | 0,70 | 445,80 | 0,80 | 445,00 | | |
| | BE2_C3 | 445,0 | 3,65 | 441,35 | 0,50 | 3,10 | 444,50 | Limos arcillosos | 3,60 | 441,40 | No | 441,40 | | |
| | BE2_C4 | 441,0 | 2,00 | 439,00 | 0,30 | 0,20 | 440,70 | Arcillas | 0,50 | 440,50 | 1,50 | NO | | |
| | BE2_C5 | 443,5 | 3,30 | 440,20 | 0,70 | 2,10 | 442,80 | Limos, arcillas y Arenas con arcillas | 2,80 | 440,70 | 0,50 | NO | | |
| BALSA ELEVADA 1 | BE1_C1 | 426,0 | 2,90 | 423,10 | 0,40 | 1,20 | 425,60 | Arcillas y limos | 1,60 | 424,40 | 1,30 | NO | | |
| | BE1_C2 | 428,0 | 3,00 | 425,00 | 0,40 | 1,40 | 427,60 | 0,5 m de Gravas, debajo limos arcillosos | 1,80 | 426,20 | 1,20 | NO | | |
| | BE1_C3 | 427,5 | 3,30 | 424,20 | 0,40 | 1,90 | 427,10 | 0,5 m y 0,4 m de gravas. Entre ambos Limos arcillosos | 2,30 | 425,20 | 1,00 | NO | | |
| | BE1_C4 | 425,5 | 3,00 | 422,50 | 0,40 | 2,20 | 425,10 | 0,4 y 0,5 m de gravas. Entre ambos limos arcillosos | 2,60 | 422,90 | 0,40 | NO | | |
| | BE1_C5 | 427,0 | 2,50 | 424,50 | 0,40 | 0,90 | 426,60 | 0,2 m de gravas, debajo arcillas | 1,30 | 425,70 | 1,20 | NO | | |
| | BE1_C6 | 423,0 | 2,00 | 421,00 | 0,60 | 0,50 | 422,40 | Gravas | 1,10 | 421,90 | 0,90 | NO | | |
| | BE1_C7 | 427,0 | 2,50 | 424,50 | 0,30 | 1,00 | 426,70 | 0,6m de gravas y debajo 0,4m de limos | 1,30 | 425,70 | 0,40 | 425,30 | | |
| | BE1_C8 | 428,0 | 2,80 | 425,20 | 0,40 | 1,00 | 427,60 | 0,3 m de limos y debajo 0,7 m de gravas | 1,40 | 426,60 | 0,60 | 426,00 | | |
| BALSA PIE DE CANAL V4 | BP_C1 | 388,0 | 2,00 | 386,00 | 0,50 | 1,10 | 387,50 | Limos con arcillas y arenas | 1,60 | 386,40 | 0,30 | 386,10 | | |
| | BP_C2 | 390,0 | 2,10 | 387,90 | 0,30 | 1,00 | 389,70 | Limos con arcillas y arenas | 1,30 | 388,70 | 0,60 | 388,10 | | |
| | BP_C3 | 390,0 | 1,90 | 388,10 | 0,60 | 0,50 | 389,40 | Arcillas limosas | 1,10 | 388,90 | 0,60 | 388,30 | | |
| | BP_C9 | 387,0 | 1,90 | 385,10 | 0,50 | 0,70 | 386,50 | Limos con arcillas y arenas | 1,20 | 385,80 | 0,40 | 385,40 | | |
| | BP_C10 | 388,5 | 1,90 | 386,60 | 0,50 | 0,80 | 388,00 | Limos con arenas y arcillas | 1,30 | 387,20 | 0,50 | 386,70 | | |
| | BP_C11 | 384,5 | 2,00 | 382,50 | 0,50 | 0,50 | 384,00 | Limos con arenas y arcillas | 1,00 | 383,50 | 1,00 | NO | | |
| | BP_C13 | 385,5 | 1,10 | 384,40 | 0,40 | NO | | | 0,40 | 385,10 | 0,50 | 384,60 | | |
| | BP_C27 | 387,0 | 1,35 | 385,65 | 0,40 | NO | | | 0,40 | 386,60 | 0,95 | 385,65 | 1,35 Rezume desde UG-III | |
| BALSA PIE DE CANAL V10 | BPV10_C1 | 389,0 | 2,40 | 386,60 | 0,50 | 1,80 | 388,50 | Limos arcillosos | 2,30 | 386,70 | NO | 386,70 | | |
| | BPV10_C2 | 387,0 | 1,35 | 385,65 | 0,20 | NO | 386,80 | | 0,20 | 386,80 | 1,00 | 385,80 | | |
| | BPV10_C3 | 387,5 | 4,70 | 382,80 | 0,50 | 3,40 | 387,00 | Limos arcillosos | 3,90 | 383,60 | 0,80 | NO | | A base |
| | BPV10_C4 | 390,0 | 2,50 | 387,50 | 0,40 | 0,50 | 389,60 | Limos arenosos con cantos | 0,90 | 389,10 | NO | 389,10 | | |

| | | | UG-I: TIERRA DE LABOR / SUELO VEGETAL | UG-II: RECUBRIMIENTO CUATERNARIO | | UG-III: SUSTRATO TERCIARIO | | NIVEL DE AGUA | SUELOS BLANDOS-SATURADOS |
|---|---|---|---|---|---|---|---|---|---|
| UNIDAD DE OBRA | REF. | Prof. alcanzada (m) | ESPESOR (m) | ESPESOR (m) | Observaciones | PROF. (m) APARICIÓN | ESPESOR (m) SUBNIVEL II-A (ALTERACIÓN) | | |
| RED DE RIEGO | RR-C1 | 1,60 | 0,40 | 0,40 | Limos con arcillas y arenas | 0,80 | 0,20 | NO | NO |
| | RR-C2 | 3,40 | 0,40 | 2,50 | Limos arcillosos | 2,90 | 0,50 | 3,10 | SI (por debajo de 2,4 m) |
| | RR-C3 | 3,40 | 0,50 | 2,90 | Arcillas limosas | NO | | 2,70 | SI (por debajo de 2,0 m) |
| | RR-C4 | 3,40 | 0,50 | 2,00 | Arcillas y arenas arcillosas | 2,50 | 0,90 | 2,30 | SI (por debajo de 1,9 m) |
| | RR-C5 | 2,90 | 0,50 | 2,40 | Arcillas limosas | NO | | 1,70 | SI (por debajo de 1,2 m) |
| | RR-C6 | 3,20 | 0,50 | 2,70 | Arcillas limosas | NO | | 1,30 | SI (por debajo de 1,3 m) |
| | RR-C7 | 3,00 | 0,70 | 2,00 | Arcillas limosas a base 0,5 m de gravas | 2,70 | 0,30 | 1,70 | SI (por debajo de 1,4 m) |
| | RR-C8 | 1,90 | 0,35 | 0,25 | Arcillas arenosas | 0,60 | 0,60 | 1,7 (Rezume en UG-III) | NO |
| | RR-C9 | 1,20 | 0,40 | NO | | 0,40 | 0,40 | 1,05 (Rezume en UG-III) | NO |
| | RR-C10 | 2,30 | 0,2 (Relleno tierras) | NO | | 0,20 | 0,40 | NO | NO |
| | RR-C11 | 1,80 | 0,30 | 0,30 | Arcillas | 0,60 | 0,30 | NO | NO |
| | RR-C12 | 2,10 | 0,40 | 0,20 | Arcillas | 0,60 | 0,80 | NO | NO |
| | RR-C13 | 2,40 | 0,40 | 1,80 | Limos arcillosos | 2,20 | 0,20 | NO | NO |
| | RR-C14 | 2,40 | 0,50 | 0,40 | Gravas con arcillas | 0,90 | 0,50 | 1,7 (Rezume en UG-III) | NO |
| | RR-C15 | 2,10 | 0,40 | 0,50 | Limos y arenas arcillosas | 0,90 | NO | NO | NO |
| | RR-C16 | 2,30 | 0,70 | 0,30 | Limos arenosos | 1,00 | 0,50 | NO | NO |
| | RR-C17 | 3,10 | 0,50 | 2,60 | Arcillas limosas | NO | | 1,70 | SI (por debajo de 1,4 m) |
| | RR-C18 | 2,30 | 0,30 | NO | | 0,30 | 1,20 | NO | NO |
| | RR-C19 | 2,30 | 0,40 | 0,80 | 0,4 m de gravas, debajo Limos arcillosos | 1,20 | 0,40 | NO | NO |
| | RR-C20 | 2,20 | 0,50 | 0,30 | Arcillas limosas | 0,80 | 0,50 | NO | NO |
| | RR-C21 | 1,70 | 0,40 | NO | | 0,40 | 0,70 | NO | NO |
| | RR-C22 | 2,00 | 0,40 | 0,90 | 0,2 m de gravas, debajo arenas arcillosas | 1,30 | 0,70 | 1 (Rezume en UG-III) | NO |
| | RR-C23 | 3,00 | 0,40 | 2,60 | Limos con arcillas y arenas | NO | | 2,20 | SI (por debajo de 1,8 m) |
| | RR-C24 | 2,80 | 0,30 | 1,30 | Arcillas | 1,60 | 1,20 | 0,80 | SI (por debajo 0,7 m) |
| | RR-C25 | 2,80 | 0,50 | 1,10 | 0,2 m de gravas, debajo arcillas y arenas limosas | 1,60 | 0,40 | 1,4 (Rezume en UG-III) | NO |

### 4.1.7. Ensayos de penetración dinámica tipo DPSH

Se realizaron 8 ensayos de penetración dinámica tipo DPSH. Mediante un equipo automático montado sobre orugas, de la casa TECOINSA. se realizaron cinco de ellos, el 24 de Marzo del 2021. El 3 de Mayo de 2021 se realizaron los otros tres en este caso con el equipo de golpeo de la máquina de sondeos RL-800.

Los ensayos se han realizado de acuerdo con la norma UNE 103802:1998.

Las coordenadas UTM de los mismos se resumen en las tablas incluidas en el capítulo 1, donde se incluye también su cota, obtenida a partir de la topografía facilitada. Su posición se refleja en los planos del anejo I.

Los ensayos se replantearon de la siguiente forma:

. En la balsa elevada 1, se realizaron dos ensayos, referenciados como BE1-P1 y BE1-P2, para complementar la información geotécnica en dicha balsa ante la ampliación que se hizo de la misma.

. En la red de riego para el paso de la misma bajo infraestructuras existentes donde, en las calicatas previas realizadas en estos cruces, se detectó un espesor significativo de suelos blandos y la presencia de nivel de agua. Concretamente se realizaron 4 ensayos, tres en los cruces de sendas tuberías con la carretera A1211, denominados como RR-P1, P2 y P4. El cuatro de los ensayos se realizó en el cruce de una tubería de la red bajo la línea de ferrocarril convencional Zaragoza-Lérida.

. En la estación de bombeo-arqueta de seccionamiento se realizaron dos ensayos (EB-P1 y EB-P2).

La metodología del ensayo y características del equipo utilizado, así como los resultados obtenidos en cada uno de los ensayos de penetración dinámica se recogen en el anejo IV.

## 4.2. TRABAJOS DE LABORATORIO

### 4.2.1. Ensayos realizados

Las muestras tomadas en los sondeos y las calicatas fueron examinadas por personal especializado y agrupadas de modo conveniente. Se decidió someter a ensayo una serie de muestras representativas de cada uno de los tipos de terreno aparecidos. Los ensayos han sido realizados por TERRALABS que cuenta con las acreditaciones pertinentes para estos trabajos.

El tipo de ensayos, la normativa aplicada y el número de ellos se recogen en la tabla adjunta.

| Tipo de ensayo en suelos | Normativa | Nº ensayos |
|---|---|---|
| Granulometría por tamizado | UNE-103101/95 | 12 |
| Límites de Atterberg | UNE-103103/94 y UNE-103104/93 | 21 |
| Determinación de la densidad de un suelo | UNE 103301/94 | 11 |
| Determinación de la humedad natural de un suelo | UNE-103300/93 | 11 |
| Compresión simple en suelos | UNE-103400/93 | 14 |
| Corte directo tipo CU (consolidado y no drenado) | UNE-103401/98 | 1 |
| Corte directo tipo CD (consolidado y drenado) | UNE-103401/98 | 4 |
| Presión de hinchamiento de un suelo en edómetro | UNE 103602/96 | 7 |
| Compactación Proctor Modificado | UNE 103501/94 | 7 |
| Hinchamiento libre de un suelo en edómetro | UNE 103601/96 | 2 |
| Colapso en suelos | UNE 103204/94 | 1 |
| Dispersabilidad por tubificacion, Pin Hole | NLT-207/91 | 2 |
| Contenido en sales solubles | UNE 103205/06 | 4 |
| Contenido en materia orgánica | UNE 103204/93 | 3 |
| Contenido en yesos | une 103206/06 | 2 |
| Contenido de sulfatos solubles en suelos | UNE 103201/96 | 4 |
| Contenido de sulfatos solubles en aguas | Anejo 5º EHE | 1 |

Adicionalmente de una muestra de agua tomada en el sondeo BPV10-S1 se realizó la determinación del contenido en sulfatos, para determinar el grado de agresividad a los hormigones.

### 4.2.2. Resultados

Los resultados obtenidos en los ensayos de laboratorio se recogen de forma resumida en la tabla adjunta. En el anejo V se incluyen los boletines de estos ensayos.

| Cata / Sondeo | Profundidad (m) | Tipo muestra | Clasificación USCS | % Grava (>5mm) | % Arena (5 - 0,08 mm) | % Finos (<0,08 mm) | LL % | LP % | IP | Densidad aparente (g/cm³) En probeta | Humedad natural (%) En probeta | Densidad seca (g/cm³) | Densidad aparente (g/cm³) | Humedad natural (%) | Resistencia compresión uniaxial | | Corte Directo CU | | Presión de hinchamiento (kg/cm²) | Proctor Modificado (PM) | | Corte Directo CD remoldeada 98% PM | | Hinchamiento libre (%) remoldeada al 98% PM | Índice de colapso (Ic %) a 2 kg/cm² remoldeada al 98% PM | Clasificación dispersabilidad Pin Hole | Sales solubles (%) | Yesos (%) | Materia orgánica (%) | Sulfatos suelos SO3 (%) | Sulfatos aguas (mg/l) | Litología | UNIDAD GEOTÉCNICA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | qu (kg/cm²) | Deformación a rotura (%) | Cohesión (kPa) | Angulo roz. Int. (º) | | Densidad máx (g/cm³) | Humedad óptima (%) | Cohesión (kPa) | Angulo roz. Int. (º) | | | | | | | | | | |
| BE1-C2 | 1,2 | MA | ML | 1 | 26 | 73 | NO | NO | NP | | | | | | | | | | | 2,02 | 10,04 | 18,46 | 34,45 | | 0,4 | D1 | 0,10 | | 0,30 | | | Limos arcillosos con arenas | II |
| BE1-C3 | 2,6 | MA | CL | 2 | 17 | 81 | 32,0 | 18,8 | 13,2 | | | | | | | | | | 0,24 | 1,99 | 10,15 | | | | | | | | | | | Arcillas con yesos | III-A |
| BE2-C1 | 0,8-1,0 | MA | CL | 0 | 23 | 77 | 33,0 | 20,3 | 12,8 | | | | | | | | | | | 1,86 | 13,48 | 30,11 | 26,20 | 3,8 | | | 19,90 | 20,51 | | | | Arcillas con yesos | III-A |
| BE2-C3 | 1,5 | MA | CL | 0 | 8 | 92 | 38,5 | 21,1 | 17,4 | | | | | | | | | | | 1,74 | 16,58 | | | | | | | | 0,87 | | | Limos arcillosos | II |
| BP-C2 | 0,6-0,9 | MA | CL | 1 | 6 | 93 | 30,0 | 18,7 | 11,3 | | | | | | | | | | | 1,92 | 12,11 | | | | | | | | | | | Limos con arcillas y arenas | II |
| BP-C2 | 1,7 | MA | CL | 1 | 19 | 80 | 31,0 | 19,7 | 11,2 | | | | | | | | | | | 1,94 | 11,24 | 39,24 | 25,51 | 5,9 | | | 3,60 | 3,20 | | | | Arcillas con yesos | III-A |
| BPV10-C1 | 0,8-1,5 | MA | CL | 0 | 4 | 96 | 30,6 | 19,7 | 10,8 | | | | | | | | | | | 1,89 | 12,88 | 13,89 | 28,26 | | | D2 | <0,1 | | 1,00 | | | Limos arcillosos | II |
| RR-C2 | 1 | MA | CL | 1 | 6 | 93 | 40,2 | 25,3 | 14,9 | | | | | | | | | | | | | | | | | | | | | | | Limos arcillosos | II |
| RR-C5 | 0,8 | MA | CL | 1 | 12 | 87 | 28,0 | 17,6 | 10,3 | | | | | | | | | | | | | | | | | | | | | 3,08 | | Arcillas limosas | II |
| RR-C8 | 0,8 | MA | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0,11 | | Arcillas grisáceas | III-A |
| RR-C8 | 1,5 | MA | | | | | 34,6 | 22,0 | 12,7 | | | 1,76 | 2,06 | 17,3 | | | | | 0,19 | | | | | | | | | | | | | Argilitas grisáceas | III-B |
| RR-C10 | 1,5 | MA | | | | | 44,4 | 28,6 | 15,8 | 2,23 | 15,62 | 1,94 | 2,26 | 16,5 | 14,68 | 3,27 | | | 0,65 | | | | | | | | | | | 0,33 | | Argilitas grisáceas | III-B |
| RR-C15 | 1,5-2,0 | MA | | | | | 35,2 | 21,4 | 13,8 | | | 2,01 | 2,28 | 13,9 | | | | | | | | | | | | | | | | < 0,1 | | Argilitas marrones | III-B |
| RR-C19 | 2 | MA | | | | | 40,7 | 25,5 | 15,3 | | | 2,02 | 2,29 | 13,2 | | | | | 0,19 | | | | | | | | | | | | | Argilitas marrones | III-B |
| RR-C23 | 1,6 | MA | CL-ML | 0 | 8 | 92 | 24,5 | 17,6 | 6,9 | | | | | | | | | | | | | | | | | | | | | | | Limos con arcillas y arenas | II |
| BE2-S1 | 4,9-5,1 | TP | | | | | 47,3 | 23,7 | 23,6 | 2,24 | 19,09 | | | | 4,36 | 3,92 | | | | | | | | | | | | | | | | Arcilla-Argilita marrón | III-B |
| BE1-S1 | 2,0-2,6 | MI | | | | | | | | 2,15 | 14,65 | | | | 2,62 | 7,11 | | | | | | | | | | | | | | | | Arcilla marrón grisácea | III-A |
| BE1-S1 | 4,7-5,0 | TP | | | | | 26,7 | 21,1 | 5,7 | 2,34 | 10,69 | | | | 16,69 | 3,59 | | | 0,10 | | | | | | | | | | | | | Argilita marrón grisácea | III-B |
| BE1-S1 | 7,8-8,0 | TP | | | | | | | | | | | | | 2,99 | 4,88 | | | | | | | | | | | | | | | | Argilita grisácea | III-B |
| BP-S1 | 2,8-3,0 | TP | | | | | | | | 2,34 | 12,98 | 2,09 | 2,3 | 9,8 | 8,44 | 5,66 | | | | | | | | | | | | | | | | Argilita marrón grisácea | III-B |
| BP-S1 | 5,0-5,2 | TP | | | | | 36,7 | 21,8 | 14,9 | 2,20 | 17,22 | 1,89 | 2,19 | 16 | 4,90 | 8,06 | | | 0,20 | | | | | | | | | | | | | Argilita marrón grisácea | III-B |
| BP-S2 | 1,2-1,8 | MI | | | | | 26,5 | 20,9 | 5,6 | 2,23 | 14,32 | 1,96 | 2,16 | 10,2 | 4,09 | 6,23 | | | | | | | | | | | | | | | | Argilita marrón con arenas | III-A |
| BPV10-S1 | 1,2-1,8 | MI | CL | 1 | 29 | 70 | 30,0 | 19,8 | 10,2 | 2,02 | 17,68 | 1,64 | 1,98 | 20,7 | 1,01 | 7,68 | | | | | | | | | | | | | | | | Limos arcillosos marrones | II |
| BPV10-S1 | 4,2-4,5 | TP | | | | | | | | 2,20 | 18,48 | | | | 2,76 | 8,68 | | | | | | | | | | | | | | | | Argilitas grisáceas | III-B |
| BPV10-S2 | 1,2-1,8 | MI | CL | 0 | 7 | 93 | 36,5 | 21,3 | 15,2 | | | 1,71 | 2,05 | 19,6 | | | 82,99 | 21,2 | | | | | | | | | | | | | | Limos arcillosos marrones | II |
| BPV10-S2 | 2,8-3,4 | MI | | | | | | | | 2,17 | 13,53 | 1,88 | 2,1 | 11,6 | 2,73 | 4,54 | | | | | | | | | | | | | | | | Arcillas grisáceas a marrones | II / III-A |
| BPV10-S2 | 6,2-6,5 | TP | | | | | 34,9 | 21,9 | 13,0 | 2,18 | 17,94 | 1,93 | 2,24 | 16,4 | 4,44 | 4,21 | | | 0,25 | | | | | | | | | | | | | Argilitas grisáceas | III-B |
| EB-S1 | 1,2-1,8 | MI | | | | | | | | | | | | | 1,83 | 10,07 | | | | | | | | | | | | | | | | Limos arcillosos | II |
| EB-S1 | 4,5-4,85 | MI | | | | | | | | | | | | | 3,76 | 10,83 | | | | | | | | | | | | | | | | Arcillas grisáceas | III-B |
| BPV10-S1 | | AGUA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1838,0 | | |

# 5. CARACTERÍSTICAS DE LOS MATERIALES Y PERFIL LITOLÓGICO DEL TERRENO

Los materiales reconocidos en el área estudiada y para el conjunto de todas las actuaciones previstas, se han agrupado en tres grandes unidades o niveles geotécnicos:

- Nivel I (UG-I): Tierra de labor / Suelo vegetal.
- Nivel II (UG-II): Recubrimientos cuaternarios. Mayoritariamente formado por suelos finos. De forma minoritaria pueden aparecer suelos granulares gruesos formados por gravas subangulosas calizas con una matriz muy abundante de limos arcillosos-arenosos.
- Nivel III (UG-III): Sustrato Terciario. Formado principalmente por arcillas-argilitas grisáceas a marrones con un variable contenido en yesos, entre los que se intercalan niveles-estratos de espesor variable (en general centimétrico) de yesos alabastrinos, calizas tableadas y areniscas. La parte superior de esta unidad se encuentra alterada (UG III-A).

A continuación se caracterizan geotécnicamente estos niveles.

## 5.1.- NIVEL I (UG-I). TIERRA DE LABOR / SUELO VEGETAL

Se ha detectado en todos los ensayos realizados (sondeos y calicatas). Tiene una composición variable entre limosa y limo-arcillosa a arenosa con escaso contenido en cantos y con una coloración en general marrón oscura y posee raíces. Únicamente en una de las calicatas realizadas (RR-10) se ha detectado un relleno de tierras con algún cascote.

Aparece en la superficie del terreno y presenta espesores de 0,2 a 0,7, con un espesor medio general de 0,45 m.

Este nivel carece de interés geotécnico ya que debe ser retirado en todas las zonas de actuación.

## 5.2.- NIVEL II (UG-II). RECUBRIMIENTO CUATERNARIO

En este nivel se han incluido todos los suelos de cualquier naturaleza que aparecen recubriendo el sustrato terciario de la zona (UG-III).

Desde el punto de vista composicional, según los reconocimientos realizados, los suelos porcentualmente mayoritarios, son granulares finos: limos arcillosos, limos con arcillas-arenas, arcillas, limos-arenas con arcillas. Presentan rizocreciones y áreas blanquecinas de sulfatos, y de forma dispersa algunas gravas.

En la balsa elevada 1 y en algunas calicatas de la red de riego, a techo y/o base de este nivel aparecen capas de espesor limitado de 0,2 a 0,6-0,7 m, formadas por gravas de tamaño fino a medio con abundante matriz de arcillas limosas a arenosas, a mezcla de arcillas limosas con gravas. Los cantos son subangulosos de calizas.

El espesor global de este nivel es muy variable, tal y como se refleja en las tablas de los apartados 4.1.1. y 4.1.6, pudiendo en algunos casos no aparecer. Se interpreta como un depósito de tipo coluvial-aluvial (Unidad cartográfica 224 descrita en el capítulo 3.2.).

<u>Dada la baja representatividad de los términos de gravas, la caracterización se ha centrado en los términos mayoritarios, correspondientes a los suelos finos.</u>

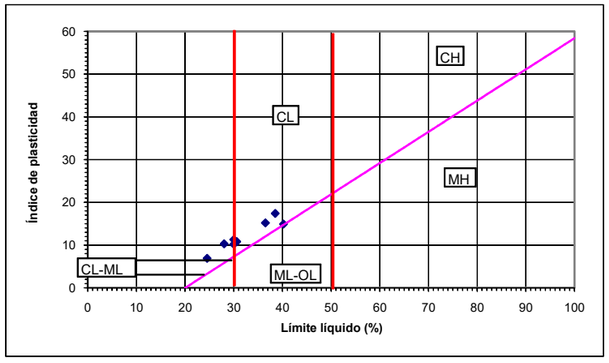
### 5.2.1. Caracterización general

En la tabla adjunta se muestran los resultados de los ensayos de laboratorio. La muestra tomada en el tránsito de la UG-II a la UG-IIIA, finalmente se ha incluido como propiamente de la UG-IIIA, por lo que no se ha considerado los resultados obtenidos a los efectos de caracterización de la UG-II.

| Cata / Sondeo | Profundidad (m) | Tipo muestra | Clasificación USCS | % Grava (>5mm) | % Arena (5 - 0,08 mm) | % Finos (<0,08 mm) | LL % | LP % | IP | Densidad aparente (g/cm³) En probeta | Humedad natural (%) En probeta | Densidad seca (g/cm³) | Densidad aparente (g/cm³) | Humedad natural (%) | Resistencia compresión uniaxial | | Corte Directo CU | | Proctor Modificado (PM) | | Corte Directo CD remoldeada 98% PM | | Índice de colapso (C %) a 2 kg/cm² remoldeada a 98% PM | Clasificación disperabilidad Pfa / Hde | Sales solubles (%) | Yesos (%) | Materia orgánica (%) | Sulfatos sueltos SO3 (%) | Litología | UNIDAD GEOTÉCNICA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | qu (kg/cm²) | Deformación a rotura (%) | Cohesión (kPa) | Angulo roz. Int. (º) | Densidad máx (g/cm³) | Humedad óptima (%) | Cohesión (kPa) | Angulo roz. Int. (º) | | | | | | | | |
| BE1-C2 | 1,2 | MA | ML | 1 | 26 | 73 | NO | NO | NP | | | | | | | | | | 2,02 | 10,04 | 18,46 | 34,45 | 0,4 | D1 | 0,10 | | 0,30 | | Limos arcillosos con arenas | II |
| BE2-C3 | 1,5 | MA | CL | 0 | 8 | 92 | 38,5 | 21,1 | 17,4 | | | | | | | | | | 1,74 | 16,58 | | | | | | | 0,87 | | Limos arcillosos | II |
| BP-C2 | 0,6-0,9 | MA | CL | 1 | 6 | 93 | 30,0 | 18,7 | 11,3 | | | | | | | | | | 1,92 | 12,11 | | | | | | | | | Limos con arcillas y arenas | II |
| BPV10-C1 | 0,8-1,5 | MA | CL | 0 | 4 | 96 | 30,6 | 19,7 | 10,8 | | | | | | | | | | 1,89 | 12,88 | 13,89 | 28,26 | | D2 | <0,1 | | 1,00 | | Limos arcillosos | II |
| RR-C2 | 1 | MA | CL | 1 | 6 | 93 | 40,2 | 25,3 | 14,9 | | | | | | | | | | | | | | | | | | | | Limos arcillosos | II |
| RR-C5 | 0,8 | MA | CL | 1 | 12 | 87 | 28,0 | 17,6 | 10,3 | | | | | | | | | | | | | | | | | | | 3,08 | Arcillas limosas | II |
| RR-C23 | 1,6 | MA | CL-ML | 0 | 8 | 92 | 24,5 | 17,6 | 6,9 | | | | | | | | | | | | | | | | | | | | Limos con arcillas y arenas | II |
| BPV10-S1 | 1,2-1,8 | MI | CL | 1 | 29 | 70 | 30,0 | 19,8 | 10,2 | 2,02 | 17,68 | 1,64 | 1,98 | 20,7 | 1,01 | 7,68 | | | | | | | | | | | | | Limos arcillosos marrones | II |
| BPV10-S2 | 1,2-1,8 | MI | CL | 0 | 7 | 93 | 36,5 | 21,3 | 15,2 | | | 1,71 | 2,05 | 19,6 | | | 82,99 | 21,2 | | | | | | | | | | | Limos arcillosos marrones | II |
| EB-S1 | 1,2-1,8 | MI | | | | | | | | | | | | | 1,83 | 10,07 | | | | | | | | | | | | | Limos arcillosos | II |
| BPV10-S2 | 2,8-3,4 | MI | | | | | | | | 2,17 | 13,53 | 1,88 | 2,1 | 11,6 | 2,73 | 4,54 | | | | | | | | | | | | | Arcillas grisáceas a marrones | II / III-A |

De las 9 muestras ensayadas, 7 de ellas se clasifican (según SUCS) como CL “Arcillas de media plasticidad” minoritariamente de baja plasticidad. Una octava muestra se cataloga como CL-ML (Arcilla limosa de baja plasticidad) y la novena de ellas se clasifica como ML "limo de baja plasticidad con arena". Todas ellas se caracterizan porque la fracción fina (tamaño inferior a 0,08 mm) es dominante, con porcentajes del 70 al 96% (media del 89%). La fracción arena (entre 5 y 0,08 mm) tiene un porcentaje muy variable, entre 4 y 29% (en media 10%). La fracción grava (> 5 mm) es mínima a nula.

Los valores de plasticidad obtenidos, salvo en la muestra catalogada como ML, en el resto son principalmente de media plasticidad y minoritariamente de baja plasticidad.




La densidad seca promedio obtenida es de 1,67 g/cm³. La densidad aparente promedio es de 2,0 g/cm³, con una humedad del 20% (varía entre 19,6 y 20,7%).

### 5.2.2. Caracterización resistente por ensayos de campo

Para la caracterización resistente de esta unidad por ensayos de campo se dispone de:

- 5 ensayos SPT.

| Sondeo | Profundidad (m) | | Ensayo SPT Nº de golpes / 15 cm | | | | $N_{SPT}$ | $N_{60}$ |
|---|---|---|---|---|---|---|---|---|
| | | | $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{15}$ | | |
| BE1-S1 | 1,00 | 1,45 | 6 | 6 | 8 | | 14 | **14** |
| BE1-S2 | 1,20 | 1,80 | 7 | 12 | 10 | 10 | 22 | **22** |
| EB-S1 | 1,80 | 2,40 | 0 | 0 | 3 | 5 | 3 | **3** |
| BPV10-S1 | 1,80 | 2,25 | 2 | 4 | 3 | | 7 | **7** |
| BPV10-S2 | 1,80 | 2,25 | 5 | 8 | 9 | | 17 | **17** |

- 4 muestras inalteradas (se considera como $N_{SPT}$ equivalente el 60% del golpeo de la muestra inalterada $N_{MI}$).

| Sondeo | Profundidad (m) | Toma de Muestra Inalterada Nº de golpes / 15 cm | | | | $N_{MI}$ | $N_{SPT}$ (60% $N_{MI}$) | NIVEL |
|---|---|---|---|---|---|---|---|---|
| | | $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{15}$ | | | |
| EB-S1 | 1,2-1,8 | 4 | 7 | 9 | 10 | 16 | 10 | II |
| BPV10-S1 | 1,20-1,80 | 5 | 4 | 5 | 4 | 9 | 5 | II |
| BPV10-S2 | 1,20-1,80 | 8 | 7 | 9 | 12 | 16 | 10 | II |
| BPV10-S2 | 2,8-3,40 | 8 | 8 | 14 | 18 | 22 | 13 | II / III-A |

- 8 ensayos DPSH. Los valores de N20 los traducimos directamente a golpeo de NSPT.

En los ensayos realizados en la Balsa elevada 1. Para el caso del BE1-P1 y hasta 2,6 m de profundidad, donde interpretamos finalizaría la UG-II, los golpeos N20, varían entre 8 y 19. Para el caso del BE1-P2 y hasta 2,0 m de profundidad, donde se interpreta la finalización de la UG-II, los golpeos N20, varían entre 16 y 20.

En los cuatro ensayos realizados, en puntos de cruce de la red de riego bajo infraestructuras, y en donde por las calicatas se detectó una consistencia blanda a muy blanda de este nivel, los golpeos obtenidos en los tramos resistentes asociados a esta unidad varían entre 4 y 6. Localmente en la parte superior alcanzan golpeos de 10.

En los ensayos realizados en la estación de bombeo. Para el EB-P1 y hasta 1,0 m de profundidad (final de la UG-II) el golpeo N20=11. Para el EB-P2 y hasta los 3 m de profundidad (final de la UG-II que hemos interpretado), el golpeo N20 es de 7 hasta 1,8 m de profundidad, reduciéndose a N20=3 hasta los 2,6 m de profundidad, volviéndose a incrementar en los 0,4 m finales a un N20=10.

A la vista de estos resultados, podemos diferenciar dos tipos extremos dentro de esta unidad:

. Suelos finos de consistencia media a rígida, con golpeos NSPT de 8 a 19, y al que asignaríamos como característico un golpeo de 13.

. Suelos finos de consistencia blanda a muy blanda con golpeos NSPT de 7 a 4, asignándose un valor de 5.

### 5.2.3. Parámetros geotécnicos

Como ya hemos indicado la caracterización geotécnica se realiza para los materiales mayoritarios que corresponden con suelos finos limosos-arcillosos con arenas que presentan una plasticidad media, muy minoritariamente es baja a nula.

Se considera que el comportamiento de esta unidad sería el de un suelo cohesivo, pudiendo tener cierto comportamiento mixto (cohesivo-granular) en los términos más arenosos o de una nula-baja plasticidad.

**Resistencia a compresión simple - Cohesión**

Aplicando el gráfico de Sowers y la expresión de Pasquilini, para arcillas de media plasticidad se obtiene los siguientes valores de resistencia a compresión simple:

. Suelos de consistencia media (NSPT=13), de 0,9 a 1,9 Kg/cm$^2$.

. Suelos de consistencia blanda a muy blanda (NSPT=5), de 0,5 a 0,7 Kg/cm$^2$.

Marangon estima que c (cohesión sin drenaje)≅ N/α donde α tendría valores de 27 para arcillas de baja plasticidad y limos arcillosos, 13 para arcillas de mediana plasticidad y 8 para arcillas de alta plasticidad. Terzaghi e Peck (1948) sugiere un valor general de α de 15.

Stroud (1974) para arcillas no sensitivas propone la siguiente expresión de cálculo de la cohesión sin drenaje ($c_u$):

$$c_u(KN/m2) = K \times NSPT$$

El valor de K puede variar entre 3,5 e 6,5 kN/m$^2$. Para suelos de media plasticidad puede adoptarse un valor de 4 a 5.

Con estas expresiones adicionales se determinarían los siguientes valores de cohesión:

. Suelos de consistencia media (NSPT=13), de 1,0 a 0,6 Kg/cm$^2$.

. Suelos de consistencia blanda a muy blanda (NSPT=5), de 0,38 a 0,22 Kg/cm$^2$.

Para materiales arcillo-limosos, WASCHKOWSKI (1982) propone una relación entre la resistencia dinámica unitaria en punta del penetrómetro dinámico ($q_d$ en $10^2$ kPa) y la resistencia al corte no drenada ($S_u$ en $10^2$ kPa) según la expresión

$$C_u = \frac{9{,}8xq_d - 1{,}62}{11{,}27}$$

Para valores de resistencia de:

- Del orden de 100 Kg/cm$^2$ (10000 KPa), suelos de consistencia media, la resistencia al corte sin drenaje sería de 0,86 kg/cm$^2$.

- Del 30-60 kg/cm$^2$ (3000-6000 kPa), la resistencia al corte sin drenaje sería de 0,26 a 0,52 kg/cm$^2$.

Sobre una muestra inalterada que por su golpeo estaría dentro de los suelos de consistencia blanda, se obtuvo un valor de resistencia a compresión simple de 1,0 Kg/cm$^2$ con una deformación del 7,7%. Sobre una segunda muestra, en este caso de un suelo de consistencia media a blanda, el valor de resistencia a compresión simple fue de 1,83 Kg/cm$^2$, pero con una deformación muy elevada, del 10%.

En el ensayo de corte directo tipo CU realizado sobre una muestra inalterada que por su golpeo estaría dentro de los suelos de consistencia media, se obtiene una cohesión de 0,83 Kg/cm$^2$.

A la vista de estos resultados y dado que estos materiales pueden tener un contenido significativo de arenas y una plasticidad menor, adoptamos del lado de la seguridad, los siguientes valores:

. Para los términos de consistencia media; resistencia a compresión simple de 1,6 Kg/cm$^2$. Cohesión de 0,8 Kg/cm$^2$.

. Para los términos de consistencia blanda a muy blanda; resistencia a compresión simple de 0,7 Kg/cm$^2$. Cohesión de 0,3 Kg/cm$^2$.

**Ángulo de rozamiento interno**

En principio se trata de suelos con un comportamiento dominantemente cohesivo, no obstante y asumiendo cierta componente friccional fruto del de la presencia de arenas o debido a casos locales de baja plasticidad, se ha estimado el ángulo de rozamiento interno.

Aplicando la expresión de Jiménez Salas para suelos arcillosos-limosos españoles plásticos se determina un ángulo de rozamiento interno de 31º.

Según expresión de Sorenson y Okkels (2013) para arcillas normalmente consolidadas y a partir del índice de plasticidad (PI) se obtendría un ángulo de rozamiento interno de 29º.

$\phi$=44-14*log(PI) si IP<50 y $\phi$=30-6*log(PI) si IP>=50.

De considerar un comportamiento mixto, y aplicando la expresión recogida en PARRA y RAMOS (2006) en arcosas españolas, el ángulo de rozamiento interno estimado varía entre 23 (consistencia blanda) y 28º (consistencia media).

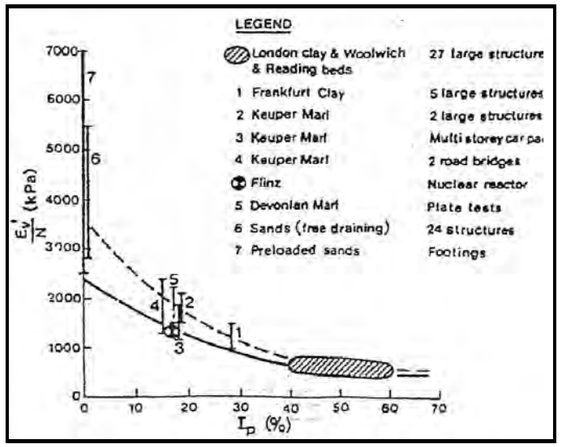
En el ensayo de corte directo tipo CU se obtuvo un valor de 21,2º, para una muestra catalogable dentro de los términos de consistencia blanda.

A los efectos, y como característico de estos materiales se asignan los siguientes valores de ángulo de rozamiento interno:

. Para los términos de consistencia media, 28º.
. Para los términos de consistencia blanda, 21º.

**Módulo de deformación**

Para la estimación de la deformabilidad, considerando un comportamiento puramente cohesivo puede aplicarse la correlación de Stroud (1974) incluida en la figura 23 de la publicación "*Design parameters for stiff clays*" dependiente del índice de plasticidad del material, y que se muestra en la figura siguiente.




Para suelos de media plasticidad puede considerarse una relación E/N= 1500 kPa, de donde se obtendría un módulo de deformación de 195 kg/cm$^2$, para las arcillas de consistencia media. Para las de consistencia blanda el módulo obtenido sería de 75 Kg/cm$^2$.

También puede estimarse según la fórmula propuesta por Henkel y Wroth E= 220x$c_u$, obteniéndose para $c_u$=0,8 kg/cm$^2$ un módulo de deformación de E= 176 kg/cm$^2$. Para los términos de consistencia blanda, $c_u$=0,3 kg/cm$^2$, se obtiene un módulo de 66 Kg/cm$^2$.

A la vista de estos resultados, se adopta los siguientes valores de módulo de deformación:

. Para los términos de consistencia media, E=185 kg/cm$^2$.
. Para los términos de consistencia blanda, E=70 Kg/cm$^2$.

En resumen, los parámetros geotécnicos adoptados para la unidad II constituida por suelos finos, son los siguientes:

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad (t/m$^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación (kg/cm$^2$) |
|---|---|---|---|---|---|---|---|
| II | Media | 13 | 2,0 | 1,6 | 0,8 | 28º | 185 |
| | Blanda | 5 | 2,0 | 0,7 | 0,3 | 21º | 70 |

**5.2.4.- Otros aspectos geotécnicos**

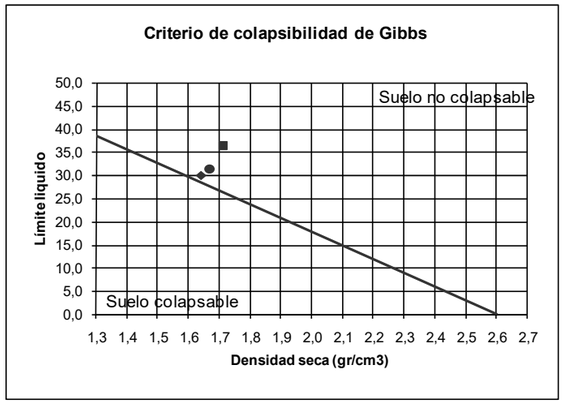
**Colapsabilidad**

Rodríguez Ortiz indica que un suelo con plasticidad tiene riesgo de sufrir colapso si cumple la relación:

$$\gamma_d < (1{,}92 - 0{,}016 W_L)$$

Atendiendo a dicha expresión el valor de densidad crítica se sitúa entre 1,27 y 1,53 g/cm$^3$ (media de 1,42 g/cm$^3$). Estos valores son inferiores a la densidad seca obtenida en dos muestras analizadas, donde los valores de densidad seca son de 1,64 y 1,71 g/cm$^3$.

Aplicando el criterio de colapsabilidad de Gibbs, tanto a dos muestras para las que se realizó los ensayos de determinación de la densidad y humedad, como para los valores medios de todas las muestras, se reconoce que en todos los casos se disponen en el campo de los suelos no colapsables.



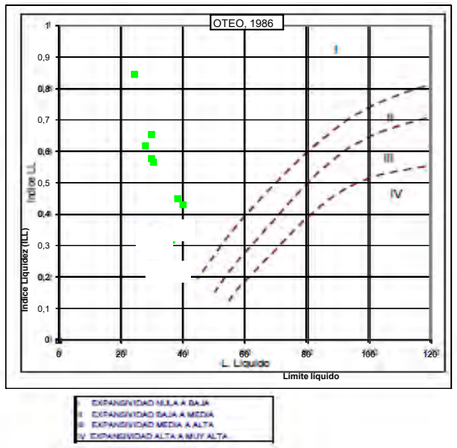

Estos resultados nos indicarían que los suelos son no colapsables o de un bajo riesgo de colapso.

**Expansividad**

Según los valores de plasticidad y en base a la tabla siguiente, se situarían en la frontera de los suelos de la categoría I y II, de expansividad baja a baja-media.

| Grado | Expansividad | Finos % | LL | Ind. Lambe kPa | Presión Hincham. Kpa | Hincham. Libre % |
|---|---|---|---|---|---|---|
| I | Baja | <30 | <35 | <80 | <25 | <1 |
| II | Baja a Media | 30-60 | 35-50 | 80-150 | 25-125 | 1-4 |
| III | Media a alta | 60-95 | 50-65 | 150-230 | 125-300 | 4-10 |
| IV | Muy alta | >95 | >65 | >230 | >300 | >10 |

Aplicando los criterios de expansividad basados en la plasticidad y humedad del suelo (Oteo, 1986 para suelos españoles) reflejados en la figura adjunta puede observarse que las muestras caen en el campo I de expansividad nula-baja.




A la vista de estos resultados, podemos concluir que los materiales del nivel I presentan una nula a baja expansividad potencial, con presiones de hinchamiento probables inferiores a 0,2-0,3 Kg/cm$^2$.

**Dispersabilidad**

Mediante ensayo pinhole se ha valorado la dispersabilidad por tubificación. Obteniéndose que ambas muestras son dispersivas (D1 y D2).

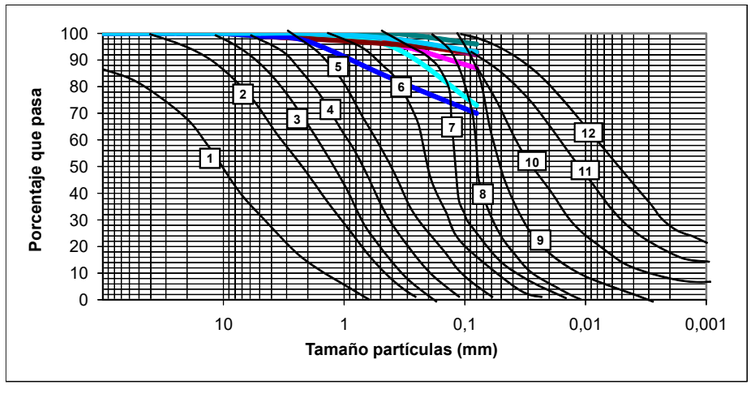
**Agresividad química a los hormigones**

El contenido en sulfatos solubles obtenido en una muestra fue del 3,08 % de $SO_3$, por lo que su agresividad a los hormigones sería alta (ambiente Qc), según EHE.

**Permeabilidad**

La permeabilidad se puede estimar comparando las curvas de Breddin (figura adjunta) con las obtenidas en laboratorio. En este caso las colas de las curvas apuntan a una clase superior a 7, por lo que les corresponden permeabilidades **K ≤ 10$^{-4}$ cm/s**.

| CLASE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K (cm/s) | 3 | 0,7 | 0,1 | 0,05 | $9.10^{-3}$ | $5.10^{-3}$ | $2.10^{-3}$ | $7.10^{-4}$ | $7.10^{-5}$ | $1.10^{-5}$ | $<1.10^{-5}$ | $<<1.10^{-5}$ |



**Excavabilidad**

Estos materiales son excavables con medios convencionales (excavadoras).

**Aprovechamiento**

En este apartado se analiza de una forma general el aprovechamiento de este tipo de terreno, pero sin entrar al detalle de la problemática de los suelos blandos y saturados, para los que su aprovechamiento pasa primeramente por un secado previo.

Según PG-3, por su granulometría y plasticidad, se catalogan como suelos tolerables.

Desde el punto de vista químico los contenidos en sales solubles y materia orgánica mantendrían la catalogación.

El asiento de colapso sobre muestra remoldeada al 98% PM y para una carga de 2,0 Kg/cm$^2$, fue del 0,4%, por lo que también respecto a este parámetro mantiene la calificación de tolerable.

Para la puesta en obra de los materiales, se han realizado cuatro ensayos Proctor de tipo Modificado, obteniéndose valores de densidad máxima de 2,02 a 1,74 gr/cm$^3$ y humedades óptimas de 10 a 16,6%. Dado que los términos limosos no plásticos son minoritarios, a efectos posteriores de cálculo, consideramos como generales de esta unidad los siguientes:

. Densidad máxima: 1,85 g/cm$^3$.
. Humedad óptima: 14%.

Para determinar el comportamiento geotécnico de estos materiales compactados, se han realizado dos ensayos de corte directo CD (consolidado y drenado), uno sobre una muestra de composición limosa y sin plasticidad y otra sobre una muestra arcillosa de plasticidad media.

Los resultados obtenidos fueron los siguientes: cohesión de 18,46 a 13,89 KPa; y ángulo de rozamiento interno: 34,45º y 28,6º.

A los efectos de cálculos posteriores, y dado que mayoritariamente son los términos plásticos los dominantes, adoptamos como parámetros resistentes para el nivel I compactado, los siguientes:

. Cohesión: 16 KPa.
. Ángulo de rozamiento interno: 28º.

Son suelos catalogados como dispersivos, por lo que este aspecto deberá tenerse presente a la hora del aprovechamiento de los mismos.

Respecto a la permeabilidad del material compactado es esperable valores similares o algo inferiores a los obtenidos para el terreno natural.

### 5.2.5.- Suelos granulares gruesos

Ya hemos indicado que este tipo de materiales tiene una reducida representatividad, y donde son más frecuentes, es en la balsa elevada 1.

No se tiene una caracterización general de estos materiales, y tampoco ensayos de campo que inequívocamente se asocien a los mismos.

Considerando exclusivamente los datos de SPT, MI y DPSH de la balsa elevada 1, estimaríamos un valor de NSPT=17, para la UG-II, pudiendo asociarse este valor también este tipo de suelos granulares.

Con dicho valor, utilizando diversas correlaciones para suelos granulares gruesos, se estima los siguientes parámetros geotécnicos:

. Ángulo de rozamiento interno de 34º.
. Módulo de deformación elástica, E=225 Kg/cm$^2$.

Dado el alto contenido en matriz y el carácter arcillo-limoso de la misma, consideramos puede asumirse una cierta cohesión en este terreno que estimamos en 2 Tn/m$^2$.

## 5.3.- NIVEL III (UG-III). SUSTRATO TERCIARIO

Está formado principalmente por arcillas-argilitas grisáceas a marrones con un variable contenido en yesos cristalinos dispuestos como bandas-áreas-venas asi como dispersos y yesos alabastrinos como pequeños nódulos. Entre las arcillas-argilitas se intercalan niveles-estratos de espesor variable (en general centimétrico) de yesos alabastrinos, calizas tableadas y areniscas.

En la mayor parte de los casos se detecta una parte superior alterada (subnivel III-A). De iniciarse el sustrato Terciario con capas de yesos, areniscas cementadas o calizas, esta zona alterada no se detecta.

Aparece principalmente debajo de la UG-II, y minoritariamente bajo la UG-I, a una profundidad variable, según reflejamos en las tablas resumen de los apartados 4.1.1. y 4.1.6. El espesor reconocido de esta unidad es reducido, no obstante y según los antecedentes geológicos su espesor sería de varias decenas de metros. El espesor de alteración (UG-IIIA) también es muy variable, aunque en general es inferior a 1,0-1,5 m.

### 5.3.1. Caracterización general

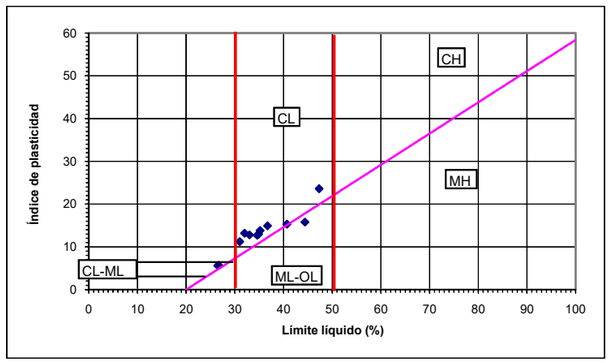
En la tabla adjunta se muestran los resultados de los ensayos de laboratorio. La muestra tomada en el tránsito de la UG-II a la UG-IIIA, se ha incluido como propiamente de la UG-IIIA.

Esta caracterización se ha centrado en los términos mayoritarios que corresponden con las arcillas-argilitas con variable contenido en yesos.

| Cata / Sondeo | Profundidad (m) | Tipo muestra | Clasificación USCS | % Grava (>5mm) | % Arena (5 - 0,08 mm) | % Finos (<0,08 mm) | LL % | LP % | IP | Densidad aparente (g/cm³) En probeta | Humedad natural (%) En probeta | Densidad seca (g/cm³) | Densidad aparente (g/cm³) | Humedad natural (%) | Resistencia compresión uniaxial | | Presión de hinchamiento (kg/cm²) | Proctor Modificado (PM) | | Corte Directo CD remoldeada 98% PM | | Hinchamiento libre (%) remoldeada al 98% PM | Sales solubles (%) | Yesos (%) | Materia orgánica (%) | Sulfatos sueltos SO3 (%) | Litología | UNIDAD GEOTÉCNICA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | qu (kg/cm²) | Deformación a rotura (%) | | Densidad max (g/cm³) | Humedad óptima (%) | Cohesión (kPa) | Angulo roz. Int. (º) | | | | | | | |
| BPV10-S2 | 2,8-3,4 | MI | | | | | | | | 2,17 | 13,53 | 1,88 | 2,1 | 11,6 | 2,73 | 4,54 | | | | | | | | | | | Arcillas grisáceas a marrones | II / III-A |
| BE1-C3 | 2,6 | MA | CL | 2 | 17 | 81 | 32,0 | 18,8 | 13,2 | | | | | | | | 0,24 | 1,99 | 10,15 | | | | | | | | Arcillas con yesos | III-A |
| BE2-C1 | 0,8-1,0 | MA | CL | 0 | 23 | 77 | 33,0 | 20,3 | 12,8 | | | | | | | | | 1,86 | 13,48 | 30,11 | 26,20 | 3,8 | 19,90 | 20,51 | | | Arcillas con yesos | III-A |
| BP-C2 | 1,7 | MA | CL | 1 | 19 | 80 | 31,0 | 19,7 | 11,2 | | | | | | | | | 1,94 | 11,24 | 39,24 | 25,51 | 5,9 | 3,60 | 3,20 | | | Arcillas con yesos | III-A |
| RR-C8 | 0,8 | MA | | | | | | | | | | | | | | | | | | | | | | | | 0,11 | Arcillas grisáceas | III-A |
| BE1-S1 | 2,0-2,6 | MI | | | | | | | | 2,15 | 14,65 | | | | 2,62 | 7,11 | | | | | | | | | | | Arcilla marrón grisácea | III-A |
| BP-S2 | 1,2-1,8 | MI | | | | | 26,5 | 20,9 | 5,6 | 2,23 | 14,32 | 1,96 | 2,16 | 10,2 | 4,09 | 6,23 | | | | | | | | | | | Argilita marrón con arenas | III-A |
| RR-C8 | 1,5 | MA | | | | | 34,6 | 22,0 | 12,7 | | | 1,76 | 2,06 | 17,3 | | | 0,19 | | | | | | | | | | Argilitas grisáceas | III-B |
| RR-C10 | 1,5 | MA | | | | | 44,4 | 28,6 | 15,8 | 2,23 | 15,62 | 1,94 | 2,26 | 16,5 | 14,68 | 3,27 | 0,65 | | | | | | | | | 0,33 | Argilitas grisáceas | III-B |
| RR-C15 | 1,5-2,0 | MA | | | | | 35,2 | 21,4 | 13,8 | | | 2,01 | 2,28 | 13,9 | | | | | | | | | | | | < 0,1 | Argilitas marrones | III-B |
| RR-C19 | 2 | MA | | | | | 40,7 | 25,5 | 15,3 | | | 2,02 | 2,29 | 13,2 | | | 0,19 | | | | | | | | | | Argilitas marrones | III-B |
| BE2-S1 | 4,9-5,1 | TP | | | | | 47,3 | 23,7 | 23,6 | 2,24 | 19,09 | | | | 4,36 | 3,92 | | | | | | | | | | | Arcilla-Argilita marrón | III-B |
| BE1-S1 | 4,7-5,0 | TP | | | | | 26,7 | 21,1 | 5,7 | 2,34 | 10,69 | | | | 16,69 | 3,59 | 0,10 | | | | | | | | | | Argilita marrón grisácea | III-B |
| BE1-S1 | 7,8-8,0 | TP | | | | | | | | | | | | | 2,99 | 4,88 | | | | | | | | | | | Argilita grisácea | III-B |
| BP-S1 | 2,8-3,0 | TP | | | | | | | | 2,34 | 12,98 | 2,09 | 2,3 | 9,8 | 8,44 | 5,66 | | | | | | | | | | | Argilita marrón grisácea | III-B |
| BP-S1 | 5,0-5,2 | TP | | | | | 36,7 | 21,8 | 14,9 | 2,20 | 17,22 | 1,89 | 2,19 | 16 | 4,90 | 8,06 | 0,20 | | | | | | | | | | Argilita marrón grisácea | III-B |
| BPV10-S1 | 4,2-4,5 | TP | | | | | | | | 2,20 | 18,48 | | | | 2,76 | 8,68 | | | | | | | | | | | Argilitas grisáceas | III-B |
| BPV10-S2 | 6,2-6,5 | TP | | | | | 34,9 | 21,9 | 13,0 | 2,18 | 17,94 | 1,93 | 2,24 | 16,4 | 4,44 | 4,21 | 0,25 | | | | | | | | | | Argilitas grisáceas | III-B |
| EB-S1 | 4,5-4,85 | MI | | | | | | | | | | | | | 3,76 | 10,83 | | | | | | | | | | | Arcillas-Argilitas grisáceas | III-B |

Según SUCS, las tres muestras ensayadas se catalogan como CL "Arcillas de mediana plasticidad con arena". La fracción granulométrica dominante es la fina (tamaño inferior a 0,08 mm) con contenidos superiores al 75%. La fracción arena (entre 5 y 0,08 mm) representa un 17 a 23%. Consideramos que estos valores altos de fracción arena, están asociados no solo a las finas laminaciones más arenosas que aparecen entre las arcillas sino también a los cristales de yesos que se disponen en venas-áreas y dispersos dentro de las arcillas. La fracción grava (> 5 mm) es mínima a nula.

Respecto a la plasticidad de 12 muestras ensayadas, y según reflejamos en el gráfico adjunto, la mayor parte son de plasticidad media, pudiendo asignarse un valor medio de LL del 35,3% y un índice de plasticidad del 13,1.




Para los términos arcillosos alterado (UG-IIIA) se determina una densidad aparente promedio de 2,1 g/cm$^3$, con una humedad del 10%. Para los términos arcillosos-argiliticos más sanos (UG-IIIB) la densidad aparente promedio de 2,2 g/cm$^3$, con una humedad del 14%

**5.3.2. Caracterización resistente por ensayos de campo**

Para la caracterización resistente de esta unidad por ensayos de campo se dispone de:

- 10 ensayos SPT.

| Sondeo | Profundidad (m) | | Ensayo SPT Nº de golpes / 15 cm $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{SPT}$ | $N_{60}$ | Litología dominante | NIVEL |
|---|---|---|---|---|---|---|---|---|---|---|
| BE2-S1 | 1,60 | 2,20 | 13 | 17 | 27 | 65 | 44 | **44** | Arcillas limosas. Sustrato Terciario alterado | III-A |
| BP-S2 | 1,80 | 2,25 | 10 | 31 | 25 | | 56 | **56** | Arcillas marrones. Sustrato alterado alterado | III-A |
| BPV10-S2 | 3,40 | 3,85 | 8 | 13 | 15 | | 28 | **28** | Arcillas grisáceas. Sustrato alterado | III-A |
| EB-S1 | 3,00 | 3,10 | R | | | | Rzo | **Rzo** | Yesos. Sustrato alterado | III-A |
| EB-S1 | 4,85 | 5,25 | 12 | 36 | R | | Rzo | 86 | Argilitas grisáceas. Sustrato Terciario más sano | III-B |
| BE1-S1 | 2,60 | 3,05 | 14 | 33 | 38 | | 71 | **71** | Argilitas marrón grisáceas. Sustrato Terciario más sano | III-B |
| BE1-S2 | 3,35 | 3,70 | 14 | 38 | R | | Rzo | 88 | Argilitas. Sustrato Terciario alterado más sano | III-B |
| BP-S1 | 1,42 | 1,87 | 25 | 17 | 53 | | 70 | **70** | Argilitas. Sustrato Terciario alterado más sano | III-B |
| BPV10-S1 | 3,20 | 3,65 | 29 | 19 | 27 | | 46 | **46** | Argilitas grisáceas. Sustrato Terciario más sano | III-B |
| BPV10-S2 | 4,60 | 5,05 | 30 | 32 | 30 | | 62 | **62** | Argilitas grisáceas. Sustrato Terciario más sano | III-B |

Analizando los datos, se reconoce un golpeo muy variable, en promedio la UG-IIIA posee un promedio inferior a 45. Mientras que en la UG-IIIB aunque solo se obtiene rechazo en dos de los ensayos, el golpeo promedio es superior a 60.

- 9 muestras inalteradas (se considera como $N_{SPT}$ equivalente el 60% del golpeo de la muestra inalterada $N_{MI}$).

| Sondeo | Profundidad (m) | Toma de Muestra Inalterada Nº de golpes / 15 cm $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{15}$ | $N_{MI}$ | $N_{SPT}$ (60% $N_{MI}$) | Litología dominante | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| BPV10-S2 | 2,8-3,40 | 8 | 8 | 14 | 18 | 22 | 13 | Limos arcillosos / arcillas grisácea | II / III-A |
| BE2-S1 | 1,00-1,60 | 17 | 12 | 23 | 23 | 35 | 21 | Arcillas limosas. Sustrato Terciario alterado | III-A |
| BE1-S1 | 2,00-2,60 | 15 | 25 | 33 | 50 | 58 | 35 | Arcillas marrón grisáceas. Sustrato Terciario alterado | III-A |
| BP-S2 | 1,20-1,80 | 17 | 41 | 31 | 36 | 72 | 43 | Arcillas marrones. Sustrato Terciario alterado | III-A |
| EB-S1 | 4,5-4,85 | 18 | 41 | R | | Rzo | Rzo | Arcillas / Argilitas | III-A / III-B |
| BE1-S2 | 1,90-2,30 | 19 | 26 | R | | Rzo | Rzo | Arcillas grisáceas. Sustrato Terciario alterado a sano | III-A / III-B |
| BPV10-S1 | 2,80-3,19 | 7 | 39 | R | | Rzo | Rzo | Arcillas / Argilitas | III-A / III-B |
| BE1-S2 | 3,00-3,35 | 22 | 55 | R | | Rzo | Rzo | Arcillas grisáceas. Sustrato Terciario más sano | III-B |
| BP-S1 | 1,20-1,42 | 17 | R | | | Rzo | Rzo | Yesos. Sustrato Terciario más sano | III-B |

En el caso del ensayo realizado en el tránsito II / III-A, el golpeo asignable al III-A sería el de los dos tramos finales de hinca, es decir, un NMI=32 (NSPT=19).

En los ensayos realizados en el tránsito III-A / III-B, y considerando los tramos iniciales como representativos del III-A, se determinarían NMI=45-46 a 59 (NSPT=27 a 35).

En el caso del III-B, se obtiene rechazo.

- 8 ensayos DPSH. Los valores de N20 los traducimos directamente a golpeo de NSPT.

En los dos ensayos realizados en la Balsa elevada 1, las capas resistentes que asociamos a la UG-III, dan los siguientes golpeos:

. BE1-P1. Para la UG-IIIA el golpeo N20 medio es de 30. El rechazo se asocia a la aparición de la UG-IIIB.

. BE1-P2. Entre 2 y 2,6 m un N20=26 que incluimos dentro de la UG-IIIA. De 2,8 hasta 3,6 m (profundidad de rechazo) el N20 medio es de 51, que sería más propio de la UG-IIIB.

En los cuatro ensayos realizados, en puntos de cruce de la red de riego bajo infraestructuras, las capas resistentes que asociamos al nivel III-A, dan los siguientes golpeos:

. RR-P1, entre 2,4 y 2,8 m, N20=24.
. RR-P2, entre 4 y 5,2 m, N20=14.

. RR-P3, entre 4,2 y 4,4 m, N20=19.
. RR-P4, entre 2,4 y 3,0 m, N20=29.

El nivel III-B se asocia al rechazo al ensayo o bien a golpeos superiores a 60.

En los dos ensayos realizados en la estación de bombeo-arqueta de seccionamiento, las capas resistentes que asociamos a la UG-III, dan los siguientes golpeos:

. EB-P1. Entre 1 y 1,6 m (rechazo) el golpeo medio es de 64 que asociamos a la UG-IIIB.

. EB-P2. Entre 3 y 3,8 m el golpeo medio N20=20 y se asocia a la UG-IIIA. El Rechazo sería propio de la aparición de la UG-IIIB.

A la vista de estos resultados, podemos diferenciar establecer como valores característicos de SPT, los siguientes:

. Para la parte alterada, sin considerar los golpeos más elevados que serían más propios de términos más sanos, se determina un NSPT= 23.

. Para la parte sana, se asignaría un golpeo NSPT de rechazo o al menos superior a 60. En cualquier caso a efectos de cálculos se adopta un valor máximo NSPT=50.

### 5.3.3. Parámetros geotécnicos

Como ya hemos indicado la caracterización geotécnica se realiza sobre los materiales arcillosos-argiliticos, ya que las intercalaciones más duras (yesos, areniscas cementadas y calizas-margocalizas) son minoritarias y de espesor reducido.

Desde el punto de vista del comportamiento geotécnico de esta unidad, consideramos que los términos alterados (UG-IIIA) se catalogarían como un suelo cohesivo de consistencia muy firme.

Para el sustrato sano (UG-IIIB) el comportamiento sería propiamente el de un macizo rocoso formado mayoritariamente por rocas de dureza muy blanda (argilitas). No obstante, dada la baja resistencia de las argilitas, hemos considerado un comportamiento más propio de un suelo cohesivo duro.

**Resistencia a compresión simple – Cohesión (UG IIIA y III-B)**

Aplicando el gráfico de Sowers y la expresión de Pasquilini, para arcillas de media plasticidad se obtiene los siguientes valores de resistencia a compresión simple:

. UG-IIIA (NSPT=23), 3,0 y 3,4 Kg/cm$^2$.

. UG-IIIB (NSPT=50), superior a 4,0 Kg/cm$^2$ y 7,4 Kg/cm$^2$.

En los tres ensayos de compresión uniaxial realizados sobre arcillas de la UG-IIIA, se obtuvieron resistencias de 2,6 a 4,0 kg/cm$^2$ (valor medio de 3,1 Kg/cm$^2$).

En los nueve ensayos realizados sobre argilitas de la UG-IIIB, los valores de resistencia obtenidos fueron muy variables, desde 2,76 kg/cm$^2$ a 16,69 kg/cm$^2$, con un valor medio de 7,0 Kg/cm$^2$.

A la vista de estos resultados, adoptaremos los siguientes valores:

. UG-IIIA; **$q_u$=3,0 kg/cm$^2$**.

. UG-IIIB; **$q_u$=6,0 kg/cm$^2$**.

Respecto a los parámetros de corte a corto plazo, a partir de la expresión habitualmente considerada $c_u$=0,5·$q_u$, obtendríamos los siguientes valores:

UG-IIIA: **$c_u$ =1,5 kg/cm$^2$**.
UG-IIIb: **$c_u$ =3,0 kg/cm$^2$**.

**Módulo de deformación**

Para la estimación de la deformabilidad, considerando un comportamiento puramente cohesivo puede aplicarse la correlación de Stroud (1974) incluida en la figura 23 de la publicación "*Design parameters for stiff clays*" dependiente del índice de plasticidad del material, y que se muestra en la figura del apartado 5.2.3.

Para suelos de media plasticidad puede considerarse una relación E/N= 1500 kPa, de donde se obtendría un módulo de deformación de 345 kg/cm$^2$ para la UG-IIIA y de 750 Kg/cm$^2$ para la UG-IIIB.

También puede estimarse según la fórmula propuesta por Henkel y Wroth E= 220x$c_u$, obteniéndose para la UG-IIIA, un módulo de deformación de E=330 kg/cm$^2$. Para la UG-IIIB, se obtiene un módulo de 660 Kg/cm$^2$.

A la vista de estos resultados, se adopta los siguientes valores de módulo de deformación:

. Para la UG-IIIA, E=335 kg/cm$^2$.
. Para la UG-IIIB, E=700 Kg/cm$^2$.

En resumen, los parámetros geotécnicos adoptados para la unidad III constituida principalmente por términos arcillosos-argiliticos, son los siguientes:

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad (t/m$^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación (kg/cm$^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

### 5.3.4.- Otros aspectos geotécnicos (UG III-A y III-B)

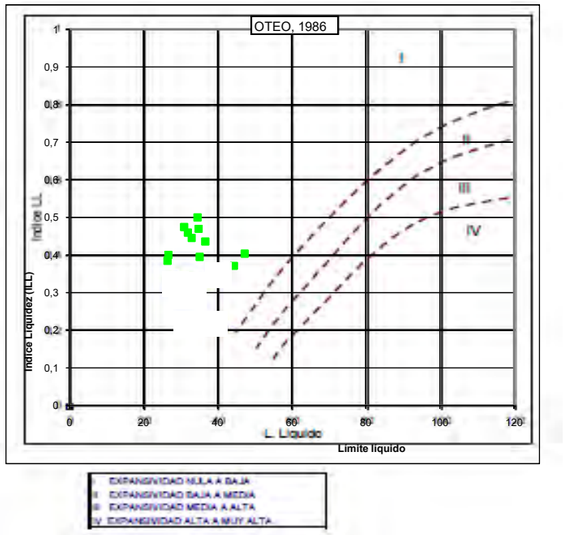
**Colapsabilidad**

Dada las características de los materiales que componen esta unidad, se descartan problemas de colapsabilidad.

**Expansividad**

Según los valores de plasticidad y en base a la tabla incluida en el apartado 5.2.4., las arcillas-argilitas se situarían en la frontera de los suelos de categoría I y II, de expansividad baja a baja-media.

Aplicando los criterios de expansividad basados en la plasticidad y humedad del suelo (Oteo, 1986 para suelos españoles) reflejados en la figura adjunta puede observarse que las muestras caen en el campo I de expansividad nula-baja.




Las presiones de hinchamiento obtenidas en 7 ensayos realizados, varían entre 0,1 y 0,65 kg/cm$^2$, propias de suelos de expansividad baja a baja-media. El valor medio se sitúa en 0,3 Kg/cm$^2$.

Esta baja expansividad potencial también se refleja en los materiales compactados al 98%PM, para los que se ha obtenido índices de hinchamientos libre variables, del 3,8 al 5,9 %. Estos valores son algo superiores a los esperables, según la presión de hinchamiento media y la tabla del apartado 5.2.4, ya que dichos valores serían inferiores al 2%.

A la vista de estos resultados, podemos concluir que las arcillas-argilitas de la UG-III (tanto A como B) presentan una baja expansividad potencial, con presiones de hinchamiento probables inferiores a 0,5 Kg/cm$^2$.

**Agresividad química a los hormigones**

El contenido en sulfatos solubles obtenido en tres muestras es muy variable desde inferior a 0,1% de $SO_3$ que los calificaría como no agresivos según EHE; hasta de 0,33% de $SO_3$ que los calificaría como de agresividad (ambiente Qb).

El contenido en sales solubles y yesos de dos muestras ensayadas, consideramos sería propio de materiales de agresividad media a alta.

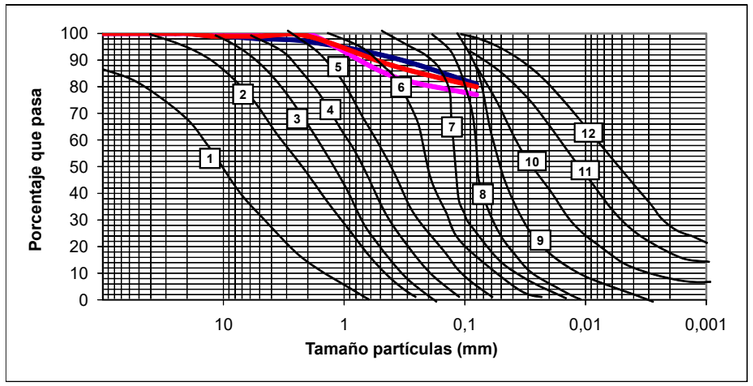
Esta marcada variación del contenido en sulfatos solubles y yesos, y por lo tanto de agresividad, consideramos se debe a que los yesos se distribuyen de forma heterogénea en las arcillas-argilitas.

Del lado de la seguridad, consideramos debe adoptarse una calificación general de agresividad fuerte (ambiente Qc) para esta unidad.

**Permeabilidad**

La permeabilidad de la UG-IIIA se puede estimar comparando las curvas de Breddin (figura adjunta) con las obtenidas en laboratorio. En este caso las colas de las curvas apuntan a una clase superior a 7, por lo que les corresponden permeabilidades **K ≤ 10$^{-4}$ cm/s**.

| CLASE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K (cm/s) | 3 | 0,7 | 0,1 | 0,05 | $9.10^{-3}$ | $5.10^{-3}$ | $2.10^{-3}$ | $7.10^{-4}$ | $7.10^{-5}$ | $1.10^{-5}$ | $<1.10^{-5}$ | $<<1.10^{-5}$ |

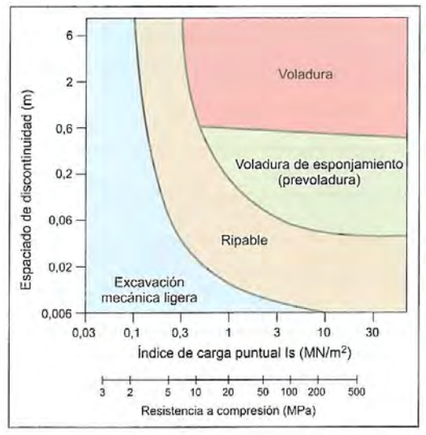



En el caso del sustrato sano (UG-IIIB), la permeabilidad del mismo además de la asociable a la propia argilita, dependerá también del grado de fracturación y discontinuidades existentes. En este sentido, sería esperable para la UG-IIIB una permeabilidad igual o algo mayor a la asignada a la UG-IIIA.

**Excavabilidad**

Los materiales arcillosos de la parte alterada del sustrato (UG IIIA) son excavables con medios convencionales.

Las argilitas de la UG-IIIB (sustrato sano) partir de los valores de resistencia a compresión simple asignables (6 Kg/cm$^2$), su RQD (77%) que se traduciría en un espaciado medio del orden de 0,2 a 0,3 m y aplicando la clasificación de la excavabilidad de Franklin (1974), estos materiales quedarían incluidos dentro de los terrenos excavables con medios potentes.



Los yesos, areniscas y calizas intercaladas dentro de las argilitas, son materiales rocosos más duros. Según lo observado durante la realización de las calicatas consideramos son litologías que de poseer un espesor reducido (inferior a 0,2 m) son excavables con medios potentes. Para espesores superiores, su excavación requeriría medios más potentes como martillo percutor o rippers.

En resumen, dado que la litología mayoritaria son las arcillas y argilitas y el resto de litologías (yesos, areniscas y calizas) aparecen como intercalaciones aisladas, en general de poco espesor, consideramos puede considerarse a esta unidad en su conjunto como excavable con medios potentes a fácilmente ripable.

**Aprovechamiento**

Desde el punto de vista de su aprovechamiento en obra, la excavación de la parte alterada de este nivel (UG-IIIA) generaría un suelo arcilloso con variable contenido en yesos. De la parte sana (III-B) se obtendría un todo-uno de características granulométricas finas y constituido principalmente por fragmentos de rocas muy blandas, dada la dominancia de los términos argiliticos con variable contenido en yesos (en áreas, venas, dispersos o como nódulos). Además este todo-uno de composición argilitica, evolucionaría a un suelo arcilloso dada su fácil alteración por la intemperie y también por los medios mecánicos de compactación.

Localmente este todo-uno, podría contener cantos de mayor tamaño y más duros, asociados al arranque y mezcla de los estratos de yesos, areniscas y calizas.

Para el análisis de aprovechamiento de este nivel, independientemente de corresponder a la UG-IIIA o UG-IIIB y a la presencia de términos intercalados más duros, se considera que todo el generaría un suelo arcilloso con un variable contenido en yesos.

Según PG-3, por su granulometría y plasticidad, se catalogan como suelos tolerables.

Desde el punto de vista químico los contenidos en sales solubles y yesos son muy variables. Una muestra posee valores de contenidos en yeso y sales solubles que están dentro de los límites admitidos para un suelo tolerable. Por el contrario, la segunda muestra ensayada muestra contenidos en yesos y sales, muy superiores que los catalogaría como suelos inadecuados o suelos con yesos.

Adicionalmente en tres muestras donde se determinó el contenido en sulfatos que de una forma indirecta nos puede reflejar contenidos en yesos, se reconoció un bajo contenido en sulfatos y por lo tanto también sería esperable un bajo contenido en yesos.

Esta marcada variación del contenido en yesos que representan a grandes rasgos la mayoría de las sales solubles, se debe a la distribución irregular y heterogénea del yeso dentro de las arcillas-argilitas.

Los términos arcillosos-argiliticos, presenta una cierta expansividad que se manifiesta en los materiales compactados, ya que en los ensayos de hinchamiento libre realizados para una compactación del 98% del PM se obtienen valores variables desde un máximo de 5,9% a un mínimo del 3,8%. Como ya hemos indicado en apartados anteriores, estos valores son algo superiores a los esperables, según la presión de hinchamiento media y la tabla del apartado 5.2.4, ya que los hinchamientos libres esperables serían inferiores al 2%. En este sentido, y según este parámetro, se calificarían como tolerables a marginales.

En resumen, de poder realizar una excavación selectiva y separar las intercalaciones básicamente arcillosas de los términos de yesos o de arcillas con alto contenido en yesos, se podría obtener un material donde la problemática de contenido en yesos sería menor pero que plantearía una limitación a considerar para su aplicación, especialmente para los diques, que es su cierta expansividad.

Para la puesta en obra de los materiales de composición básicamente arcillosa con variable contenido en yesos, se han realizado tres ensayos Proctor de tipo Modificado, obteniéndose los siguientes valores:

. Densidad máxima de 1,86 a 1,94 gr/cm$^3$, media de 1,93 gr/cm$^3$.
. Humedad óptima de 10,15 a 13,48%, promedio de 11,6%.

Con estos valores para el material compactado al 100%PM se determina una densidad aparente (a la humedad óptima) de 2,15 gr/cm$^3$.

Respecto al comportamiento geotécnico de estos materiales compactados, que corresponden a una mezcla de argilitas y yesos pero donde dominan los términos arcillosos, se han realizado dos ensayos de corte directo tipo CD (consolidado y drenado), obteniéndose resultados muy similares, pudiendo considerar a los efectos de cálculos posteriores los valores medios de ambos ensayos:

- Ángulo de rozamiento interno: 25,8º
- Cohesión: 0,34 Kg/cm$^2$.

## 5.4.- NIVEL AGUA

La presencia de agua en el terreno no responde a la existencia de un acuífero regional, tal y como se indica en el apartado 3.4. Tiene una distribución irregular tal y como se ha indicado en el apartado 4.1.5, para el caso de las balsas y estación de bombeo y como también se refleja en las tablas resumen de sondeos y calicatas (apartados 4.1.1. y 4.1.6).

En este sentido este aspecto se tratará de forma concreta para cada unidad de obra en el capítulo 6.

# 6.- CONCLUSIONES Y RECOMENDACIONES CONSTRUCTIVAS

La empresa CINGRAL, S.L. encarga a IGEOSUMA, S.L. la realización de un estudio geotécnico para el proyecto de “Modernización integral del regadío de la Comunidad de Regantes de Santa Ana, en los TTMM de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta (Huesca)”.

En el proyecto se contempla la construcción de cuatro balsas de almacenamiento de agua, una estación de bombeo y la colocación de una red de tuberías en todo el ámbito de la zona regable.

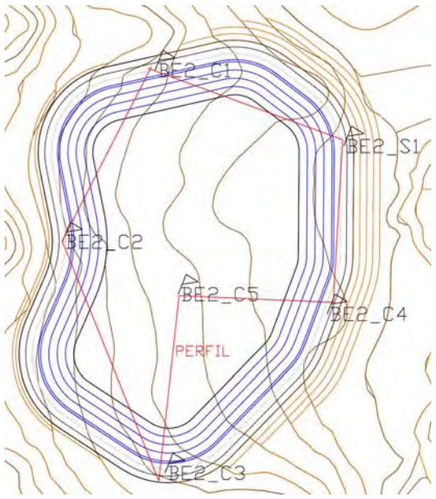
El estudio ha consistido en la recopilación bibliográfica, en el reconocimiento geológico por técnicos cualificados de la zona en la que se ubicarán los elementos de obra antes indicados y en la valoración geotécnica del terreno, basada en los datos geológicos tomados durante el reconocimiento y en los obtenidos a partir los ensayos geotécnicos de campo y ensayos de laboratorio ejecutados.

Los ensayos geotécnicos han consistido en la realización de 8 sondeos, 79 calicatas y 8 ensayos de penetración dinámica tipo DPSH.

Manteniendo la separación de unidades de obra, se establecen las conclusiones y recomendaciones constructivas para cada una de ellas.

## 6.1. BALSA ELEVADA 2

El estudio del terreno ha consistido en el reconocimiento geológico superficial por técnicos cualificados y en su caracterización geotécnica basada en los trabajos de campo y ensayos de laboratorio ejecutados. Los trabajos de campo específicos realizados han consistido en: 1 sondeo (BE-S1) y 5 calicatas (BE2-C1 a BE2-C5). En la figura adjunta se recoge de forma esquemática la posición de los ensayos que también se incluyen en el plano de situación del anejo IA.




Está proyectada sobre una finca agrícola que tiene una pendiente general oeste a este, y un desnivel del orden de 8 metros.

### 6.1.1 Características

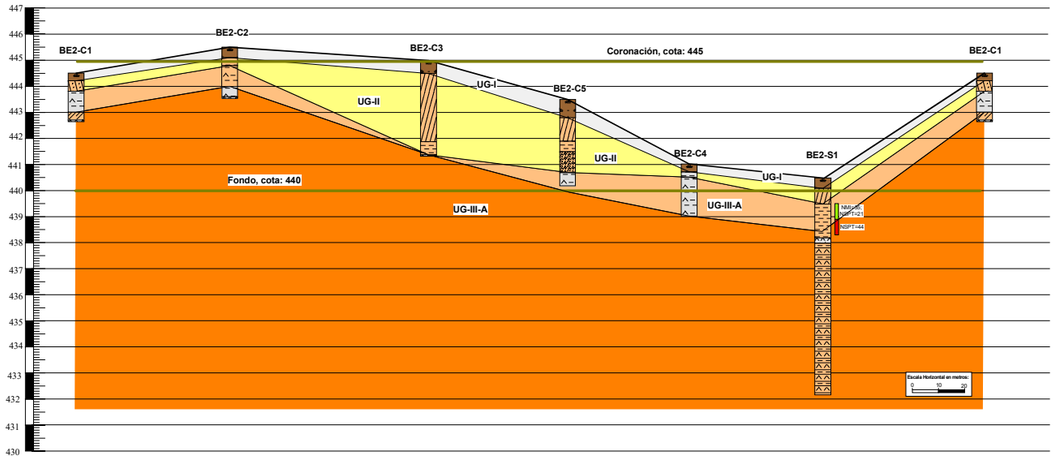
La balsa proyectada es mixta, parte excavada y parte terraplenada. Tiene las siguientes características geométricas:

- Cota de coronación: 445 m. (ancho de coronación 4,0 m).
- Cota de fondo: 440 m.
- Cota terreno: 448-440 m
- Talud exterior (terraplén): 2 H:1V con una altura máxima de 5,0 m.
- Talud interior balsa bajo coronación (desmonte y terraplén): 2,5H:1V, altura 5,0 m.
- Talud exterior en desmonte por encima de coronación: 1H:1V.

Se ha previsto la colocación de una lámina para impermeabilización del vaso de la balsa.

### 6.1.2 Modelo geológico-geotécnico

El modelo geológico-geotécnico para esta balsa queda reflejado en el perfil de correlación realizado y reflejado en el plano de situación anterior y que se ha incluido en el anejo VI-B de este estudio, y que también incluimos en la figura adjunta.




La distribución vertical y horizontal de los diferentes niveles litológico-geotécnicos descritos en el capítulo 5 es la siguiente:

- **Nivel I (UG-I): Tierra de labor / suelo vegetal.**

Se halla presente en toda la superficie a ocupar por la balsa con un espesor generalmente comprendido entre 0,30 y 0,70 m, valor medio 0,4 m.

- **Nivel II (UG-II): Recubrimiento cuaternario.**

En todos los casos se tratan de los suelos granulares finos (limos arcillosos, arcillas limosas, limos con arenas y arcillas).

Aparecen en todo el ámbito de la balsa, pero con espesores marcadamente variables. Concretamente en las calicatas C3 y C5 es de 2,1 a 3,0 m, mientras que en el resto de ensayos es inferior a 1 m (0,2 a 0,6 m).

Por la semejanza composicional observada con los recubrimientos cuaternarios de otras zonas próximas, podrían aplicarse en primera instancia los parámetros geotécnicos establecidos en el capítulo 5 para los suelos granulares finos de consistencia media.

No obstante en el caso concreto de esta balsa, no se dispone de ensayos de resistencia específicos de la UG-II que permitan determinar sin lugar a dudas que las características geotécnicas de los mismos son las determinadas con carácter general para esta UG-II de suelos finos de consistencia media.

En este sentido, consideramos que previamente al inicio de la obra, en la zona de mayor espesor de la UG-II, se realicen varios ensayos tipo DPSH, para ver si los golpeos obtenidos están dentro del rango de los establecidos para dicha unidad.

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|
| II | Media | 13 | 2,0 | 1,6 | 0,8 | 28º | 185 |

*Adicionalmente y a los efectos de análisis posteriores, debe considerarse la dispersabilidad asociada a estos materiales.*

- **Nivel III (UG-III): Sustrato Terciario.**

Aparece en todos los ensayos bajo la anterior unidad. Debido al variable espesor de la UG-II, en una parte de la balsa aparece cerca de superficie mientras que en otra se profundiza.

Salvo en la C-3, debido a la aparición de un nivel de yeso alabastrino, en el resto se reconoce en la parte superior de esta unidad, un tramo alterado (UG-IIIA) compuesto por arcillas a arcillas limosas con yesos. El espesor varía entre 0,5 y 1,5 m, en media se determinaría un espesor de 0,9 m.

Por debajo, el sustrato sano está formado por Arcillas duras-Argilitas marrones a grisáceas con yesos cristalinos (en venillas, discontinuidades o en zonas) y yesos nodulares, entre las que se intercalan capas de yesos alabastrino y muy puntualmente delgados estratos (< 5 cm) de margas calcáreas.

Para la parte alterada y más sana del sustrato terciario, se consideran los parámetros geotécnicos establecidos en el capítulo 5.

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

- **Nivel freático**

No se ha detectado presencia de agua en ninguna de las investigaciones y hasta la profundidad máxima alcanzada por el sondeo (8,3 metros). Según las cotas de los diferentes ensayos puede decirse que no se ha detectado nivel de agua al menos hasta la cota del fondo de la balsa.

### 6.1.3. Cimentación dique

Según el modelo de terreno reconocido y descrito anteriormente, tras la eliminación del suelo vegetal aparecería los suelos granulares finos de consistencia media de la UG-II, con un espesor muy variable de un mínimo de 0,2 m a un máximo de 3,1 metros.

Para la altura prevista de terraplén y dadas las características geotécnicas generales asignadas a la UG-II en donde apoyará, consideramos que a priori no van a existir problemas de capacidad portante y de asiento elástico.

Según lo indicado en el capítulo 5 de caracterización general de esta unidad, y por los datos de materiales similares en otras zonas cercanas, el riesgo de colapsabilidad de estos materiales es bajo. Además, se catalogan como suelos de nula a baja expansividad.

A continuación, se analiza la estabilidad global del dique y su terreno de apoyo, considerando como situación más desfavorable la siguiente:

- Altura de terraplén de 5,0 m; realizado con los materiales de la excavación. A los efectos y dado que según el perfil realizado, el volumen de material procedente de la UG-II puede ser alto, se han considerado los parámetros geotécnicos asignados al relleno compactado al 98%PM de estos materiales:
  .Densidad aparente: 2,1 g/cm3.
  . Ángulo de rozamiento interno: 28º
  . Cohesión: 0,16$Kg/cm^2$.

- Modelo de terreno bajo terraplén formado por 0,6 m de la UG-II y debajo la UG-III con 0,9 m alterados. Los parámetros geotécnicos considerados son los reflejados en el apartado 6.1.2.

- Las inclinaciones adoptadas para el terraplén son las indicadas al inicio de este capítulo: 2,5H:1V para el talud interior y 2H:1V para el exterior. El ancho en coronación del dique es de 4 metros.

El análisis de estabilidad se realiza utilizando los métodos tradicionales de Bishop, Janbu, etc y mediante la aplicación del programa de cálculo SLOPE / W. Para este análisis sólo se ha valorado únicamente la posibilidad de círculos de rotura pasando por debajo del cimiento y no la estabilidad propia del dique que se analiza en el apartado de estabilidad de taludes. Las soluciones gráficas obtenidas en el programa se reflejan en el Anejo VIII.

Las situaciones de estabilidad analizadas y los factores de seguridad (FS) a considerar, son los establecidos por el Ministerio de Fomento para Balsas:
- Final de construcción, con un FS mínimo de 1,3.
- Embalse lleno, con un FS mínimo de 1,5.
- Rotura de lámina, con un FS mínimo de 1,3.
- Desembalse rápido, con un FS mínimo de 1,1.

Para las inclinaciones proyectadas, los factores de seguridad mínimos obtenidos en las cuatro situaciones de cálculo (final de construcción, embalse lleno, rotura de lámina y desembalse rápido) corresponden con la rotura por el talud del terraplén, por lo que los factores de seguridad de rotura por cimiento en estas mismas situaciones de cálculo serán superiores (mayores de 2) claramente por encima a los factores mínimos exigidos por el Ministerio de Fomento e indicados anteriormente.

Adicionalmente se han analizado el asiento elástico esperable mediante la aplicación del programa Settle v2.0 de Rocscience. Las salidas gráficas de este análisis se incluyen en el Anejo X.

El asiento máximo esperable sería de 2,65 cm, asumible por una estructura flexible como la que corresponde a un terraplén.

Por último, la dispersabilidad de la UG-II, es un factor a tener presente en lo concerniente al mantenimiento de la estabilidad del cimiento en el tiempo, ya que puede verse alterada caso de producirse filtraciones hacia el terreno. Este aspecto se analiza en detalle en el apartado 6.1.9.

### 6.1.4. Fondo de la balsa

Según el perfil de correlación y la cota prevista para la solera de la balsa (440), la excavación en la mayor parte los casos, alcanzará la UG-III tanto su parte alterada como sana. Únicamente en el entorno del sondeo se dispondría sobre un delgado espesor de la UG-II de consistencia media.

La UG-III no plantea problemas de colapsabilidad y los términos arcillosos de la misma poseen una expansividad baja, con presiones de hinchamiento probables inferiores a 0,5 $Kg/cm^2$.

En este sentido, en las zonas donde aparezca esta unidad consideramos sería aconsejable realizar un labrado profundo de las arcillas-argilitas y su recompactación enérgica del lado húmedo. Además como medida preventiva para minorar los cambios de humedad deberá contemplarse un drenaje adecuado del fondo que permita conducir las aguas de los posibles rezumes y/o fugas que puedan aparecer.

La UG-II, no plantea problemas de colapsabilidad ni de hinchamiento, pero son materiales dispersables.

Respecto a la dispersabilidad, mientras no haya fugas en la lámina, no plantearía problemas, no obstante no debe minorarse este riesgo que analizamos en el apartado 6.1.9.

### 6.1.5. Estabilidad de taludes

Los taludes a ejecutar son de tres tipos:

- Tipo 1.- Taludes permanentes en terraplén para el dique de la balsa. (interior a 2,5H:1V y exterior 2H:1V)

La situación más desfavorable sería la del entorno del sondeo, donde el dique alcanza la mayor altura y que ya se ha analizado en la estabilidad global del terraplén. Los factores de seguridad obtenidos, en las cuatro situaciones de cálculo (final de construcción, embalse lleno, rotura de lámina y desembalse rápido), son superiores a 2 y están por encima de los mínimos exigidos.

- Tipo 2.- Talud permanente en desmonte bajo camino de coronación (en interior de la balsa). 2,5H:1V

Para este caso se ha considerado como situación más desfavorable la del entorno de la C3. El esquema considerado sería:

. Desmonte de 5 m de altura, con los 3 primeros metros de la UG-II y debajo la UG-III con 0,9 m de la zona alterada (UG-III-A).

. Los parámetros geotécnicos asignados a los niveles de terreno afectados por la excavación son los ya indicados en el apartado 6.1.2.

El análisis de estabilidad se realiza conjuntamente con el talud en desmonte tipo 3.

- Tipo 3.- Talud permanente en desmonte sobre camino de coronación (1H:1V).

La calicata más cercana a este tipo de talud (C2) se ha realizado aproximadamente a la cota de la base del mismo, por lo que no se ha podido reconocer de forma directa el terreno que constituiría dicho talud.

No obstante por lo observado en superficie, y lo reconocido en dicha calicata, sería esperable un desmonte formado principalmente por la UG-III y en coronación un reducido espesor de la UG-II.

A los efectos del análisis de la estabilidad se ha considerado el siguiente esquema geológico:

. Un talud sobre coronación de 2,0 metros de altura.

. Todo el talud formado por la unidad UG-II de consistencia media.

Los parámetros geotécnicos asignados a los niveles de terreno afectados por la excavación son los ya indicados en el apartado 6.1.2.

El análisis de estabilidad del talud tipo 2 y 3 se realiza conjuntamente y la solución obtenida se incluye en el anejo VIII.

El factor de seguridad obtenido es de 5,9 que garantiza una adecuada estabilidad del talud.

### 6.1.6 Excavabilidad

En la excavación de la balsa se verán afectados todos los niveles geotécnicos identificados (I, II y III, parte alterada y sana).

Ante la no detección de agua en el terreno (hasta la profundidad de investigación alcanzada), las excavaciones se desarrollarán en condiciones secas.

Para la caracterización de la excavabilidad se dispone en primer lugar del comportamiento observado de estos terrenos durante la realización de las calicatas, asi como de los valores de resistencia a compresión uniaxial en las argilitas de la UG III-B. Según lo ya indicado en el capítulo 5, la excavabilidad de estos niveles geotécnicos es la siguiente:

. Los suelos de la UG-I y UG-II y la parte alterada del sustrato Terciario (UG-IIIA) son excavables con medios convencionales.

. El sustrato Terciario sano (UG-IIIB), dado que la litología mayoritaria son las arcillas y argilitas y el resto de litologías (yesos y calizas) aparecen como intercalaciones aisladas, en general de poco

espesor, consideramos puede considerarse a esta unidad en su conjunto como excavable con medios potentes a fácilmente ripable. De aparecer estratos de yesos o calizas de espesor superior a 0,3-0,4m, la excavación de los mismos requerirá del uso de martillo rompedor o equipos desgarradores (rippers) potentes.

### 6.1.7. Materiales para la construcción de diques

Los materiales que se obtendrán de las excavaciones serán los correspondientes a las tres unidades geotécnicas reconocidas, y de acuerdo a la caracterización de los mismos realizada en el capítulo 5, se establece el siguiente aprovechamiento:

. Tierra de labor / suelo vegetal (UG-I) que deberá retirarse a vertedero o aprovecharse en revegetación de taludes o en rellenos para nivelaciones agrícolas.

. Suelos limosos de la UG-II de consistencia media que por su granulometría y plasticidad se calificarían como tolerables según PG-3. Por su quimismo (contenido en sales solubles y materia orgánica) mantendrían esta catalogación.

En los ensayos pin-hole realizados sobre estos materiales se reconoce que son dispersables, desde D1 a D2, aspecto a considerar en su aprovechamiento.

En este sentido este tipo de materiales podría aplicarse a rellenos de diques siempre que se utilice una lámina impermeabilizante que está proyectada para el caso de esta balsa y además contemplar, las siguientes limitaciones y condiciones de puesta de obra:

- Posibilitar su mezcla con los términos arcillosos con pocos yesos de la UG-III.

- Adoptar medidas que eviten la entrada de agua al dique. A este respecto la aplicación de una lámina impermeabilizante es una medida que evita el contacto del agua por el interior de la balsa. Por el exterior, sería recomendable una cierta revegetación de los taludes para evitar su reguerización, asi como medidas de conducción de las aguas pluviales desde coronación mediante bajantes hormigonadas.

. De la UG-III la excavación no selectiva del mismo va a generar una mezcla variable de arcillas de alteración con yesos, fragmentos de argilitas con yesos y fragmentos de yesos heterométricos. Es decir, se obtendría desde un suelo arcilloso con variable contenido de yeso cristalino junto con fragmentos de argilitas y yesos a un todo uno de granulometría variable, de fina a gruesa, formado por argilitas con yesos.

Estos materiales por su composición química, con un contenido en yesos muy variable, se han catalogado según PG-3, desde tolerables a inadecuados-suelos con yesos. Por los valores de hinchamiento libre obtenidos, se catalogarían como marginales.

En este sentido, y según lo indicado en el capítulo 5, de poder realizar una excavación selectiva y separar los términos arcillosos con bajos contenidos en yesos de los términos de arcillas con altos contenidos en yesos o de las intercalaciones de yesos se podría obtener un material que por su hinchamiento libre lo calificaríamos de forma general como marginal, pudiendo llegar a tolerable, y en el que la problemática del contenido en yesos sería más reducida.

Estas limitaciones (contenido en yesos y cierta expansividad del material argilitico compactado), debe ser valorado finalmente por el proyectista a la hora de determinar su aplicación o no en diques de balsa.

Lo aconsejable sería, dado que se colocará una lámina impermeabilizante por su interior, realizar una excavación selectiva que permita aprovechar mayoritariamente los términos básicamente argiliticos con pocos yesos, descartándose las zonas de mayor contenido en yesos.

En cualquier caso, el uso de estos materiales (argilitas con pocos yesos) en diques, pasa por un seguimiento exhaustivo de los materiales y de su puesta en obra basada entre otros aspectos en:

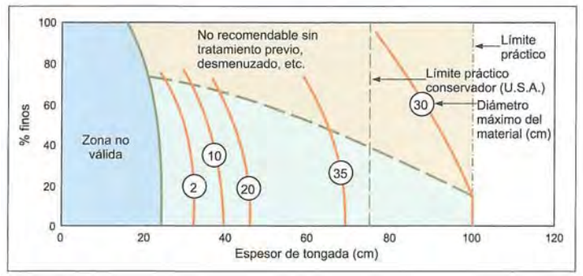
- Control de los materiales aprovechables que evite la introducción de grandes fragmentos de yesos o de zonas arcillosas con alto contenido en yesos.

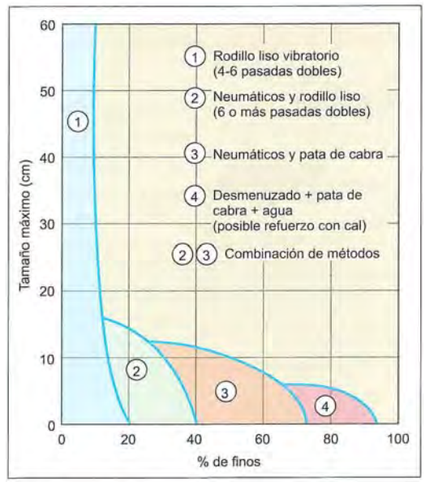
- Si es posible procurar la mezcla de estos materiales con los limos de la UG-II.

- Control riguroso e intensivo de la compactación que deberá realizarse del lado húmedo.

Adicionalmente y para evitar cambios de humedad del material, debería contemplarse medidas que eviten la entrada de agua al dique por su lado exterior, como las ya indicadas para el caso del aprovechamiento de los materiales de la UG-II.

Los criterios generales de puesta de obra de los materiales en lo que respecta al espesor de tongadas que está en función del tamaño máximo del material y su contenido en finos, así como del método de compactación, se recogen en las figuras anejas.




Para el caso de los materiales procedentes de la UG-II sería aconsejable tongadas de 25-30 cm y un tratamiento de desmenuzado. Para los materiales procedentes de la UG-III (solo los términos dominantemente argiliticos) y dado que sería esperable encontrar fragmentos de tamaño superior a 2 cm sería recomendable tongadas de 35-40 cm.

Para la compactación de los materiales de la UG-II con contenidos en finos superiores al 60-80%, el método más aconsejable sería el uso del rodillo pata de cabra. Para los materiales procedentes de la UG-III (términos arcillas-argilitas con pocos yesos) dado que será esperable un menor contenido en finos y la presencia de cantos de argilitas fácilmente disgregables a arcillas consideramos recomendable también el uso de rodillo de pata de cabra.

En el caso de la puesta en obra de los materiales excavados de la UG-II, y a partir de los valores de humedad obtenidos en las muestras ensayadas de la balsa de pie de canal V10 que son altos, sería necesario un cierto secado previo de los mismos. No obstante por lo observado, esta unidad y para el caso de esta balsa, presentaría humedades inferiores, por lo que la necesidad de secado o el aprovechamiento directo deberá valorarse en fase de obra mediante la realización de ensayos complementarios de determinación de la humedad.

Para la puesta en obra de la UG-III, dada la humedad natural promedio determinada (14%) y la humedad óptima de compactación (12%), podría aplicarse prácticamente de forma directa o con una mínima aireación, máxime cuando hemos indicado la necesidad de su compactación del lado húmedo

### 6.1.8. Agresividad

Los materiales afectados por la construcción de la balsa (UG-II y UG-III), según lo indicado en el capítulo 5, se catalogan como agresivos a los hormigones, ambiente Qc, según EHE).
Por lo tanto, en las obras de hormigón en contacto con el terreno (cualquiera que se la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

### 6.1.9. Otras consideraciones

La dispersabilidad asociada a los materiales de la UG-II, es un aspecto que de generarse filtraciones-entradas de agua, tanto sobre el terreno en estado natural o sobre el terreno compactado, puede comprometer la estabilidad de la balsa en su conjunto.

A este respecto consideramos debe valorarse la posibilidad de la colocación de una doble lámina y un adecuado drenaje para el interior de la balsa; asi como medidas que para los taludes exteriores reduzcan o minoren la posible entrada de agua a este terreno (natural o compactado) y que entre otras como ya hemos indicado serían una cierta revegetación y drenajes de conducción de las aguas pluviales desde coronación mediante bajantes hormigonadas.

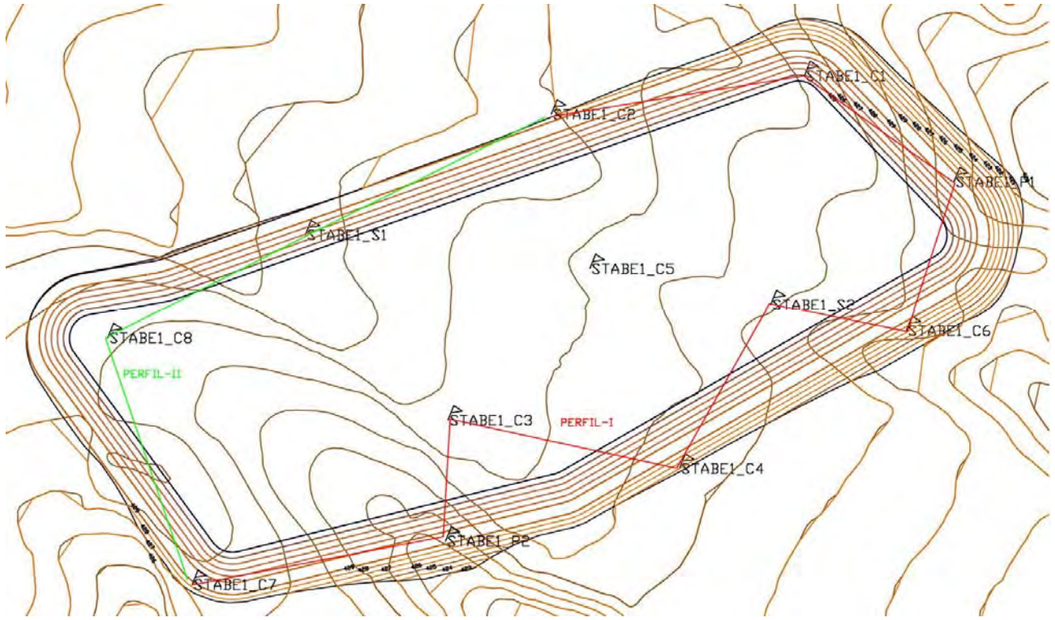
Estas mismas medidas son también muy adecuadas para el fondo de balsa en la UG-III y para el dique realizado con la UG-III.

Esta dispersabilidad, en lo que respecta a los materiales compactados, consideramos se verá reducida de facilitar la mezcla de esta unidad con la UG-III. Esta mezcla de unidades también será beneficiosa para los materiales compactados procedentes de la UG-III.

Como se ha indicado en el apartado 6.1.2., previamente al inicio de la obra, en la zona de mayor espesor de la UG-II, deberán realizarse varios ensayos tipo DPSH, para ver si los golpeos obtenidos están dentro del rango de los establecidos para la unidad UG-II de consistencia media.

## 6.2. BALSA ELEVADA 1

El estudio del terreno ha consistido en el reconocimiento geológico superficial por técnicos cualificados y en su caracterización geotécnica basada en los trabajos de campo y ensayos de laboratorio ejecutados. Los trabajos de campo específicos realizados han consistido en: 2 sondeos (BE1-S1 a BE2-S2), 8 calicatas (BE1-C1 a BE1-C8) y 2 ensayos de penetración dinámica tipo DPSH (EB1-P1 y P2). En la figura adjunta se recoge de forma esquemática la posición de los ensayos que también se incluyen en el plano de situación del anejo IA.




Está proyectada sobre varias fincas agrícolas que en conjunto muestran una pendiente general de NW a SE, y un desnivel del orden de 8 metros (cota superior 430 y cota inferior 422).

### 6.2.1 Características

La balsa proyectada es mixta, parte excavada y parte terraplenada. Tiene las siguientes características geométricas:

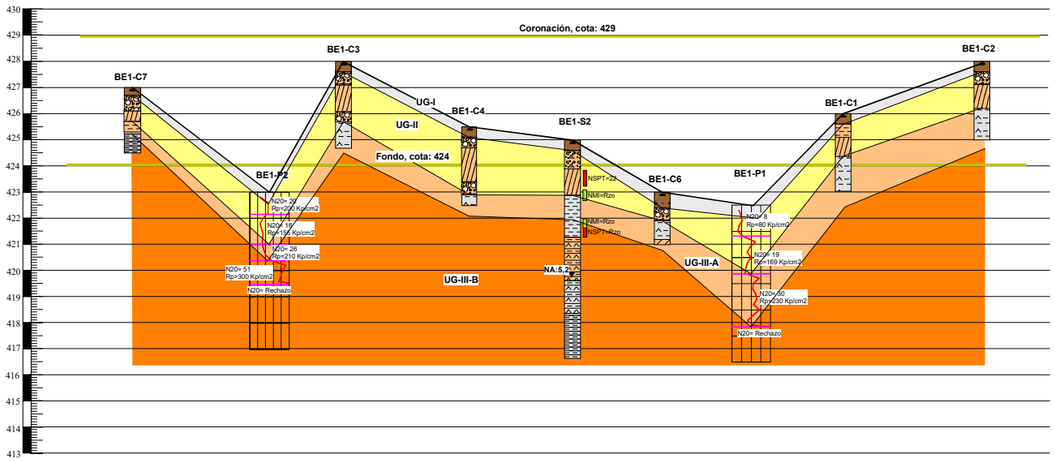
- Cota de coronación: 429 m (ancho de coronación 5 m).
- Cota de fondo: 424 m.
- Cota terreno: 430-422 m
- Talud exterior (terraplén): 2H:1V con una altura máxima de 8 m, en la esquina este de la balsa.
- Talud interior balsa bajo coronación (desmonte y terraplén): 2,5H:1V, altura 5,0 m.
- Talud exterior en desmonte por encima de coronación: 1H:1V, con altura del orden de 1,0 m.

Se ha previsto la colocación de una lámina para impermeabilización del vaso de la balsa.

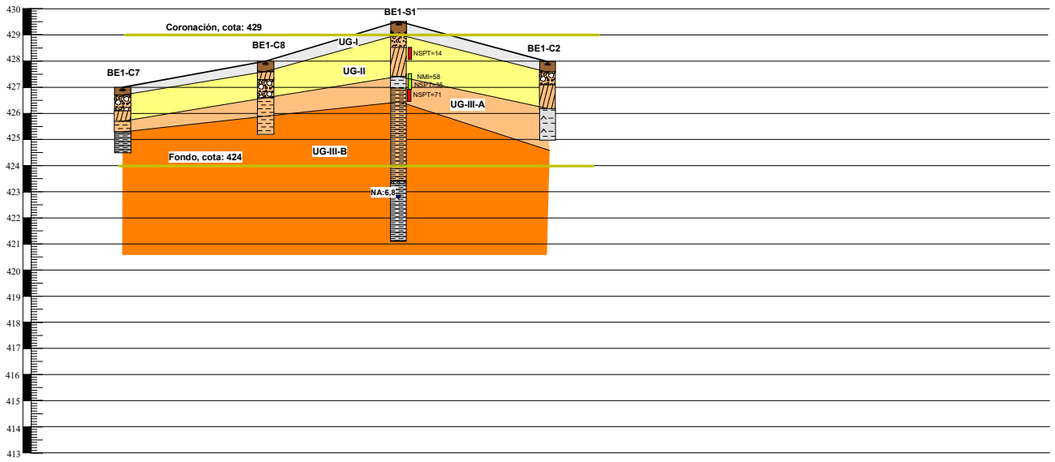
### 6.2.2 Modelo geológico-geotécnico

El modelo geológico-geotécnico para esta balsa queda reflejado en los dos perfiles de correlación realizados y reflejados en el plano de situación anterior que se han incluido en el anejo VI-A de este estudio y también incluimos en las figuras adjuntas.

Perfil-I




Perfil-II




La distribución vertical y horizontal de los diferentes niveles litológico-geotécnicos descritos en el capítulo 5 es la siguiente:

- **Nivel I (UG-I): Tierra de labor / suelo vegetal.**

Se halla presente en toda la superficie a ocupar por la balsa con un espesor generalmente comprendido entre 0,3 y 0,6m, valor medio 0,45 m.

- **Nivel II (UG-II): Recubrimiento cuaternario.**

Mayoritariamente son suelos granulares finos: limos arcillosos, arcillas limosas, y limos con arenas y arcillas. No obstante son frecuentes las intercalaciones a techo y/o base de suelos granulares gruesos con espesores de 0,2 a 0,6 m.

Aparece debajo de la unidad anterior y su espesor global varía entre mínimos de 0,5-0,9 a máximos de 2,2 m, con un valor medio de 1,4 m.

Los golpeos obtenidos en los SPT, MI y DPSH, están dentro del rango de los definidos para la unidad UG-II de consistencia media, por lo que los parámetros considerados son los establecidos en el capítulo 5.2:

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|
| II | Media | 13 | 2,0 | 1,6 | 0,8 | 28º | 185 |

Para las intercalaciones de gravas, según hemos indicado en el apartado, los parámetros estimados son propios de un terreno con un igual o mejor comportamiento geotécnico que los suelos limosos. En este sentido, a efectos de los análisis posteriores hemos considerado que la unidad en su conjunto se comportaría como un suelo limoso de consistencia media, con los parámetros geotécnicos resumidos en la tabla anterior.

- **Nivel III (UG-III): Sustrato Terciario.**

Aparece en todos los ensayos bajo la anterior unidad.

Se reconoce en la parte superior de esta unidad, un tramo alterado (UG-IIIA) compuesto por arcillas a arcillas limosas con yesos. El espesor varía entre 0,4 y 1,3 m, alcanzándose un máximo de 2,0 m solo en el P1. En media se determinaría un espesor de 0,9 m.

Por debajo, el sustrato sano está formado principalmente por arcillas duras-Argilitas marrones a grisáceas con yesos cristalinos (en venillas, discontinuidades o en zonas) con una distribución y contenido muy variable. Además se intercalan: estratos de yesos nodulares-alabastrinos con espesores iguales o inferiores a 10 cm, asi como estratos de areniscas variablemente cementadas de espesor centimétrico.

Para la parte alterada (III-A) y más sana (III-B) del sustrato terciario, se consideran los parámetros geotécnicos establecidos en el capítulo 5.3.

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

- **Nivel freático**

Según lo expuesto en el apartado 4.1.5, no resulta evidente establecer la existencia de agua en el terreno hasta la profundidad alcanzada, no obstante, consideramos que de aparecer se limitaría a rezumes locales de muy escaso caudal que asociaríamos al sustrato Terciario, ya que ni en los sondeos ni en las calicatas se ha detectado agua o humedades significativas en el recubrimiento cuaternario existente por encima.

### 6.2.3. Cimentación dique

Según el modelo de terreno reconocido y descrito anteriormente, tras la eliminación de la tierra labor-suelo vegetal (UG-I) aparecería los suelos granulares finos de la UG-II de consistencia media, con un espesor de entre 0,5 a 2,2 m (promedio de 1,4 m).

Para la altura prevista de terraplén y dadas las características geotécnicas generales asignadas a la UG-II y UG-III, consideramos que a priori no van a existir problemas de capacidad portante y de asiento elástico.

Según lo indicado en el capítulo 5.2 de caracterización general de la UG-II el riesgo de colapsabilidad de estos materiales es bajo. Además se catalogan como suelos de nula a baja expansividad. La problemática de los mismos está en relación son su dispersabilidad, y las consideraciones al respecto son las ya establecidas en el capítulo 6.1.9 para la balsa Elevada 2.

A continuación se analiza la estabilidad global del dique y su terreno de apoyo, considerando como situación más desfavorable la correspondiente al entorno del DPSH BE1-P1:

- Altura de terraplén de 7,0 m; realizado con los materiales de la excavación. Dado que según los perfile realizados el volumen de material procedente de la UG-II sería superior al de la UG-III, adoptamos como parámetros geotécnicos los establecidos en el apartado 5.2.4. para el material compactado de la UG-II:
  .Densidad aparente: 2,1 g/cm3.
  . Ángulo de rozamiento interno: 28º
  . Cohesión: 0,16$Kg/cm^2$.

- Modelo de terreno bajo terraplén formado por: 2,0 metros de UG-II, por debajo la UG-III con una parte alterada de 2,0 metros de espesor y debajo el sustrato sano (III-B). Los parámetros geotécnicos considerados son los reflejados en el apartado 6.2.2.

- Las inclinaciones adoptadas para el terraplén son las indicadas al inicio de este capítulo: 2,5H:1V para el talud interior y 2H:1V para el exterior. El ancho del dique en coronación es de 5 metros.

El análisis de estabilidad se realiza utilizando los métodos ya indicado en el capítulo 6.1.3. Y las condiciones de cálculo y los factores exigibles a las mismas son los indicados por el Ministerio de Fomento para balsas y que se han indicado en el capítulo 6.1.3.

Para este análisis se ha valorado la posibilidad de círculos de rotura pasando por debajo del cimiento comprobándose que los factores de seguridad son superiores a los obtenidos en el análisis de estabilidad propia del dique que se analiza en el apartado de estabilidad de taludes para las tres situaciones de cálculo final de construcción, rotura de lámina y desembalse rápido.

Las soluciones gráficas obtenidas en el programa se reflejan en el Anejo VIII.

Adicionalmente se han analizado el asiento elástico esperable mediante la aplicación del programa Settle v2.0 de Rocscience. La salida gráfica de este análisis se incluye en el Anejo IX.

El asiento máximo esperable sería de 4,0 cm, asumible por una estructura flexible como la que corresponde a un terraplén.

**6.2.4. Fondo de la balsa**

Según los perfiles de correlación y la cota prevista para la solera de la balsa (424), ésta se dispondrá tanto sobre la UG-II como sobre la UG-III (parte alterada y sana).

Dado que estas mismas unidades aparecen en el fondo de la balsa elevada 2, serán aplicables las consideraciones establecidas al respecto en el apartado 6.1.4.

En el entorno del ensayo BE1-P2, situado en el fondo de una vaguada y en el entorno de los ensayos BE1-P1 y BE1-C6; la cota del terreno (423-422) está por debajo de la cota de solera, por lo que ésta se dispondrá sobre el relleno compactado que deberá realizarse.

Para este caso, tanto si se utilizan los materiales de la UG-II como los de la UG-III para realizar el relleno compactado, deberá tenerse presente las consideraciones indicadas en el punto 6.1.7. para el aprovechamiento de los mismos en la construcción de diques.

**6.2.5. Estabilidad de taludes**

Los taludes a ejecutar son de tres tipos:

- Tipo 1.- Taludes permanentes en terraplén para el dique de la balsa. (interior a 2,5H:1V y exterior 2H:1V)

La situación más desfavorable es la descrita para el análisis de estabilidad del cimiento del dique en el apartado 6.2.3.

El análisis de estabilidad se realiza utilizando los métodos ya indicado en el capítulo 6.1.3. Y las condiciones de cálculo y los factores exigibles a las mismas son los indicados por el Ministerio de Fomento para balsas y que también se han indicado en el capítulo 6.1.3.

La solución obtenida en el programa se refleja en el Anejo VIII.

Los factores de seguridad obtenidos, en las tres situaciones de cálculo (final de construcción, rotura de lámina y desembalse rápido), son de 2,14, 1,88 y 1,83, respectivamente, y todos ellos están por encima de los mínimos exigidos por el Ministerio de Fomento para Balsas.

- Tipo 2.- Talud permanente en desmonte bajo camino de coronación (en interior de la balsa). 2,5H:1V

En este caso hemos considerado como situación más desfavorable geotécnicamente la del entorno del sondeo S-1.

El esquema considerado sería:

. Desmonte de 5 metros de altura.

. Como modelo de terreno para este desmonte se ha considerado los datos del S-1, junto con los de la C-3, adoptando los más desfavorables de ambos. Concretamente 1,9 m de la UG-II, debajo la UG-III con un espesor de alteración de 1,0 m.

Los parámetros geotécnicos asignados a los niveles de terreno afectados por la excavación son los ya indicados en el apartado 6.2.2.

El análisis de estabilidad se realiza utilizando los métodos ya indicado en el capítulo 6.1.3. Y las condiciones de cálculo y los factores exigibles a las mismas son los indicados por el Ministerio de Fomento para balsas y que también se han indicado en el capítulo 6.1.3.

La solución obtenida en el programa se refleja en el Anejo VIII.

El factor de seguridad obtenido es de 7,3 que garantiza una adecuada estabilidad del talud.

- Tipo 3.- Talud permanente en desmonte sobre camino de coronación (1H:1V).

Este tipo de talud aparecería en el lateral noroeste de la balsa, aproximadamente entre los ensayos S1 y C8. La altura del mismo sería del orden de 1-1,5 m sobre camino de coronación.

A los efectos del análisis de la estabilidad se ha considerado como esquema geológico el reconocido en el entorno del S-1, y por lo tanto la totalidad de este talud sobre coronación se desarrollaría en la UG-II de consistencia media. Por debajo del camino de coronación se ha considerado el modelo definido para el talud tipo 2.

Los parámetros geotécnicos asignados a estos niveles son los ya indicados en el apartado 6.2.2.

El análisis de estabilidad se realiza con idéntica metodología y programa que se han indicado en apartados anteriores y de forma conjunta con el talud tipo II. La solución obtenida en el programa se refleja en el Anejo VIII.

Concretamente se ha obtenido un factor de seguridad de 6,3, que garantiza una adecuada estabilidad del talud.

**6.2.6.- Presencia de agua-Drenaje**

Según lo expuesto en el apartado 4.1.5, no resulta evidente establecer la existencia de agua en el terreno hasta la profundidad alcanzada, no obstante consideramos que de aparecer se limitaría a rezumes locales de escaso caudal que asociaríamos al sustrato Terciario.

En este sentido, de aparecer estos rezumes deberán contemplarse medidas de drenaje en dichos puntos.

En los taludes puede contemplarse la realización de pequeñas zanjas rellenas de grava según la dirección de máxima pendiente que conecten con una zanja drenante perimetral, no debiendo descartarse que también deban realizarse zanjas drenantes en el fondo de balsa que conecten con la zanja perimetral, caso de aparecer afloramientos de agua en dicho fondo.

### 6.2.7 Excavabilidad

En la excavación de la balsa se verán afectados todos los niveles geotécnicos identificados (I, II y III, parte alterada y sana).

Dado que estas mismas unidades aparecen en la balsa elevada 2 y con unas características muy similares, serán aplicables las consideraciones establecidas al respecto en el apartado 6.1.6.

### 6.2.8. Materiales para la construcción de diques

Como ya hemos indicado, los materiales que se obtendrán de las excavaciones serán los correspondientes a las tres unidades geotécnicas reconocidas que con similares características se han detectado en la balsa elevada 2, por lo que consideramos también aplicable los aprovechamientos, limitaciones y consideraciones realizadas al respecto en el apartado 6.1.7.

### 6.2.9. Agresividad

Los materiales afectados por la construcción de la balsa (UG-II y UG-III), según lo indicado en el capítulo 5, se catalogan como agresivos a los hormigones, ambiente Qc, según EHE).

El agua existente en el terreno se cataloga como de agresividad media (ambiente Qb)

Por lo tanto, con independencia de la existencia de agua o no en el terreno, en las obras de hormigón en contacto con el terreno (cualquiera que sea la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

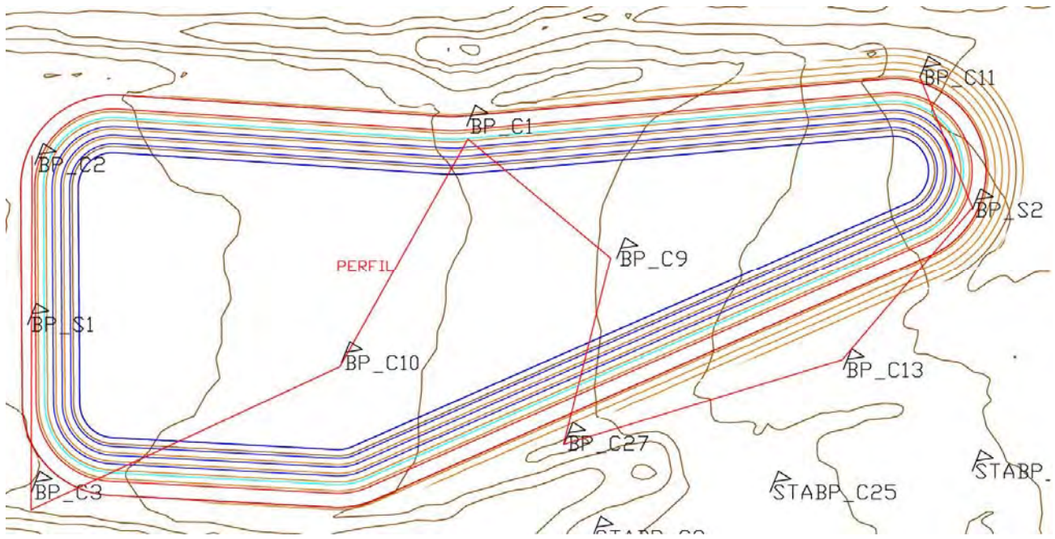
### 6.2.10. Otras consideraciones

Al igual que en la balsa elevada 2, debe tenerse presente la problemática de dispersabilidad en los materiales de la UG-II, siendo aplicables las recomendaciones y consideraciones realizadas al respecto en el apartado 6.1.9.

Estas mismas medidas también serían adecuadas para el fondo de balsa en la UG-III y para el dique realizado con la UG-III.

## 6.3. BALSA PIE DE CANAL V4

El estudio del terreno ha consistido en el reconocimiento geológico superficial por técnicos cualificados y en su caracterización geotécnica basada en los trabajos de campo y ensayos de laboratorio ejecutados. Los trabajos de campo específicos realizados han consistido en: 2 sondeos (BP-S1 a BP-S2) y 8 calicatas (BP-C1 a C3, BP-C9 a C-11, BP-C13 y BP-C27). En la figura adjunta se recoge de forma esquemática la posición de los ensayos que también se incluyen en el plano de situación del anejo IC.




Está proyectada sobre una finca agrícola que tiene una pendiente general oeste a este, y un desnivel del orden de 6 metros.

Como rasgo adicional a destacar del entorno de la zona de estudio, señalar que a una distancia de unos 10 m al norte, existe un azarbe que discurre paralelo a un lateral de la balsa, cuyo fondo según plano topográfico se sitúa entre las cotas 386 a 385. En dicho desagüe, circula agua de forma permanente y según lo observado procede de fugas del canal existente al oeste de la balsa.

### 6.3.1 Características

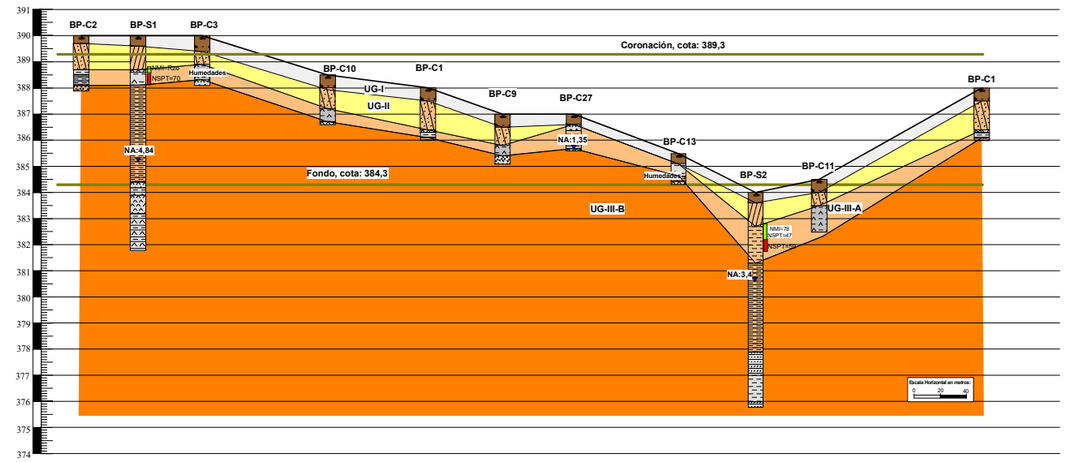
La balsa proyectada es mixta, parte excavada y parte terraplenada. Tiene las siguientes características geométricas:

- Cota de coronación: 389,3 m (ancho de coronación 4 m).
- Cota de fondo: 384,3 m.
- Cota terreno: 390-384 m
- Talud exterior (terraplén): 2H:1V con una altura máxima de 5,0 m.
- Talud interior balsa bajo coronación (desmonte y terraplén): 2,5H:1V, altura 5,0 m.
- Talud exterior en desmonte por encima de coronación: 1H:1V, altura 1,0 m.

Se ha previsto la colocación de una lámina para impermeabilización del vaso de la balsa.

### 6.3.2 Modelo geológico-geotécnico

El modelo geológico-geotécnico para esta balsa queda reflejado en el perfil de correlación realizado y reflejado en el plano de situación anterior que se ha incluido en el anejo VI-C de este estudio y también incluimos en la figura adjunta.




La distribución vertical y horizontal de los diferentes niveles litológico-geotécnicos descritos en el capítulo 5 es la siguiente:

- **Nivel I (UG-I): Tierra de labor / suelo vegetal.**

Se halla presente en toda la superficie a ocupar por la balsa con un espesor generalmente comprendido entre 0,3 y 0,6m, valor medio 0,45 m.

- **Nivel II (UG-II): Recubrimiento cuaternario.**

En todos los casos se tratan de los suelos granulares finos: limos arcillosos, arcillas limosas, y limos con arenas y arcillas. En algunos casos, aparecen cantos dispersos de calizas y yesos, y en la C-3 se detecta una delgada capa (10 cm) de gravas de calizas-yesos con arcillas.

Salvo en las calicatas C13 y C27, en el resto se ha detectado esta unidad. Las calicatas donde no se ha detectado, se disponen en el borde sureste de la balsa. En el resto, los espesores detectados varían entre 0,5 y 1,1 m, con un valor medio de 0,8 m.

Para este nivel se consideran los parámetros geotécnicos establecidos en el capítulo 5, para los suelos finos de la UG-II de consistencia media.

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|
| II | Media | 13 | 2,0 | 1,6 | 0,8 | 28º | 185 |

- **Nivel III (UG-III): Sustrato Terciario.**

Aparece en todos los ensayos bajo la anterior unidad, excepto en el caso de la C13 y C27 que aparece directamente bajo el suelo vegetal (UG-I).

Se reconoce en la parte superior de esta unidad, un tramo alterado (UG-IIIA) compuesto por arcillas a arcillas limosas con yesos. El espesor varía entre 0,4 y 1,4 m, en media se determinaría un espesor de 0,7 m.

Por debajo, el sustrato sano está formado principalmente por arcillas duras-Argilitas marrones a grisáceas con yesos cristalinos (en venillas, discontinuidades o en zonas) entre las que se intercalan: estratos de yesos nodulares-alabastrinos con espesores de 0,2 a 0,7 m, estratos de areniscas cementadas de 0,2 a 0,9 m y delgadas capas (0,1-0,2 m) de margo calizas laminadas-tableadas marrones.

Para la parte alterada (III-A) y más sana (III-B) del sustrato terciario, se consideran los parámetros geotécnicos establecidos en el capítulo 5.

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

- **Nivel freático**

Según lo expuesto en el apartado 4.1.5., se concluye que existe agua en el terreno que estaría asociada al Sustrato Terciario (en sus discontinuidades) y se manifestaría como rezumes de entidad variable en el mismo. La procedencia de esta agua, consideramos está asociada a fugas del canal que discurre por encima de la zona de estudio, junto con las procedentes del desagüe que discurre al norte.

### 6.3.3. Cimentación dique

Según el modelo de terreno reconocido y descrito anteriormente, tras la eliminación de la tierra labor-suelo vegetal (UG-I) aparecería los suelos granulares finos de la UG-II de consistencia media, con un espesor de entre 0,5 y 1,1 m (promedio de 0,8 m). Localmente, lateral sureste (entorno de las calicatas C27 y C13), aparecería directamente la UG-III.

Para la altura prevista de terraplén y dadas las características geotécnicas generales asignadas a la UG-II y UG-III, consideramos que a priori no van a existir problemas de capacidad portante y de asiento elástico.

Según lo indicado en el capítulo 5 de caracterización general de la UG-III el riesgo de colapsabilidad de estos materiales es bajo. Además se catalogan como suelos de nula a baja. La problemática de los mismos está en relación son su dispersabilidad, y las consideraciones al respecto son las ya establecidas en el capítulo 6.1. para la balsa Elevada 2.

En lo referente a la UG-III, son materiales sin riesgo de colapsabilidad y su hinchamiento es bajo (a priori con presiones de hinchamiento probables inferiores al 0,5 Kg/cm), por lo que no creemos necesario tratamiento en la zona de apoyo del dique.

A continuación se analiza la estabilidad global del dique y su terreno de apoyo, considerando como situación más desfavorable la correspondiente al entorno del sondeo S2:

- Altura de terraplén de 5,0 m; realizado con los materiales de la excavación. Dado que el material mayoritario que se excavaría sería el de la UG-III, adoptamos como parámetros geotécnicos los establecidos en el apartado 5.3.4 para el material compactado de dicha unidad:
  . Densidad aparente: 2,15 $g/cm^3$.
  . Ángulo de rozamiento interno: 26º
  . Cohesión: 0,34 $Kg/cm^2$.

- Modelo de terreno bajo terraplén formado por 0,9 metros de UG-II de consistencia media, por debajo la UG-III con una parte alterada de 1,4 metros y debajo el sustrato sano (III-B). Los parámetros geotécnicos considerados son los reflejados en el apartado 6.3.2.

- Las inclinaciones adoptadas para el terraplén son las indicadas al inicio de este capítulo: 2,5H:1V para el talud interior y 2H:1V para el exterior. El ancho del dique en coronación es de 4 metros.

El análisis de estabilidad se realiza utilizando los métodos ya indicado en el capítulo 6.1.3. Y las condiciones de cálculo y los factores exigibles a las mismas son los indicados por el Ministerio de Fomento para balsas y que se han indicado en el capítulo 6.1.3.

Para este análisis se ha valorado únicamente la posibilidad de círculos de rotura pasando por debajo del cimiento y no la estabilidad propia del dique que se analiza en el apartado de estabilidad de taludes. Las soluciones gráficas obtenidas en el programa se reflejan en el Anejo VIII.

Para las inclinaciones proyectadas los factores de seguridad obtenidos son de 2,9 a 3,4, superiores a los exigidos en las cuatro situaciones de cálculo: final de construcción, embalse lleno, rotura de lámina y desembalse rápido.

Adicionalmente se han analizado el asiento elástico esperable mediante la aplicación del programa Settle v2.0 de Rocscience. La salidas gráfica de este análisis se incluye en el Anejo IX.

El asiento máximo esperable sería de 2,3 cm, asumible por una estructura flexible como la que corresponde a un terraplén.

### 6.3.4. Fondo de la balsa

Según el perfil de correlación y la cota prevista para la solera de la balsa (384,3), la excavación en la mayor parte los casos, alcanzará la UG-III tanto su parte alterada como sana. Únicamente en el entorno del S2 y C11 (extremo este) se dispondría sobre la UG-II, que en dicha zona tiene un espesor de 0,5 a 0,9 m.

Dado que estas mismas unidades aparecen en el fondo de la balsa elevada 2, serán aplicables las consideraciones establecidas al respecto en el apartado 6.1.4.

### 6.3.5. Estabilidad de taludes

Los taludes a ejecutar son de tres tipos:

- Tipo 1.- Taludes permanentes en terraplén para el dique de la balsa. (interior a 2,5H:1V y exterior 2H:1V)

La situación más desfavorable es la descrita para el análisis de estabilidad del cimiento del dique en el apartado 6.3.3.

Dado que los círculos de rotura obtenidos para el caso de rotura por el cimiento, son los de menor factor de seguridad, puede decirse que para círculos de rotura que pasen exclusivamente por los taludes del dique los factores de seguridad serán mayores superiores.

- Tipo 2.- Talud permanente en desmonte bajo camino de coronación (en interior de la balsa). 2,5H:1V

En este caso hemos considerado como situación más desfavorable geotécnicamente la del entorno de la calicata C-1.

El esquema considerado sería:

. Desmonte de 3 m de altura sobre el que se dispondría un dique de 2 m.
. El desmonte estaría formado en su parte superior por 1,1 m de la UG-II de consistencia media y debajo la UG-III con un espesor de alteración de 1,4 m.

Los parámetros geotécnicos asignados a los niveles de terreno afectados por la excavación son los ya indicados en el apartado 6.3.2.

Para el material del terraplén, se han considerado los obtenidos en los materiales procedentes de la compactación del nivel III que será el mayoritariamente excavado, y que se han indicado en el apartado 6.3.3.

El análisis de estabilidad se realiza utilizando los métodos ya indicado en el capítulo 6.1.3. Y las condiciones de cálculo y los factores exigibles a las mismas son los indicados por el Ministerio de Fomento para balsas y que se han indicado en el capítulo 6.1.3.

El análisis de estabilidad se realiza con idéntica metodología y programa que se han indicado en el apartado 6.1.3. La solución obtenida en el programa se refleja en el Anejo VIII.

El factor de seguridad obtenido es de 6,0 que garantiza una adecuada estabilidad del talud.

- Tipo 3.- Talud permanente en desmonte sobre camino de coronación (1H:1V).

Este tipo de taludes se desarrollan en el lateral oeste y tendrían una altura sobre coronación del orden de 1,0 m.

A los efectos del análisis de la estabilidad se ha considerado como esquema geológico el reconocido en los ensayos (C2, S1 y C3) en el que la totalidad de este talud sobre coronación se desarrolla en la UG-II de consistencia media. Por debajo del camino de coronación se ha considerado 1 m de la UG-II de consistencia media y bajo esta la UG-III con 1,4 m superiores alterados.

Los parámetros geotécnicos asignados a estos niveles son los ya indicados en el apartado 6.3.2.

El análisis de estabilidad se realiza con idéntica metodología y programa que se han indicado en apartados anteriores. La solución obtenida en el programa se refleja en el Anejo VIII.

Concretamente se ha obtenido un factor de seguridad de 9,0, que garantiza una adecuada estabilidad del talud.

### 6.3.6.- Presencia de agua-Drenaje

Según hemos señalado la presencia de agua en el terreno (en el sustrato Terciario UG-III) es clara y su origen-alimentación asociamos a las fugas en el canal que discurre próximo a la zona, aunque también puede asociarse en parte al desagüe que discurre próximo al lateral norte de la balsa (a unos 10 m) y cuya cota de fondo queda entre 1 y 2 m por encima de la solera de la balsa. En este desagüe circula permanentemente el agua debido a que se alimenta por de las fugas del canal, pero puede tener caudales puntuales más altos en épocas de lluvia ya que también funciona, aguas arriba, como colector de la escorrentía.

Por lo tanto, una actuación de impermeabilización del canal en el entorno de la zona de la balsa junto con una protección e impermeabilización del desagüe, serían unas medidas muy favorables para reducir la presencia de agua en el terreno.

La magnitud y flujo de agua esperable sería limitada. A priori se manifestaría como rezumes desde la UG-III. Estos rezumes no serían de un caudal alto pero si tendrían un carácter permanente, al menos mientras no se eviten las fugas procedentes del canal o las posibles entradas de agua desde el desagüe.

Dado del funcionamiento esperable del agua en el terreno, deberán contemplarse medidas de drenaje en los puntos o zonas donde se detecten estos rezumes o afloramientos de agua.

En los taludes puede contemplarse la realización de pequeñas zanjas rellenas de grava según la dirección de máxima pendiente que conecten con una zanja drenante perimetral, no debiendo descartarse que también deban realizarse zanjas drenantes en el fondo de balsa que conecten con la zanja perimetral.

Consideramos que este drenaje debería diferenciarse y separarse del que se establezca para el control de posibles fugas en la lámina impermeabilizante, por lo que podría contemplarse una doble lámina para su separación.

### 6.3.7 Excavabilidad

En la excavación de la balsa se verán afectados todos los niveles geotécnicos identificados (I, II y III, parte alterada y sana).

Dado que estas mismas unidades aparecen en la balsa elevada 2 y con unas características muy similares, serán aplicables las consideraciones establecidas al respecto en el apartado 6.1.6.

### 6.3.8. Materiales para la construcción de diques

Como ya hemos indicado, los materiales que se obtendrán de las excavaciones serán los correspondientes a las tres unidades geotécnicas reconocidas que con similares características se han detectado en la balsa elevada 2, por lo que consideramos también aplicable los aprovechamientos, limitaciones y consideraciones realizadas al respecto en el apartado

### 6.3.9. Agresividad

Los materiales afectados por la construcción de la balsa (UG-II y UG-III), según lo indicado en el capítulo 5, se catalogan como agresivos a los hormigones, ambiente Qc, según EHE).

El agua existente en el terreno se cataloga como de agresividad media (ambiente Qb)

Por lo tanto, con independencia de la existencia de agua o no en el terreno, en las obras de hormigón en contacto con el terreno (cualquiera que se la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

### 6.3.10. Otras consideraciones

Al igual que en la balsa elevada 2, debe tenerse presente la problemática de dispersabilidad en los materiales de la UG-II. En este caso la magnitud de la misma sería más reducida ya que esta unidad es de un menor espesor.

No obstante, son aplicables las recomendaciones y consideraciones realizadas al respecto en el apartado 6.1.9.

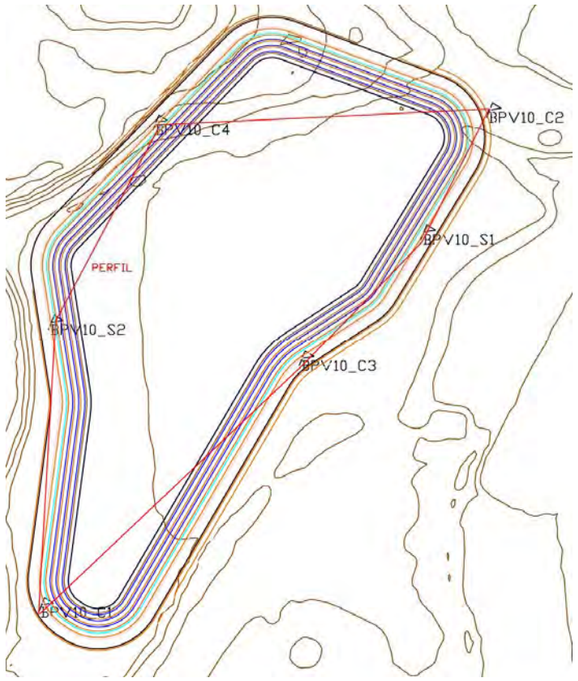
Estas mismas medidas también serían adecuadas para el fondo de balsa en la UG-III y para el dique realizado con la UG-III.

Durante la realización de los reconocimientos de campo de la estación de bombeo y arqueta de seccionamiento, concretamente en los ensayos EB-P2 y EB-S2, situados, respectivamente, a unos 10 y 20 m de distancia del pie del talud del dique de la balsa, se ha detectado un cambio del modelo de terreno identificado en los ensayos específicos realizados en la vertical del dique (BP-C11 y BP-S2). Concretamente esta modificación consiste en la presencia de un espesor superior de suelos de la UG-II (espesor del orden de 2,6 m) y consecuentemente una profundización de la UG-III, asi como la aparición de suelos de consistencia blanda en la base de la UG-II. Por el contrario en los ensayos específicos realizados en el dique el modelo de terreno consistía en: un espesor inferior a 1 m de la UG-II, ausencia de suelos blandos y un sustrato Terciario (UG-III) cercano a superficie (1 a 1,3 m de profundidad).

Ante la presencia cercana de este cambio de modelo de terreno y la problemática asociada al mismo, consideramos que previamente a los trabajos de construcción del dique en esta zona, se deberán realizar reconocimientos complementarios (del tipo calicata o ensayo DPSH) con objeto de verificar si se mantiene el modelo establecido o hay variaciones significativas al mismo.

## 6.4. BALSA PIE DE CANAL V10

El estudio del terreno ha consistido en el reconocimiento geológico superficial por técnicos cualificados y en su caracterización geotécnica basada en los trabajos de campo y ensayos de laboratorio ejecutados. Los trabajos de campo específicos realizados han consistido en: 2 sondeos (BPV10-S1 a BPV10-S2) y 4 calicatas (BPV10-C1 a C4). En la figura adjunta se recoge de forma esquemática la posición de los ensayos que también se incluyen en el plano de situación del anejo I.




Está proyectada sobre un terreno con una pendiente general oeste a este, y un desnivel del orden de 5 metros (entre las cotas 392 y 387)

### 6.4.1 Características

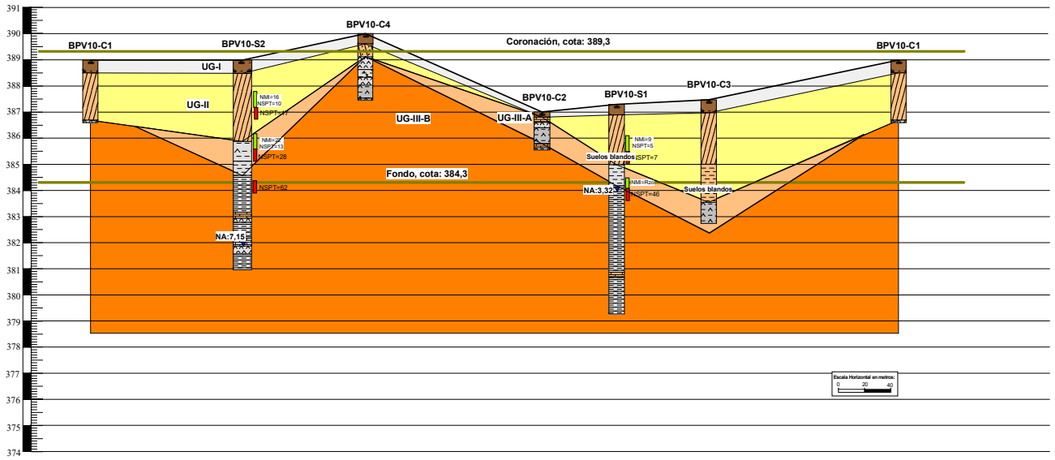
La balsa proyectada es mixta, parte excavada y parte terraplenada. Tiene las siguientes características geométricas:

- Cota de coronación: 389,3 m. (ancho de coronación 4 m).
- Cota de fondo: 384,3 m.
- Cota terreno: 392-387 m
- Talud exterior (terraplén): 2H:1V con una altura máxima de 2,5 m.
- Talud interior balsa bajo coronación (desmonte y terraplén): 2,5H:1V, altura 5,0 m.
- Talud exterior en desmonte por encima de coronación: 1H:1V, altura 2,5-3,0m.

Se ha previsto la colocación de una lámina para impermeabilización del vaso de la balsa.

### 6.4.2 Modelo geológico-geotécnico

El modelo geológico-geotécnico para esta balsa queda reflejado en el perfil de correlación realizado y reflejado en el plano de situación anterior y que se ha incluido en el anejo VI-D de este estudio y también en la figura adjunta.




La distribución vertical y horizontal de los diferentes niveles litológico-geotécnicos descritos en el capítulo 5 es la siguiente:

- **Nivel I (UG-I): Tierra de labor / suelo vegetal.**

Se halla presente en toda la superficie a ocupar por la balsa con un espesor comprendido entre 0,2 y 0,5 m, valor medio 0,4 m.

- **Nivel II (UG-II): Recubrimiento cuaternario.**

Se ha detectado en todos los ensayos realizados, excepto en la C-2.

En todos los casos donde se ha detectado, está formado principalmente por suelos granulares finos: limos arcillosos, arcillas limosas y limos arenosos, en ocasiones con cantos de calizas y yesos.

Los espesores son muy variables. Son mínimos (de 0,4 m) en la C-4 situada sobre la ladera del relieve que limita la balsa por el noroeste. En las tres restantes calicatas y en los sondeos, que se disponen en las fincas agrícolas, los espesores van de 1,8 a 3,4 m. Los mayores espesores se localizan en la parte topográfica más baja (2,6 a 3,4 m, S-2 y C-3) y los menores en la parte alta (1,8 a 1,9, C-1 y S-1). Puede definirse un espesor medio de 2,5 m, excepto en el borde norte-noroeste, donde por la presencia de un relieve cercano el espesor de este nivel sería menor o incluso no aparecer.

En las partes topográficamente bajas (entorno S1 y C-3) se han detectado suelos de consistencia algo blanda dentro de la UG-II, a profundidades de 1,2 m caso del S-1 y a 2,4 m en la C-3. Los suelos existentes por encima son de consistencia media, también lo son en su totalidad los detectados en la parte topográficamente alta de la balsa (C1 y S2).

Para este nivel se consideran los parámetros geotécnicos establecidos en el capítulo 5, para los suelos finos de la UG-II tanto de consistencia media como blanda.

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|
| II | Media | 13 | 2,0 | 1,6 | 0,8 | 28º | 185 |
| | Blanda | 5 | 2,0 | 0,7 | 0,3 | 21º | 70 |

- **Nivel III (UG-III): Sustrato Terciario.**

Aparece en todos los ensayos bajo la anterior unidad, excepto en el caso de la C2 que aparece directamente bajo el suelo vegetal (UG-I).

La presencia de una parte alterada (III-A) en su parte superior, depende de si esta unidad se inicia con estratos de yesos-calizas o se inicia en arcillas-argilitas. En el segundo de los casos se diferencia claramente una zona alterada con un espesor de 0,8 a 1,3 m. En el primero de los casos, para las calicatas, después de arrancar el estrato duro superficial aparecen términos arcillosos que suelen estar alterados y poseen espesores de 0,3 a 0,6 m.

Por lo tanto y con carácter general, independientemente de la detección de estratos duros en la parte superior, hemos considerado que de forma general un espesor de alteración global (UG-IIIA) de 1,0 metro.

Esta zona alterada está formada mayoritariamente por arcillas arenosas con yesos.

El sustrato sano está formado principalmente por Arcillas duras-Argilitas marrones a grisáceas con yesos cristalinos (en venillas, discontinuidades o en zonas) entre las que se intercalan: estratos de yesos nodulares-alabastrinos con espesores de 0,15 a 0,5 m y de calizas-margocalizas (con espesores de 0,15-0,25 m).

Para la parte alterada (III-A) y más sana (III-B) del sustrato terciario, se consideran los parámetros geotécnicos establecidos en el capítulo 5.

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

- **Nivel freático**

Según lo expuesto en el apartado 4.1.5. y a pesar del resultado del S2, consideramos que hasta la profundidad alcanzada puede concluirse que existe agua en el terreno aunque de una distribución y entidad variable.

La presencia de agua en el terreno estaría asociada principalmente al sustrato Terciario, y en menor medida también al recubrimiento cuaternario, en las zonas topográficamente más bajas y con mayor espesor de suelos. Consideramos que no determina un nivel freático como tal, y corresponderían con flujos-rezumes que podrían ser de una magnitud no desdeñable en esas zonas más bajas.

Al igual que para la balsa de pie de canal V4, consideramos que el agua en el terreno está asociada a fugas del canal que discurre próximo y por encima de la zona de estudio., asi como a las infiltraciones procedentes del desagüe que discurre al sur.

### 6.4.3. Cimentación dique

Según el modelo de terreno reconocido y descrito anteriormente, tras la eliminación de la tierra labor-suelo vegetal (UG-I) aparecería los suelos granulares finos de la UG-II de consistencia media, con un espesor variable. Únicamente en el entrono de la C-2 aparecería directamente la UG-III.

La UG-II no plantea riesgo de colapsabilidad y su potencial hinchamiento es nulo a bajo, lo que si debe tenerse presente es su cierta dispersabilidad que hemos tratado en apartados anteriores y las consideraciones que al respecto ya han sido establecidas en el capítulo 6.1.9 para la balsa Elevada 2.

En lo referente a la UG-III, (unidad muy minoritaria en el apoyo del terraplén) son materiales sin riesgo de colapsabilidad y su hinchamiento es bajo (a priori con presiones de hinchamiento probables inferiores al 0,5 $Kg/cm^2$), por lo que no creemos necesario tratamiento en la zona de apoyo del dique sobre dichos materiales.

A continuación se analiza la estabilidad global del dique y su terreno de apoyo, considerando como situación más desfavorable la correspondiente al entorno del sondeo S1:

- Altura de terraplén de 2,5 m; realizado con los materiales de la excavación. Dada el alto porcentaje de materiales que se obtendrían de la UG-II, adoptamos los parámetros geotécnicos asignados a estos materiales compactados al 98%PM, que del lado de la seguridad, son algo inferiores a los que se han obtenido de la compactación de la UG-III.
  .Densidad aparente: 2,1 g/cm3.
  . Ángulo de rozamiento interno: 28º
  . Cohesión: 0,16$Kg/cm^2$.

- Modelo de terreno bajo terraplén formado por 1 m de UG-II de consistencia media, 2,5 m de UG-II de consistencia blanda, y por debajo la UG-III con una parte alterada de 1,0 metros y debajo el sustrato sano (III-B). Los parámetros geotécnicos considerados son los reflejados en el apartado 6.4.2.

- Las inclinaciones adoptadas para el terraplén son las indicadas al inicio de este capítulo: 2,5H:1V para el talud interior y 2H:1V para el exterior. El ancho del dique en coronación es de 4 metros.

El análisis de estabilidad se realiza utilizando los métodos ya indicado en el capítulo 6.1.3. Y las condiciones de cálculo y los factores exigibles a las mismas son los indicados por el Ministerio de Fomento para balsas y que se han indicado en el capítulo 6.1.3.

Para este análisis se ha valorado únicamente la posibilidad de círculos de rotura pasando por debajo del cimiento y no la estabilidad propia del dique que se analiza en el apartado de estabilidad de taludes. Las soluciones gráficas obtenidas en el programa se reflejan en el Anejo VIII.

Para las inclinaciones proyectadas los factores de seguridad obtenidos son de 2,6 a 5, superiores a los exigidos en las cuatro situaciones de cálculo analizadas: final de construcción, embalse lleno, rotura de lámina y desembalse rápido.

Adicionalmente se han analizado el asiento elástico esperable mediante la aplicación del programa Settle v2.0 de Rocscience. La salida gráfica de este análisis se incluye en el Anejo IX.

El asiento máximo esperable sería de 2,5 cm, asumible por una estructura flexible como la que corresponde a un terraplén.

En el lateral este de la balsa aproximadamente entre el S1 y C-3, dada la detección de suelos blandos en la base de la UG-II, consideramos que en fases iniciales de la obra deberá realizarse una campaña complementaria de ensayos tipo DPSH, para verificar si el modelo de terreno en todo el lateral este se ajusta al considerado en el perfil de correlación incluido en el apartado 6.4.2.

### 6.4.4. Fondo de la balsa

Según el perfil de correlación y la cota prevista para la solera de la balsa (384,3), la excavación en la mayor parte los casos, alcanzará la UG-III tanto su parte alterada como sana. Únicamente en el entorno de la C-3 se dispondría sobre la UG-II, que en dicha zona tendría un espesor por debajo de solera de 0,7 m, y tendría una consistencia blanda.

Dado que estas mismas unidades aparecen en el fondo de la balsa elevada 2, serán aplicables las consideraciones establecidas al respecto en el apartado 6.1.4. para el caso de la UG-III.

En el caso del entorno de la C-3, la presencia de suelos blandos de la UG-II, a priori con un espesor reducido bajo la solera de la balsa, aconseja la realización de un saneo total o de al menos 0,5 m, y su sustitución por suelos granulares que a su vez pueden actuar como drenajes de fondo de las aguas freáticas, ya que según el S-1 la cota del nivel de agua detectado está ligeramente por debajo de la cota de la solera.

### 6.4.5. Estabilidad de taludes

Los taludes a ejecutar son de tres tipos:

- Tipo 1.- Taludes permanentes en terraplén para el dique de la balsa. (interior a 2,5H:1V y exterior 2H:1V)

La situación más desfavorable es la descrita para el análisis de estabilidad del cimiento del dique en el apartado 6.4.3.

Dado que los círculos de rotura por cimiento son los de menor factor de seguridad, puede decirse que para círculos de rotura que pasen exclusivamente por los taludes del dique los factores de seguridad serían superiores y estarían por encima de los mínimos exigidos para las condiciones de cálculo del Ministerio de Fomento (final de construcción, embalse lleno, rotura de lámina y desembalse rápido).

- Tipo 2.- Talud permanente en desmonte bajo camino de coronación (en interior de la balsa). 2,5H:1V

En este caso hemos considerado como situación más desfavorable geotécnicamente la del entorno del sondeo S-2.

El esquema considerado bajo camino de coronación sería: 3 m de la UG-II de consistencia media, debajo la UG-III con 1,0 m de tramo alterado (III-A). Los parámetros geotécnicos asignados a los niveles de terreno afectados por la excavación son los ya indicados en el apartado 6.4.2. Se ha considerado un nivel de agua a 0,3 m por debajo del pie del desmonte interior.

El análisis de estabilidad se realiza conjuntamente con el talud tipo 3.

- Tipo 3.- Talud permanente en desmonte sobre camino de coronación (1H:1V).

Este tipo de taludes se desarrollan en el lateral noroeste y tendrían una altura sobre coronación del orden de 2,5 a 3,0 m.

Los ensayos realizados no han permitido identificar que tipo de terreno aparecería entre la cota 390 y 392. De lado de la seguridad hemos considerado que estaría constituido por la UG-II de consistencia media. Los parámetros geotécnicos asignados a este nivel son los ya indicados en el apartado 6.4.2.

El análisis de estabilidad conjunto de ambos tipos de taludes (2 y 3) se realiza con idéntica metodología y programa que se han indicado apartados anteriores. La solución obtenida en el programa se refleja en el Anejo VIII.

Concretamente se ha obtenido un factor de seguridad de 3,5, que garantiza una adecuada estabilidad del talud.

### 6.4.6 Presencia de agua-Drenaje

Según hemos señalado la presencia de agua en el terreno (en el sustrato Terciario UG-III y en menor medida en el recubrimiento cuaternario) es clara y su origen-alimentación asociamos a las fugas en el canal que discurre próximo a la zona y también al desagüe que discurre al sur.

La magnitud y flujo de agua esperable según los datos obtenidos en las pruebas de achique son muy variados. Concretamente es un flujo lento (imperceptible) en el S-2, topográficamente más alto; y es significativo en el caso del S-1 (topográficamente más bajo). Estos rezumes y flujos de agua tendrían un caudal variable pero permanente, al menos mientras no se eviten las fugas procedentes del canal.

Por lo tanto, una actuación de impermeabilización del canal en el entorno de la zona de actuación, sería una medida muy favorable para reducir la presencia de agua en el terreno.

Dado del funcionamiento esperable del agua en el terreno, deberán contemplarse medidas de drenaje en los puntos o zonas donde se detecten estos rezumes o afloramientos de agua.

En los taludes puede contemplarse la realización de pequeñas zanjas rellenas de grava según la dirección de máxima pendiente que conecten con una zanja drenante perimetral, no debiendo descartarse que también deban realizarse zanjas drenantes en el fondo de balsa que conecten con la zanja perimetral.

En el caso que el afloramiento de agua en los taludes parta de los suelos limosos blandos de la UG-II, consideramos que podría darse un tratamiento de drenaje más intensivo con zanjas drenantes más cercanas y algo más profundas que incluyan la colocación de grava y también de geotextil. Esta actuación permitiría a la vez un refuerzo del talud.

Consideramos que este drenaje debería diferenciarse y separarse del que se establezca para el control de posibles fugas en la lámina impermeabilizante, por lo que podría contemplarse una doble lámina para su separación.

### 6.4.7 Excavabilidad

En la excavación de la balsa se verán afectados todos los niveles geotécnicos identificados (I, II y III, parte alterada y sana).

Dado que estas mismas unidades aparecen en la balsa elevada 2 y con unas características muy similares, serán aplicables las consideraciones establecidas al respecto en el apartado 6.1.6.

### 6.4.8. Materiales para la construcción de diques

Como ya hemos indicado, los materiales que se obtendrán de las excavaciones serán los correspondientes a las tres unidades geotécnicas reconocidas que con similares características se han detectado en la balsa elevada 2, por lo que consideramos también aplicable los aprovechamientos, limitaciones y consideraciones realizadas al respecto en el apartado.

Como aspecto diferencial, señalar que en esta balsa se excavaran suelos de la UG-II de consistencia blanda que tienen unos elevados contenidos de humedad. Por lo tanto para dichos materiales deberá contemplarse un secado previo antes de su puesta en obra.

### 6.4.9. Agresividad

Los materiales afectados por la construcción de la balsa (UG-II y UG-III), según lo indicado en el capítulo 5, se catalogan como agresivos a los hormigones, ambiente Qc, según EHE).

El agua existente en el terreno se cataloga como de agresividad media (ambiente Qb)

Por lo tanto, con independencia de la existencia de agua o no en el terreno, en las obras de hormigón en contacto con el terreno (cualquiera que se la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

### 6.4.10. Otras consideraciones

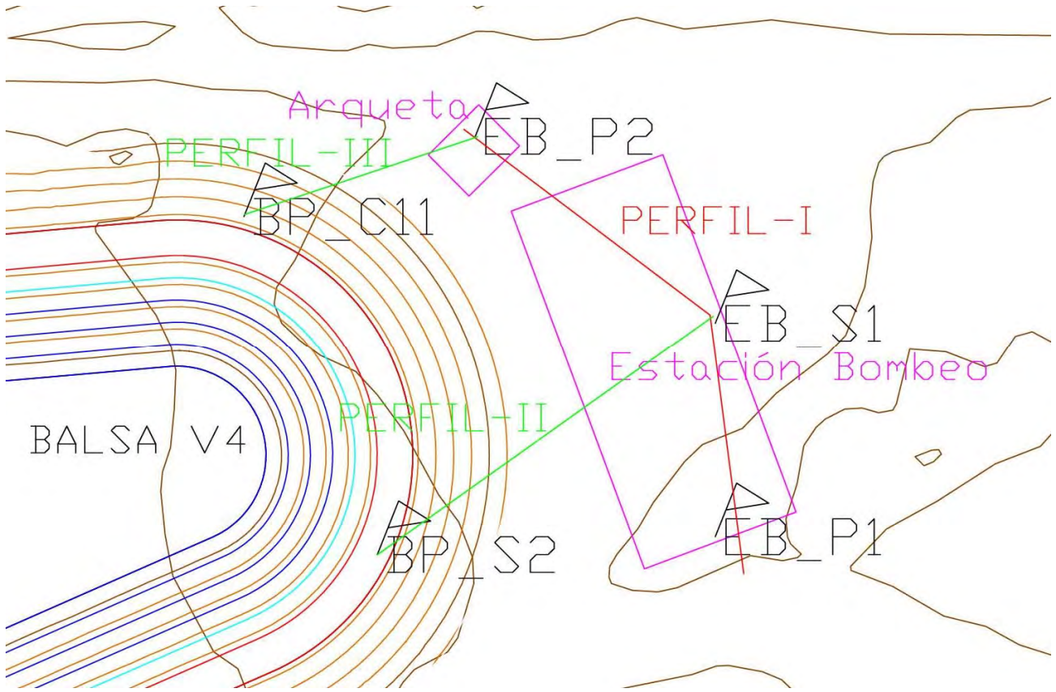
Al igual que en la balsa elevada 2, debe tenerse presente la problemática de dispersabilidad en los materiales de la UG-II, siendo aplicables las recomendaciones y consideraciones realizadas al respecto en el apartado 6.1.9.

Estas mismas medidas también serían adecuadas para el fondo de balsa en la UG-III y para el dique realizado con la UG-III.

Según hemos indicado en el apartado 6.4.3., consideramos que en fases iniciales de la obra deberá realizarse una campaña complementaria de ensayos tipo DPSH, en el lateral este de la balsa para verificar si el modelo de terreno dicho lateral se ajusta al considerado en el perfil de correlación incluido en el apartado 6.4.2.

## 6.5. ESTACIÓN DE BOMBEO

El estudio del terreno ha consistido en el reconocimiento geológico superficial por técnicos cualificados y en su caracterización geotécnica basada en los trabajos de campo y ensayos de laboratorio ejecutados. Los trabajos de campo específicos realizados han consistido en: 1 sondeo (EB-S1) y dos ensayos DPSH (EB-P1 y P2). Además en las proximidades se cuenta con los resultados de los ensayos BP-C11 y BP-S2. En la figura adjunta se recoge de forma esquemática la posición de los ensayos que también se incluyen en el plano de situación del anejo I.




Está proyectada sobre una parcela agrícola con una pendiente general oeste a este, y un desnivel del orden de 1 metros (entre las cotas 384 y 383).

### 6.5.1 Características

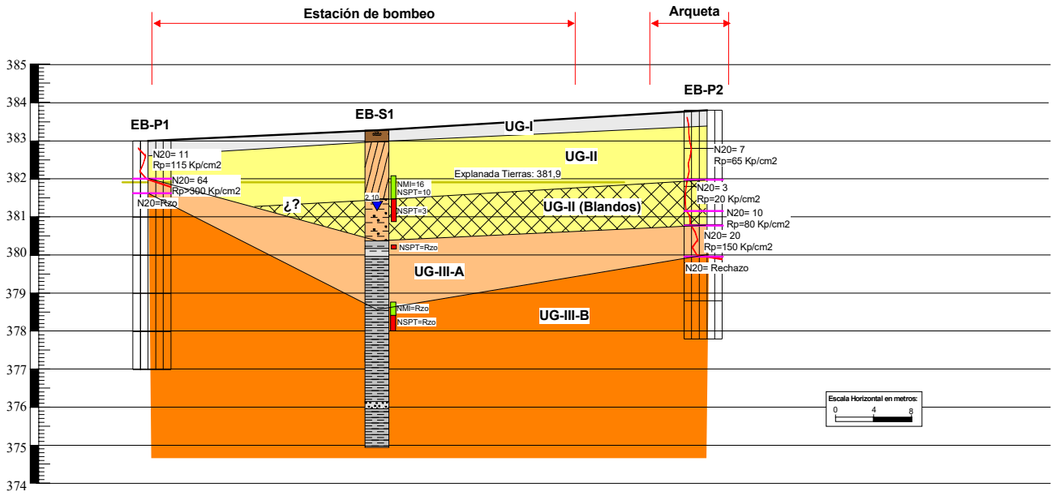
La estación de bombeo, es un edificio de una sola altura y planta rectangular de aproximadamente 43x18 m.

La cota de explanada en tierras proyectada es la 381,9 (cota de solera 382,3 menos 0,2m de hormigón y menos 0,2 m de zahorra).

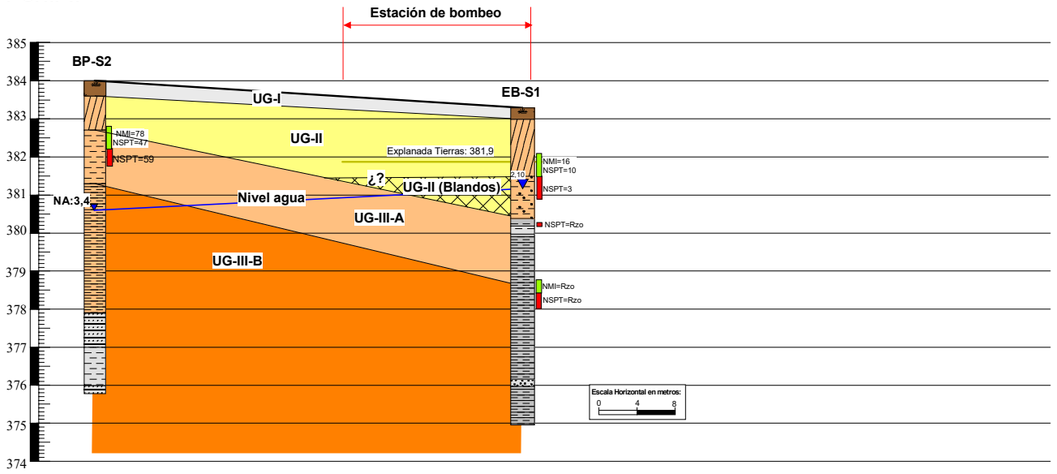
### 6.5.2 Modelo geológico-geotécnico

El modelo geológico-geotécnico queda reflejado en los perfiles de correlación I y II marcados en el plano de situación anterior y que se han incluido en el anejo VI-E de este estudio y también en las figuras adjuntas.

Perfil-I




Perfil-II




La distribución vertical y horizontal de los diferentes niveles litológico-geotécnicos descritos en el capítulo 5 es la siguiente:

- **Nivel I (UG-I): Tierra de labor / suelo vegetal.**

Se halla presente en toda la superficie a ocupar con un espesor comprendido entre 0,3 y 0,4 m, valor medio 0,35 m.

- **Nivel II (UG-II): Recubrimiento cuaternario.**

Se ha detectado en el sondeo S-1 e interpretado en los dos ensayos DPSH.

Según el sondeo realizado está formado por suelos limo arcillosos con arenas y por debajo de 1,8 m son frecuentes los cantos subangulosos de calizas y yesos.

La profundidad alcanzada por esta unidad es muy variable, concretamente al sur (ensayo P1) se extiende hasta 1,0 m mientras que en la parte central y norte profundiza hasta los 2,9 a 3,0 m.

Esta variabilidad en sentido sur a norte, también se manifiesta en sentido oeste a este, según los ensayos próximos realizados en la balsa V4 (BP-C11 y BP-S2). Concretamente en los ensayos citados, y situados al oeste, la profundidad alcanzada por la UG-II es 1,0 a 1,3 m.

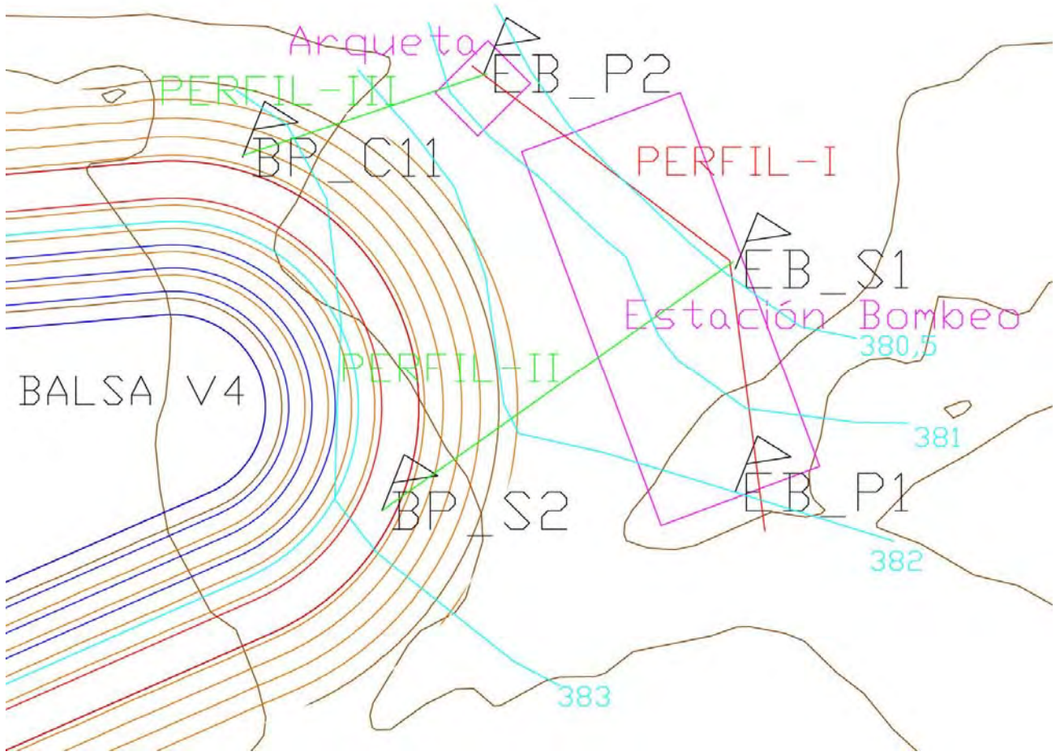
Otro aspecto reconocido en esta unidad es la presencia de suelos de consistencia blanda en los ensayos con mayor espesor de la UG-II (EB-P2 y EB-S1), dichos suelos saturados de agua aparecen sobre 1,8 m de profundidad y se extienden hasta la aparición de la UG-III.

Para la parte superior de la UG-II de consistencia media a blanda, dado que el golpeo medio obtenido fue del orden de 9 algo menor al determinado como característico, se adoptan unos parámetros geotécnicos algo inferiores a los establecidos en el capítulo 5. En el caso de la parte inferior de consistencia blanda, dado que tiene un NSPT=3 algo inferior al determinado como característico, también se consideran unos parámetros geotécnicos algo inferiores a los establecidos como generales en dicho capítulo.

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|
| II | Media-blanda | 9 | 2,0 | 1,1 | 0,5 | 24º | 120 |
| | Blanda-muy blanda | 3 | 2,0 | 0,5 | 0,2 | 20º | 45 |

- **Nivel III (UG-III): Sustrato Terciario.**

Aparece en todos los ensayos bajo la anterior unidad. En la figura adjunta y basándonos en los ensayos realizados y en los del entorno se ha realizado un plano de isolineas de profundidad de aparición de esta unidad.




Este nivel presenta una parte superior alterada (III-A) de un espesor variable, nulo en el extremo EB-P1, y del orden de 0,8 a 1,8 m en los ensayos EB-P2 y EB-S1. En los ensayos cercanos alcanza un espesor de 1,0 m. Puede considerarse a los efectos un espesor medio de alteración de 1,2 m.

Esta zona alterada está formada arcillas grisáceas con yesos.

El sustrato sano está formado principalmente por Arcillas duras-Argilitas marrones a grisáceas entre las que se intercalan yesos alabastrinos y areniscas.

Para la parte alterada (III-A) y más sana (III-B) del sustrato terciario, se consideran los parámetros geotécnicos establecidos en el capítulo 5.

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

- **Nivel freático**

Según el sondeo realizado (EB-S1) para esta zona se determina la presencia de un nivel de agua situado sobre los 2,1 m de profundidad (cota aproximada 381,2) que satura la base de los suelos arcillo-limosos del recubrimiento cuaternario. En el sondeo cercano (BP-S2), donde no se detectan espesores altos de la UG-II también se detecta agua pero en este caso dentro del sustrato Terciario (UG-III). En este caso se dispone a una cota del orden de la 380,6.

A la vista de ello, en esta zona existe una clara presencia de agua en el terreno, aproximadamente sobre la cota 381, que se dispone sobre la UG-II si ésta se extiende hasta dicha cota o bien sobre la UG-III si dicha cota es alcanzada por esta unidad.

No se considera un nivel freático regional, y consideramos está claramente alimentado por las fugas del canal e indirectamente por las aguas infiltradas desde el azarbe próximo.

### 6.5.3 Cimentación

A la vista del modelo de terreno y la cota de explanada en tierras proyectada, la solución de cimentación pasa por la realización de zapatas a pozos de cimentación que trasladen las cargas a la UG-III. De acuerdo al plano de isolineas incluido en el apartado 6.5.2., los pozos serían de longitudes máximas del orden de 2 m.

Dado que la cimentación apoyaría mayoritariamente en la parte alterada (III-A) realizamos la estimación de carga admisible del terreno por hundimiento para el caso de la zona alterada.

A este respecto aplicando la ecuación simplificada

$$q_{adm}\left(\frac{q_h}{FS=3}\right) = c(cohesión)\cdot N_c^*(\,factordeSkempton,1951)$$

Para una zapata cuadrada el factor Nc=6,2, obteniéndose una carga admisible mínima por hundimiento de 3,0 kg/cm$^2$. De optar por una zapata corrida, Nc=5,1 y la carga admisible por hundimiento sería de 2,5 Kg/cm$^2$.

Por otro lado, para la determinación de los asientos se ha utilizado la siguiente fórmula de cálculo elástico:

$$S = \Delta p \times B \times \frac{1-\nu^2}{E} \times I_w$$

donde:

| | | |
|---|---|---|
| S | = | asiento total |
| $\Delta$p | = | presión media transmitida por la zapata |
| B | = | anchura de la zapata |
| E | = | módulo de Young. |
| $\nu$ | = | coeficiente de Poisson que toma valor de 0,3 |
| $I_w$ | = | Factor de influencia, que depende de la relación L/B de las dimensiones de la zapata. Para una zapata aislada y cuadrada toma valor medio de 0,88, siendo de 2,12 para zapatas corridas con L/B de 10. |

Con dicha expresión, se obtiene que para un asiento máximo de 2,54 cm (habitual en edificación) se podrían aplicar dichas cargas siempre que las dimensiones de las cimentaciones no sean superiores a 3,0 metros de ancho en zapatas aisladas y de 1,7 m de ancho en zapatas corridas.

Un aspecto muy condicionante en estas cimentaciones, es la problemática de su ejecución en las zonas de mayor espesor de la UG-II, con suelos blandos y un nivel de agua dentro de la UG-II.

En este sentido, deberán tomarse las medidas adecuadas que garanticen el alcanzar con certeza esta UG-III, y que entre otras estarían la realización de excavaciones ataluzadas, sostenimientos asi como achiques de agua del fondo.

En el caso de realizar excavaciones ataluzadas-tendidas, deberá realizarse un encofrado del pozo de cimentación, para que de esta forma las cargas se trasladen únicamente a la base de la UG-III y que no existan acciones laterales sobre los niveles blandos de la UG-II.

### 6.5.4 Excavaciones-Estabilidad

Las excavaciones previstas son dos:

- Desmonte permanente del orden de 1 a 1,5 m para alcanzar la cota de explanada.
- Excavaciones temporales de las cimentaciones con profundidades máximas de 1,5-2,0 m.

El desmonte a realizar afectaría en su totalidad a la unida UG-II de consistencia media a blanda, con los parámetros geotécnicos indicados en el apartado 6.5.2.

Aplicando los ábacos de Hoek y Bray (1977) para una situación tipo 3 a 4 (saturación en la base), se obtienen inclinaciones de talud de 1H:2V con factores de seguridad altos, que garantizan una adecuada estabilidad para condiciones de largo plazo.

Respecto a las excavaciones temporales de las cimentaciones, el caso más desfavorable es que la totalidad se realizara en suelos blandos de la UG-I y saturados. Esta situación, según el modelo de terreno obtenido y reflejado en los perfiles de correlación y plano de isolíneas, se daría en la mitad noreste de la estación de bombeo. En estas circunstancias las excavaciones debería realizarse ataluzadas con inclinaciones no superiores a 1,5H:1V. Alternativamente puede contemplarse su excavación mediante medidas de sostenimiento.

En cualquier caso, para este tipo de excavaciones tendrá que contemplarse además medidas de achique.

En la esquina suroeste, de confirmarse el cambio de modelo de terreno (UG-III cercana a superficie y ausencia de suelos blandos en la UG-II), las excavaciones podrán realizarse con taludes subverticales.

Todas las unidades afectadas por las excavaciones (UG-I, II y III-A) son excavables con medios convencionales.

**6.5.5.- Soleras.**

Según el modelo de terreno, la solera se dispondrá mayoritariamente sobre la UG-II y minoritariamente en la esquina suroeste lo haría sobre la UG-III. Además una parte importante del apoyo sobre la UG-II se dispondría muy próximo a los suelos blandos de la misma que tienen una muy baja capacidad portante y una alta deformabilidad.

A la vista de ello, en las zonas donde la solera se disponga sobre la UG-II, deberá contemplarse un saneo de la misma del orden de 1,0 m o hasta alcanzar la UG-III, antes de dicha profundidad. Deberán ser sustituidos por un suelo seleccionado debidamente compactado. Para un adecuado apoyo de este relleno compactado, previamente en la base del saneo, si esta continúa siendo de suelos blandos de la UG-II, deberá disponerse de una capa de bolos compactada que permita densificar la zona de apoyo del relleno y colocar una lámina de geotextil para evitar el lavado de los finos del relleno.

En las zonas donde la explanada en tierras alcance directamente la unidad UG-III, aunque la expansividad de las argilitas es baja (presiones de hinchamiento probables inferiores a 0,5 Kg/cm$^2$) consideramos sería necesario una cierta sobreexcavación del terreno, del orden de 0,25 m y su sustitución por suelo seleccionado o zahorra con un contenido en finos de al menos un 15%. Además deberá procurarse un contacto gradual de estas zonas con las indicadas anteriormente a sanear por la presencia de suelos blandos.

A los efectos de dimensionado de estas soleras serán por una parte el terreno de la UG-III-A y los materiales utilizados en el saneo y su puesta en obra los que determinen el coeficiente de balasto a aplicar. En el caso de la UG-III puede considerarse un coeficiente de balasto para placa de 30x30 ($k_{30}$) de 4,9 Kp/cm$^3$. Para el relleno de saneo, de utilizar un suelo seleccionado debidamente compactado este coeficiente para placa de 30x30 podría ser como mínimo de 9 kp/cm$^3$. A la vista de ambos resultados adoptaríamos el menor de ellos para el dimensionado de la solera.

En cualquier caso una vez realizado el relleno deberán realizarse ensayos de placa de carga.

**6.5.6.- Impermeabilidad de soleras**

De acuerdo con el Documento Básico HS1 del Código Técnico de la Edificación, el grado de impermeabilidad mínimo exigido a las soleras/losas que están en contacto con el terreno se obtiene, en función de la presencia de agua y del coeficiente de permeabilidad del terreno, en las siguientes tablas.

| GRADO DE IMPERMEABILIDAD SOLERAS / LOSAS | | |
|---|---|---|
| Presencia de agua | Coeficiente de permeabilidad del terreno | |
| | $K>10^{-5}$ cm/s | $K<10^{-5}$ cm/s |
| Alta | 5 | 4 |
| Media | 4 | 3 |
| Baja | 2 | 1 |

La presencia de agua se considera:

- BAJA cuando la cara inferior de la losa-solera en contacto con el terreno o de la cimentación del muro se encuentran por encima del nivel freático
- MEDIA cuando la cara inferior de la losa en contacto con el terreno o de la cimentación del muro se encuentran a la misma profundidad que el nivel freático o a menos de 2 metros por debajo
- ALTA cuando la cara inferior de la losa en contacto con el terreno o de la cimentación del muro se encuentran a 2 o más metros por debajo del nivel freático.

En este caso, la presencia de agua es "baja".

La solera estará en contacto con los suelos seleccionados de saneo de la UG-II y en menor medida con la UG-III. Para los primeros, la permeabilidad dependerá de sus características, no obstante para este tipo de suelos los valores de permeabilidad suelen ser superiores a $10^{-3}$ cm/s. Para la UG-III se asigna (apartado 5.3) una permeabilidad $K \leq 10^{-4}$ cm/s.

Por lo tanto, para la solera será exigible un grado de impermeabilidad 2.

**6.5.7.- Agresividad del terreno.**

El terreno (UG-II y UG-III), se cataloga como de fuerte agresividad (ambiente Qc, según EHE).

El agua existente en el terreno se cataloga como de agresividad media (ambiente Qb)

Por lo tanto, con independencia de la existencia de agua o no en el terreno, en las obras de hormigón en contacto con el terreno (cualquiera que sea la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

En los hormigones que exclusivamente apoyen sobre los saneos de suelos seleccionados, podrá contemplarse una valoración de agresividad diferente de realizarse los ensayos oportunos de determinación del contenido en sulfatos.

**6.5.8.- Sismicidad.**

En lo referente a la sismicidad y de acuerdo con la zonación dada por la Norma de Construcción sismorresistente publicada en el BOE nº 244 de 11 de Octubre de 2002 y denominada NCSR-02, los términos municipales oscenses de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta, dentro de los que se desarrolla la actuación, poseen una aceleración sísmica básica ($a_b$) inferior a 0,04 g (g=9,8 m/s$^2$). En la *"Actualización de Mapas de Peligrosidad Sísmica de España 2012"* (IGN) la aceleración sísmica PGA para un periodo de recurrencia de 475 años para esos términos municipales siendo inferior a 0,04·g.

**6.5.9.- Exposición al Radón procedente del terreno.**

El RD 732/2019 introduce en el documento básico DB-HS Salubridad del CTE (Código Técnico de Edificación) una nueva exigencia básica: la sección HS6 “Protección frente a la exposición al radón”.

Dicha sección es de aplicación en los edificios de nueva construcción situados en los municipios que se incluyen en su Apéndice B. Las medidas de protección que se deberán implementar varían en función de la zona de riesgo asignada, Zona I o Zona II.

Los municipios de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta están incluidos en el listado de la citada norma dentro de la zona 1, por lo que aplicarán las medidas de protección frente al Radon que señala la normativa.

## 6.6. ARQUETA DE SECCIONAMIENTO

El estudio del terreno en la arqueta de seccionamiento se ha incluido dentro del realizado para la estación de bombeo. No obstante, el ensayo DPSH EB-P2 se ha realizado específicamente en la posición proyectada de este elemento.

La posición de este ensayo y los del entorno se reflejan en el plano incluido en el apartado 6.5.

### 6.6.1 Características

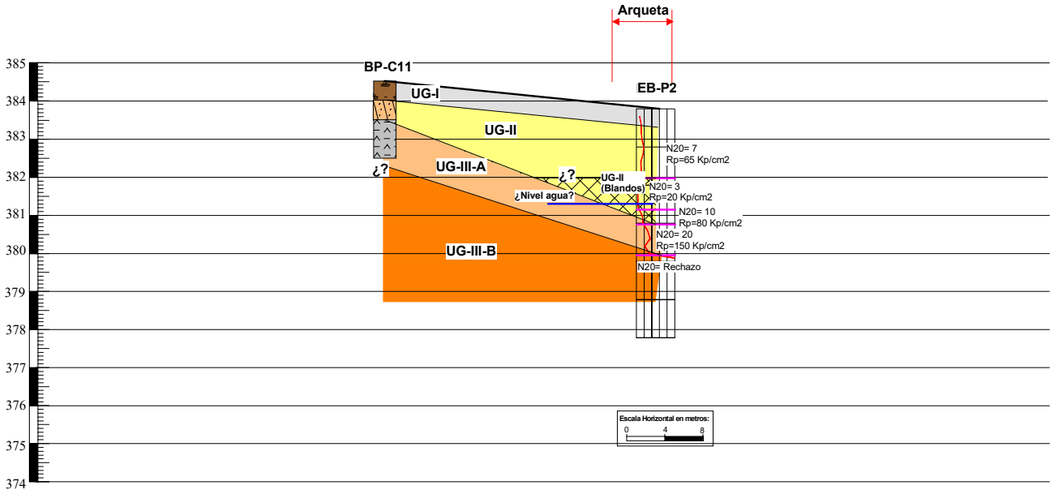
Las dimensiones de la arqueta son de aproximadamente 6,5 a 8,0 m.

A fecha de realización del presente informe no estaba determinada todavía la cota de solera de la misma. No obstante se ha considerado dos posibles cotas, aproximadamente la 382 y la 380,5, obtenidas sobre el supuesto de la disposición de la misma a 2,0 a 3,5 m por debajo de la cota de solera del fondo de la balsa (384,3).

### 6.6.2 Modelo geológico-geotécnico

El modelo geológico-geotécnico queda reflejado en el perfil de correlación I incluido en el apartado 6.5. y en el perfil III que incluimos. Ambos también se han adjuntado en el anejo VI-E.

Perfil-III




La distribución vertical y horizontal de los diferentes niveles litológico-geotécnicos descritos en el capítulo 5 es la siguiente:

- **Nivel I (UG-I): Tierra de labor / suelo vegetal.**

Se puede considerar un espesor medio de 0,35 m.

- **Nivel II (UG-II): Recubrimiento cuaternario.**

Según el sondeo próximo, está formado por suelos limo arcillosos con arenas y por debajo de 1,8 m son frecuentes los cantos subangulosos de calizas y yesos.

La profundidad alcanzada por esta unidad es de 3,0 m. No obstante, según reflejamos en el perfil III y como también se indicó en el apartado 6.5, existe una variabilidad en sentido oeste y este que se manifiesta por una reducción del espesor de esta unidad hacia el oeste donde según la C-11, alcanzaría una profundidad de 1,0 m.

Las características geotécnicas de esta unidad son semejantes a las indicadas para la estación de bombeo. Es decir, la presencia de suelos de consistencia blanda y saturados de agua que aparecen sobre 1,8 m de profundidad y se extienden hasta la aparición de la UG-III.

Los parámetros geotécnicos asignados son los indicados para la estación de bombeo.

- **Nivel III (UG-III): Sustrato Terciario.**

Aparece bajo la anterior unidad a 3,0 m de profundidad, si bien y de acuerdo al perfil de correlación III y el plano de isolíneas de cota del apartado 6.5, dicha profundidad puede reducirse hacia el oeste.

Presenta una parte superior alterada (III-A) de un espesor de 0,8 m.

Según los sondeos próximos, esta zona alterada está formada arcillas grisáceas con yesos.

El sustrato sano está formado principalmente por Arcillas duras-Argilitas marrones a grisáceas entre las que se intercalan yesos alabastrinos y areniscas.

Los parámetros geotécnicos asignados son los indicados para la estación de bombeo.

- **Nivel freático**

De acuerdo a los sondeos existe un nivel de agua sobre la cota 381 que satura la base de los suelos arcillo-limosos del recubrimiento cuaternario.

No se considera un nivel freático regional, y consideramos está claramente alimentado por las fugas del canal e indirectamente por las aguas infiltradas desde el azarbe próximo.

### 6.6.3 Cimentación

En la opción de cota de apoyo a la 382, la arqueta desplantará directamente sobre los suelos de consistencia blanda a muy blanda de la UG-II, que no son adecuados para el apoyo de la misma.

En esta situación, será necesario realizar un saneo completo de estos suelos, hasta alcanzar la UG-III que a priori se dispone sobre las cotas 381 a 380,5.

Deberán ser sustituidos por suelos seleccionados debidamente compactados en tongadas.

Este tipo de rellenos compactados tienen una capacidad portante suficiente dado que las cargas que transmitirá la arqueta serán muy reducidas.

En la opción de cota de apoyo 380,5, la arqueta desplantará sobre la parte alterada de la unidad UG-III, que tiene unas características portantes suficientes para las tensiones reducidas que transmitirá la arqueta. En este caso y aunque es baja la expansividad de los materiales arcillosos de la UG-III, consideramos sería necesario una cierta sobreexcavación del terreno, del orden de 0,25 m y su sustitución por suelo seleccionado o zahorra con un contenido en finos de al menos un 15%.

### 6.6.4 Excavaciones. Estabilidad

Para alcanzar las cotas de apoyo de la arqueta y realizar el saneo en el caso del apoyo a cota 382, debe realizarse excavaciones temporales de 3,5 a 4,0 m de profundidad.

Estas excavaciones van a desarrollarse sobre la unidad UG-II de consistencia media-banda en sus primeros 1,8 m y de consistencia blanda a muy blanda por debajo, y cortarán un nivel de agua que situamos en la cota 381.

A la vista de este modelo de terreno, las excavaciones deberán realizarse con taludes tendidos, de inclinaciones no superiores a 1H:1V en la parte superior y 1,5H:1V en la zona de inferior de suelos blandos a muy blandos.

Además deberá contemplarse medidas de achique.

De no poder ataluzarse las excavaciones deberá realizarse el sostenimiento de la misma mediante tablestacas debidamente apuntaladas y empotradas en la UG-III.

Todas las unidades afectadas por las excavaciones (UG-I, II y III-A) son excavables con medios convencionales.

### 6.6.5.- Agresividad del terreno.

El terreno (UG-II y UG-III), se cataloga como de fuerte agresividad (ambiente Qc, según EHE).

El agua existente en el terreno se cataloga como de agresividad media (ambiente Qb)

Por lo tanto, con independencia de la existencia de agua o no en el terreno, en las obras de hormigón en contacto con el terreno (cualquiera que sea la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

En los hormigones que exclusivamente apoyen sobre los saneos de suelos seleccionados, podrá contemplarse una valoración de agresividad diferente de realizarse los ensayos oportunos de determinación del contenido en sulfatos.

## 6.6. RED DE TUBERÍAS

La red de tuberías de este proyecto contempla diámetros variables (125 a 1400 mm) y diferentes tipos de materiales (PVC, PEAD y PRFV).

Existe una tubería general de impulsión que parte de la balsa de pie de canal V4 y se dirige hacia las balsas elevadas. Para la misma la profundidad del zanjeo suele ser somera.

El resto de la red de tuberías es de gravedad. Para las mismas la profundidad de las zanjas estará condicionada por la topografía y por la necesidad de que en todas ellas el recubrimiento mínimo será de 1 m sobre la generatriz superior. Según nos indicó la ingeniería redactora del proyecto las alturas de las zanjas serán previsiblemente inferiores a 3 metros en los diámetros pequeños, pero podrían alcanzar los 4 a 5 m en algunos puntos para el caso de los mayores diámetros.

El relleno proyectado es variable según los diámetros y tipo de tubería, pero de forma general consta de los siguientes materiales:

- Grava 6/12.

- Relleno seleccionado y compactado al 95%PN, que procederá de los materiales de la propia excavación que no sean el suelo vegetal y cuya única limitación es el tamaño máximo, que no debe exceder de 25 mm. En general, se extenderá hasta 0,3 m por encima de la generatriz superior de la tubería.

- Relleno ordinario, de tapado de zanja, que procederá de los materiales de la propia excavación que no sean el suelo vegetal y cuya única limitación será también el tamaño máximo (ausencia de bolos y bloques).

En ninguno de los dos tipos de relleno (seleccionado y ordinario) existe una limitación por composición química o por expansividad, colapsabilidad o dispersabilidad.

Para el estudio del terreno afectado por la red de tuberías se han realizado 25 calicatas, denominadas como RR-C1 a RR-C25. Los perfiles obtenidos se recogen en el anejo III-E.

En las zonas de cruce de tuberías bajo infraestructuras, en donde las calicatas marcaron la presencia de suelos blandos, se realizaron ensayos DPSH, concretamente 4 denominados como RR-P1 a RR-P4. Los registros obtenidos se incluyen en el anejo IV.

La posición de las calicatas y dpsh, se incluye en el plano del anejo I-E.

### 6.6.1 Modelo geológico-geotécnico. Tramificación

A lo largo de toda la red de tuberías las combinaciones de litologías son variadas, pero son variantes de un perfil tipo formado por las tres unidades geológicas-geotécnicas descritas en el capítulo 5:

- UG-I.- Tierra de labor-suelo vegetal. Se ha detectado en todas las calicatas, excepto en la RR-C10, donde aparece un relleno de tierras con algunos cascotes.

- UG-II.- Recubrimiento cuaternario, mayoritariamente formado por suelos finos (limos arcillosos-arenosos y arcillas). Minoritariamente aparecen suelos granulares gruesos formados por gravas calizas, subangulosas y de tamaño medio a fino con una matriz muy abundante de arcillas arenosas.

- UG-III.- Sustrato Terciario. Formado mayoritariamente por arcillas-argilitas con yesos cristalinos (en áreas, venas y dispersos) y alabastrinos en nódulos. Dentro de las mismas aparecen finas laminaciones de arenas-limos, y estratos intercalados de yesos alabastrinos, areniscas y calizas-margocalizas, con espesores en general reducidos.

Los espesores y profundidades de estas unidades se resumen en la tabla incluida en el apartado 4.1.6.

Durante la realización de las calicatas y hasta la profundidad alcanzada en las mismas (en general de 2 a 3 m), en parte de ellas, se ha detectado la presencia de agua, aspecto que condiciona la realización de las zanjas, en especial la estabilidad de las mismas.

El agua se ha detectado en dos contextos. Uno, saturando los suelos finos del recubrimiento cuaternario UG-II, lo que supone la detección de suelos de consistencia blanda a muy blanda. Otro, dentro de los materiales de la UG-III, constituyendo rezumes de variable entidad, pero en ningún caso generando terrenos muy blandos.

En la tabla incluida en el apartado 4.1.6. se indica las calicatas donde se ha detectado agua y suelos blandos.

Teniendo presente la representatividad de los ensayos realizados, sobre la longitud de tuberías proyectada, se ha realizado una zonificación-tramificación centrada específicamente en la presencia o no de una UG-II de consistencia blanda asi como de un nivel de agua dentro de la misma.

Concretamente se ha determinado dos tipos de zona:

- Zona A. Donde la casuística esperable sería la presencia de una UG-II de consistencia blanda y agua saturando parte de esta unidad. En esta zona serían habituales espesores significativos de la UG-II, en general superiores a 2,0 m. La unidad UG-III aparecería a profundidades superiores a los 2,5 a 3,0 m.

- Zona B. La casuística esperable sería la siguiente: la UG-II donde aparezca sería de consistencia media y mayoritariamente poseería espesores inferiores a 1 metro. La UG-III aparecería próxima a la superficie, a profundidades en general inferiores a 1-1,5 metros. Caso de aparecer agua, ésta se dispone dentro de la UG-III, se manifiesta como rezumes de variable entidad y en ningún caso supone la aparición de suelos de consistencia blanda.

La extensión de ambas zonas, se refleja de forma aproximada y con la certidumbre asociable al número de calicatas realizadas, en el plano del anejo VII.

### 6.6.2 Tierra de labor-suelo vegetal-rellenos

El espesor promedio de tierra de labor-suelo vegetal a considerar a los efectos de su retirada temporal de la zona de zanja es de un promedio de 0,45 m.

Solo se ha detectado un relleno de tierras muy superficial (0,2 m de espesor) en la RR-C10.

### 6.6.3 Excavabilidad y Estabilidad de las zanjas

Basándonos en la tramificación realizada en el apartado anterior se han analizado estos dos aspectos para cada una de las zonas.

De forma general se ha considerado profundidades de zanja de 3,0 m.

**Zona A**

La excavación podrá realizarse en su totalidad con medios convencionales.

Las excavaciones, de no ser muy superficiales, consideramos que de forma general afectarán a suelos de consistencia blanda de la UG-II y deberán realizarse con la presencia de un nivel de agua saturando parte de la UG-II.

En estas condiciones, será necesario contemplar medidas de achique generalizadas que rebajen el nivel de agua y permitan trabajar en condiciones secas.

En el fondo de la zanja, caso de confirmarse la presencia de suelos blandos-muy blandas, deberá contemplarse la colocación de una capa de bolos clavados en dichos suelos, con objeto de mejorar la capacidad soporte del terreno y garantizar un mejor apoyo de la tubería.

En lo referente al talud de excavación, se analiza como situación más desfavorable para una altura máxima de 3,0 m, el caso de un terreno formado en su totalidad por la UG-II de consistencia blanda, asi como un nivel de agua a 1,0 m. y una sobrecarga de 2 $T/m^2$ en coronación de la zanja (cordón de acopio de tierras).

El análisis de estabilidad se realiza utilizando los métodos tradicionales de Bishop, Janbu, etc y mediante la aplicación del programa de cálculo SLOPE / W. La solución gráfica obtenida en el programa se refleja en el Anejo VIII.

En estas condiciones, aplicando como factor de seguridad mínimo 1,4, se obtienen inclinaciones de talud de 1V:1H. Como ya hemos indicado la presencia de agua obligará a su achique.

Para la parte superior del suelo vegetal-tierra de labor (UG-I), de no ser retirado de la excavación, consideramos aplicaría la inclinación general de la zanja 1H:1V.

Dado que la presencia de agua en el terreno está relacionada con el riego, consideramos que serían las épocas de no riego las más adecuadas para la realización de las zanjas en estas zonas.

En aquellas zonas que por limitaciones de espacio no pueda adoptarse la inclinación señalada, deberá realizarse la entibación de las excavaciones.

**Zona B**

La excavación podrá realizarse en su totalidad con medios convencionales pero potentes, no descartándose la necesidad de uso del martillo picador caso de aparecer intercalaciones de espesor significativo de yesos, areniscas o calizas-margo calizas, dentro de la UG-IIIB

En la mayor parte de los casos la excavación podrá realizarse en condiciones secas, no obstante pueden aparecer rezumes de agua que obligarán a realizar achiques.

Considerando el caso más desfavorable de que la totalidad de la zanja se desarrollará en los suelos finos de consistencia media de la UG-II, situación a priori poco probable según lo observado en las calicatas realizadas en esta zona, se ha realizado el análisis de estabilidad para las siguientes condiciones: una altura de 3,0 m, una inclinación de talud de 1H:5V y un fondo de zanja con un ancho de 2,0 m. La metodología de cálculo aplicada es la ya indicada para la zona A, y las salida gráfica se incluye en el anejo VIII.

En estas condiciones y para dicha inclinación se obtiene un factor de seguridad 2,4 que garantiza una adecuada estabilidad del mismo.

Para la parte superior del suelo vegetal-tierra de labor (UG-I), de no ser retirado de la excavación, consideramos sería necesario tender de forma local el talud a una inclinación 1H:1V.

### 6.6.4 Aprovechamiento materiales excavados para relleno de zanjas

Aunque no se aplica a los rellenos de zanjas, en el capítulo 5 se ha realizado la catalogación de los materiales de la UG-II y UG-III según criterio PG-3, que de forma resumida es la siguiente:

. Los suelos finos que son los mayoritarios en la UG-II, son tolerables aunque presentan cierta dispersabilidad. Dada la presencia local de gravas dentro de esta unidad, no se realizó una caracterización de las mismas, no obstante por lo observado podrían catalogarse como suelos adecuados a seleccionados.

. Las arcillas y argilitas con variable contenido en yesos de la UG-III, se catalogan como suelos tolerables a marginales, por su granulometría, plasticidad e hinchamiento. Por su variable contenido en yesos su catalogación varía desde tolerables a inadecuados.

A la vista de estas características, todos los materiales obtenidos de las excavaciones (excepto los de la UG-I) podrán ser utilizados directamente en los rellenos ordinarios, previa eliminación de los fragmentos de roca de mayor tamaño en el caso de los materiales procedentes de la excavación de la UG-IIIB.

Los procedentes de la UG-II podrán ser utilizados también de forma directa en los rellenos seleccionados, únicamente de aparecer términos de gravas será necesario un cribado previo para la eliminación de los elementos superiores a 25 mm.

Los procedentes de la excavación de la UG-IIIA podrán aplicarse como relleno seleccionado siempre que se verifique durante la excavación que no aparecen fragmentos rocosos duros y que los cantos no son de tamaños superiores a 25mm. De no ser asi, deberá realizarse un cribado previo que supondrá una reducción del volumen aprovechable.

La excavación de la parte sana (UG-IIIB) generará un todo-uno de granulometría variable, a priori fina, donde pueden aparecer fragmentos más gruesos fruto del arranque de estratos duros (yesos, areniscas, calizas) intercalados entre las argilitas. En este caso, la aplicación de estos materiales al relleno seleccionado requerirá de un tratamiento previo de cribado que supondrá una reducción del volumen aprovechable.

Este aprovechamiento general considerado se debe matizar en relación con la zonificación realizada.

Concretamente para el caso de la zona A, la presencia de suelos blandos y saturados dentro de la UG-II, condiciona claramente su colocación en las zanjas. **En este sentido su uso en los rellenos**

**ordinarios y en especial para los rellenos seleccionados que deben ser compactados, pasa previamente por el secado de los mismos.**

Para la zona B, no existiría esa limitación en la puesta de obra, salvo en el caso de que aparezcan rezumes de entidad dentro de la UG-III que genere una elevada humedad en los materiales excavados de esta unidad.

Según los aprovechamientos y limitaciones indicadas, las necesidades de materiales para rellenos ordinarios quedarían cubiertas con los productos de excavación, siempre que en el caso de la zona A se facilite el secado de los suelos blandos y saturados de la UG-II. Para el relleno seleccionado-compactado, en la zona A, quedaría también cubierto si también se facilita el secado de los suelos blandos y saturados de la UG-II. Para la zona B, consideramos que para cubrir las necesidades de relleno seleccionado, puede ser necesario un cierto aporte externo en aquellos tramos donde las zanjas corten un espesor significativo de la UG-IIIB, debido a la merma de volumen reutilizable por exceso de fragmentos rocosos de tamaño grueso (superior a 25 mm).

Las gravas que de forma local aparecen dentro de la UG-II, se descartan para su uso como relleno granular 6/12, ya que los cantos son de morfologías subangulosas. Por tanto para el relleno de grava en zanjas deberá preverse el aporte completo del mismo desde fuentes externas.

### 6.6.5 Agresividad

Los materiales afectados por la construcción de la balsa (UG-II y UG-III), según lo indicado en el capítulo 5, se catalogan como agresivos a los hormigones, ambiente Qc, según EHE).

El agua existente en el terreno se cataloga como de agresividad media (ambiente Qb)

Por lo tanto, con independencia de la existencia de agua o no en el terreno, en las obras de hormigón en contacto con el terreno (cualquiera que sea la unidad geotécnica) deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente de agresividad fuerte por sulfatos.

## 6.7. CRUCES DE INFRAESTRUCTURAS

La red de tuberías cruza varias infraestructuras que indicamos a continuación y reflejamos en el plano del anejo I-E:

- Dos cruces bajo la FFCC. (Cruces A y B).
- Tres cruces bajo la carretera A-1211. (Cruces C, D y E).
- Un cruce bajo la carretera A-1210. (Cruce F).
- Dos cruces bajo la carretera local entre Torralba de Aragón y Senés de Alcubierre. (Cruces G y H).
- Dos cruces bajo la carretera local entre Torralba de Aragón y Frula (Cruces I y J).
- Dos cruces bajo la carretera local entre Senes de Alcubierre y Torres de Barbués. (Cruces K y L).

A fecha de realización del informe los cruces de las infraestructuras de carretera de orden autonómico no estaban definidos; si debían realizarse mediante hinca o mediante zanja a medias calzadas. A priori para el caso de las carreteras locales no se plantea esta disyuntiva y podrían realizarse por zanja y medias calzadas.

En el caso de ser necesario su realización por hinca, la condición genérica exigida es que debe garantizarse una profundidad mínima de 1,5 m desde la plataforma de la carretera hasta la generatriz superior de la vaina de protección. Y de existir cunetas perimetrales, la distancia de 1,5 m debe cumplirse desde la base de la cuneta.

En el caso de las líneas férreas, ADIF, exige una profundidad mínima de paso de la tubería de 3,4 m desde la plataforma hasta la generatriz superior de la vaina de protección. En los dos cruces está previsto el paso de una tubería de 1,2 m de diámetro.

Para el análisis de estos cruces se han realizado los ensayos de campo que resumimos en la tabla adjunta.

| REFERENCIA CRUCE | TIPO | ENSAYOS | POSICIÓN EN TRAMIFICACIÓN DE LA RED DE TUBERÍAS |
|---|---|---|---|
| A | FFCC | RR-P3 y RR-C6 | ZONA A |
| B | FFCC | RR-C10 | ZONA B |
| C | Crta A-1211 | RR-P4 y RR-C7 | ZONA A |
| D | Crta A-1211 | RR-P2 y RR-C5 | ZONA A |
| E | Crta A-1211 | RR-P1 y RR-C2 | ZONA A |
| F | Crta A-1210 | RR-C25 | ZONA B |
| G | Crta Local Torralba de Aragón -Senés de Alcubierre | RR-C8 | ZONA B |
| H | Crta Local Torralba de Aragón -Senés de Alcubierre | No | ZONA B |
| I | Crta Local Torralba de Aragón-Frula | No | ZONA B |
| J | Crta Local Torralba de Aragón-Frula | RR-C9 | ZONA B |
| K | Crta Local Senés de Alcubierre-Torres de Barbués | No | ZONA B |
| L | Crta Local Senés de Alcubierre-Torres de Barbués | RR-C19 | ZONA B |

### 6.7.1 Cruces FFCC

6.7.1.1.- Cruce A

Dentro de la tramificación de la red de tuberías, este cruce se dispone en la zona A.

En este punto de cruce el FFCC discurre en terraplén y sobre 2 a 2,5 m por encima del terreno.

Se realizó un ensayo DPSH (RR-P3) y una calicata (RR-C6) cuya situación reflejamos en la figura adjunta y también se recoge en el plano del anejo I-E.

Se determina un modelo de terreno formado de arriba a abajo por las siguientes unidades:

. UG-I, suelo vegetal con un espesor de 0,4 m.

. UG-II formada por arcillas limosas que se extenderían hasta una profundidad de 4,2 m. Esta unidad en prácticamente su totalidad sería de consistencia blanda, y por lo tanto serían aplicables los parámetros geotécnicos generales asignadas a la misma en el apartado 5.2, que resumimos en la tabla adjunta.

| Unidad geotécnica | Consistencia | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Angulo rozamiento interno | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|---|
| II | Blanda | 5 | 2,0 | 0,7 | 0,3 | 21º | 70 |

. UG-III, aparece bajo la anterior, tiene un escaso espesor de alteración (III-A), 0,2 m. El rechazo a 4,6 m lo asociamos a la aparición de la parte sana del mismo (III-B). Los parámetros geotécnicos de estas unidades se han asignado en el apartado 5.3. y resumimos en la tabla adjunta.

| Unidad geotécnica | Subnivel | $N_{SPT}$ | Densidad ($t/m^3$) | Resistencia compresión simple (Kg/cm2) | Cohesión (kg/cm2) | Módulo deformación ($kg/cm^2$) |
|---|---|---|---|---|---|---|
| III | A | 23 | 2,1 | 3,0 | 1,5 | 335 |
| | B | 50 | 2,2 | 6,0 | 3,0 | 700 |

. Existe un nivel de agua a una profundidad de 1,3 m.

Considerando que el cruce se desarrolla bajo un terraplén de 2,0-2,5 m de altura y dada la exigencia mínima de profundidad indicada anteriormente, la tubería (generatriz superior) se dispondrá aproximadamente 1,0 a 1,5 m por debajo de la superficie de realización de ensayos. Por lo tanto, la tubería atravesaría los materiales de la unidad UG-II de consistencia blanda y además cortaría el nivel de agua.

En estas condiciones, la metodología de cruce más aconsejable sería la hinca convencional por empuje sin necesidad de equipo de rozado o de excavación especial en el frente.

*Deberá confirmarse con el gestor de la línea férrea que no se han realizado ningún tratamiento de mejora o consolidación del terreno bajo el terraplén en esta zona que pudiera interferir con la hinca prevista.*

La dificultad de este cruce radica en la ejecución de los pozos de ataque y recepción, por la presencia de un nivel de agua muy próximo a la superficie asi como unos suelos de consistencia blanda que tienen una alta deformabilidad y baja resistencia al corte.

A la vista de ello para la realización del pozo de ataque deberá realizarse un sostenimiento de la excavación mediante un tablestacado debidamente apuntalado que se empotre en la unidad UG-III. Complementado con las medidas de drenaje pertinentes para mantener el nivel de agua por debajo de la cota de actuación.

En función de la cota a la que se proyecte la hinca, habrá que sanear los suelos blandos hasta la UG-III, para apoyar la solera (con un suelo granular interpuesto) y cimentar el muro de reacción.

Las excavaciones tanto del pozo de ataque como el de recepción podrán realizarse con medios convencionales.

El nivel UG-II y UG-III se catalogan como de fuerte agresividad por sulfatos (ambiente Qc, de EHE) por lo que tanto en los elementos de hormigón que se dispongan sobre dicha unidad, deberán utilizarse cementos sulforesistentes y dosificaciones acordes a un ambiente Qc de agresividad.

En función del diámetro de la tubería podría plantearse una perforación dirigida que eliminaría buena parte de estos inconvenientes. No obstante, su valoración deberá remitirse a empresas especializadas en este tipo de trabajos.

6.7.1.2.- Cruce B

Dentro de la tramificación de la red de tuberías, este cruce se dispone en la zona B.

Se realizó una calicata (RR-C10) cuya situación reflejamos en la figura adjunta y también se recoge en el plano del anejo I-E.

En este punto de cruce el FFCC discurre en terraplén y sobre 2 a 2,5 m por encima del terreno en el lateral donde se realizó la cata y sobre 1 m en el otro lateral.

Según la calicata realizada, se determina un modelo de terreno formado, de arriba a abajo, por las siguientes unidades:

. UG-I, formado por un relleno de tierras de 0,2 m de espesor.

. UG-III, aparece directamente bajo la anterior y presenta unos primeros 0,4 m alterados (III-A) constituidos por arcillas limosas con intercalaciones centimétricas de areniscas. Debajo aparece sano (III-B) y está formado por una primera capa de areniscas-limolitas trabadas y algo cementadas de 0,6 m de espesor a la que sigue 1,1m de argilitas grisáceas con alguna intercalación de arenisca de hasta 10 cm de espesor.

Los parámetros geotécnicos de esta unidad son los indicados en el apartado 5.3.

. No se detecta agua ni rezumes.

En el lateral enfrentado a la calicata, se observó también la presencia cercana a superficie de la unidad UG-III.

Considerando que el cruce arrancaría del lado de más altura de terraplén (2 a 2,5 m) y dada la exigencia mínima de profundidad indicada anteriormente, la tubería (generatriz superior) se dispondrá aproximadamente 1,0 a 1,5 m por debajo de la profundidad de la RR-C10. Por lo tanto, la tubería atravesaría los materiales de la unidad UG-III-B, es decir, un terreno constituido por rocas blandas.

En estas condiciones, la metodología de cruce más aconsejable sería la de hinca con escudo abierto y con perforación-rozado en el frente de avance y por delante de la hinca.

A los efectos de valoración de esta posible solución pueden considerarse los siguientes parámetros:

- Densidad: 2,2 g/cm$^3$
- Resistencia a compresión simple mínima de 6 Kg/cm$^2$. En los términos de areniscas la resistencia a compresión sería superior, orientativamente, dado que no están fuertemente cementadas, podrían considerarse valores de hasta 20-30 Kg/cm$^2$.
- Abrasividad: muy baja en las argilitas y baja en las areniscas.

La losa-solera del pozo de ataque se dispondrá sobre el nivel III-B, a priori sobre los materiales argiliticos, de una buena capacidad portante, sin problemas de colapsabilidad y que posee una baja expansividad. En este sentido y a los efectos de dimensionado de la losa puede considerarse los parámetros indicados en el apartado 5.3.

El muro de reacción se dispondrá en su totalidad sobre los materiales de la UG-III (primeros 0,4 m de la UG-IIIA y debajo la UG-IIIB). A los efectos de cálculo del mismo pueden considerarse los parámetros geotécnicos asignados a estos dos tipos de materiales en el apartado 5.3.

Las excavaciones tanto del pozo de ataque como el de recepción podrán realizarse con medios convencionales pero potentes pudiendo ser necesario localmente el uso del martillo rompedor en los tramos de areniscas. Todas ellas serán en seco. Al tratarse de excavaciones temporales, podrían adoptarse taludes subverticales, no obstante por motivos de seguridad sería conveniente retirar la UG-I de la cabecera del talud de excavación.

El nivel UG-III se cataloga como de fuerte agresividad por sulfatos (ambiente Qc, de EHE) por lo que, tanto en la losa como en el muro, que se disponen sobre dicha unidad, deberán utilizarse en los hormigones, cementos sulforesistentes y dosificaciones acordes a una ambiente Qc de agresividad.

### 6.7.2 Cruces de carreteras

A falta de una definición de los mismos establecemos algunas consideraciones generales al respecto.

6.7.2.1. Caso de cruce en zanja por medias calzadas.

A este respecto y de acuerdo a la zonificación realizada para la red de riego, diferenciamos los cruces dispuestos en la zona A y los de la zona B.

- En la zona A se disponen los cruces C, D y E, todos ellos afectan a la Ctra 1211.

A los efectos se aplicarán las consideraciones realizadas al respecto para esta zona A que se han reflejado en el apartado 6.6.

No obstante, en lo que respecta a las excavaciones consideramos más adecuado utilizar medidas de sostenimiento que un ataluzamiento.

- En la zona B, se disponen los cruces F, G, H, I, J, K y L.

Para estos casos aplicarán las consideraciones reflejadas en el apartado 6.6. para esta zona.

6.7.2.2. Caso de cruce por hinca

Esta posibilidad se daría en los cruces de las carreteras de rango autonómico (cruces C, D, E y F).

Cruce C

Dentro de la tramificación de la red de tuberías, este cruce se dispone en la zona A.

Se realizó un ensayo DPSH (RR-P4) y una calicata (RR-C7) cuya situación reflejamos en la figura adjunta y también se recoge en el plano del anejo I-E.

En este punto de cruce la carretera discurre sobre 0,5 m por encima en el lateral de la calicata y unos 0,5 m por debajo en el lateral del ensayo DPSH.

Se determina un modelo de terreno formado, de arriba a abajo, por las siguientes unidades:

. UG-I, suelo vegetal con un espesor de 0,7 m.

. UG-II formada por arcillas limosas y a base una mezcla de gravas y arcillas. Se extendería hasta 2,4 a 2,7 m de profundidad. Esta unidad en prácticamente su totalidad sería de consistencia blanda, y por lo tanto serían aplicables los parámetros geotécnicos generales asignadas a la misma en el apartado 5.2.

. UG-III, aparece directamente bajo la anterior y presenta unos primeros 0,3 a 0,6 m alterados (III-A) constituidos por arcillas. Debajo aparece sano (III-B). Los parámetros geotécnicos asignables son los indicados en el apartado 5.3.

. Existe un nivel de agua a 1,7 m de profundidad.

Considerando que el cruce se realizaría desde el lado de la calicata y dada la exigencia mínima de profundidad, la tubería (generatriz superior) se dispondrá aproximadamente sobre 1,0 a 1,5 m por debajo de la superficie de realización de dicha calicata. Por lo tanto, la tubería atravesaría los materiales de la unidad UG-II de consistencia blanda y además cortaría el nivel de agua.

En estas condiciones, la metodología de cruce más aconsejable sería la hinca convencional por empuje sin necesidad de equipo de rozado o de excavación especial en el frente.

Este cruce plantea similares problemáticas de ejecución de los pozos de ataque y recepción, asi como de la solera, a las indicadas para el cruce A descritas en el apartado 6.7.1.1. Por lo tanto, a los efectos son de aplicación lo indicado al respecto en el mencionado apartado, asi como lo referente a la agresividad, excavabilidad y la posibilidad de plantearse una perforación dirigida.

Cruce D

Dentro de la tramificación de la red de tuberías, este cruce se dispone en la zona A.

Se realizó un ensayo DPSH (RR-P2) y una calicata (RR-C5) cuya situación reflejamos en la figura adjunta y también se recoge en el plano del anejo I-E.

En este punto de cruce la carretera discurre sobre 0,5 m por encima en el lateral donde se realizó el DPSH y unos 2 m por debajo en el lateral de la calicata.

Se determina un modelo de terreno formado, de arriba a abajo, por las siguientes unidades:

. UG-I, suelo vegetal con un espesor de 0,5 m.

. UG-II formada por arcillas limosas. Se extendería hasta 4,0 m de profundidad, según ensayo DPSH Esta unidad hasta una profundidad de 1,2 a 1,4 m es de consistencia media; por debajo y hasta alcanzar la UG-III es de consistencia blanda. Los parámetros geotécnicos aplicables serían los establecidos para ambos tipos en el apartado 5.2.

. UG-III, aparece bajo la anterior y presenta 1,2 m superiores alterados (III-A). Debajo aparece sano (III-B). Los parámetros geotécnicos aplicables serían los establecidos para ambos tipos en el apartado 5.3.

. Existe un nivel de agua a 1,7 m de profundidad.

Considerando que el cruce se realizaría desde el lado de la calicata y dada la exigencia mínima de profundidad, la tubería (generatriz superior) se dispondría sobre la superficie de realización de la calicata. No obstante, dada la exigencia adicional de un recubrimiento mínimo de 1,0 m sobre la generatriz superior, será esta la profundidad mínima que debe considerarse, por lo que la tubería atravesaría la parte más superficial de la unidad UG-II de consistencia media, aunque hacia su salida (lateral del RR-P2) afectaría a la UG-II de consistencia blanda.

En estas condiciones, la metodología de cruce más aconsejable sería la hinca convencional por empuje sin necesidad de equipo de rozado o de excavación especial en el frente.

Este cruce plantea similares problemáticas de ejecución de los pozos de ataque y recepción, asi como de la solera, a las indicadas para el cruce A descritas en el apartado 6.7.1.1. Por lo tanto, a los efectos son de aplicación lo indicado al respecto en el mencionado apartado, asi como lo referente a la agresividad, excavabilidad y la posibilidad de plantearse una perforación dirigida.

Cruce E

Dentro de la tramificación de la red de tuberías, este cruce se dispone en la zona A.

Se realizó un ensayo DPSH (RR-P1) y una calicata (RR-C2) cuya situación reflejamos en la figura adjunta y también se recoge en el plano del anejo I-E.

En este punto de cruce la carretera discurre ligeramente por encima (unos 0,2-0,3 m) del terreno y en ambos lados. Señalar que en este punto de cruce, y en el lado del ensayo P1, existe un sifón de la acequia que discurre paralela a la carretera, que podría interferir en el paso de la tubería.

Se determina un modelo de terreno formado, de arriba a abajo, por las siguientes unidades:

. UG-I, suelo vegetal con un espesor de 0,4-0,6 m.

. UG-II formada por limos arcillosos a arcillas limosas. Se extendería hasta 2,9 m en el lado de la C2 y hasta 2,4 m en el del ensayo P-1. En la zona de la calicata encontramos que hasta los 2,0 m tiene una consistencia media y por debajo su consistencia es blanda. Por el contrario en el ensayo P-1, prácticamente la totalidad del nivel es de consistencia blanda. Los parámetros geotécnicos aplicables serían los establecidos para ambos tipos en el apartado 5.2.

. UG-III, aparece bajo la anterior y presenta 0,4-0,5 m superiores alterados (III-A). Debajo aparece sano (III-B). Los parámetros geotécnicos aplicables serían los establecidos para ambos tipos en el apartado 5.3.

. Existe un nivel de agua a 3,1 m de profundidad (reconocido en la calicata). Aparece en el contacto entre la UG-I y UG-II.

Tanto si el cruce se realiza desde el lado de la calicata como del lado del ensayo DPSH, dada la exigencia mínima de profundidad, la tubería (generatriz superior) se dispondría por debajo de una profundidad de 1,5 m en la superficie de los puntos de ensayo, por lo que atravesaría la unidad UG-II.

En estas condiciones, la metodología de cruce más aconsejable sería la hinca convencional por empuje sin necesidad de equipo de rozado o de excavación especial en el frente.

Previamente deberá verificarse la posición del sifón, ya que dicho elemento supone una interferencia en la hinca de la tubería.

Este cruce plantea similares problemáticas de ejecución de los pozos de ataque y recepción, asi como de la solera, a las indicadas para el cruce A descritas en el apartado 6.7.1.1. Por lo tanto, a los efectos son de aplicación lo indicado al respecto en el mencionado apartado, asi como lo referente a la agresividad, excavabilidad y la posibilidad de plantearse una perforación dirigida.

<u>Cruce F</u>

Dentro de la tramificación de la red de tuberías, este cruce se dispone en la zona B.

Se realizó una calicata (RR-C25) cuya situación reflejamos en la figura adjunta y también se recoge en el plano del anejo I-E.

En este punto de cruce, la carretera discurre ligeramente por encima del terreno, sobre 1 m por encima en el lateral de la calicata y del orden de 0,5 m en el lateral contrario.

Según la calicata realizada, se determina un modelo de terreno formado, de arriba a abajo, por las siguientes unidades:

. UG-I, suelo vegetal con un espesor de 0,5 m

. UG-II, formada por arcillas limosas a arenas limosas que se extenderían hasta 1,6 m de profundidad. Los parámetros geotécnicos a priori serían los asignados a esta unidad con una consistencia media, que hemos indicado en el apartado 5.2.

. UG-III, aparece directamente bajo la anterior y presenta unos primeros 0,4 m alterados (III-A) constituidos por arcillas. Debajo aparece sana (III-B) y está formada por una primera capa de areniscas trabadas pero no cementadas de 0,5 m de espesor a la que sigue 0,3 m de argilitas rojizas. Los parámetros geotécnicos de esta unidad son los indicados en el apartado 5.3

. Se detecta un rezume de agua a 1,4 m en el contacto de las unidades II y III.

Considerando que el cruce se realizaría desde el lado de la calicata y dada la exigencia mínima de profundidad, la tubería (generatriz superior) se dispondría inicialmente por debajo de 0,5 m de la superficie de donde se realizó la calicata. No obstante, por la exigencia adicional en el tapado de las zanjas de tubería, ésta deberá disponerse más profunda con objeto de respetar una profundidad mínima de 1,0 m desde la generatriz superior.

Considerando dicha profundidad mínima y según el perfil de la calicata, la tubería atravesaría las unidades II o la II y la III-A, dependiendo de la profundidad final y el diámetro de la tubería.

Dado que la base topográfica facilitada tiene una precisión limitada, consideramos que es crucial realizar una topografía más precisa con objeto de determinar con más precisión el desnivel existente entre el terreno y la plataforma. De este resultado, junto con el diámetro de la tubería, va a depender si finalmente ésta atraviesa solo la unidad II o alcanza la unidad III-A

Esta situación de cruce entre dos materiales de diferente comportamiento, resulta problemática a los efectos de la definición del sistema más adecuado para la hinca. En este sentido y ante la incertidumbre de posición de ese cambio de terreno respecto a la tubería, recomendamos del lado de la seguridad establecer una profundidad de cruce de la tubería que situé a la misma siempre en la UG-III, es decir, debe contemplarse una profundidad mínima para la generatriz superior de la tubería de 2,0 m.

En estas condiciones, la metodología de cruce más aconsejable sería la de hinca con escudo abierto y con perforación-rozado en el frente de avance y por delante de la hinca.

A los efectos de valoración de esta posible solución pueden considerarse los siguientes parámetros:

- Densidad: 2,2 g/cm$^3$
- Resistencia a compresión simple mínima de 6 Kg/cm$^2$. En los términos de areniscas la resistencia a compresión sería superior, orientativamente, dado que no están fuertemente cementadas, podrían considerarse valores de hasta 20-30 Kg/cm$^2$.
- Abrasividad: muy baja en las argilitas y baja en las areniscas.

La losa-solera del pozo de ataque se dispondrá sobre el nivel III-B de una buena capacidad portante, sin problemas de colapsabilidad y que posee una baja expansividad. En este sentido y a los efectos de dimensionado de la losa puede considerarse los parámetros indicados para este terreno en el apartado 5.3.

El muro de reacción se dispondrá también en su totalidad sobre los materiales de la UG-IIIB. A los efectos de cálculo del mismo pueden considerarse los parámetros geotécnicos asignados a estos materiales en el apartado 5.3.

Las excavaciones tanto del pozo de ataque como el de recepción podrán realizarse con medios convencionales pero potentes.

La presencia de un rezume de agua obligara a la adopción de medidas achique.

Al tratarse de excavaciones temporales, podrían adoptarse taludes subverticales, no obstante por motivos de seguridad y dada la presencia de suelos limosos-arenosos muy húmedos asi como un rezume de agua, consideramos debe adoptarse una inclinación de 1H:1V y además sería conveniente retirar la UG-I de la cabecera del talud de excavación.

Los niveles II y III se catalogan como de fuerte agresividad por sulfatos (ambiente Qc, de EHE) por lo que tanto en la losa como en el muro, deberán utilizarse en los hormigones, cementos sulforesistentes y dosificaciones acordes a una ambiente Qc de agresividad.

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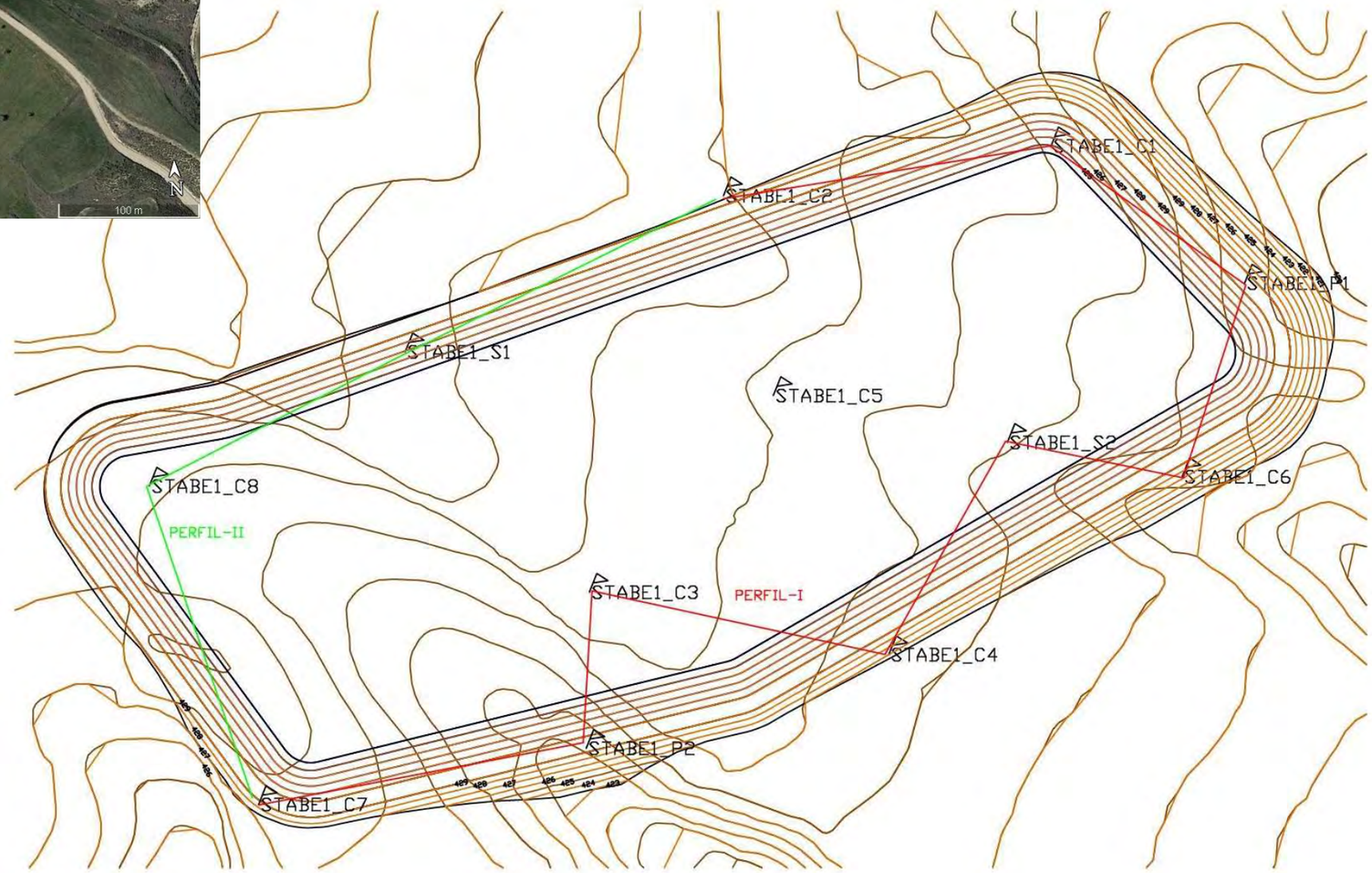
# ANEJOS

# I.- PLANTA DE SITUACIÓN ENSAYOS

# I.A.- BALSA ELEVADA 1

# BALSA ELEVADA 1
# CROQUIS SITUACIÓN ENSAYOS

IGEOSUMA, S.L.



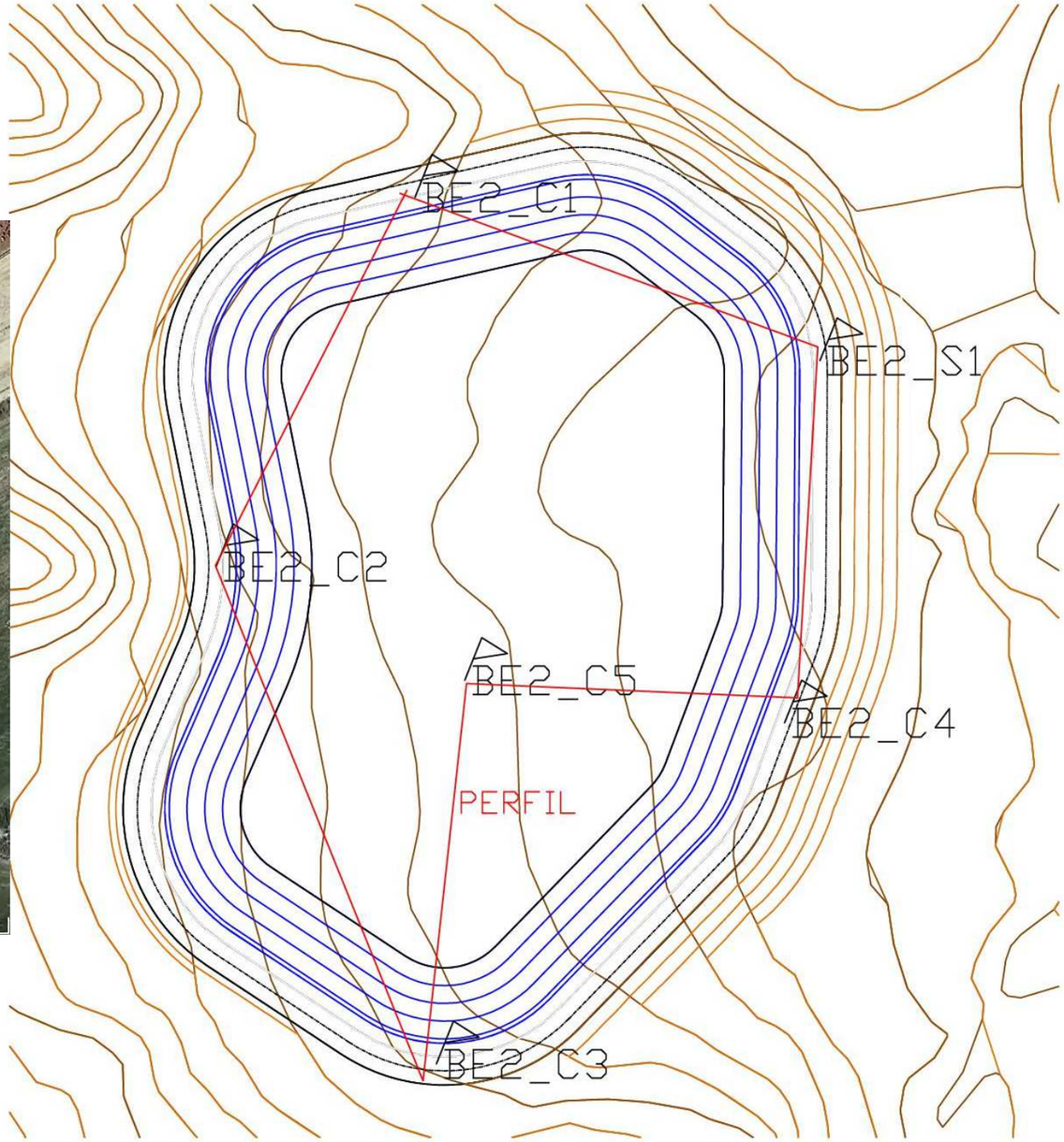

**INFORME:** *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

**REFERENCIA:** *0673*

**FECHA:** *Abril de 2021*

# I.B.- BALSA ELEVADA 2

# BALSA ELEVADA 2
# CROQUIS SITUACIÓN ENSAYOS



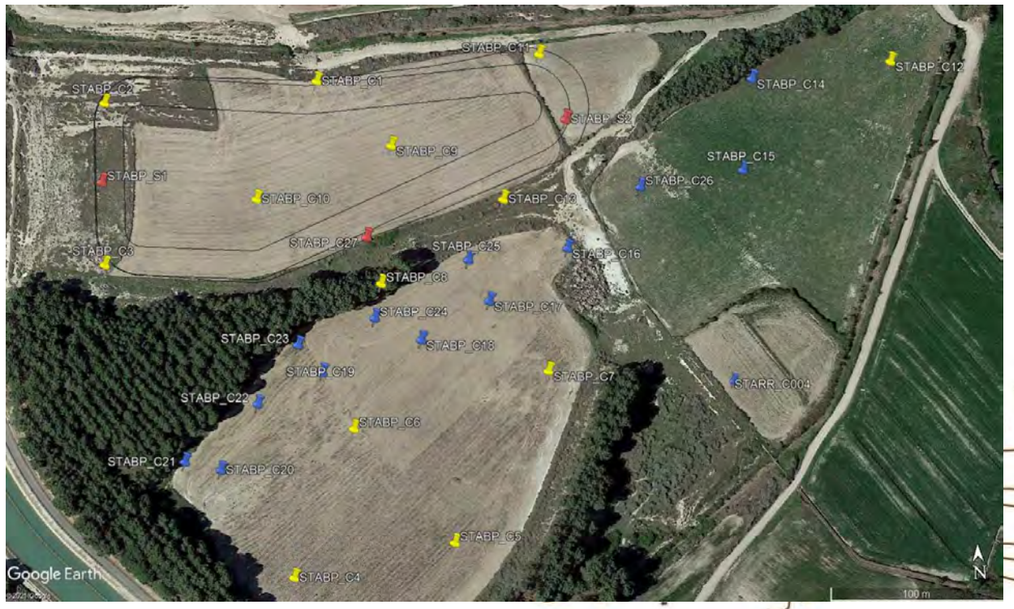

**INFORME:** *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

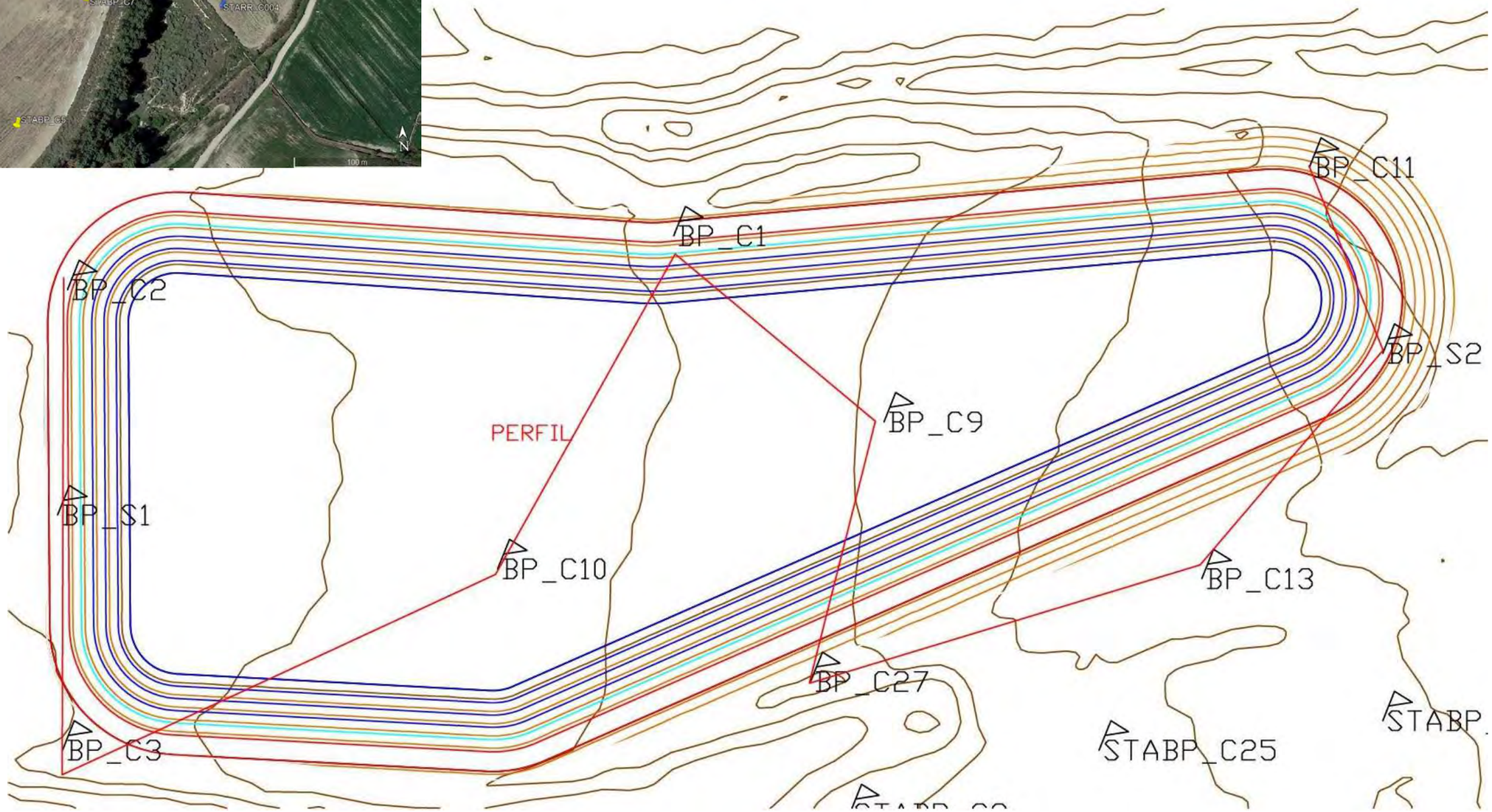
**REFERENCIA:** *0673*

**FECHA:** *Abril de 2021*

# I.C.- BALSA PIE DE CANAL V4

# BALSA PIE DE CANAL V4
# CROQUIS SITUACIÓN ENSAYOS



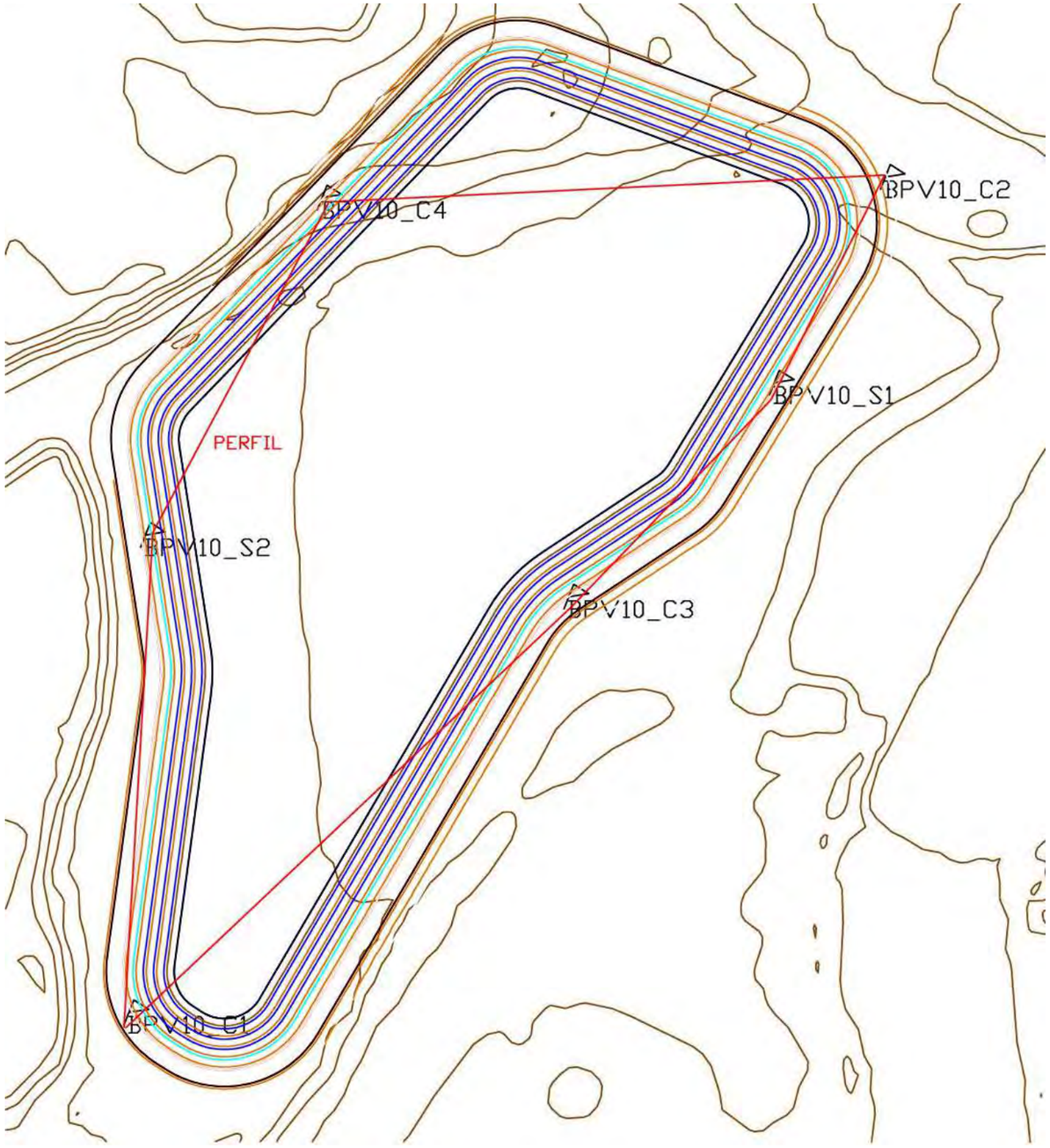

INFORME: *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

REFERENCIA: *0673*

FECHA: *Abril de 2021*

# I.D.- BALSA PIE DE CANAL V10

# BALSA PIE DE CANAL V10
# CROQUIS SITUACIÓN ENSAYOS

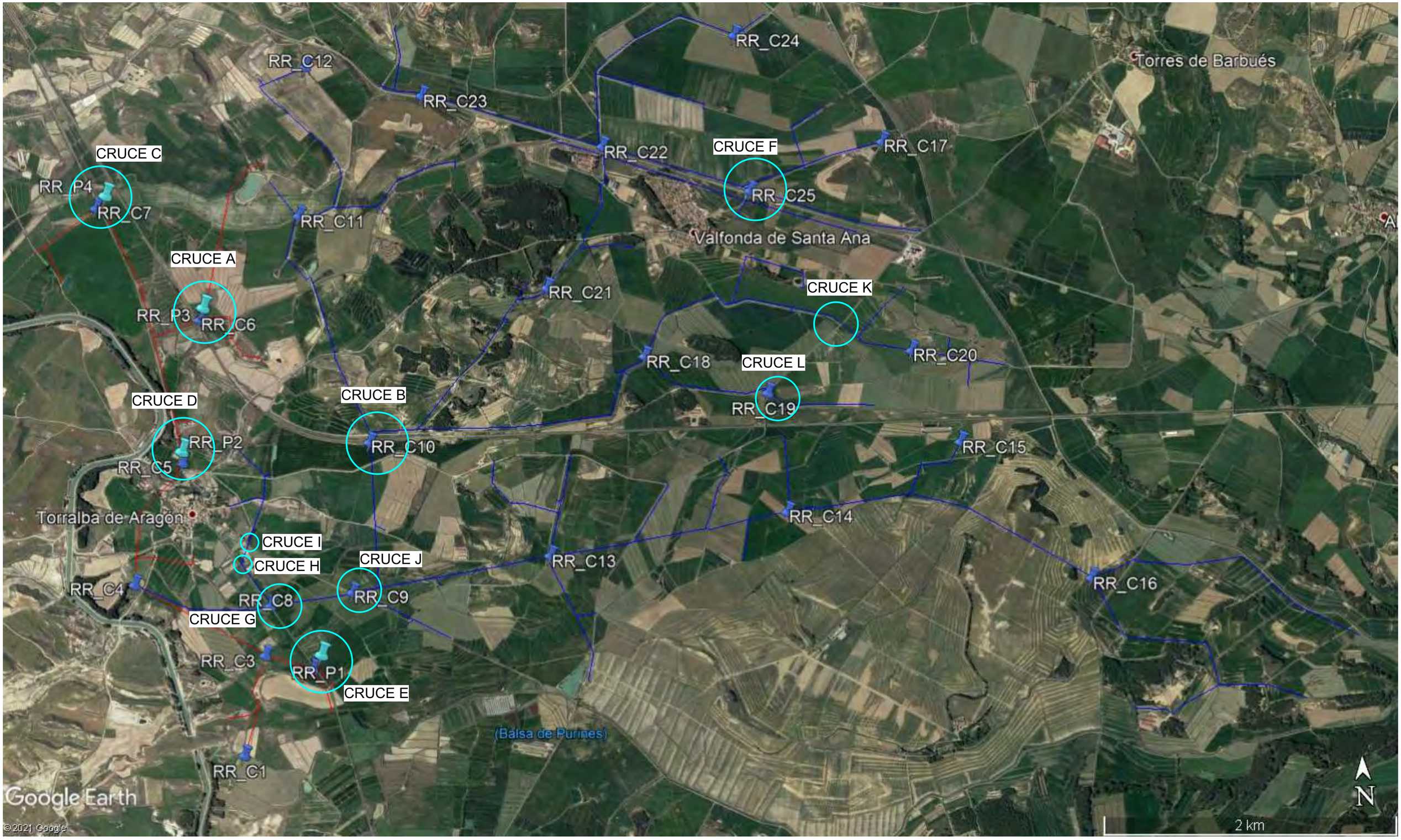



**INFORME:** ***ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)***

**REFERENCIA:** *0673*
**FECHA:** *Abril de 2021*

# I.E.- RED DE RIEGO Y CRUCES INFRAESTRUCTURAS

# RED DE TUBERÍAS Y CRUCES INFRAESTRUCTURAS
## CROQUIS SITUACIÓN ENSAYOS

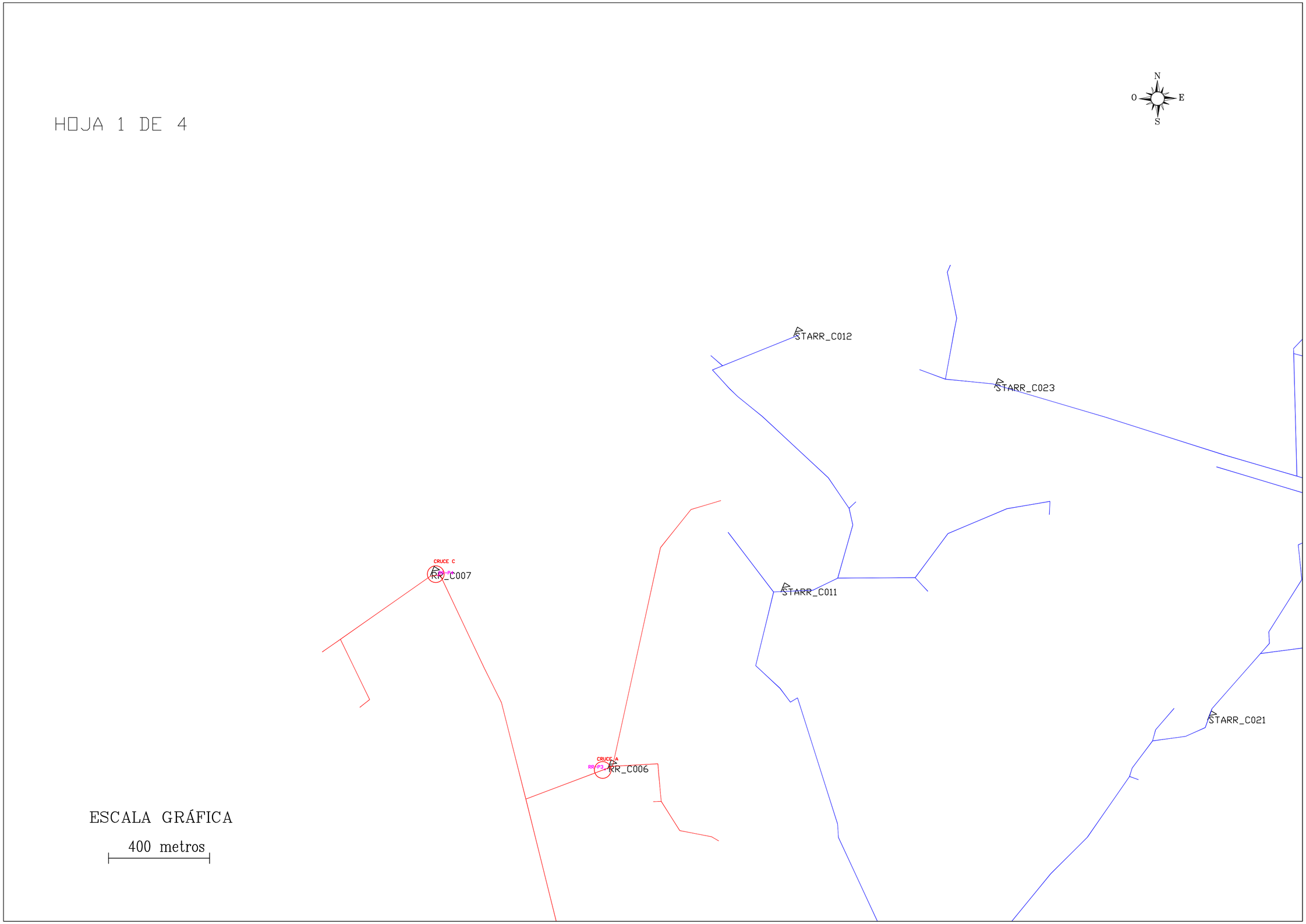



INFORME: *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

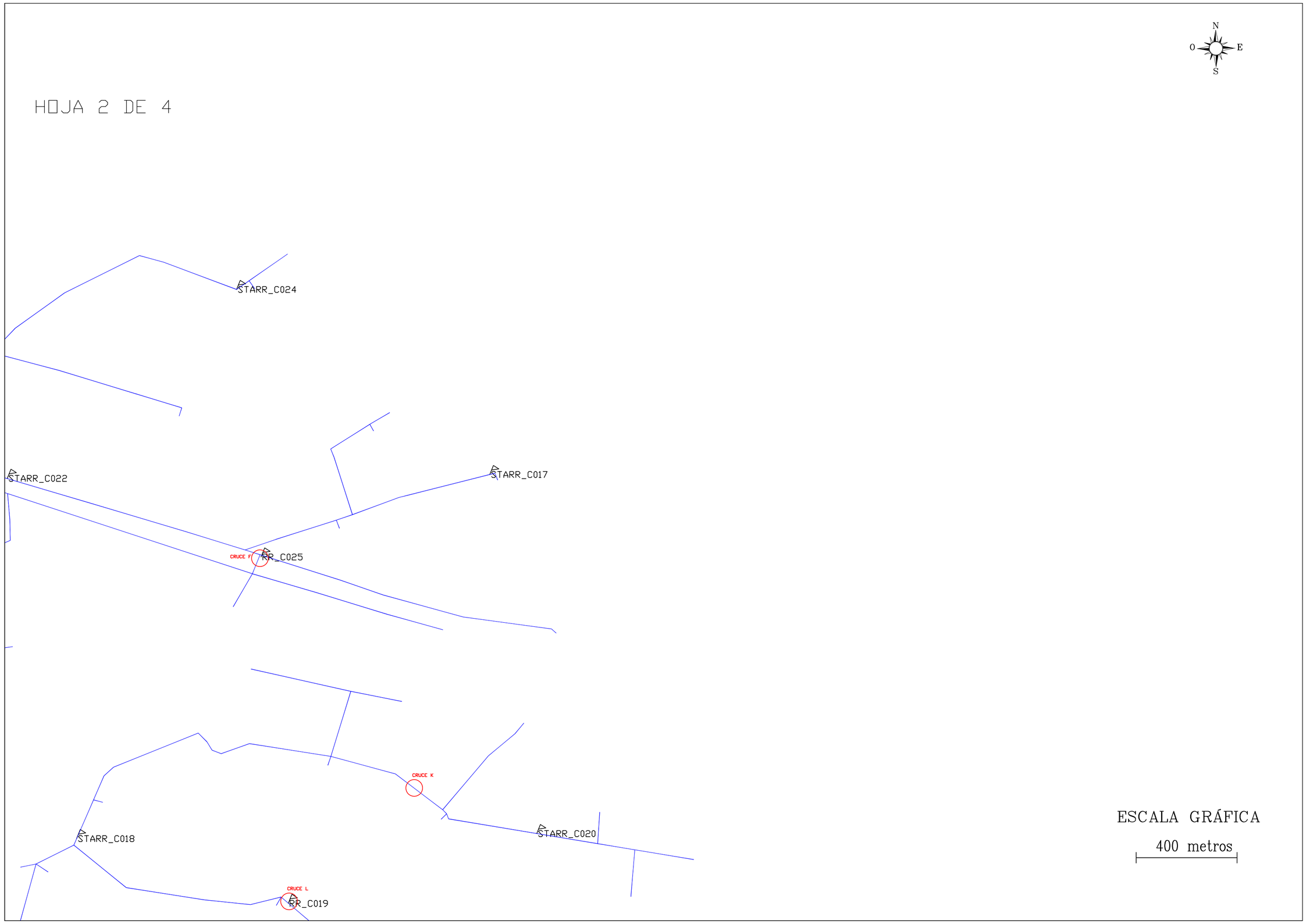
REFERENCIA: *0673*

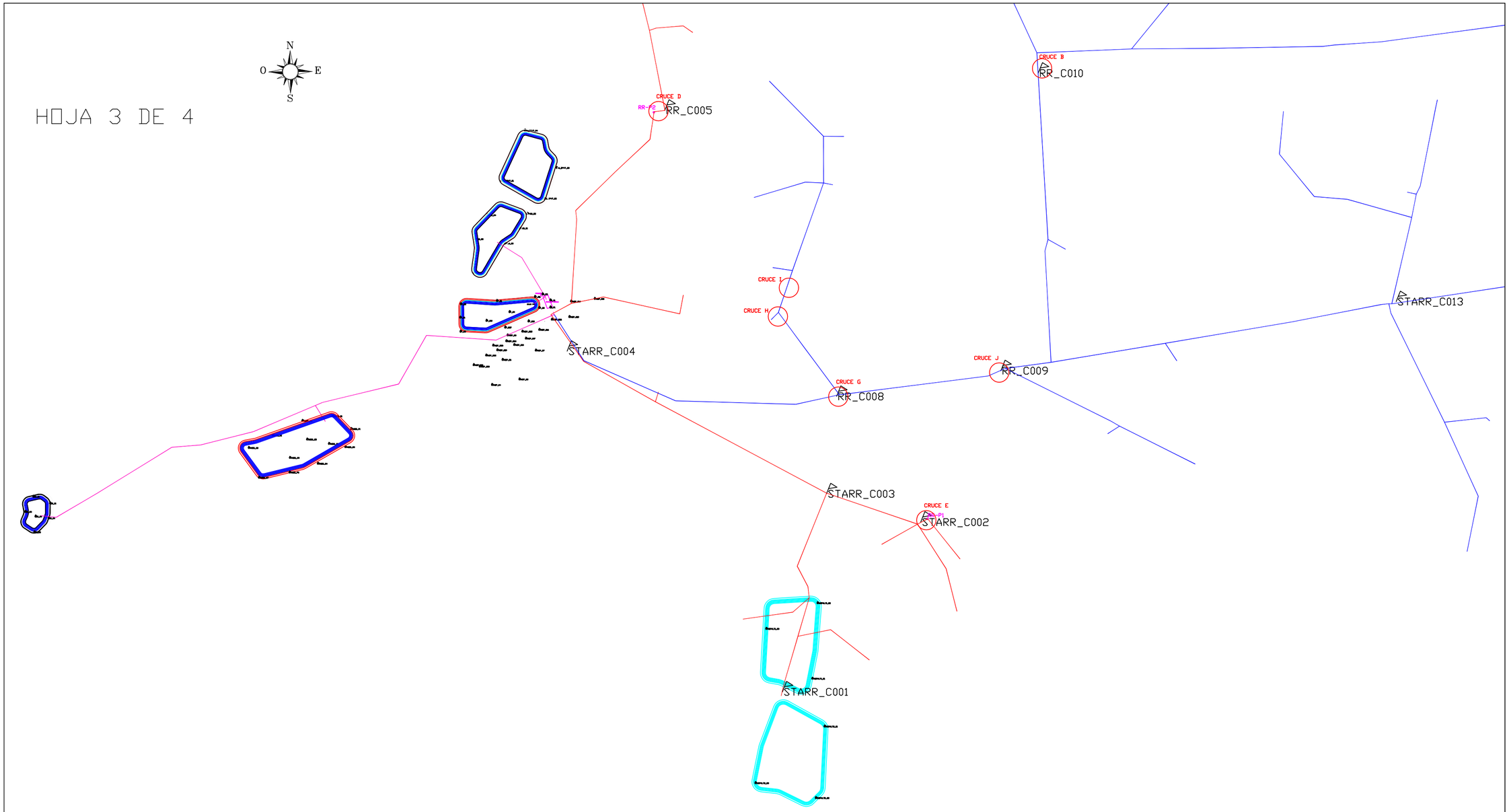
FECHA: *Abril de 2021*

HOJA 1 DE 4


N
O
E
S
STARR_C012
STARR_C023
CRUCE C
RR_C007
STARR_C011
STARR_C021
CRUCE A
RR_C006
ESCALA GRÁFICA
400 metros

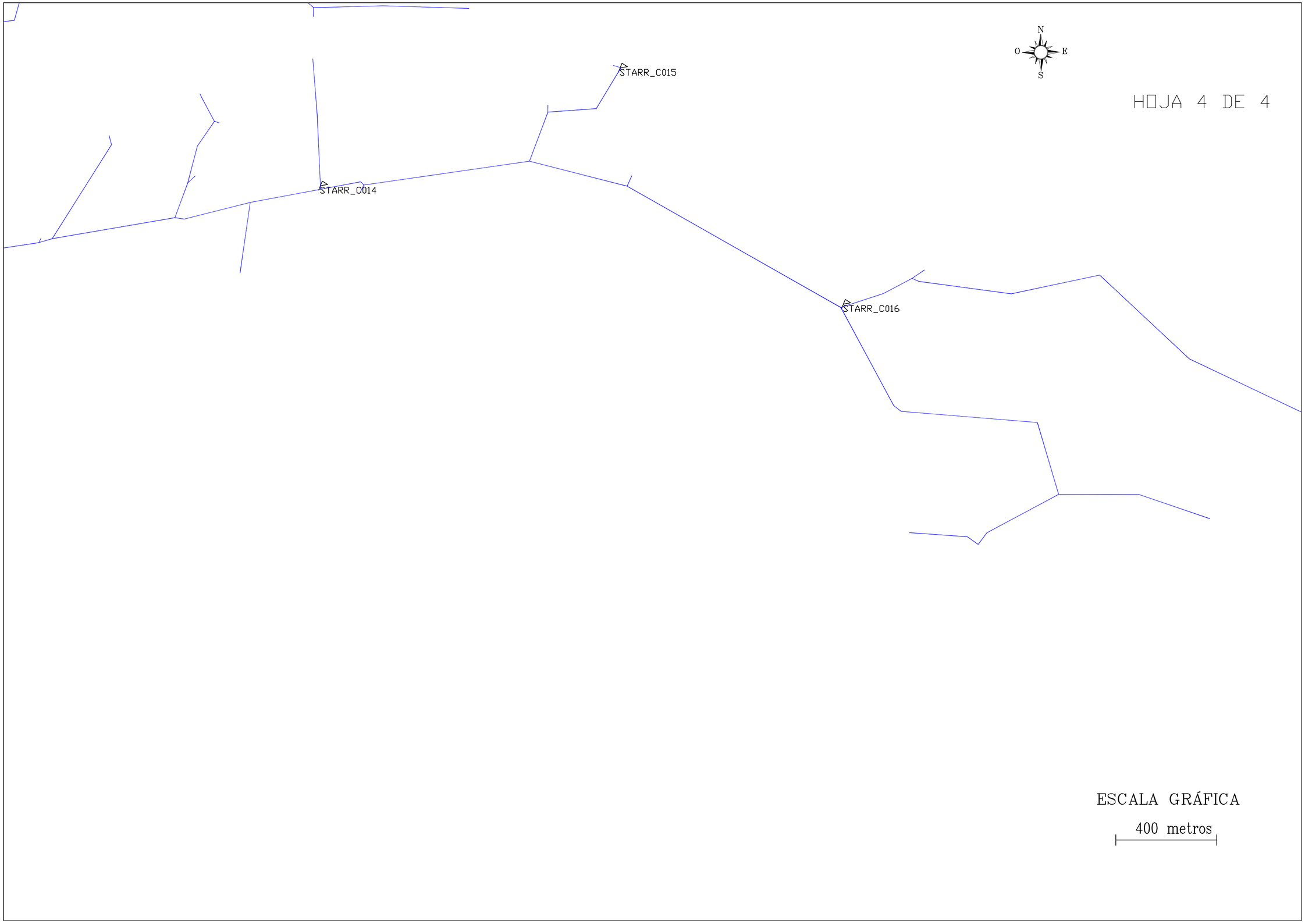
HOJA 2 DE 4


N
O
E
S
STARR_C024
STARR_C022
STARR_C017
CRUCE F
RR_C025
CRUCE K
STARR_C018
STARR_C020
CRUCE L
RR_C019
ESCALA GRÁFICA
400 metros



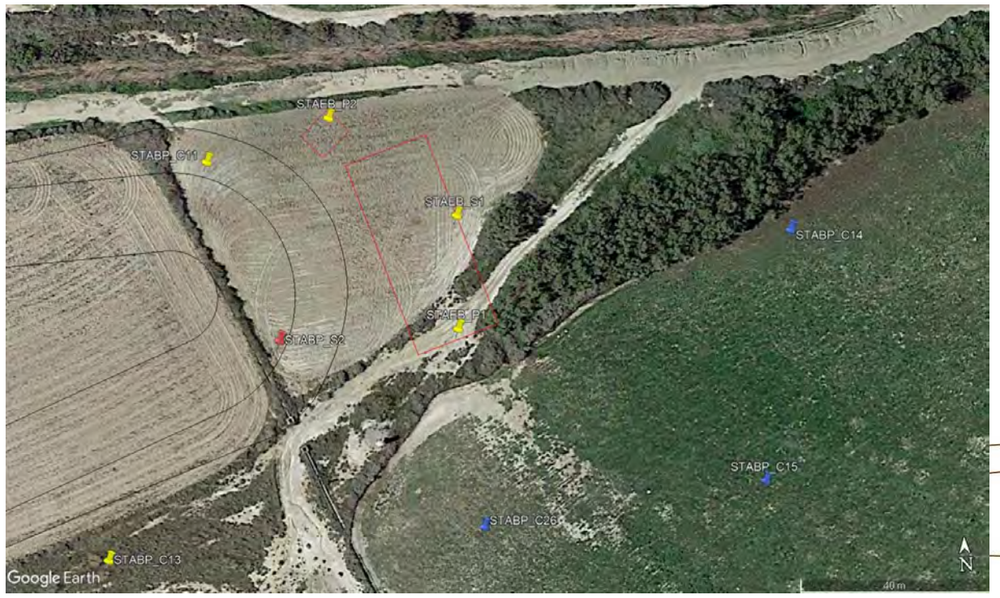

ESCALA GRÁFICA

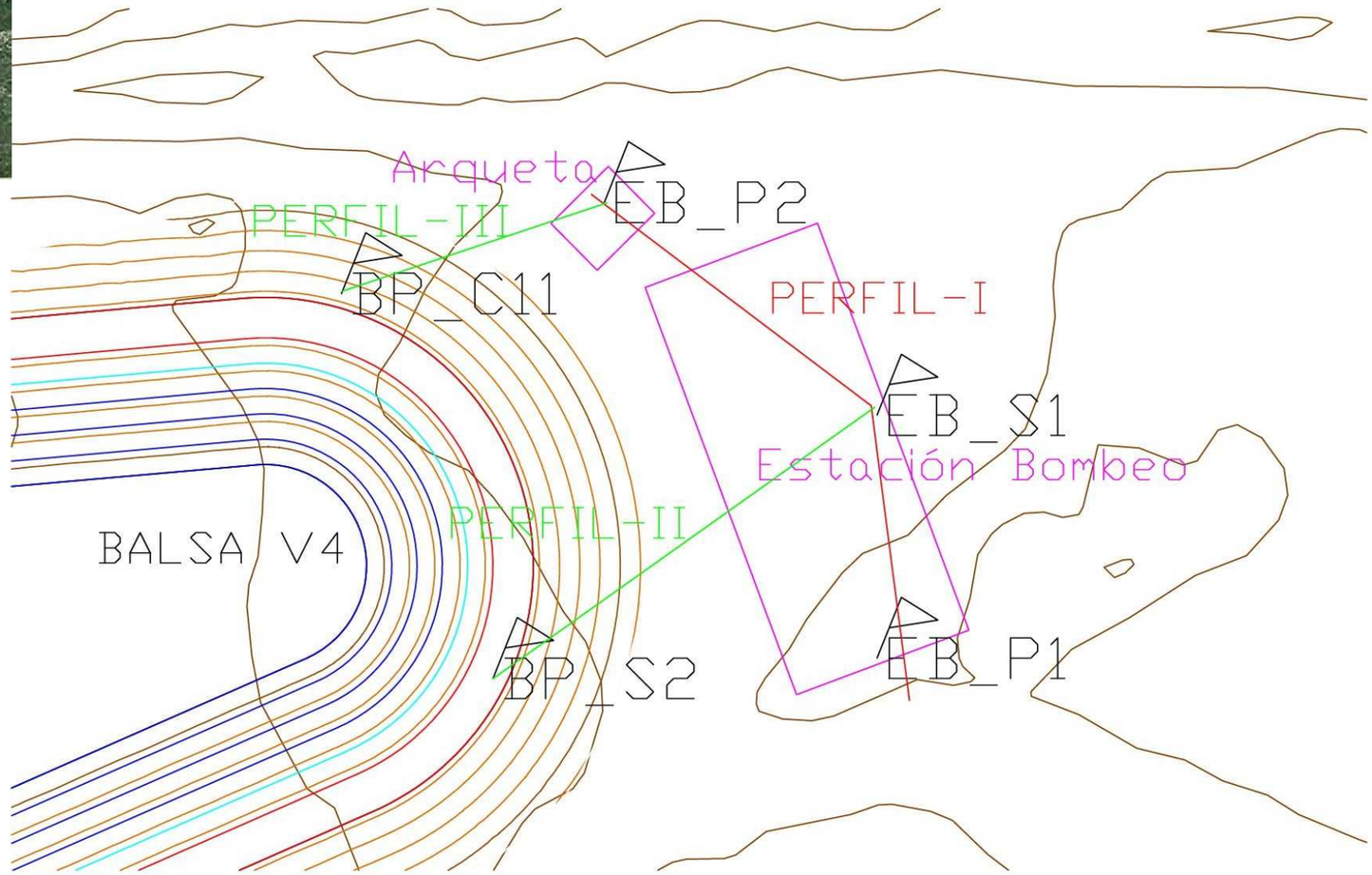
400 metros


N
O
E
S
HOJA 4 DE 4
STARR_C015
STARR_C014
STARR_C016
ESCALA GRÁFICA
400 metros

# I.F.- ESTACIÓN DE BOMBEO Y ARQUETA

# ESTACIÓN DE BOMBEO Y ARQUETA
# CROQUIS SITUACIÓN ENSAYOS




**INFORME:** *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*
**REFERENCIA:** *0673*
**FECHA:** *Abril de 2021*

# I.G.- BALSA PIE DE CANAL ALTERNATIVA 1 (DESCARTADA)

# BALSA PIE DE CANAL ALT1 (DESCARTADA)
# CROQUIS SITUACIÓN ENSAYOS

# I.H.- BALSA PIE DE CANAL ALTERNATIVA 2 (DESCARTADA)

# BALSA PIE DE CANAL ALT2 (DESCARTADA)
# CROQUIS SITUACIÓN ENSAYOS

# I.I.- BALSA PIE DE CANAL V7 (DESCARTADA)

# BALSA PIE DE CANAL V7 (DESCARTADA)
# CROQUIS SITUACIÓN ENSAYOS

INFORME: *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

REFERENCIA: *0673*

FECHA: *Abril de 2021*

# II.- PERFILES LITOLÓGICOS DE LOS SONDEOS

# II.A.- BALSA ELEVADA 1

**IGEOSUMA, S.L.**

| SONDEO: BE1-S1 | EMPLAZAMIENTO: BALSA ELEVADA 1 | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 704972 |
| | Referencia: 0673 — Fecha de realización: 22 de Marzo de 2021 | Y = 4644718 |
| | | Z = 429,5 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,50 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 1,00 | | Mezcla de limos (con arenas y arcillas), marrones y gravas finas-medias, subangulosas, de calizas. A base alguna grava gruesa. | | | | | | |
| 2,10 | | Arcillas limosas a Limos arcillosos marrón amarillentos con algunas gravas dispersas. | II | 2,00 MI 15-25-33-50 | 1,00–1,45 | 6-6-8 N = 14 | | |
| 2,55 | | Arcillas marrón grisáceas a grisáceas. | III-A | 2,60 | 2,60–3,05 | 14-33-38 N = 71 | | |
| 6,10 | | Argilita marrón a marrón grisácea, con: . intercalaciones de arenas-areniscas a base. . yesos en venillas y en nódulos. . áreas de óxidos de hierro a base. A techo nivel de yeso alabastrino de 3 cm de espesor. | III-B | 3,20–3,40 TP; 4,70–5,00 TP | | | | 3,05 – 72% – 3,70; 89% – 5,70 |
| 6,20 | | Yeso cristalino-alabastrino con interdigitaciones de arcillas grises. | | 6,10–6,40 TP | | | | 63% |
| 8,40 | | Argilitas grisáceas a marrón grisáceas con: . intercalaciones centimétricas (< 2 cm) de areniscas grisáceas. (Entre 7,7 y 8,4 m son más frecuentes y alcanzan espesores de 4 cm). . venillas de yesos . tapizados de óxidos de hierro en estratificación. | | 7,80–8,00 TP | | | | 7,30 – 56% – 8,4 |

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: TECOINSA TP-60

**IGEOSUMA, S.L.**

# SONDEO BE1-S1 (BALSA ELEVADA 1)

**IGEOSUMA, S.L.**

| SONDEO: BE1-S2 | EMPLAZAMIENTO: BALSA ELEVADA 1 | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 705165 |
| | | Y = 4644689 |
| | Referencia: 0673 — Fecha de realización: 22 de Febrero de 2021 | Z = 425 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,40 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 1,10 | | Mezcla de arcillas limosas, marrones con algo de arenas y gravas finas-medias, subangulosas, de calizas. Con algún bolo | II | | | | | |
| 2,10 | | Limos arcillosos grisáceos. | | MI 19-26-R (1,90–2,30) | 1,30–1,80 | 7-12-10-10 N = 22 | | |
| 3,70 | | Arcillas limosas grisáceas con pasadas de arenas coherentes. Sustrato alterado. | III-A | MI 22-55-R (3,00–3,35) | 3,35–3,70 | 14-38-R N = Rzo | | |
| 5,35 | | Argilita marrón a marrón grisácea, laminadas y con bandeados de color marrón rojizo. Con algunas venillas rellenas de yeso cristalino. | III-B | TP (5,00–5,30) | | | | 4,5 |
| 6,60 | | Argilita grisácea con abundantes yesos en venillas y en niveles nodulares de hasta 4 cm. | | TP (6,00–6,30) | | | | 87% |
| 8,30 | | Argilita grisácea con intercalaciones centimétricas (< 2 cm) de areniscas grisáceas. | | | | | | 7,40<br>100%<br>8,3 |

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: ROLATEC RL-800

**IGEOSUMA, S.L.**

## SONDEO BE1-S2 (BALSA ELEVADA 1)

# II.B.- BALSA ELEVADA 2

**IGEOSUMA, S.L.**

| SONDEO: BE2-S1 | EMPLAZAMIENTO: BALSA ELEVADA 2 | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 704209 |
| | | Y = 4644485 |
| | Referencia: 0673 — Fecha de realización: 19 de Febrero de 2021 | Z = 440,5 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,40 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 1,00 | | Limos con arenas y arcillas, marrón claras. Con:<br>. eflorescencias y áreas blanquecinas de sulfatos.<br>. cantos dispersos (tamaño fino, gravilla) de calizas. | II | | | | | |
| 2,30 | | Arcillas limosas rígidas a duras marrones con yesos. | III-A | 1,00 – 1,60 MI 17-12-23-20 | 1,60 – 2,20 | 13-17-27-65 N = 44 | | |
| 2,50 | | Yesos alabastrinos. | | | | | | |
| 8,30 | | Arcilla dura a argilita marrón clara, laminada con abundante yeso cristalino en venillas y yesos alabastrinos nodulares .<br>A base son grisáceas. | III-B | 4,90 – 5,10 TP<br>7,40 – 7,80 TP | | | | 2,7<br>61%<br>5,7<br>79%<br>8,3 |

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: ROLATEC RL-800

**IGEOSUMA, S.L.**

# SONDEO BE2-S1 (BALSA ELEVADA 2)

# II.C.- BALSA PIE DE CANAL V4

**IGEOSUMA, S.L.**

| SONDEO: BP-S1 | EMPLAZAMIENTO: BALSA PIE DE CANAL | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 23 de Marzo de 2021 | X = 705615 |
| | | Y = 4645122 |
| | | Z = 390 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,40 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 1,30 | | Limos con arcilla y arena, marrones con áreas blanquecinas (sulfatos). A techo un bolo de yeso alabastrino. | II | 1,20 MI | | | | |
| 1,40 | | Yesos alabastrinos entre limos-arenas marrones | | 17-R | 1,42 | | | |
| 1,90 | | Arcillas grisáceas con yesos. | III-A | 1,42 | 1,87 | 25-17-53 N = 70 | | |
| | | Argilita marrones y a base grisáceas a verde grisáceas, con: . intercalaciones centimétricas de arenas-areniscas. . yesos dispersos. . discontinuidades tapizadas de óxidos. . intercalaciones de margo calizas marrones a base. | III-B | 2,80 TP 3,00; 3,60 TP 3,80; 5,00 TP 5,20 | | | | 2,50; 80%; 4,40; 69%; 5,40 |
| 5,60 | | Yeso cristalino-alabastrino con interdigitaciones de arcillas grises. | | | | | | |
| 5,80 | | Argilitas grisáceas con yesos en venillas. | | | | | | 79% |
| 6,10 | | Yeso cristalino-alabastrino con intercalaciones centimétricas de argilitas grises y de calizas margosas grisáceas con una fina laminación de color. | | | | | | |
| 6,80 | | Argilitas grisáceas a marrón grisáceas con: . abundantes venas rellenas de yesos. . intercalaciones de margo-calizas grisáceas con una fina laminación de color. | | 7,30 TP 7,50 | | | | 6,80; 71% |
| 8,20 | | | | | | | | 8,2 |

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: TECOINSA TP-60

**IGEOSUMA, S.L.**

# SONDEO BP-S1 (BALSA PIE DE CANAL V4)

**IGEOSUMA, S.L.**

| SONDEO: BP-S2 | EMPLAZAMIENTO: BALSA PIE DE CANAL | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 705886 |
| | | Y = 4645155 |
| | Referencia: 0673 — Fecha de realización: 23 de Marzo de 2021 | Z = 384 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,40 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 1,30 | | Limos arcillosos marrones con áreas blanquecinas de sulfatos. | II | 1,20 – 1,80 MI 17-47-31-36 | | | | |
| 2,70 | | Arcillas marrones con:<br>. pasadas de arenas.<br>. áreas blanquecinas de sulfatos y cristales de yesos. | III-A | | 1,80 – 2,25 | 10-34-25 N = 59 | | |
| 6,10 | | Argilita marrones a marrón grisáceas, con:<br>. intercalaciones centimétricas de arenas-areniscas.<br>. venillas de yesos | III-B | 3,40 – 3,60 TP<br>5,30 – 5,60 TP | | | | 3,00<br>46%<br>4,00<br>85%<br>6,00 |
| 7,00 | | Arenisca grisácea. | | | | | | |
| 8,00 | | Argilitas grisáceas alguna intercalación centimétrica de margo-caliza grisácea. | | 7,20 – 7,50 TP | | | | 78% |
| 8,20 | | Arenisca grisácea. | | | | | | 8,2 |

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: TECOINSA TP-60

**IGEOSUMA, S.L.**

# SONDEO BP-S2 (BALSA PIE DE CANAL V4)

# II.D.- BALSA PIE DE CANAL V10

**IGEOSUMA, S.L.**

| SONDEO: BPV10-S1 | EMPLAZAMIENTO: BALSA PIE DE CANAL V10 | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 705818 |
| | | Y = 4645428 |
| | Referencia: 0673 — Fecha de realización: 24 de Marzo de 2021 | Z = 387,3 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,40 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 2,30 | | Limos arcillosos marrones con áreas blanquecinas de sulfatos. A base pequeños cristales de yesos. | II | MI 1,20–1,80: 5-4-5-4 | 1,80–2,25 | 2-4-3 N = 7 | | |
| 3,10 | | Arcillas grisáceas con yesos cristalinos. | III-A | MI 2,80–3,19: 7-39-R | 3,20–3,65 | 29-19-27 N = 46 | | |
| 6,40 | | Argilita grisáceas a marrón grisáceas, con: intercalaciones centimétricas de arenas-areniscas grisáceas. | III-B | TP 4,20–4,50; TP 5,50–5,80 | | | | 3,80 – 59% – 5,20 – 82% – 6,40 |
| 6,60 | | Marga calcárea grisácea con una fina laminación de color. | | | | | | |
| 8,00 | | Argilitas grisáceas con yesos dispersos. | | TP 6,60–7,20 | | | | 85% – 8,00 |

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: TECOINSA TP-60

**IGEOSUMA, S.L.**

# SONDEO BPV10-S1 (BALSA PIE DE CANAL V10)

**IGEOSUMA, S.L.**

| SONDEO: BPV10-S2 | EMPLAZAMIENTO: BALSA PIE DE CANAL V10 | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 705665 |
| | | Y = 4645391 |
| | Referencia: 0673 — Fecha de realización: 24 de Marzo de 2021 | Z = 389 m (de plano topográfico) |

| Prof. (m) | Sección | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|---|
| 0,50 | | Tierra de labor-suelo vegetal. | I | | | | | |
| 3,10 | | Limos arcillosos marrones con áreas blanquecinas de sulfatos. | II | 1,20 – 1,80 MI 8-7-9-12; 2,80 – 3,40 MI 8-8-14-18 | 1,80 – 2,25 | 5-8-9 N = 17 | | |
| 3,85 | | Arcillas grisáceas y marrones a techo, algo arenosas por el alto contenido en yesos cristalinos. | III-A | | 3,40 – 3,85 | 8-13-15 N = 28 | | |
| 4,40 | | Arcillas grisáceas con nivelillos de yesos. | | | | | | |
| 5,80 | | Argilitas grisáceas y bandeados marrones, con: . cristales y nódulos de yeso más abundantes a base . intercalación a 5,6 m de caliza margosa marrón de 3 cm de espesor. | III-B | | 4,60 – 5,05 | 30-32-30 N = 62 | | 5,20 |
| 6,05 | | Caliza a margo-caliza marrón grisácea a base con una fina laminación de color. | | | | | | |
| 6,20 | | Yesos alabastrinos con arcillas grisáceas. | | | | | | 80% |
| 6,80 | | Argilitas grisáceas con venillas rellenas de yesos. | | 6,20 – 6,50 TP | | | | 6,80 |
| 7,10 | | Marga calcárea grisácea con una fina laminación de color. | | | | | | |
| 7,40 | | Yesos alabastrinos con arcillas grisáceas. | | 7,20 – 7,40 TP | | | | 85% |
| 8,00 | | Argilitas grisáceas con venillas rellenas de yesos. | | | | | | 8,00 |

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PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: TECOINSA TP-60

**IGEOSUMA, S.L.**

# SONDEO BPV10-S2 (BALSA PIE DE CANAL V10)

# II.E.- ESTACIÓN DE BOMBEO

**IGEOSUMA, S.L.**

| SONDEO: EB-S1 | EMPLAZAMIENTO: ESTACIÓN DE BOMBEO | COORDENADAS UTM 30T ETRS89 |
|---|---|---|
| | | X = 705924 |
| | | Y = 4645181 |
| | Referencia: 0673 — Fecha de realización: 3 de M;ayo de 2021 | Z = 383,3 m (de plano topográfico) |

| Prof. (m) | Descripción del terreno | NIVEL GEOTÉCNICO | MUESTRA | S.P.T. Prof (m) | S.P.T. N30=N15+N15 | NIVEL DE AGUA | RQD |
|---|---|---|---|---|---|---|---|
| 0,30 | Tierra de labor-suelo vegetal. | I | | | | | |
| 1,80 | Limos arcillosos marrones con algo de arena y abundantes áreas blanquecinas de sulfatos. | II | 1,20 – 1,80 MI 4-7-9-10 | 1,80 – 2,40 | 0-0-3-5 N = 3 | 2,10 | |
| 2,90 | Arcillas limosas con arenas y abundantes cantos heterométricos de calizas y algunos de yesos. Están saturadas y blandas. | | | | | | |
| 3,10 | Arcillas limosas marrones, laminadas con delgados niveles de yeso cristalino. | | | 3,00 – 3,10 | R N = Rzo | | |
| 3,30 | Yesos alabastrinos y arcillas limosas marrón grisáceas. | | | | | | |
| | Arcillas rígidas a argilitas grisáceas a marrón grisáceas con delgadas intercalaciones ( < 1 a 3 cm) de arenas grisáceas y yesos alabastrinos. | III-A / III-B | 4,50 – 4,85 MI 18-41-R; 6,00 – 6,35 TP | 4,85 – 5,25 | 12-36-R N = Rzo | | 5,40; 96% |
| 7,10 | Areniscas cementadas grisáceas. | | | | | | |
| 7,30 | Argilitas grisáceas con delgadas intercalaciones de areniscas, también grisáceas. | | 7,60 – 7,80 TP | | | | |
| 8,30 | | | | | | | 8,30 |

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PETICIONARIO: CINGRAL S.L.

Supervisión: Alfredo Zamora
Máquina: TECOINSA TP-60

**IGEOSUMA, S.L.**

## SONDEO EB-S1 (ESTACIÓN DE BOMBEO)

# III.- PERFILES LITOLÓGICOS DE LAS CALICATAS

# III.A.- BALSA ELEVADA 1

# CALICATA BE1-C1

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

| COORDENADAS |
|---|
| UTM (ETRS89) 30T |
| X = 705179 |
| Y = 4644784 |
| Z = 426 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,90 | 0,50 | | | Arcillas limosas con arenas, marrón ocres.<br>Con areas y rizocreciones blanquecinas (sulfatos) | NO SE DETECTA | Fácil | Buena | | II |
| 1,60 | 0,70 | □1,4 | | Limos con arcillas y arenas marrón claras a marrón grisáceas.<br>Con algunas áreas y eflorescencias blanquecinas (sulfatos).<br>Algo húmedas. | | Fácil | Buena | | |
| 2,90 | 1,30 | □2,0 | | Arcillas rígidas a argilitas, algo limosas, grisáceas a marrones. Con:<br>- Intercalacaciones de limos ocres y a base areniscas.<br>- Yesos en venas y nódulos. | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BE1-C2

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

| COORDENADAS |
|---|
| UTM (ETRS89) 30T |
| X = 705074 |
| Y = 4644768 |
| Z = 428 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,90 | 0,50 | □0,6 | | Gravas tamaño grueso a medio, subangulosas, de calizas; con abundante matriz de limos marrón claros.<br>Algún bolo (10 a 15 cm) | NO SE DETECTA | Fácil | Buena | | II |
| 1,80 | 0,90 | □1,2 | | Limos arcillosos con arenas marrón claros.<br>Con áreas y eflorescencias blanquecinas (sulfatos).<br>Algo húmedas. | | Fácil | Buena | | |
| 3,00 | 1,20 | □2,5 | | Arcillas rígidas a argilitas, algo limosas, grisáceas a marrones. Con:<br>- Yesos en venas y nódulos.<br>- Tapizados negros y rojizos (óxidos) en discontinuidades. | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

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Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BE1-C3

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705031
Y = 4644641
Z = 427,5

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,90 | 0,50 | □0,6 | | Gravas tamaño grueso a medio, subangulosas, de calizas; con abundante matriz de arcillas marrón claros. | NO SE DETECTA | Fácil | Buena | | II |
| 1,90 | 1,00 | □1,20 | | Limos arcillosos con arenas, marrón claro. | | Fácil | Buena | | |
| 2,30 | 0,40 | | | Gravas tamaño grueso a medio, subangulosas, de calizas; con abundante matriz de limos con arenas marrón claros. | | Fácil | Buena | | |
| 3,30 | 1,00 | □2,60 | | Arcillas rígidas a argilitas, grisáceas a marrones. Con:<br>- Yesos en venas y nódulos.<br>- Nivel de yeso alabastrino de 3,1 a 3,15 cm.<br>- Tapizados negros (óxidos) en discontinuidades. | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

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Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BE1-C4

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705127
Y = 4644621
Z = 425,5

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,80 | 0,40 | | | Gravas tamaño medio, subangulosas, de calizas; con abundante matriz de arcillas limosas marrón claras. | NO SE DETECTA | Fácil | Buena | | |
| 2,10 | 1,30 | | | Limos con arcillas y algo de arenas marrón claros, con eflorescencias blanquecinas (sulfatos).<br>Por debajo de 1,5 m son limos arenosos con arcillas, y aparece algún bolo de caliza. | | Fácil | Buena | | II |
| 2,60 | 0,50 | | | Gravas tamaño medio a grueso, subangulosas, de calizas; con abundante matriz de limos arenosos marrón claros. Con algún bolo. | | Fácil | Buena | | |
| 3,00 | 0,40 | | | Arcillas rígidas a argilitas, grisáceas a marrones. Con:<br>- Yesos en venas y nódulos.<br>- Tapizados negros (óxidos) en discontinuidades. | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

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Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# CALICATA BE1-C5

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673

Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705090
Y = 4644704
Z = 427

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,60 | 0,20 | | | Gravas tamaño medio a fino, subangulosas, de calizas; con abundante matriz de arcillas arenosas marrón claros. | NO SE DETECTA | Fácil | Buena | | II |
| 1,30 | 0,70 | | | Arcillas grisáceas con abundantes eflorescencias blanquecinas (sulfatos) | | Fácil | Buena | | |
| 2,50 | 1,20 | | | Arcillas rígidas a argilitas, algo limosas, grisáceas a marrones. Con:<br>- Yesos en venas y nódulos.<br>- Intercalaciones de areniscas cementadas (2-4 cm de espesor) y arenas limosas marrón amarillentas.<br>- Tapizados negros (óxidos) en discontinuidades. | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BE1-C6

EMPLAZAMIENTO: BALSA ELEVADA 1

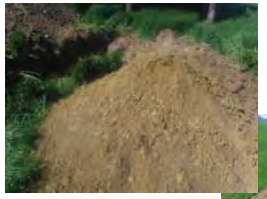
Referencia: 0673

Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705221
Y = 4644678
Z = 423

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,10 | 0,50 | | | Gravas tamaño medio, subangulosas, de calizas; con abundante matriz de limos marrón claros. Algún bolo (10 cm). | NO SE DETECTA | Fácil | Buena | | II |
| 1,80 | 0,70 | | | Arcillas grisáceas a marrones con yesos. Hasta 1,5 m algo húmedas y con áreas blanquecinas de yesos pulverulentos. Por debajo las arcillas algo más rígidas. | | Fácil | Buena | | III-A |
| 2,00 | 0,20 | | | Limos arcillosos marrón amarillentos con abundantes intercalaciones (mm) de arenas limosas coherentes y algo cementadas. | | Fácil | Buena | | |
| | | | | FIN CALICATA | | | | | |

DOCUMENTACIÓN FOTOGRÁFICA:



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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

# CALICATA BE1-C7

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673 | Fecha de realización: 3 de Mayo de 2021

COORDENADAS
UTM (ETRS89) 30T
X = 704925
Y = 4644573
Z = 427

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,90 | 0,60 | | | Gravas tamaño medio, subangulosas, de calizas; con abundante matriz de limos arenosos marrón claros. | NO SE DETECTA | Fácil | Buena | | II |
| 1,30 | 0,40 | | | Limos arcillosos con arenas marrón amarillentos y pequeños fragmentos de areniscas. | | Fácil | Buena | | |
| 1,70 | 0,40 | | | Arcillas marrón amarillentas finamente laminadas con delgadas intercalaciones de areniscas (< 1cm) y tapizados negros (óxidos) en discontinuidades. | | Fácil | Buena | | III-A |
| 2,50 | 0,80 | | | Argilitas-arcillas rígidas grisáceas a gris verdosas, laminadas, con tapizados de óxidos de hierro en discontinuidades. Por debajo de 2,1 m aparecen finas intercalaciones de areniscas (cm). | | Fácil | Buena | | III-B |
| | | | | FIN CALICATA | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

# CALICATA BE1-C8

EMPLAZAMIENTO: BALSA ELEVADA 1

Referencia: 0673 | Fecha de realización: 3 de Mayo de 2021

COORDENADAS
UTM (ETRS89) 30T
X = 704890
Y = 4644675
Z = 428

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 0,30 | | | Limos marrones con abundantes cantos heterométricos de calizas y porosidad vacuolar-radicular. | NO SE DETECTA | Fácil | Buena | | |
| 1,40 | 0,70 | | | Gravas tamaño medio a gruesa, subangulosas, de calizas; con abundante matriz de limos algo arenosos marrón claros. También algún bolo, más frecuentes a base. | | Fácil | Buena | | II |
| 2,80 | 1,40 | | | Arcillas grisáceas a marrón grisáceas, marrón amarillentas a base con: . áreas blanquecinas de sulfatos. . bandeados y delgadas intercalaciones (cm) de limos a arenas limosas, más frecuentes a base. . discontinuidades tapizadas de óxidos. . yesos dispersos o tapizando algunas discontinuidades. Más consistentes por debajo de 2,0 m. | | Fácil | Buena | | III-A / III-B |
| | | | | FIN CALICATA | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# III.B.- BALSA ELEVADA 2

**IGEOSUMA, S.L.**

# CALICATA BE2-C1

EMPLAZAMIENTO: BALSA ELEVADA 2

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

| COORDENADAS |
|---|
| UTM (ETRS89) 30T |
| X = 704152 |
| Y = 4644508 |
| Z = 444,5 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 0,40 | | | Limos arcillosos marrones con cantos de argilitas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,50 | 0,80 | 0,8 / 1,0 | | Arcillas rígidas a argilitas grisáceas a marrón grisáceas, con venas de yeso cristalino y tapizados negros (óxidos) en discontinuidades. | | Fácil | Buena | | III-A |
| 1,80 | 0,30 | | | Limolitas-Argilitas limosas marrón crema, con abundantes yesos cristalinos en venillas y también nódulos de yesos alabastrinos. | | Fácil | Buena | | III-B |
| 1,85 | 0,05 | | | Yeso alabastrino | | No excavable | | | |
| | | | | FIN CALICATA | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

# CALICATA BE2-C2

EMPLAZAMIENTO: BALSA ELEVADA 2

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

| COORDENADAS |
|---|
| UTM (ETRS89) 30T |
| X = 704124 |
| Y = 4644456 |
| Z = 446,5 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 0,30 | | | Arcillas marrón grisáceas con algunos cantos de yesos. | NO SE DETECTA | Fácil | Buena | | II |
| 1,50 | 0,80 | 1,1 / 1,4 | | Arcillas limosas marrón claras con abundantes yesos en forma de venillas y niveles lentejonares. | | Fácil | Buena | | III-A |
| 1,90 | 0,40 | | | Arcillas duras a argilitas gris verdosas con venillas de yesos cristalinos. | | Fácil | Buena | | III-B |
| | | | | Yeso alabastrino | | No excavable | | | |
| | | | | FIN CALICATA | | | | | |

DOCUMENTACIÓN FOTOGRÁFICA:

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BE2-C3

EMPLAZAMIENTO: BALSA ELEVADA 2

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 704155
Y = 4644386
Z = 445

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,10 | 2,60 | 1,5 | | Limos arcillosos marrón oscuros a techo y marrón claros por debajo de 1,1m.<br>Con abundantes áreas y rizocreciones blanquecinas (sulfatos).<br>A base con arenas finas. | NO SE DETECTA | Fácil | Buena | | II |
| 3,60 | 0,50 | 3,4 | | Limos arcillosos marrón amarillentos con porosidad vacuolar y radicular.<br>Aparecen raicillas. | | Fácil | Buena | | |
| 3,65 | 0,05 | | | Yeso alabastrino. | | No excavable | | | III-B |
| | | | | FIN CALICATA | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BE2-C4

EMPLAZAMIENTO: BALSA ELEVADA 2

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 704204
Y = 4644434
Z = 441

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,50 | 0,20 | | | Arcillas grisáceas y marrón grisáceas. | NO SE DETECTA | Fácil | Buena | | II |
| 2,00 | 1,50 | 0,8<br>1,0 | | Primeros 5 cm de yeso alabastrino, por debajo<br>Arcillas rígidas a argilitas grisáceas a marrón grisáceas, con venas de yeso cristalino.<br>Con tapizados negros (óxidos) en discontinuidades.<br>Con venillas de yesos e intercalaciones de margo calizas marrón crema (espesor < 2 cm) | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

DOCUMENTACIÓN FOTOGRÁFICA:






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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

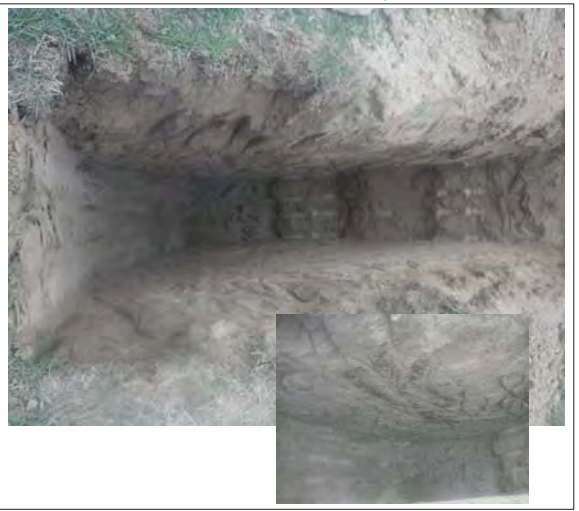
Máquina: KOMATSU WB 97 S

# IGEOSUMA, S.L.

| CALICATA BE2-C5 | EMPLAZAMIENTO: BALSA ELEVADA 2 | COORDENADAS |
|---|---|---|
| | | UTM (ETRS89) 30T |
| | | X = 704159 |
| | Referencia: 0673 / Fecha de realización: 16 de Febrero 2021 | Y = 4644440 |
| | | Z = 443,5 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,70 | 0,70 | | | Tierra de labor | NO SE DETECTA | Fácil<br>Fácil | Regular<br>Buena | | I |
| 1,60 | 0,90 | □1,0 | | Limos arcillosos marrón oscuros con abundantes áreas y rizocreciones blanquecinas (sulfatos). | | Fácil | Buena | | II |
| 2,00 | 0,40 | □1,8 | | Arcillas marrón claras con abundantes áreas blanquecinas (sulfatos). | | Fácil | Buena | | |
| 2,80 | 0,80 | □2,5 | | Arenas-limos con algo de arcilla, con abundantes fragmentos (mm) de arcillas-argilitas, asi como de yesos. | | Fácil | Buena | | |
| 3,30 | 0,50 | | | Arcillas rígidas-Argilitas gris verdosas a marrones con venillas y nódulos de yesos. A base nivel de 5cm de marga calcárea marrón con cristales de yeso. | | Fácil | Buena | | III-A |
| | | | | FIN CALICATA | | | | | |

DOCUMENTACIÓN FOTOGRÁFICA:



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|---|---|
| OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA) | Supervisión: Alfredo Zamora Rada |
| PETICIONARIO: CINGRAL, S.L. | Máquina: KOMATSU WB 97 S |

III.C.- BALSA PIE DE CANAL V4

# CALICATA BP-C1

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705741
Y = 4645179
Z = 388 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,60 | 1,10 | | | Limos con arcillas y arenas marrones. Con eflorescencias blanquecinas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,70 | 0,10 | | | Yesos alabastrinos nodulosos con arenas marrón amarillentas. Terc. Alterado. | | Fácil | Buena | | III-A |
| 1,90 | 0,20 | | | Arenas y arcillas con yesos. Terciario alterado. | | Fácil | Buena | | |
| 2,00 | 0,10 | | | Marga calcárea marrón clara con yeso alabastrino. | | Difícil | | | III-B |
| | | | | | | No excavable | | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C2

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705617
Y = 4645168
Z = 390 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,30 | 1,00 | 0,60 – 0,90 | | Limos con arcillas y arenas marrón claras. Con porosidad radicular y eflorescencias blanquecinas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,50 | 0,20 | | | Yesos alabastrinos nodulosos entre arenas yesíferas y pasadas de arcillas. Terc. alterado. | | Fácil | Buena | | |
| 1,90 | 0,40 | ⌀1,70 | | Arcillas rígidas a argilitas con alguna intercalación (< 1 cm) de arenas. Con yesos cristalinos en venillas, bandas y dispersos. | | Fácil | Buena | | III-A |
| 2,10 | 0,20 | | | Areniscas marrón grisáceas, cementadas y con intercalaciones de arcillas grisáceas con nivelillos-venillas de yesos cristalinos. | | Difícil | Buena | | III-B |
| | | | | | | No excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C3

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705616
Y = 4645074
Z = 390 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 1,10 | 0,50 | ▫1,00 | | Arcillas limosas marrones con algún canto de caliza. A techo 10 cm de una mezcla de gravas de calizas y yesos con arcillas. Están húmedas | | Fácil | Buena | | II |
| 1,70 | 0,60 | ▫1,50 | | Arcillas grisáceas y marrones con abundantes yesos cristalinos en nivelillos mm. También pasadas de arenas limosas con yesos. Terciario muy alterado. | | Fácil | Buena | | III-A |
| 1,90 | 0,20 | | | Yeso alabastrino y cristalino entre limos arenosos marrón anaranjados. | | Difícil | Buena | | III-B |
| | | | | | | No excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C4

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705724
Y = 4644891
Z = 388,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| | 2,70 | ▫1,00 | | Arcillas limosas marrón claras con eflorescencias blanquecinas (sulfatos). A 2,1 m muy húmedas-saturadas y blandas. En la base cantos de areniscas y yesos. | NA 2,4 | Fácil<br>Fácil | Buena<br>Mala por debajo de 2,1 m | | II |
| 3,10 | 0,05 | | | Yesos alabastrinos | | No Excavable | | | III |
| 3,15 | | | | | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C5

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705818
Y = 4644910
Z = 388 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 4,20 | 3,70 | 0,90 | | Arcillas limosas marrones. Húmedas.<br>Por debajo de 1,3 están muy húmedas.<br>Por debajo de 2,3 m saturadas y muy blandas. | NA<br>2,6 | Fácil<br>Fácil | Buena<br>Regular por debajo de 1,3 m y Mala por debajo de 2,3 | | II |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C6

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705760
Y = 4644977
Z = 387,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,50 | 3,10 | | | Arcillas limosas marrón con eflorescencias blanquecinas (sulfatos) y porosidad radicular en parte superior..<br>A 1,7 m muy húmedas-saturadas y blandas.<br>En la base cantos de calizas y de yesos. | NA<br>2,5 | Fácil<br>Fácil | Buena<br>Mala por debajo de 1,7 m | | II |
| 3,80 | 0,30 | | | Arcillas grisáceas con yesos cristalinos y alabastrinos. | | Fácil | | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C7

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705874
Y = 4645009
Z = 386 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,20 | 0,70 | | | Limos con arcillas, marrones.<br>Con porosidad radicular, vacuolar y eflorescencias-areas blanquecinas. | | Fácil | Buena | | II |
| 2,20 | 1,00 | | | Mezcla de gravas calizas (también de yesos) de tamaño medio y arcillas limosas marrones.<br>Muy húmedas a saturadas, y blandas por debajo de 1,5m. | NA 2,1 | Fácil | Buena Regular a Mala a base | | |
| 2,30 | 0,10 | | | Arcillas marrones muy húmedas con nivelillos (< 2 cm) de margo calizas marrones. | | Fácil | | | |
| 2,90 | 0,60 | | | Arcillas grisáceas con nivelillos y áreas de yesos cristalinos. Con discontinuidades tapizadas de óxidos de hierro. Húmedas.<br>Terciario alterado | | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C8

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705777
Y = 4645061
Z = 387,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,80 | 1,30 | | | Limos marrón claros con arcillas a base limos arenosos y algún canto de yeso.<br>En la base aparecen muy húmedos a saturados y blandas | NA (1) 1,5-1,8 | Fácil | Buena | | II |
| 2,60 | 0,80 | | | Arcillas grisáceas con venillas y áreas de yesos cristalinos.<br>Lateralmente aparecen algo menos profundos y con un nivel de yeso alabastrino de 20 a 30 cm.<br>Las discontinuidades tienen humedad-agua. | | Fácil | Buena | | III |

NA (1).- Rezume

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# CALICATA BP-C9

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705784
Y = 4645141
Z = 387 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 1,20 | 0,70 | | | Limos con arcillas y arenas, marrones. Por debajo de 0,9 son grisáceos y más arenosos. Con rizocreciones y eflorescencias blanquecinas. | | Fácil | Buena | | II |
| 1,60 | 0,40 | | | Arcillas grisáceas y marrones con abundantes yesos cristalinos en nivelillos mm y también dispersos. Terciario alterado. | | Fácil | Buena | | III-A |
| 1,90 | 0,30 | | | Areniscas-limolitas grisáceas, cementadas. Finamente estratificadas, con interestratos de arcillas-argilitas grisáceas. | | Difícil | Buena | | III-B |
| | | | | | | No excavable | | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C10

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705705
Y = 4645111
Z = 388,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 1,30 | 0,80 | 0,70 | | Limos con arenas y arcillas marrones, por debajo de 0,9 m son grisáceas. Con eflorescencias blanquecinas y algún canto de caliza. | | Fácil | Buena | | II |
| 1,80 | 0,50 | | | Arcillas grisáceas y marrones con abundantes yesos cristalinos en nivelillos mm y también dispersos. Terciario muy alterado. | | Fácil | Buena | | III-A |
| 1,90 | 0,10 | | | Yeso alabastrino y cristalino entre limos arenosos marrón anaranjados. | | Difícil | | | III-B |
| | | | | | | No excavable | | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C11

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705871
Y = 4645193
Z = 384,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,50 | 0,50 | | | Limos arenosos con arcillas, marrones.<br>Con porosidad radicular, vacuolar y eflorescencias blanquecinas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,00 | 1,00 | | | Arcillas grisáceas con abundantes yesos cristalinos en nivelillos mm y también dispersos.<br>Por debajo de 1,3 m son menos frecuentes los yesos y aparecen bandeados marrones anaranjados. | | Fácil | Buena | | III-A |
| 2,00 | | | | | | | | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C12

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 706076
Y = 4645186
Z = 383 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,50 | 0,80 | | | Arcillas limosas marrones, húmedas. A la base muy húmedas y blandas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,30 | 0,50 | | | Arcillas grisáceas y marrones con yesos cristalinos en nivelillos mm.<br>Húmedos<br>Terciario muy alterado. | | Fácil | Buena | | III |
| 2,00 | 0,50 | | | Arcillas-argilitas grisáceas con intercalaciones de areniscas marrones (estratos de < 2 a 4 cm) más frecuentes a base. | | Fácil<br>Regular a base | Buena | | |
| 2,50 | | | | | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

# CALICATA BP-C13

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705849
Y = 4645109
Z = 385,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Suelo vegetal. | NO SE DETECTA | Fácil | Regular | | I |
| 0,90 | 0,50 | | | Arcillas grisáceas con yesos. | | Fácil | Buena | | III-A |
| 1,10 | 0,20 | | | Calizas marrones finamente estratificadas con interestratos arcillosos. Superficies de discontinuidad con agua. | | Fácil | Buena | | III-B |
| | | | | Yesos alabastrinos | | No excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

# CALICATA BP-C14

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705995
Y = 4645177
Z = 383 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,90 | 1,30 | | | Limos arcillosos a arcillas limosas marrones. Con eflorescencias blanquecinas (sulfatos). A base más arenosas. Por debajo de 1,1 m muy húmedas y blandas. | NA 1,7 | Fácil | Buena<br>Regular por debajo de 1,1 m | | II |
| 2,50 | 0,60 | | | Arcillas grisáceas con pasadas de arenas, humedas.Con yesos cristalinos. | | Fácil | Buena | | |
| 2,80 | 0,30 | | | Alternancias de margocalizas marrones (estratos < 2 cm) y arcillas marrones muy húmedas. | NA 2,8 | Fácil | Buena | | III |
| 3,10 | 0,30 | | | Arcillas grisáceas y marrones, húmedas, con yesos cristalinos en venillas, bandas y nódulos. Por debajo de 3,0 m más rígidas y menos húmedas. En superficies de discontinuidad algo de agua. | | Fácil | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# CALICATA BP-C15

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705989
Y = 4645124
Z = 383,3 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,20 | 0,60 | | | Limos arcillosos marrones. Con eflorescencias blanquecinas (sulfatos). | | Fácil | Buena | | II |
| 1,70 | 0,50 | | | Arcillas marrones muy húmedas con delgadas intercalaciones de margocalizas (estratos < 2 cm) | NA 1,7 | Fácil | Buena | | III |
| 1,90 | 0,20 | | | Margocalizas marrones con interestratos de arcillas saturadas. | | Fácil | Buena | | |
| 2,00 | 0,10 | | | Yeso alabastrino | | Difícil No Excavable | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C16

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705886
Y = 4645080
Z = 385 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,20 | 0,60 | | | Arcillas limosas marrón anaranjadas con algunos cantos de calizas y yesos. A base con arenas y algo húmedas. | REZUME LENTO DESDE NIVEL III | Fácil | Buena | | II |
| 2,90 | 1,70 | | | Arcillas rígidas a argilitas grisáceas con: . Yesos cristalinos en venillas y en nódulos. . Por debajo de 2,5 m intercalaciones de calizas margosas marrones, en estratos de < 4 cm. | NA 2,9 | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C17

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705840
Y = 4645050
Z = 386 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,80 | 2,30 | | | Arcillas limosas a limos arcillosos marrones.<br>. Por debajo de 1,3 m con arenas y algunos cantos, más abundantes a base.<br>. Por debajo de 1,6 m muy húmedos-saturados y blandos. | NA 2,45 | Fácil | Buena<br>Mala Por debajo de 1,8 m | | II |
| 3,30 | 0,50 | | | Arcillas grisáceas a marrones, más rígidas a base con algunos yesos. | | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C18

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705800
Y = 4645028
Z = 387 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,50 | 1,00 | | | Arcillas limosas marrones, por debajo de 1,1 m son arenosas y grisáceas. Con:<br>. Eflorescensias y áreas blanquecinas (sulfatos).<br>. A techo 20 cm de una mezcla de arcillas y cantos de tamaño medio, subangulosos y de calizas. | REZUME LENTO DESDE NIVEL III | Fácil | Buena | | II |
| 3,10 | 1,60 | | | Arcillas grisáceas a marrones, por debajo de 2,1 m algo más rígidas.<br>. Con yesos cristalinos en venillas, en bandas y nódulos.<br>. Con intercalaciones centimétricas de areniscas coherentes pero no cementadas.<br>. La parte superior muy húmeda y humedad-agua en superficies de discontinuidad (a base). | NA 3,00 | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C19

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705742
Y = 4645010
Z = 387,7 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,50 | 2,00 | | | Arcillas limosas a limos arcillosos marrones algo arenosas a base. Con:<br>. Áreas blanquecinas de sulfatos.<br>. Algún canto de yeso y caliza por debajo de 1,6 m<br>Por debajo de 2,0 m muy húmedos y blandos. | NA | Fácil | Buena<br>Regular Por debajo de 2,0 m | | II |
| 2,80 | 0,30 | | | Arcillas grisáceas a marrones, muy húmedas con intercalaciones de margocalizas (estratos < 2 cm). | 2,7 | Fácil | Regular | | III |
| 2,90 | 0,10 | | | Yeso alabastrino | | Regular | Buena | | |
| 3,20 | 0,30 | | | Alternancia de arcillas marrones muy húmedas y margocalizas (estratos cm).<br>Superficies de estratificación húmedas o con agua. | | Fácil | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C20

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705682
Y = 4644954
Z = 389 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,00 | 1,40 | | | Limos arcillosos a arcillas limosas marrones. Con eflorescencias blanquecinas (sulfatos). A base más arenosas.<br>Por debajo de 1,4 m húmedas y blandas. | NO SE DETECTA | Fácil | Buena<br>Regular por debajo de 1,4 m | | II |
| 3,20 | 1,20 | | | Arcillas grisáceas y marrones, húmedas, con yesos cristalinos en venillas, bandas y nódulos. Por debajo de 2,6 m más rígidas y menos húmedas.<br>En superficies de discontinuidad algo de agua. | | Fácil | Buena | | III |
| | | | | Yeso alabastrino | | No Excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C21

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705661
Y = 4644959
Z = 389 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | REZUME LENTO DESDE NIVEL II y III | Fácil | Regular | | I |
| 2,20 | 1,70 | | | Limos arcillosos a arcillas limosas marrones. Con eflorescencias blanquecinas (sulfatos) y algún canto de caliza. Por debajo de 1,6 m muy húmedas y blandas. | | Fácil | Buena<br>Regular por debajo de 1,6 m | | II |
| 2,50 | 0,30 | | | Arcillas grisáceas muy húmedas. Sustrato muy alterado. | | Fácil | Buena | | |
| 3,30 | 0,80 | | | Arcillas grisáceas y marrones, húmedas, con yesos cristalinos en venillas, bandas y nódulos. Por debajo de 3,0 m más rígidas y menos húmedas. En superficies de discontinuidad algo de agua. | NA 3,3 | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C22

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673

Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705704
Y = 4644992
Z = 388,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,30 | 2,80 | | | Limos arcillosos a arcillas limosas marrones, más arenosos a base. Con algunos cantos calizos. Por debajo de 1,6 muy húmedas a saturadas y blandas. | NA 2,80 | Fácil<br>Fácil | Buena<br>Regular a Mala por debajo de 2,1 m | | II |
| 3,70 | 0,40 | | | Gravas gruesas con algún bolo (cantos subangulosos y de calizas) y abundante matriz de arenas arcillosas marrones. | | Fácil | Regular | | |
| 4,00 | 0,30 | | | Arcillas grisáceas con yesos | | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C23

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705728
Y = 4645026
Z = 388 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 1,30 | 0,70 | | | Limos arcillosos a arcillas limosas marrones. Con eflorescencias blanquecinas (sulfatos). Entre 0,9 y 1,0 m nivel con abundantes cantos calizos | | Fácil | Buena | | II |
| 1,70 | 0,65 | | | Yesos alabastrinos con interestratos arcillosos. | | Regular | Buena | | III |
| 1,85 | 0,40 | | | Arcillas marrones muy húmedas con yesos cristalinos. | | Fácil | Buena | | |
| | | | | Yeso alabastrino | | No Excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C24

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705773
Y = 4645041
Z = 387,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,80 | 0,30 | | | Mezcla de limos marrones y gravas de tamaño medio, subangulosas y de calizas. Húmedos. | | Fácil | Buena | | II |
| 1,10 | 0,30 | | | Arcillas limosas marrones. | | Fácil | Buena | | |
| 1,75 | 0,65 | | | Yesos alabastrinos con una intercalación de arcillas marrón claras, muy húmedas entre 1,4 y 1,6 m. | NA 1,75 | Regular | Buena | | III |
| 2,15 | 0,40 | | | Margo calizas marrones (finamente estratificadas) con interestratos de arcillas muy húmedas, Agua en las superficies de estratificación. | | Fácil | Buena | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BP-C25

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705828
Y = 4645074
Z = 386,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,60 | 0,60 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,00 | 1,40 | | | Limos arcillosos con algo de arena marrones. Con:<br>. Eflorescensias y áreas blanquecinas (sulfatos).<br>. Por debajo de 1,4 m muy húmedas-saturadas y blandas. | | Fácil | Buena<br>Mala Por debajo de 1,4 m | | II |
| 3,10 | 1,60 | | | Arcillas grisáceas a marrones, por debajo de 2,7 m algo más rígidas.<br>. Con yesos cristalinos en bandas y nódulos.<br>. A base intercalaciones de calizas (estratos cm)<br>. A 2,7 m aparece un nivel de agua. | NA 2,38 | Fácil | Buena | | III |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BP-C26

EMPLAZAMIENTO: BALSA PIE DE CANAL

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705929
Y = 4645115
Z = 384,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,45 | 0,45 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 1,10 | 0,65 | | | Arcillas limosas grisáceas y marrones, con yesos.<br>A base intercalaciones de margo calizas marrones | | Fácil | Buena | | III |
| 1,40 | 0,30 | | | Argilitas grisáceas rígidas. | | Fácil | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# IGEOSUMA, S.L.

| CALICATA BP-C27 | EMPLAZAMIENTO: BALSA PIE DE CANAL | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | | X = 705769 |
| | | Y = 4645088 |
| | Referencia: 0673 — Fecha de realización: 18 de Marzo 2021 | Z = 387 (de plano) |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | REZUME LENTO DESDE NIVEL III | Fácil | Regular | | I |
| 0,65 | 0,25 | | | Yeso alabastrino, lateralmente se acuña. | | Regular | Buena | | |
| 1,00 | 0,35 | | | Arcillas limosas marrones húmedas | | Fácil | Buena | | III-A |
| 1,10 | 0,10 | | | Yeso alabastrino | NA | Regular | Buena | | |
| 1,35 | 0,25 | | | Arcillas rígidas marrones con zonas alteradas y muy húmedas. Agua en estratificación. | 1,35 | Fácil | Buena | | |
| | | | | Yeso alabastrino | | No Excavable | | | III-B |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# III.D.- BALSA PIE DE CANAL V10

# CALICATA BPV10-C1

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705661
Y = 4645275
Z = 389 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Suelo vegetal | NO SE DETECTA | Fácil | Regular | | I |
| 2,30 | 1,80 | 0,80<br>1,50 | | Limos arcillosos a arcillas limosas marrones. Con rizocreciones y áreas blanquecinas de sulfatos.<br>Por debajo de 2,0 m con arenas y cristales de yesos. | | Fácil | Buena | | II |
| 2,40 | 0,10 | | | Yesos alabastrinos | | Difícil<br>No Excavable | | | III-B |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BPV10-C2

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705845
Y = 4645478
Z = 387 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,20 | 0,20 | | | Suelo vegetal | NO SE DETECTA | Fácil | Regular | | I |
| 0,40 | 0,20 | | | Margo calizas marrones (estratos de < 2 cm) e interestratos de arcillas marrones. | | Fácil | Buena | | III-A |
| 0,60 | 0,20 | | | Yesos alabastrinos | | Regular | Buena | | |
| 1,20 | 0,60 | 1,00 | | Arcillas rígidas algo limosas, grisáceas con yesos y discontinuidades con tapizados de óxidos de hierro. | | Fácil | Buena | | |
| 1,35 | 0,15 | | | Calizas marrones finamente estratificadas (estratos < 3 cm) | | Regular | Buena | | III-B |
| | | | | Yesos alabastrinos | | No Excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BPV10-C3

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705768
Y = 4645376
Z = 387,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,45 | 1,95 | ▫1,40 | | Limos arcillosos con arenas, marrones. Con:<br>. área y rizocreciones blanquecinas (sulfatos).<br>. porosidad radicular. | NO SE DETECTA | Fácil | Buena | | II |
| 3,90 | 1,45 | | | Arcillas limosas marrones , a base húmedas y algo blandas. | | Fácil | Buena | | |
| 4,70 | 0,80 | | | Arcillas grisáceas, húmedas, con yesos. Por debajo de 4,3 m más rigidas.<br>Con intercalaciones de limos arenosos.<br>En las discontinuidades algo de humedad. | | Fácil | Buena | | III-A |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BPV10-C4

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705708
Y = 4645473
Z = 390 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Suelo vegetal | | Fácil | Regular | | I |
| 0,90 | 0,50 | | | Limos arenosos marrón amarillentos con cantos de calizas y de yesos. | NO SE DETECTA | Fácil | Buena | | II |
| 1,40 | 0,50 | | | Yesos alabastrinos y cristalinos con interestratos de arcillas con yesos | | Regular | Buena | | |
| 1,70 | 0,30 | | | Arenas arcillosas con abundantes yesos. | | Fácil | Buena | | III-B |
| 2,00 | 0,30 | | | Yesos alabastrinos y cristalinos entre arcillas grisáceas con yesos. | | Regular | Buena | | |
| 2,50 | 0,50 | | | Arcillas rígidas, grisáceas a marrones con yesos y algo húmedas. | | Fácil | Buena | | |
| | | | | Yesos alabastrinos | | No Excavable | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# III.E.- RED DE RIEGO

# CALICATA RR-C1

EMPLAZAMIENTO: RED DE RIEGO

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 706722
Y = 4643839

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 0,80 | 0,40 | | | Limos con arcillas y arenas, marrón amarillentos. | | Fácil | Buena | | II |
| 1,60 | 0,80 | 1,00 / 1,20 | | Arcillas grisáceas con bandeados marrones. Por debajo de 1,0 m son rígidas a duras.<br>Con con nivelillos y tapizados de yesos cristalinos.<br>Por debajo de 1,2 m con intercalaciones centimétricas de areniscas. | | Fácil | Buena | | III-A<br>III-B |

DOCUMENTACIÓN FOTOGRÁFICA:

# CALICATA RR-C3

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 706873
Y = 4644518

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,40 | 2,90 | | | Arcillas limosas marrón claras, húmedas, con áreas y eflorescencias blanquecinas de sulfatos.<br>Por debajo de 1,8 m con arenas y algún canto de caliza y arenisca.<br>Por debajo de 2,0 m muy húmedas y blandas; y por debajo de 2,7 m saturadas y muy blandas. | NA 2,7 | Fácil<br>Fácil | Buena<br>Mala por debajo de 2,0 m | | II |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C4

EMPLAZAMIENTO: RED DE RIEGO

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705984
Y = 4645007

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,90 | 1,40 | ▫1,00 | | Arcillas algo arenosas, marrones y húmedas.<br>Con algunos cantos de calizas y yesos a base. | | Fácil | Buena a base Regular | | II |
| 2,50 | 0,60 | | | Arenas arcillosas marrones con gravas heterométricas a base.<br>Saturadas y blandas. | NA 2,3 | Fácil | Mala | | |
| 3,40 | 0,90 | | | Arcillas marrones y grisáceas, con áreas y nivelillos de yesos cristalinos.<br>A base con algunas intercalaciones centimétricas de areniscas.<br>Están húmedas. | | Fácil | Buena | | III-A |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# CALICATA RR-C5

EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA A-1211

Referencia: 0673

Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X =706319
Y = 4645833

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,90 | 2,40 | 0,80 | | Arcillas limosas grisáceas a marrón grisáceas, con áreas y eflorescencias blanquecinas de sulfatos. Húmedas.<br>Por debajo de 1,2 m muy húmedas a saturadas y blandas. | NA 1,7 | Fácil<br>Fácil | Buena<br>Mala por debajo de 1,2 m | | II |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C6

EMPLAZAMIENTO: RED DE RIEGO. CRUCE FFCC

Referencia: 0673

Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 706447
Y = 4646804

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,20 | 2,70 | 1,00 | | Arcillas limosas marrón ocres. Húmedas.<br>Por debajo de 1,3 m muy húmedas y blandas. Por debajo de 1,9 m saturadas y muy blandas. | NA 1,3 | Fácil<br>Fácil | Buena<br>Mala por debajo de 1,5 m | | II |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA RR-C7 | EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA A-1211 | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 18 de Febrero 2021 | X = 705745<br>Y = 4647570 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,70 | 0,70 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,20 | 1,50 | | | Arcillas limosas grisáceas a marrón grisáceas, con áreas y eflorescencias blanquecinas de sulfatos. Húmedas.<br>Por debajo de 1,4 m muy húmedas a saturadas y blandas. | NA 1,7 | Fácil<br>Fácil | Buena<br>Mala por debajo de 1,4 m | | II |
| 2,70 | 0,50 | | | Mezcla de gravas finas a medias, subangulosas, calcáreas y arcillas marrón claras, saturadas a muy húmedas. | | Fácil | Mala | | |
| 3,00 | 0,30 | | | Arcillas grisáceas con yesos. | | Fácil | Buena | | III-A |
| | | | | Areniscas | | Regular | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA RR-C8 | EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA A-1211 | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 17 de Febrero 2021 | X = 706908<br>Y = 4644852 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,35 | 0,35 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,60 | 0,25 | | | Arcillas arenosas grisáceas y marrones húmedas. | | Fácil | Buena | | II |
| 1,20 | 0,60 | 0,80 | | Arcillas grisáceas con bandeados marrones, y áreas con yesos cristalinos. Húmedas<br>Sustrato Terciario intensamente alterado. | | Fácil | Buena | | III-A |
| 1,70 | 0,50 | 1,50 | | Arcillas rígidas grisáceas a marrones, con nivelillos de yesos cristalinos. | NA 1,7 | Fácil | Buena | | III-B |
| 1,90 | 0,20 | | | Arcillas margosas marrones (estratos cm) entre arcillas grisáceas muy húmedas. | | Fácil | Buena | | |
| | | | | Yesos alabastrinos | | No Excavable | | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA RR-C9

EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA TORRALBA A FRULA.

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 707471
Y = 4644940

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,80 | 0,40 | | | Arcillas grisáceas con bandeados marrones y áreas-nivelillos de yesos cristalinos. Húmedas. Sustrato Terciario intensamente alterado. | | Fácil | Buena | | III-A |
| 0,90 | 0,10 | | | Margo caliza marrón amarillenta (en estratos de < =1cm) con interestratos arcillosos grises. | NA | Fácil | Buena | | III-B |
| 1,05 | 0,15 | | | Yeso alabastrino-cristalino | 1,05 | Regular(1) | Buena | | |
| 1,20 | 0,15 | | | Arcillas grisáceas y marrones muy húmedas y alteradas. | | Fácil | Buena | | |
| | | | | Yesos alabastrinos-cristalinos. | | No Excavable | | | |

(1) Los yesos se arrancan

El agua aparece bajo el primer nivel de yeso. Es de escasa magnitud.

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C10

EMPLAZAMIENTO: RED DE RIEGO. CRUCE FFCC

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 707599
Y = 4645960

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,20 | 0,20 | | | Relleno de arcillas con cantos y algunos cascotes. | | Fácil | Regular | | I |
| 0,60 | 0,40 | 0,50 | | Argilitas limosas marrones con intercalaciones de areniscas grisáceas fuertemente trabadas (estratos < 2-3cm) | | Fácil | Buena | | III-A |
| 1,20 | 0,60 | 1,00 | | Areniscas y limolitas marrón grisáceas a marrón amarillentas, fuertemente trabadas y algo cementadas. | NO SE DETECTA | Mala (1) | Buena | | III-B |
| 2,30 | 1,10 | 1,50 | | Argilitas grisáceas con áreas violáceas, y algunna intercalación de arenisca (de 2,1 a 2,2 m) | | Fácil a Regular | Buena | | |

(1) Se arranca

DOCUMENTACIÓN FOTOGRÁFICA:

OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA RR-C11

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 707133
Y = 4647505

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 0,60 | 0,30 | | | Arcillas marrón rojizas y grisáceas. | | Fácil | Buena | | II |
| 0,90 | 0,30 | | | Arcillas rígidas marrones con intercalaciones de arenas coherentes marrón grisáceas. | | Fácil | Buena | | III-A |
| 1,80 | 0,90 | | | Argilitas marrón rojizas con decoloraciones gris verdosas y algón nódulo de yeso. Con intercalaciones de areniscas fuertemente trabadas pero no cementadas, marrón grisáceas (con espesores de hasta 10 cm). | | Fácil | Buena | | III-B |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C12

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 707184
Y = 4648518

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | NO SE DETECTA | Fácil | Regular | | I |
| 0,60 | 0,20 | | | Arcillas marrón rojizas y grisáceas. | | Fácil | Buena | | II |
| 1,40 | 0,80 | 1,00 | | Arcillas rojizas , por debajo de 1,0 m son arcillas limosas marrón amarillentas y en la base son limos-arenas arcillosas. Presentan una delgada intercalación de yeso alabastrino, entre 0,8 y 0,85 m. | | Fácil | Buena | | III-A |
| 1,55 | 0,15 | | | Argilitas rojizas | | Fácil | Buena | | III-B |
| 1,80 | 0,25 | | | Areniscas grisáceas | | Regular a Mala (1) | Buena | | |
| 2,10 | 0,30 | | | Argilitas rojizas a marrón anaranjadas y gris verdosas a base. | | Fácil | Buena | | |

(1) Se arranca

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# IGEOSUMA, S.L.

| CALICATA RR-C13 | EMPLAZAMIENTO: RED DE RIEGO. | COORDENADAS |
|---|---|---|
| | | UTM (ETRS89) 30T |
| | | X = 708826 |
| | Referencia: 0673 / Fecha de realización: 17 de Febrero 2021 | Y = 4645177 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,20 | 1,80 | | | Limos arcillosos marrón anaranjados.<br>Por debajo de 1,1 m muy húmedos y blandos. Por debajo de 1,4 m, saturados y muy blandos. | NA 1,4 | Fácil<br>Fácil | Buena<br>Mala por debajo de 1,2 m | | II |
| 2,40 | 0,20 | | | Arcillas grisáceas y rojizas, húmedas. | | Fácil | Buena | | III-A |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA RR-C14

EMPLAZAMIENTO: RED DE RIEGO

Referencia: 0673 | Fecha de realización: 16 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 710449
Y = 4645457

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,90 | 0,40 | 0,70 | | Gravas finas a medias, subangulosas, calcáreas. Con abundante matriz de de arcillas con arenas-limos marrones, muy húmedas. | | Fácil | Buena | | II |
| 1,40 | 0,50 | 1,20 | | Arcillas marrón amarillentas, con bandeados grisáceos. Húmedas. Sustrato terciario intensamente alterado. | | Fácil | Buena | | III-A |
| 1,80 | 0,40 | | | Arcillas rígidas versicolores (marrón rojizas y grisáceas) con zonas más alteradas y húmedas. | NA 1,7 | Fácil | Buena | | |
| 2,00 | 0,20 | | | Arenisca marrón grisácea. | | Regular(2) | Buena | | III-B |
| 2,40 | 0,40 | 2,40 | | Argilitas marrón rojizas-anaranjadas cor decoloraciones grisáceas y verdosas. Algo de agua en las discontinuidades. | | Fácil | Buena | | |

(1) El nivel de agua se detecta dentro del sustrato Terciario y se manifiesta como un flujo escaso (rezume).

(2) Se arranca.

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C15

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 711637
Y = 4645924

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,90 | 0,50 | 0,60 | | Limos a arenas muy finas arcillosas, marrón amarillentas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,20 | 0,30 | 1,00 | | Areniscas marrón amarillentas a marrón grisáceas. | | Regular(1) | Buena | | |
| 2,10 | 0,90 | 1,50 – 2,00 | | Argilitas marrón rojizas-anaranjadas con decoloraciones gris-verdosas, e intercalaciones de areniscas gris-azuladas. | | Fácil | Buena | | III-B |

(1) Se arranca.

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA RR-C16 | EMPLAZAMIENTO: RED DE RIEGO. | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 17 de Febrero 2021 | X = 712522<br>Y = 4644988 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,70 | 0,70 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,00 | 0,30 | | | Limos arenosos marrón amarillentos. | | Fácil | Buena | | II |
| 2,30 | 1,30 | | | Arcillas a argilitas algo limosas marrones con decoloraciones gris-verdosas, por debajo de 1,5 m son anaranjadas a marrón rojizas. | | Fácil | Buena | | III-A<br>III-B |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA RR-C17 | EMPLAZAMIENTO: RED DE RIEGO. | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 18 de Febrero 2021 | X =711123<br>Y = 4647970 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,10 | 2,60 | | | Arcillas limosas con algo de arena, grisáceas y marrones con áreas blanquecinas de sulfatos y también yesos cristalinos dispersos.<br>Por debajo de 1,1 m muy húmedas y blandos. Por debajo de 1,4 m saturados y muy blandos.<br>Por debajo de 2,3 m menos húmedos y algo más compactos.<br>El nivel de agua es de poca entidad, se trata de un rezume. | NA<br>1,7 | Fácil<br>Fácil | Buena<br>Regular a Mala por debajo de 1,4 m y hasta 2,3 m<br>Regular a Buena por debajo de 2,3 m | | II |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# CALICATA RR-C18

EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA A TORRE DE BARBUÉS

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 709485
Y = 4646526

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,45 | 0,15 | | | Arenisca grisácea cementada. | | Mala (1) | Regular(2) | | |
| 1,50 | 1,05 | | | Arcillas rígidas a arcillas rojizas con decoloraciones verdosas.<br>Con nivelillos de yesos cristalinos.<br>Con zonas más alteradas y húmedas y algo de agua en superficies de discontinuidad. | NO SE DETECTA | Fácil | Buena | | III-A |
| 1,90 | 0,30 | | | Areniscas marrones a grisáceas, trabadas pero no cementadas y algo húmedas. | | Regular | Buena | | III-B |
| 2,30 | 0,40 | | | Arcillas rojizas y verdosas con nivelillos de yesos cristalinos.<br>Algo de agua en superficies de discontinuidad. | | Fácil | Buena | | |

(1) Se arranca
(2) Inestabilidad por efecto del arranque, al quedar bloques sueltos.

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C19

EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA A TORRE DE BARBUÉS

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 710324
Y = 4646269

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,80 | 0,40 | □0,60 | | Mezcla de gravas finas a medias, subangulosas con arcillas arenosas marrones.<br>Húmedas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,20 | 0,40 | □1,00 | | Limos arcillosos marrón amarillentos con cristales de yesos dispersos. | | Fácil | Buena | | |
| 1,60 | 0,40 | □1,40 | | Arcillas rígidas marrones anaranjadas a rojizas, con intercalaciones de areniscas coherentes pero no cementadas (estratos < 2 cm).<br>Con nivelillos de yesos cristalinos, y algo de agua en las discontinuidades. | | Fácil | Buena | | III-A |
| 1,90 | 0,30 | □1,80 | | Areniscas marrones a grisáceas. | | Regular | Buena | | III-B |
| 2,30 | 0,40 | □2,00 | | Arcillas marrón claras a marrón amarillentas. | | Fácil | Buena | | |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA RR-C20

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 17 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 711309
Y = 4646546

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,80 | 0,30 | | | Arcillas limosas marrones muy húmedas. | NO SE DETECTA | Fácil | Buena | | II |
| 1,30 | 0,50 | | | Arcillas marrón rojizas con bandeados grisáceos. | | Fácil | Buena | | III-A |
| 1,80 | 0,50 | | | Arenisca marrón a gris azulada. Fuertemente trabada pero no cementada. | | Regular a mala (1) | Buena | | III-B |
| 2,20 | 0,40 | | | Argilitas rojizas a marrón rojizas. | | Fácil | Buena | | |

(1) Se arranca.

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C21

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 708823
Y = 4646998

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,10 | 0,70 | | | Arcillas rígidas a argilitas marrón anaranjadas a rojizas. | NO SE DETECTA | Fácil | Buena | | III-A |
| 1,30 | 0,20 | | | Arenisca grisácea fuertemente trabada y algo cementada. | | Mala (1) | Buena | | III-B |
| 1,60 | 0,30 | | | Argilitas a limolitas marrón rojizas con decoloraciones verdosas. | | Regular | Buena | | |
| 1,70 | 0,10 | | | Areniscas marrón amarillentas. | | Mala | | | |

(1) Se arranca

No Excavable

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA RR-C22 | EMPLAZAMIENTO: RED DE RIEGO. | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 18 de Febrero 2021 | X = 709210<br>Y = 4647955 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,60 | 0,20 | | | Mezcla de gravas medias, subangulosas con arcillas arenosas. Húmedas. | | Fácil | Buena | | II |
| 1,30 | 0,70 | 1,00 | | Arenas arcillosas marrones localmente gris azuladas, con algunos fragmentos de areniscas trabadas pero no cementadas. Muy húmedas a saturadas en la base. | NA 1,00 | Fácil | Regular a Mala a base | | |
| 2,00 | 0,70 | | | Areniscas marrones a gris azuladas, trabadas pero no cmentadas, más coherentes a base. | | Fácil a Regular a base | Buena | | III-A |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

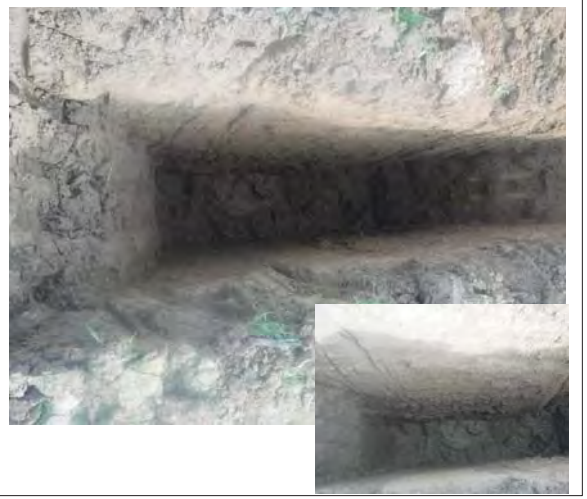
Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA RR-C23 | EMPLAZAMIENTO: RED DE RIEGO. | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 18 de Febrero 2021 | X = 707979<br>Y = 4648314 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,00 | 2,60 | 1,60 | | Limos con arcillas y arenas, con algunas hiladas de cantos y cantos dispersos (de tamaño fino, angulosos, calizos). Húmedos. Por debajo de 1,8 m muy húmedas y blandos. Por debajo de 2,1 m saturados y muy blandos. | NA 2,2 | Fácil / Fácil | Buena / Mala por debajo de 1,8 m | | II |

DOCUMENTACIÓN FOTOGRÁFICA:



OBRA: ESTUDIO GEOTECNICO PARA PROYECTO DE MODERNIZACÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)

PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA RR-C24

EMPLAZAMIENTO: RED DE RIEGO.

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 710119
Y = 4648704

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,30 | 0,30 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,60 | 1,30 | | | Arcillas marrones con rizocreciones y áreas blanquecinas de sulfatos, con restos de cañas y zonas con acumulaciones de materia orgánica de color negro. Las cañas llegan hasta 1,3 m de profundidad. Húmedas. Por debajo de 0,7 m muy húmedas-saturadas y blandas. | NA 0,8 | Fácil | Buena<br>Por debajo de 0,8 m Regular a Mala a base | | II |
| 2,80 | 1,20 | | | Arcillas grisáceas y marrones con áreas blanquecinas de sulfatos, asi como niveliillos de yeso cristalino. Muy húmedas. Sustrato Terciario intensamente alterado. | | Fácil | Buena | | III-A |

DOCUMENTACIÓN FOTOGRÁFICA:

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA RR-C25

EMPLAZAMIENTO: RED DE RIEGO. CRUCE CARRETERA A-1210

Referencia: 0673 | Fecha de realización: 18 de Febrero 2021

COORDENADAS
UTM (ETRS89) 30T
X = 710216
Y = 4647643

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular Buena | | I |
| 0,70 | 0,20 | | | Gravas finas a medias, subangulosas, de calizas y con abundante matriz de arcillas limosas. | | Fácil | Buena | | |
| 1,20 | 0,50 | | | Arcillas limosas marrones con áreas blanquecinas de sulfatos. | NA | Fácil | Buena | | II |
| 1,60 | 0,40 | | | Arenas limosas con arcillas marrón ocres. | 1,4 | Fácil | Regular-Buena | | |
| 2,00 | 0,40 | | | Arcillas marrones, con una intercalación de 1,7 a 1,8 m de areniscas coherentes y húmedas. | 1,7 | Fácil | Buena | | III-A |
| 2,50 | 0,50 | | | Areniscas trabadas pero no cementadas, ocres, gris azuladas y marrón amarillentas. | | Fácil a Regular | Buena | | III-B |
| 2,80 | 0,30 | | | Arcillas rojizas con decoloraciones grisáceas. | | Fácil | Buena | | |

El flujo de agua es poco intenso y se catalogarían como rezumes.

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# III.F.- BALSA PIE DE CANAL ALTERNATIVA 1 (DESCARTADA)

**IGEOSUMA, S.L.**

| CALICATA BPALT1-C1 | EMPLAZAMIENTO: BALSA PIE DE CANAL. ALTERNATIVA 1 | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 2 de Marzo 2021 | X = 706822<br>Y = 4643884 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 0,30 | | | Limos arcillosos marrones | NO SE DETECTA | Fácil | Buena | | II |
| 1,00 | 0,30 | | | Arcillas algo arenosas grisáceas, con cristales de yesos a techo nivel de arenisca cementada grisácea. | | Fácil | Buena | | |
| 2,10 | 1,10 | 1,00 – 1,50 | | Arcillas rígidas a argilitas grisáceas con yesos e interclaciones de arenas coherentes ( estratos de < 2 cm).<br>Entre 1,8 y 2,0 m intercalaciones de margocalizas anaranjadas (estratos < 1 cm). | | Fácil | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

| CALICATA BPALT1-C2 | EMPLAZAMIENTO: BALSA PIE DE CANAL. ALTERNATIVA 1 | COORDENADAS UTM (ETRS89) 30T |
|---|---|---|
| | Referencia: 0673 — Fecha de realización: 2 de Marzo 2021 | X = 706840<br>Y = 4644143 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 0,30 | | | Limos arcillosos marrones | NO SE DETECTA | Fácil | Buena | | II |
| 1,00 | 0,30 | | | Arcillas con cantos de calizas y bolos de yesos. | | Fácil | Buena | | |
| 1,70 | 0,70 | | | Arcillas arenosas marrones a grisáceas, con delgadas intercalaciones de arenas coherentes. | | Fácil | Buena | | III |
| 2,50 | 0,80 | | | Arcillas rígidas grisáceas con intercalaciones de areniscas y yesos cristalinas.<br>Entre 2,1 y 2,2 nivel de arenisca cementada. | | Fácil | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# IGEOSUMA, S.L.

| CALICATA BPALT1-C3 | EMPLAZAMIENTO: BALSA PIE DE CANAL. ALTERNATIVA 1 | COORDENADAS |
|---|---|---|
| | | UTM (ETRS89) 30T |
| | | X = 706664 |
| | Referencia: 0673 / Fecha de realización: 2 de Marzo 2021 | Y = 4644055 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 1,80 | 1,40 | | | Limos arcillosos marrones, con:<br>. Porosidad radicular y areas blanquecinas de sulfatos.<br>.cantos de callizas<br>Por debajo de 1,5 m, muy húmedas y algo blandas. | NO SE DETECTA | Fácil | Buena | | II |
| 2,10 | 0,30 | | | Mezcla de arcillas marrones y cantos de calizas subangulosos (tamaño medio a fino). Húmedas | | Fácil | Buena | | |
| 2,80 | 0,70 | | | Arcillas arenosas grisáceas, húmedas con yesos y algunas intercalaciones de arenas coherentes. | | Fácil | Buena | | III |
| 3,10 | 0,30 | | | Alternancia de arenas coherentes grisáceas y arcillas marrones-grisáceas. | | Fácil | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# III.G.- BALSA PIE DE CANAL ALTERNATIVA 2 (DESCARTADA)

# CALICATA BPALT2-C1

EMPLAZAMIENTO: BALSA PIE DE CANAL. ALTERNATIVA 2.

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 706864
Y = 46443720

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,40 | 2,00 | □1,50 | | Arcillas limosas a limos arcillosos marrones, a base son arenas arcillosas con gravillas y gravas finas. Con eflorescencias blanquecinas y porosidad radicular en la parte superior. | NO SE DETECTA | Fácil | Buena | | II |
| 2,70 | 0,30 | | | Yesos alabastrinos nodulares entre arcillas marrones. | | Regular a Difícil | Buena | | |
| 3,00 | 0,30 | | | Arcillas grisáceas y marrones laminadas con yesos e intercalaciones de margo calizas a base. | | Fácil | Buena | | III |

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Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BPALT2-C2

EMPLAZAMIENTO: BALSA PIE DE CANAL. ALTERNATIVA 2.

Referencia: 0673 | Fecha de realización: 2 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 706834
Y = 4643475

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 2,70 | 2,20 | | | Limos arcillosos con algo de arena, marrones, con:<br>. Porosidad radicular y areas blanquecinas de sulfatos.<br>. cantos disperso de calizas (tamaño medio).<br>A base más arenosos. | NO SE DETECTA | Fácil | Buena | | II |
| 3,00 | 0,30 | | | Arenas arcillosas con nódulos-cantos de yesos. | | Fácil | Buena | | |
| 3,30 | 0,30 | | | Yesos alabastrinos nodulares entre arcillas marrones y con alguna intercalación de margocaliza marrón (espesor < 1 cm) | | Difícil No Excavable | Buena | | III |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# IGEOSUMA, S.L.

| CALICATA BPALT2-C3 | EMPLAZAMIENTO: BALSA PIE DE CANAL. ALTERNATIVA 2. | COORDENADAS |
|---|---|---|
| | | UTM (ETRS89) 30T |
| | | X = 706627 |
| | Referencia: 0673 / Fecha de realización: 2 de Marzo 2021 | Y = 4643526 |

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| | 0,70 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 1,50 | | | Limos arcillosos marrones, con:<br>. Porosidad radicular y areas blanquecinas de sulfatos.<br>. Arenas por debajo de 1,3 m<br>. bolos dispersos a base | | Fácil | Buena | | II |
| 2,20 | 1,30 | | | Arcillas marrones, húmedas.<br>Por debajo de 3,0 muy húmedas-saturadas y blandas. | NA 3,25 | Fácil | Buena<br>Regular por debajo de 2,8 m | | |
| 3,50 | 0,40 | | | Arcillas grisáceas y marrones. | | Fácil | Buena | | III |
| 3,90 | | | | | | | | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# III.H.- BALSA PIE DE CANAL V7 (DESCARTADA)

**IGEOSUMA, S.L.**

# CALICATA BPV7-C1

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705756
Y = 4645591
Z = 388 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,40 | 0,40 | | | Tierra de labor | III | Fácil | Regular | | I |
| 1,20 | 0,80 | | | Arcillas limosas marrones con areas blanquecinas de sulfatos. Algo húmedas a base. | DESDE NIVEL | Fácil | Buena | | II |
| 1,50 | 0,30 | | | Arenisca grisácea y arcillas marrones con yesos, húmedas. | | Fácil | Buena | | III |
| 2,60 | 1,10 | 1,50 – 2,00 | | Arcillas marrones y grisáceas con yesos, más rígidas por debajo de 1,7 m. A 2,5-2,6 m zona alterada y más húmeda. Las superficies de discontinuidad húmedas o con algo de agua. | REZUME LENTO | Fácil | Buena | | |
| 2,75 | 0,15 | | | Caliza finamente estratificada (estratos < 2 cm) con interestratos arcillosos húmedos. | NA 2,75 | Difícil No Excavable | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

**IGEOSUMA, S.L.**

# CALICATA BPV7-C2

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705902
Y = 4645530
Z = 385 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,70 | 0,20 | | | Arenas limosas marrones. | | Fácil | Buena | | II |
| 1,80 | 1,10 | | | Arcillas grisáceas con bandeados marrones. Con: . tapizados de óxidos de hierro en discontinuidades . Yesos cristalinos en venillas y nódulos. . intercalaciones de arenas coherentes (estratos < 4 cm) base. | NO SE DETECTA | Fácil | Buena | | III |
| 2,00 | 0,20 | | | Areniscas coherentes y algo cementadas con venillas de yesos. | | Regular | Buena | | |
| 2,50 | 0,50 | | | Arcillas rígidas grisáceas con bandeados marrones. Con: . tapizados de óxidos de hierro en discontinuidades . Yesos cristalinos en venillas y nódulos. . intercalaciones de arenas coherentes | | Fácil | Buena | | |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada

Máquina: KOMATSU WB 97 S

# CALICATA BPV7-C3

EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705946
Y = 4645635
Z = 385 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 3,00 | 2,50 | | | Arcillas limosas con algún canto disperso y algo de arena.<br>Por debajo de 1,1 m muy húmedas y blandas. | NA<br>2,5 | Fácil | Buena<br>Regular a Mala Por debajo de 1,3 | | II |

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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

IGEOSUMA, S.L.

# CALICATA BPV7-C4

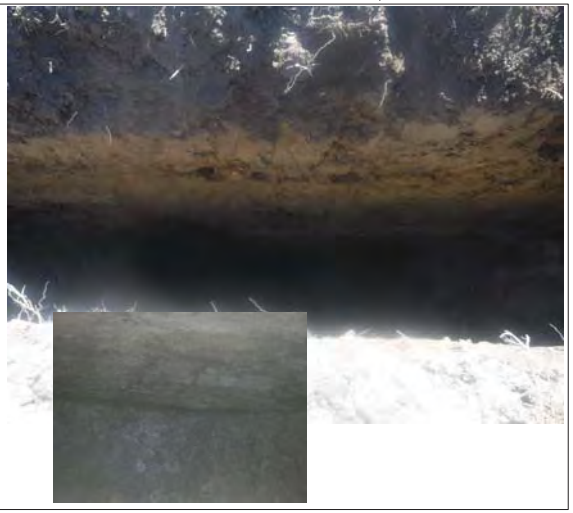
EMPLAZAMIENTO: BALSA PIE DE CANAL V10

Referencia: 0673 | Fecha de realización: 18 de Marzo 2021

COORDENADAS
UTM (ETRS89) 30T
X = 705837
Y = 4645763
Z = 388,5 (de plano)

| Profundidad (metros) | Espesor (m) | Muestras | Perfil litológico | DESCRIPCIÓN | Nivel Freático (metros) | Excavabilidad | Estabilidad | Ensayos de campo | NIVEL |
|---|---|---|---|---|---|---|---|---|---|
| 0,50 | 0,50 | | | Tierra de labor | | Fácil | Regular | | I |
| 0,80 | 0,30 | | | Arcillas marrones y grisáceas con fragmentos de calizas, muy húmedas y blandas. | | Fácil | Buena | | II |
| 1,40 | 0,60 | | | Arcillas grisáceas muy húmedas y blandas. Sustrato terciario intensamente alterado.<br>A techo 5 cm de calizas marrones. | | Fácil | Buena | | |
| 2,15 | 0,75 | | | Arcillas rígidas grisáceas con bandeados marrones y yesos.<br>Las superficies de discontinuidad húmedas o con algo de agua.<br>Entre 1,6 y 1,7 m intercalación de arenisca grisácea. | | Fácil | Buena | | III |
| 2,35 | 0,20 | | | Caliza finamente estratificada. En la estratificación agua. | | Fácil | Buena | | |
| 3,70 | 1,35 | | | Arcillas rígidas-argilitas grisáceas con bandeados marrones y yesos. Con:<br>. intercalaciones de arenas coherentes (estratos 3-4 cm)<br>. superficies de discontinuidad húmedas y con agua.<br>A 3,4 m intercalación de calizas<br>Rezume de agua a 3,4 m. | NA<br>3,5 | Fácil | Buena | | |

DOCUMENTACIÓN FOTOGRÁFICA:



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PETICIONARIO: CINGRAL, S.L.

Supervisión: Alfredo Zamora Rada
Máquina: KOMATSU WB 97 S

# IV.- ENSAYOS DE PENETRACIÓN DINÁMICA DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA TIPO DPSH.*

### Definición

El ensayo de penetración dinámica tipo DPSH (Prueba de Penetración dinámica super-pesada) está regulado por la norma UNE 103802:1998.

El ensayo continuo de penetración dinámica consiste en determinar la resistencia del terreno a la penetración de una puntaza maciza de hierro, situada en el extremo de una varilla, que se hinca en el terreno mediante el golpeo de una maza en caída libre. Este varillaje tiene un diámetro inferior al de la puntaza para evitar, en lo posible, el rozamiento del mismo con el suelo.

En el ensayo tipo DPSH la puntaza es cilíndrica, de base circular, con un área de 19,5 $cm^2$, una altura de 10 cm y terminada en un cono de altura 4 cm y ángulo de 90º en el vértice. El varillaje tiene un diámetro de 32 mm y la maza tiene un peso de 65 Kg. y se deja caer desde una altura de 75 cm.

La resistencia del terreno, a la penetración dinámica, se expresa por el número de golpes necesarios para clavar la varilla una longitud de 20 cm. Dicho número de golpes se designará, en lo sucesivo, por $N_{20}$.

En el equipo utilizado se dispone de martillo de seguridad, dispositivo que permite izar la maza y liberarla siempre a la misma altura, en caída libre por la guiadera, garantizando así la uniformidad en la energía de golpeo y en la frecuencia.

### Realización del ensayo

El ensayo se inicia clavando en el terreno la puntaza utilizada hasta alcanzar los primeros 10 cm. Una vez hincada la puntaza se coloca el anillo-guía en su posición definitiva en la base del equipo y se continúa la penetración, mediante los golpes necesarios para introducir cada una de las divisiones de 20 cm de las varillas.

La velocidad de golpeo de la maza se debe estimar en el intervalo de 15 a 30 golpes por minuto.

Se dará por finalizado el ensayo cuando dadas 2 andanadas, de 100 golpes cada una, la penetración sea igual o inferior a 5 cm (en cada una de ellas aisladamente). Siempre que la penetración sea inferior a 20 cm, el número de golpes que se considerará será el proporcional correspondiente. Esta situación de finalización del ensayo por elevado golpeo o imposibilidad de penetración, se denomina como Rechazo.

### Cálculo de resultados

Para el cálculo de los resultados no deben incluirse los valores obtenidos en los 30-50 cm superiores, ya que corresponden a la fase de hinca de la puntaza y al tramo de terreno con bajo confinamiento por lo que los golpes pueden presentar anomalías.

En base a los resultados del ensayo de penetración dinámica DPSH, se puede estimar la resistencia dinámica del terreno utilizando la fórmula holandesa de hinca:

$$Q_d = \frac{Pm^2 \times H}{(P_m + P_p)\ A\ 20/n20} \qquad \text{donde:}$$

$Q_d$ = Resistencia dinámica unitaria en $kg/cm^2$.
$P_m$ = Peso de la maza (65 kg.)
H = Altura de caída libre (75 cm).
$P_p$ = Peso de la puntaza y cabeza de golpeo (1,5 kg) + varillas (8,84 kg/m).
A = Sección de la puntaza (19,5 $cm^2$).
20/n20 = Penetración por golpe (cm).

A partir del valor de la resistencia dinámica $Q_d$ se puede estimar la resistencia estática unitaria $R_P$ (véase Buisson y otros), según diversos coeficientes de transformación que dependen fundamentalmente de la naturaleza de terreno y de su estado en el momento de realizar el ensayo. Con el valor de resistencia estática unitaria $R_p$ obtenido puede valorarse la carga admisible del terreno según diversas correlaciones (véase Sanglerat, Meyerhof y otros).

# IGEOSUMA, S.L.

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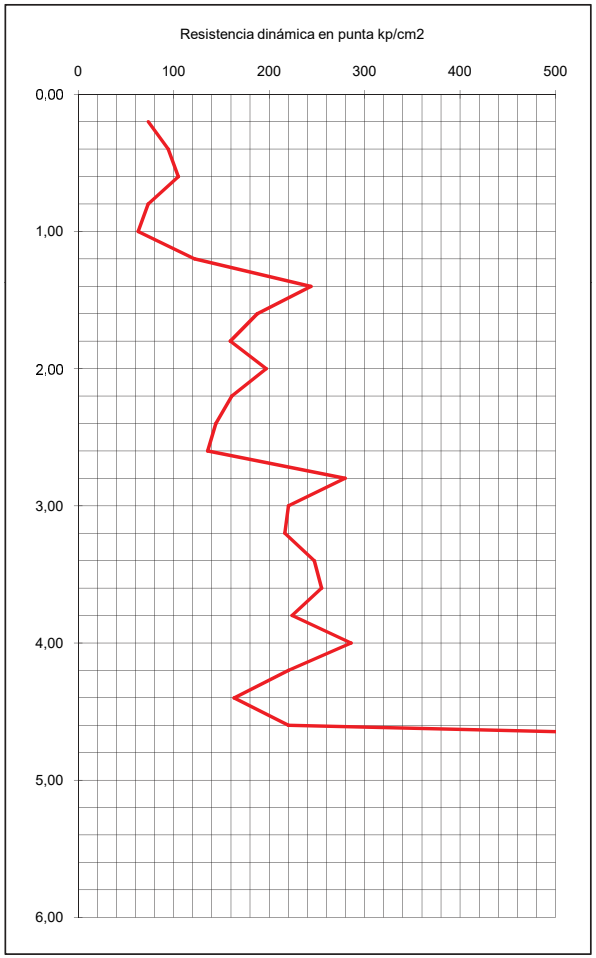
**FECHA:** 24.03.21
**ENSAYO Nº:** BE1-P1
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 705241 4644740
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

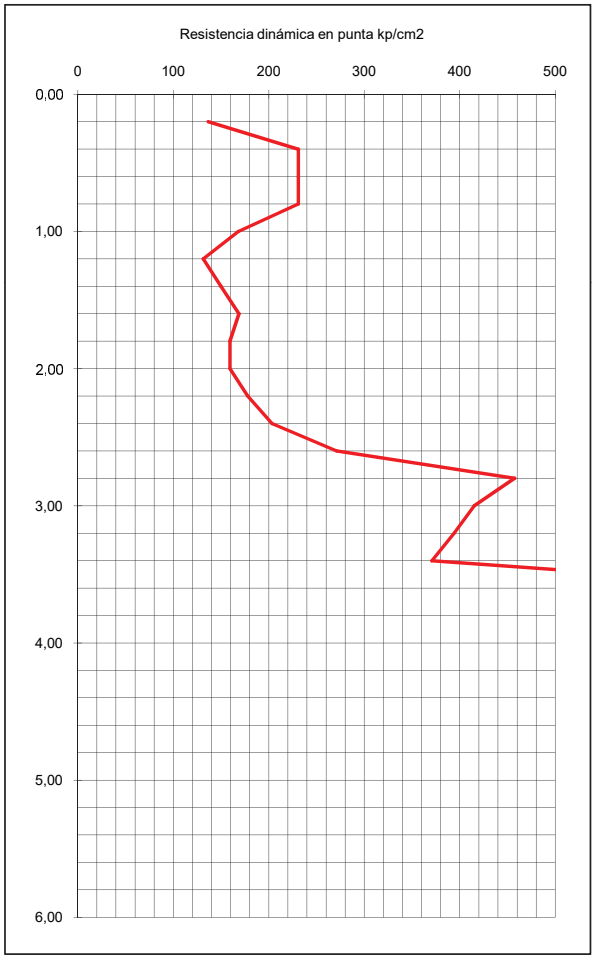
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 7 | 8,20 | ..... |
| 0,40 | 9 | 8,40 | ..... |
| 0,60 | 10 | 8,60 | ..... |
| 0,80 | 7 | 8,80 | ..... |
| 1,00 | 6 | 9,00 | ..... |
| 1,20 | 13 | 9,20 | ..... |
| 1,40 | 26 | 9,40 | ..... |
| 1,60 | 20 | 9,60 | ..... |
| 1,80 | 17 | 9,80 | ..... |
| 2,00 | 21 | 10,00 | ..... |
| 2,20 | 19 | 10,20 | ..... |
| 2,40 | 17 | 10,40 | ..... |
| 2,60 | 16 | 10,60 | ..... |
| 2,80 | 33 | 10,80 | ..... |
| 3,00 | 26 | 11,00 | ..... |
| 3,20 | 28 | 11,20 | ..... |
| 3,40 | 32 | 11,40 | ..... |
| 3,60 | 33 | 11,60 | ..... |
| 3,80 | 29 | 11,80 | ..... |
| 4,00 | 37 | 12,00 | ..... |
| 4,20 | 31 | 12,20 | ..... |
| 4,40 | 23 | 12,40 | ..... |
| 4,60 | 31 | 12,60 | ..... |
| 4,80 | 200 | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 3.05.21
**ENSAYO Nº:** BE1-P2
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 705030 4644591
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

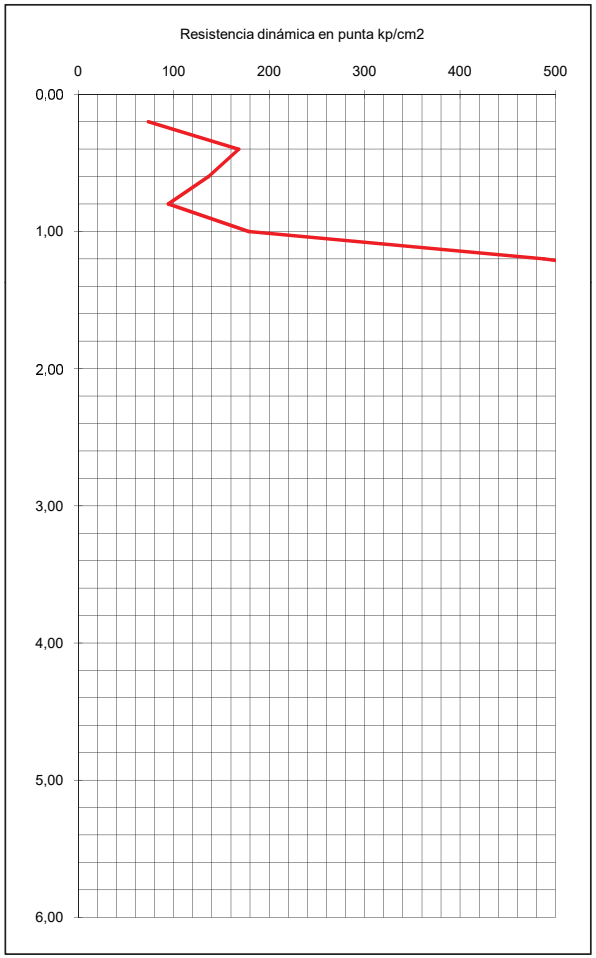
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 13 | 8,20 | ..... |
| 0,40 | 22 | 8,40 | ..... |
| 0,60 | 22 | 8,60 | ..... |
| 0,80 | 22 | 8,80 | ..... |
| 1,00 | 16 | 9,00 | ..... |
| 1,20 | 14 | 9,20 | ..... |
| 1,40 | 16 | 9,40 | ..... |
| 1,60 | 18 | 9,60 | ..... |
| 1,80 | 17 | 9,80 | ..... |
| 2,00 | 17 | 10,00 | ..... |
| 2,20 | 21 | 10,20 | ..... |
| 2,40 | 24 | 10,40 | ..... |
| 2,60 | 32 | 10,60 | ..... |
| 2,80 | 54 | 10,80 | ..... |
| 3,00 | 49 | 11,00 | ..... |
| 3,20 | 51 | 11,20 | ..... |
| 3,40 | 48 | 11,40 | ..... |
| 3,60 | 100 | 11,60 | ..... |
| 3,80 | ..... | 11,80 | ..... |
| 4,00 | ..... | 12,00 | ..... |
| 4,20 | ..... | 12,20 | ..... |
| 4,40 | ..... | 12,40 | ..... |
| 4,60 | ..... | 12,60 | ..... |
| 4,80 | ..... | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 3.05.21
**ENSAYO Nº:** EB-P1
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 705924 4645157
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

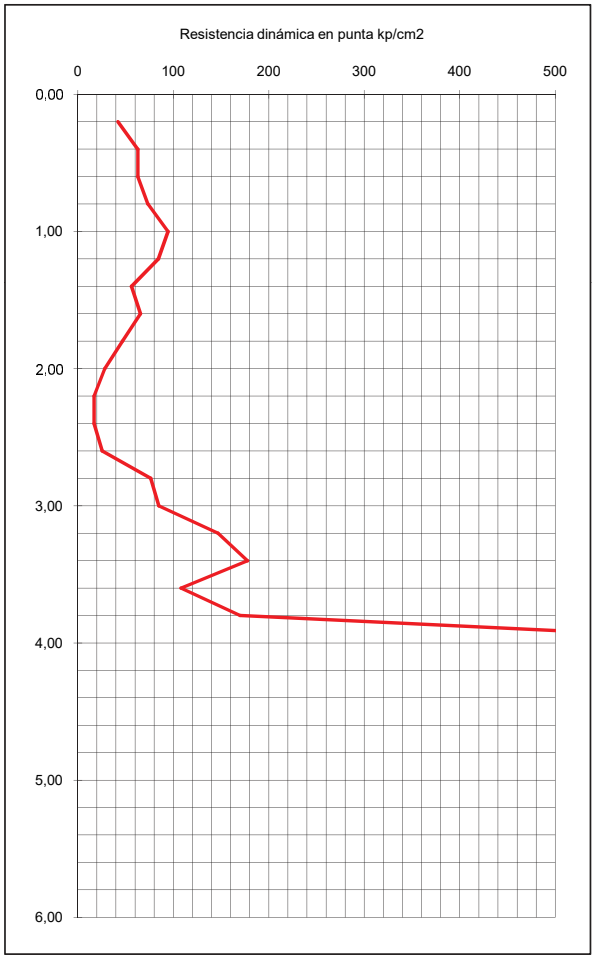
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 7 | 8,20 | ..... |
| 0,40 | 16 | 8,40 | ..... |
| 0,60 | 13 | 8,60 | ..... |
| 0,80 | 9 | 8,80 | ..... |
| 1,00 | 17 | 9,00 | ..... |
| 1,20 | 52 | 9,20 | ..... |
| 1,40 | 75 | 9,40 | ..... |
| 1,60 | 100 | 9,60 | ..... |
| 1,80 | ..... | 9,80 | ..... |
| 2,00 | ..... | 10,00 | ..... |
| 2,20 | ..... | 10,20 | ..... |
| 2,40 | ..... | 10,40 | ..... |
| 2,60 | ..... | 10,60 | ..... |
| 2,80 | ..... | 10,80 | ..... |
| 3,00 | ..... | 11,00 | ..... |
| 3,20 | ..... | 11,20 | ..... |
| 3,40 | ..... | 11,40 | ..... |
| 3,60 | ..... | 11,60 | ..... |
| 3,80 | ..... | 11,80 | ..... |
| 4,00 | ..... | 12,00 | ..... |
| 4,20 | ..... | 12,20 | ..... |
| 4,40 | ..... | 12,40 | ..... |
| 4,60 | ..... | 12,60 | ..... |
| 4,80 | ..... | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 3.05.21
**ENSAYO Nº:** EB-P2
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 705897 4645202
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

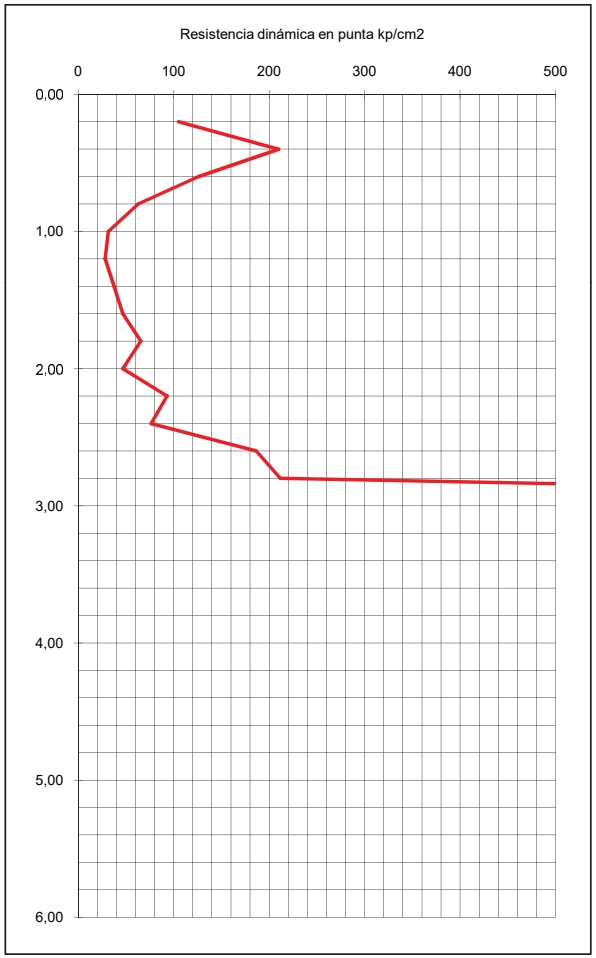
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 4 | 8,20 | ..... |
| 0,40 | 6 | 8,40 | ..... |
| 0,60 | 6 | 8,60 | ..... |
| 0,80 | 7 | 8,80 | ..... |
| 1,00 | 9 | 9,00 | ..... |
| 1,20 | 9 | 9,20 | ..... |
| 1,40 | 6 | 9,40 | ..... |
| 1,60 | 7 | 9,60 | ..... |
| 1,80 | 5 | 9,80 | ..... |
| 2,00 | 3 | 10,00 | ..... |
| 2,20 | 2 | 10,20 | ..... |
| 2,40 | 2 | 10,40 | ..... |
| 2,60 | 3 | 10,60 | ..... |
| 2,80 | 9 | 10,80 | ..... |
| 3,00 | 10 | 11,00 | ..... |
| 3,20 | 19 | 11,20 | ..... |
| 3,40 | 23 | 11,40 | ..... |
| 3,60 | 14 | 11,60 | ..... |
| 3,80 | 22 | 11,80 | ..... |
| 4,00 | 100 | 12,00 | ..... |
| 4,20 | ..... | 12,20 | ..... |
| 4,40 | ..... | 12,40 | ..... |
| 4,60 | ..... | 12,60 | ..... |
| 4,80 | ..... | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 24.03.21
**ENSAYO Nº:** RRP1
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 707220 4644433
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

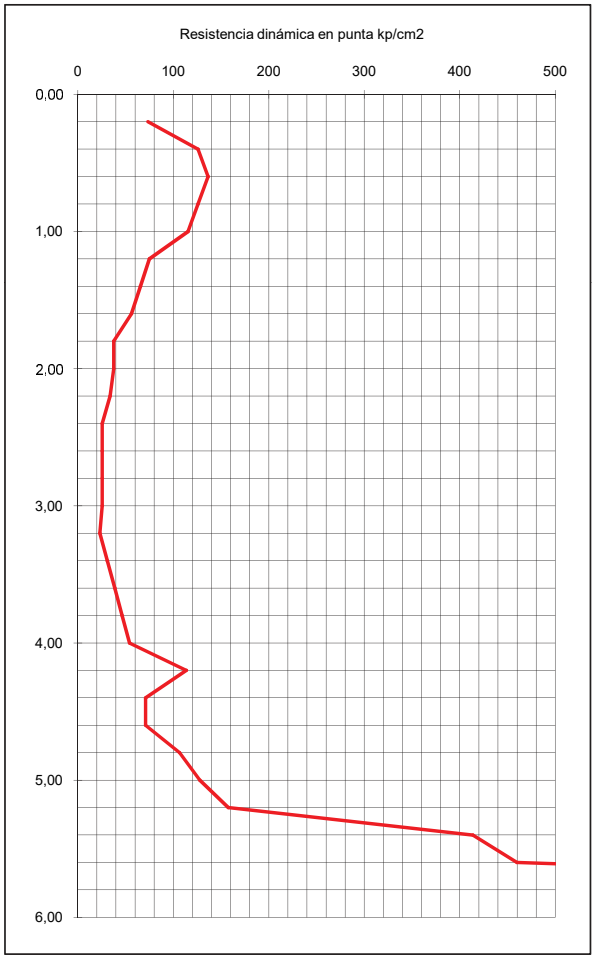
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 10 | 8,20 | ..... |
| 0,40 | 20 | 8,40 | ..... |
| 0,60 | 12 | 8,60 | ..... |
| 0,80 | 6 | 8,80 | ..... |
| 1,00 | 3 | 9,00 | ..... |
| 1,20 | 3 | 9,20 | ..... |
| 1,40 | 4 | 9,40 | ..... |
| 1,60 | 5 | 9,60 | ..... |
| 1,80 | 7 | 9,80 | ..... |
| 2,00 | 5 | 10,00 | ..... |
| 2,20 | 11 | 10,20 | ..... |
| 2,40 | 9 | 10,40 | ..... |
| 2,60 | 22 | 10,60 | ..... |
| 2,80 | 25 | 10,80 | ..... |
| 3,00 | 200 | 11,00 | ..... |
| 3,20 | ..... | 11,20 | ..... |
| 3,40 | ..... | 11,40 | ..... |
| 3,60 | ..... | 11,60 | ..... |
| 3,80 | ..... | 11,80 | ..... |
| 4,00 | ..... | 12,00 | ..... |
| 4,20 | ..... | 12,20 | ..... |
| 4,40 | ..... | 12,40 | ..... |
| 4,60 | ..... | 12,60 | ..... |
| 4,80 | ..... | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 24.03.21
**ENSAYO Nº:** RRP-2
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 706281 4645826
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

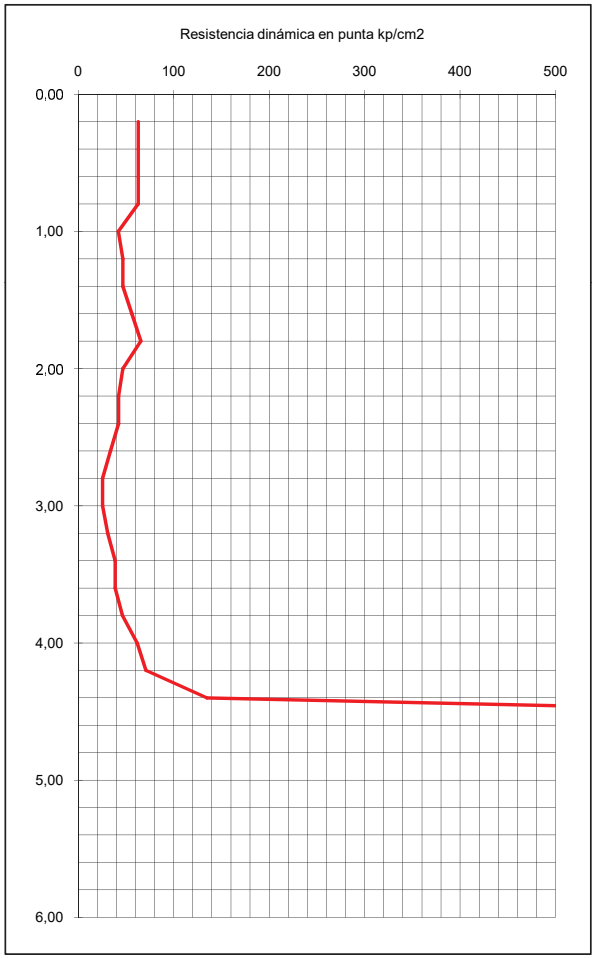
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 7 | 8,20 | ..... |
| 0,40 | 12 | 8,40 | ..... |
| 0,60 | 13 | 8,60 | ..... |
| 0,80 | 12 | 8,80 | ..... |
| 1,00 | 11 | 9,00 | ..... |
| 1,20 | 8 | 9,20 | ..... |
| 1,40 | 7 | 9,40 | ..... |
| 1,60 | 6 | 9,60 | ..... |
| 1,80 | 4 | 9,80 | ..... |
| 2,00 | 4 | 10,00 | ..... |
| 2,20 | 4 | 10,20 | ..... |
| 2,40 | 3 | 10,40 | ..... |
| 2,60 | 3 | 10,60 | ..... |
| 2,80 | 3 | 10,80 | ..... |
| 3,00 | 3 | 11,00 | ..... |
| 3,20 | 3 | 11,20 | ..... |
| 3,40 | 4 | 11,40 | ..... |
| 3,60 | 5 | 11,60 | ..... |
| 3,80 | 6 | 11,80 | ..... |
| 4,00 | 7 | 12,00 | ..... |
| 4,20 | 16 | 12,20 | ..... |
| 4,40 | 10 | 12,40 | ..... |
| 4,60 | 10 | 12,60 | ..... |
| 4,80 | 15 | 12,80 | ..... |
| 5,00 | 18 | 13,00 | ..... |
| 5,20 | 24 | 13,20 | ..... |
| 5,40 | 63 | 13,40 | ..... |
| 5,60 | 70 | 13,60 | ..... |
| 5,80 | 200 | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 30.03.21
**ENSAYO Nº:** RRP-3
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 706436 4646802
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

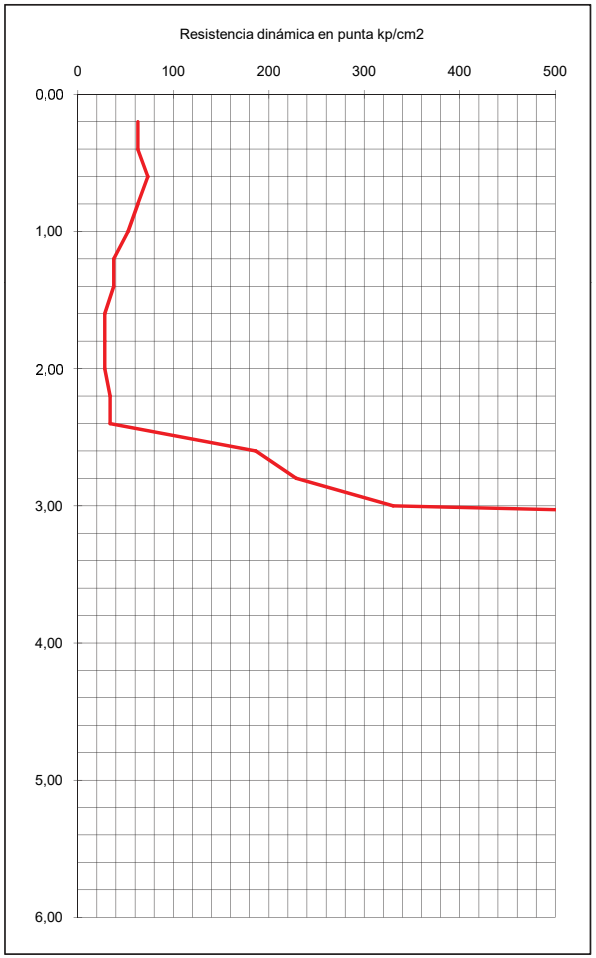
| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 6 | 8,20 | ..... |
| 0,40 | 6 | 8,40 | ..... |
| 0,60 | 6 | 8,60 | ..... |
| 0,80 | 6 | 8,80 | ..... |
| 1,00 | 4 | 9,00 | ..... |
| 1,20 | 5 | 9,20 | ..... |
| 1,40 | 5 | 9,40 | ..... |
| 1,60 | 6 | 9,60 | ..... |
| 1,80 | 7 | 9,80 | ..... |
| 2,00 | 5 | 10,00 | ..... |
| 2,20 | 5 | 10,20 | ..... |
| 2,40 | 5 | 10,40 | ..... |
| 2,60 | 4 | 10,60 | ..... |
| 2,80 | 3 | 10,80 | ..... |
| 3,00 | 3 | 11,00 | ..... |
| 3,20 | 4 | 11,20 | ..... |
| 3,40 | 5 | 11,40 | ..... |
| 3,60 | 5 | 11,60 | ..... |
| 3,80 | 6 | 11,80 | ..... |
| 4,00 | 8 | 12,00 | ..... |
| 4,20 | 10 | 12,20 | ..... |
| 4,40 | 19 | 12,40 | ..... |
| 4,60 | 200 | 12,60 | ..... |
| 4,80 | ..... | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

# IGEOSUMA, S.L.

**CLIENTE:** IGEOSUMA, S.L.
**OBRA:** ESTUDIO GEOTÉCNICO PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTE (HUESCA)

**FECHA:** 30.03.21
**ENSAYO Nº:** RRP-4
**COTA:** - **CORDENADAS:** UTM (ETRS89) 30T 705777 4647571
**EQUIPO:** DPSH

## *ENSAYO DE PENETRACIÓN DINÁMICA CONTINUA*




### *GOLPEO*

| Prof (m) | $N_{DPSH}$ | Prof (m) | $N_{DPSH}$ |
|---|---|---|---|
| 0,20 | 6 | 8,20 | ..... |
| 0,40 | 6 | 8,40 | ..... |
| 0,60 | 7 | 8,60 | ..... |
| 0,80 | 6 | 8,80 | ..... |
| 1,00 | 5 | 9,00 | ..... |
| 1,20 | 4 | 9,20 | ..... |
| 1,40 | 4 | 9,40 | ..... |
| 1,60 | 3 | 9,60 | ..... |
| 1,80 | 3 | 9,80 | ..... |
| 2,00 | 3 | 10,00 | ..... |
| 2,20 | 4 | 10,20 | ..... |
| 2,40 | 4 | 10,40 | ..... |
| 2,60 | 22 | 10,60 | ..... |
| 2,80 | 27 | 10,80 | ..... |
| 3,00 | 39 | 11,00 | ..... |
| 3,20 | 200 | 11,20 | ..... |
| 3,40 | ..... | 11,40 | ..... |
| 3,60 | ..... | 11,60 | ..... |
| 3,80 | ..... | 11,80 | ..... |
| 4,00 | ..... | 12,00 | ..... |
| 4,20 | ..... | 12,20 | ..... |
| 4,40 | ..... | 12,40 | ..... |
| 4,60 | ..... | 12,60 | ..... |
| 4,80 | ..... | 12,80 | ..... |
| 5,00 | ..... | 13,00 | ..... |
| 5,20 | ..... | 13,20 | ..... |
| 5,40 | ..... | 13,40 | ..... |
| 5,60 | ..... | 13,60 | ..... |
| 5,80 | ..... | 13,80 | ..... |
| 6,00 | ..... | 14,00 | ..... |
| 6,20 | ..... | 14,20 | ..... |
| 6,40 | ..... | 14,40 | ..... |
| 6,60 | ..... | 14,60 | ..... |
| 6,80 | ..... | 14,80 | ..... |
| 7,00 | ..... | 15,00 | ..... |
| 7,20 | ..... | 15,20 | ..... |
| 7,40 | ..... | 15,40 | ..... |
| 7,60 | ..... | 15,60 | ..... |
| 7,80 | ..... | 15,80 | ..... |
| 8,00 | ..... | 16,00 | ..... |

## EMPLAZAMIENTOS ENSAYOS DE PENETRACIÓN DINÁMICA

BE1-P1

BE1-P2

EB-P1

EB-P2

RR-P1

RR-P2

IGEOSUMA, S.L.

EMPLAZAMIENTOS ENSAYOS DE PENETRACIÓN DINÁMICA

RR-P3

RR-P4

# V.- BOLETINES DE ENSAYO DE LABORATORIO

| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO DE SULFATOS SOLUBLES EN SUELOS |
|---|---|---|
| | Norma | UNE 103201/96 |
| | Acta nº 2117486 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra… 214813** | |
| PROCEDENCIA | CALICATA |
| TIPO DE MUESTRA | M. ALTERADA |
| FECHA ENTRADA | 23 de febrero de 2021 |

| | |
|---|---|
| Referencia Informe….. | EXP 21999 |
| REF. CLIENTE | RR-C8 (0,80 m) |
| PETICIONARIO | IGEOSUMA |
| DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***DATOS ENSAYO*** | | |
|---|---|---|
| - | Referencia tara | VP 2 |
| % pasa | % suelo pasa tamiz 2 UNE | 83 |
| g | Muestra ensayada (g) | 9,7610 |
| T | Tara crisol (g) | 25,6861 |
| T+R | Tara crisol + Peso residuo (g) | 25,7048 |
| Rc | Corrección de cenizas Papel filtro (g) | |
| Pp=(T+R)-T-Rc | Residuo calcinado en mufla (g) | 0,0187 |
| v | Volumen de solución analizada ($cm^3$) | 250,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

***RESULTADO ENSAYO***

$\% SO_3=[[(Pp*0,34299)/((v/V)*g)]*100]*[\% pasa/100]$

***$SO_3$ (%)*** = **0,11**

| INCERTIDUMBRE ENSAYO |
|---|
| $SO_3$ (%) δ= 0,17 |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 11 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA DENSIDAD DE UN SUELO |
|---|---|---|
| | Norma | UNE 103301/94 |
| | Acta nº 2117489 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra… 214814** | |
| PROCEDENCIA | CALICATA |
| TIPO DE MUESTRA | M. BLOQUE |
| FECHA ENTRADA | 23 de febrero de 2021 |

| | |
|---|---|
| Referencia Informe….. | EXP 21999 |
| REF. CLIENTE | RR-C8 (1,50 m) |
| PETICIONARIO | IGEOSUMA |
| DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 194,97 |
| PESO CON PARAFINA (g) = | 203,16 |
| PESO SUMERGIDO (g) = | 99,50 |
| HUMEDAD (%)= | 17,29 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA ($g/cm^3$) =** | **2,06** |
| **DENSIDAD SECA ($g/cm^3$) =** | **1,76** |

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Caspe, a 11 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO** |
|---|---|---|
| | *Norma* | UNE 103300/93 |
| | *Acta nº* **2117487** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214814** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C8 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 194,80 |
| TARA + SUELO (g) = | 170,12 |
| TARA (g) = | 27,37 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **17,3** |

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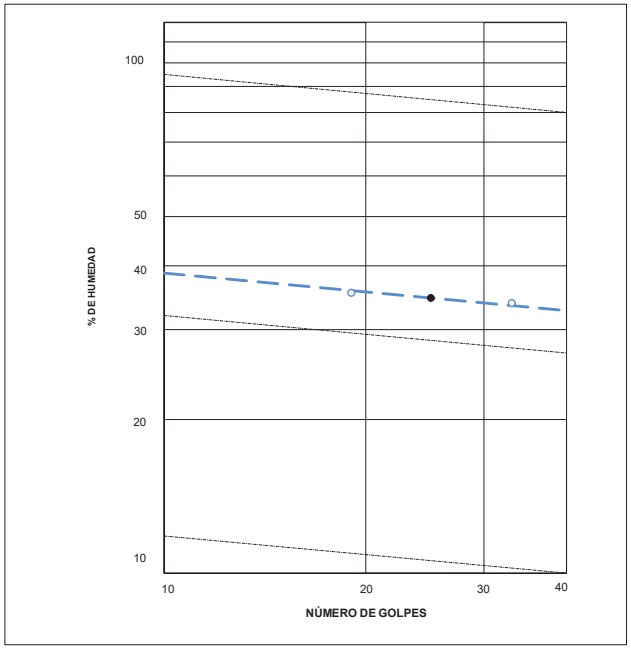
| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LÍMITES DE ATTERBERG** |
|---|---|---|
| | *Norma* | UNE 103103/94 UNE 103104/93 |
| | *Acta nº* **2117488** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214814** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C8 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***CÁLCULO LÍMITE LÍQUIDO*** | | | |
|---|---|---|---|
| - | Nº de golpes | 19 | 33 |
| - | Referencia tara | L 43 | L 41 |
| a=(t+s+a)-(t+s) | Agua | 7,29 | 6,76 |
| t+s+a | Tara + suelo + agua | 62,03 | 63,47 |
| t+s | Tara + suelo | 54,74 | 56,71 |
| t | Tara | 34,18 | 36,73 |
| s=(t+s)-t | Suelo | 20,56 | 19,98 |
| w=100*(a/s) | ***% Humedad*** | **35,5** | **33,8** |

| ***CÁLCULO LÍMITE PLÁSTICO*** | | |
|---|---|---|
| - | Referencia tara | L 44 |
| a=(t+s+a)-(t+s) | Agua | 6,90 |
| t+s+a | Tara + suelo + agua | 73,07 |
| t+s | Tara + suelo | 66,17 |
| t | Tara | 34,76 |
| s=(t+s)-t | Suelo | 31,41 |
| w=100*(a/s) | ***% Humedad*** | **22,0** |




| ***RESULTADOS DEL ENSAYO*** | |
|---|---|
| LÍMITE LÍQUIDO = | **34,6** |
| LÍMITE PLÁSTICO = | **22,0** |
| ÍNDICE PLASTICIDAD = | **12,7** |

| **INCERTIDUMBRE ENSAYO** |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Fdo.

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Responsable ensayo

Caspe, a 11 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103602/96 |
| | Acta nº 2117490 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214814** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C8 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DESCRIPCIÓN DE LA MUESTRA ENSAYADA:**

M. INALTERADA

HUMEDAD DE ENSAYO (%): 17,29

DENSIDAD SECA ENSAYO (g/cm$^3$): 1,76

**PRESIÓN DE HINCHAMIENTO (kgf/cm$^2$) 0,2**

**PRESIÓN DE HINCHAMIENTO (kPa) 19,61**

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| Terra LABS Control www.terralabscontrol.es | Ensayo | GRANULOMETRÍA DE SUELOS POR TAMIZADO |
|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117491 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214815** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C2 (1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

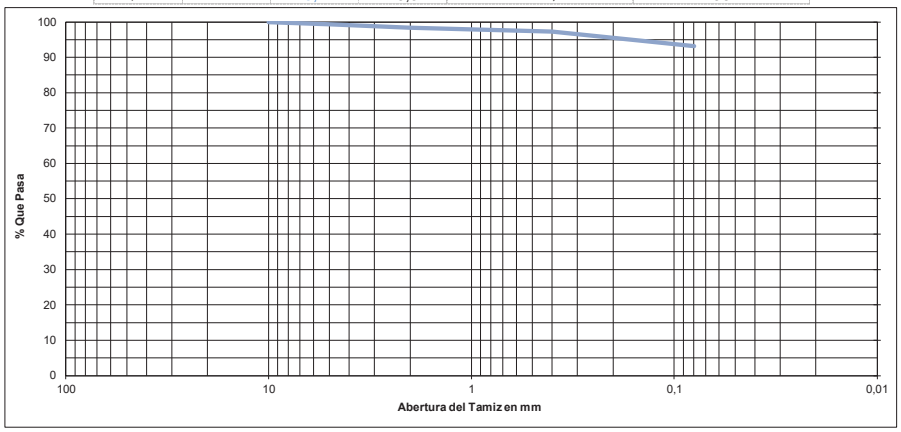
| | | |
|---|---|---|
| *A* | Muestra total seca al aire | 1253,5 |
| *B* | Gruesos lavados | 20,4 |
| *C = (A - B) * f* | Fracción fina seca | 1206,4 |
| *D = (B + C)* | Muestra total seca | 1226,7 |
| *E* | Fracción fina ensayada seca al aire | 77,3 |
| *F = E * f* | Fracción fina ensayada seca | 75,6 |
| *C/F* | | 16,0 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| *f=(100/(100+h))* | F/correc. hum. higroscópica | 1,0 |
| *h=(a/s)*100* | Humedad higroscópica % | 2,2 |
| *a=(t+s+a)-(t+s)* | Agua | 1,1 |
| *t+s+a* | Tara+suelo+agua | 77,3 |
| *t+s* | Tara+suelo | 76,2 |
| *t* | Tara | 28,9 |
| *s* | Suelo | 47,3 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | 1226,7 | 100 |
| 5 | 4 | | 8,4 | 1218,4 | 99 |
| 2 | 10 | | 12,0 | 1206,4 | 98 |
| 0,4 | 40 | 0,9 | 13,9 | 1192,5 | 97 |
| 0,08 | 200 | 3,1 | 48,8 | 1143,7 | 93 |




OBSERVACIONES:

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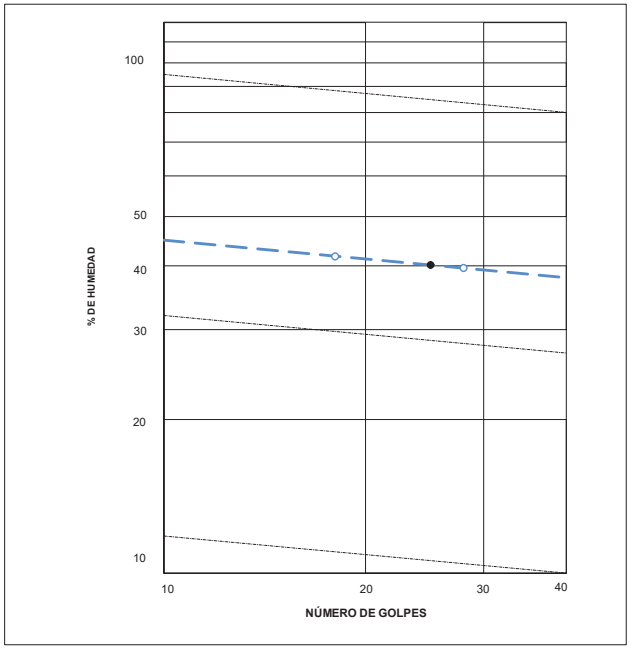
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117492 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214815** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C2 (1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULO LÍMITE LÍQUIDO | | | |
|---|---|---|---|
| - | Nº de golpes | 18 | 28 |
| - | Referencia tara | L 46 | L 43 |
| a=(t+s+a)-(t+s) | Agua | 8,83 | 9,48 |
| t+s+a | Tara + suelo + agua | 64,65 | 67,60 |
| t+s | Tara + suelo | 55,82 | 58,12 |
| t | Tara | 34,68 | 34,24 |
| s=(t+s)-t | Suelo | 21,14 | 23,88 |
| w=100*(a/s) | ***% Humedad*** | **41,8** | **39,7** |

| CÁLCULO LÍMITE PLÁSTICO | | |
|---|---|---|
| - | Referencia tara | L 25 |
| a=(t+s+a)-(t+s) | Agua | 6,22 |
| t+s+a | Tara + suelo + agua | 60,24 |
| t+s | Tara + suelo | 54,02 |
| t | Tara | 29,42 |
| s=(t+s)-t | Suelo | 24,60 |
| w=100*(a/s) | ***% Humedad*** | **25,3** |




| *RESULTADOS DEL ENSAYO* | |
|---|---|
| LÍMITE LÍQUIDO = | **40,2** |
| LÍMITE PLÁSTICO = | **25,3** |
| ÍNDICE PLASTICIDAD = | **14,9** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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|---|---|---|
| | Norma | UNE 103301/94 |
| | Acta nº 2117495 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214816** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C15 (1,50 - 2,00 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 214,63 |
| PESO CON PARAFINA (g) = | 222,85 |
| PESO SUMERGIDO (g) = | 119,81 |
| HUMEDAD (%)= | 13,86 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA (g/cm$^3$) =** | **2,28** |
| **DENSIDAD SECA (g/cm$^3$) =** | **2,01** |

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|---|---|---|
| | Norma | UNE 103300/93 |
| | Acta nº 2117493 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214816 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C15 (1,50 - 2,00 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 221,60 |
| TARA + SUELO (g) = | 198,18 |
| TARA (g) = | 29,19 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **13,9** |

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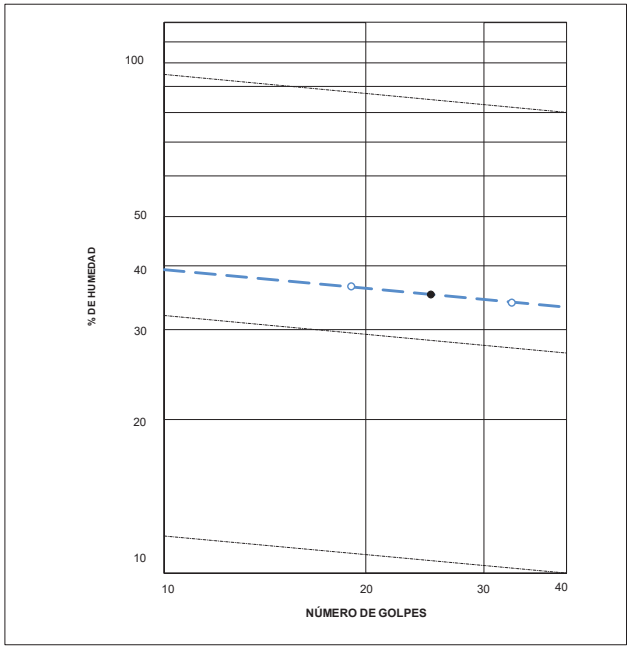
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117494 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214816 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C15 (1,50 - 2,00 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULO LÍMITE LÍQUIDO | | | | CÁLCULO LÍMITE PLÁSTICO | | |
|---|---|---|---|---|---|---|
| - | Nº de golpes | 33 | 19 | - | Referencia tara | L 17 |
| - | Referencia tara | L 46 | L 25 | a=(t+s+a)-(t+s) | Agua | 6,39 |
| a=(t+s+a)-(t+s) | Agua | 7,65 | 6,49 | t+s+a | Tara + suelo + agua | 63,59 |
| t+s+a | Tara + suelo + agua | 64,88 | 53,64 | t+s | Tara + suelo | 57,20 |
| t+s | Tara + suelo | 57,23 | 47,15 | t | Tara | 27,35 |
| t | Tara | 34,68 | 29,37 | s=(t+s)-t | Suelo | 29,85 |
| s=(t+s)-t | Suelo | 22,55 | 17,78 | | | |
| w=100*(a/s) | ***% Humedad*** | **33,9** | **36,5** | w=100*(a/s) | ***% Humedad*** | **21,4** |




| RESULTADOS DEL ENSAYO | |
|---|---|
| LÍMITE LÍQUIDO = | **35,2** |
| LÍMITE PLÁSTICO = | **21,4** |
| ÍNDICE PLASTICIDAD = | **13,8** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 11 de marzo de 2021

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|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103201/96 |
| | Acta nº 2117496 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214816 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C15 (1,50 - 2,00 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | | |
|---|---|---|
| - | Referencia tara | VP 35 |
| % pasa | % suelo pasa tamiz 2 UNE | 100 |
| g | Muestra ensayada (g) | 10,4880 |
| T | Tara crisol (g) | 25,7233 |
| T+R | Tara crisol + Peso residuo (g) | 25,7285 |
| Rc | Corrección de cenizas Papel filtro (g) | |
| Pp=(T+R)-T-Rc | Residuo calcinado en mufla (g) | 0,0052 |
| v | Volumen de solución analizada ($cm^3$) | 250,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

**RESULTADO ENSAYO**

$\% SO_3=[[(Pp*0,34299)/((v/V)*g)]*100]*[\% pasa/100]$

***$SO_3$ (%)*** **=** **< 0,1**

| INCERTIDUMBRE ENSAYO |
|---|
| $SO_3$ (%) δ= 0,17 |

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|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103101/95 |
| | Acta nº 2117497 | Nº Copia Copia 1. Igeosuma |

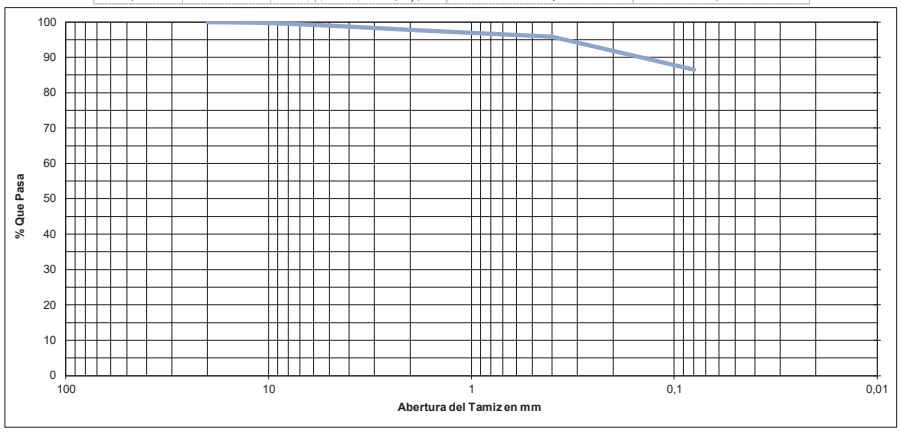
| Referencia Muestra… 214817 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C5 (0,80 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULOS PREVIOS | | |
|---|---|---|
| A | Muestra total seca al aire | 1452,0 |
| B | Gruesos lavados | 31,7 |
| C = (A - B) * f | Fracción fina seca | 1411,9 |
| D = (B + C) | Muestra total seca | 1443,6 |
| E | Fracción fina ensayada seca al aire | 72,6 |
| F = E * f | Fracción fina ensayada seca | 72,1 |
| C/F | | 19,6 |

| HUMEDAD HIGROSCÓPICA | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 0,6 |
| a=(t+s+a)-(t+s) | Agua | 0,4 |
| t+s+a | Tara+suelo+agua | 103,7 |
| t+s | Tara+suelo | 103,3 |
| t | Tara | 34,7 |
| s | Suelo | 68,6 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | 1443,6 | 100 |
| 12,5 | 1/2 | | 3,3 | 1440,2 | 100 |
| 10 | 3/8 | | 0,7 | 1439,6 | 100 |
| 5 | 4 | | 11,7 | 1427,9 | 99 |
| 2 | 10 | | 16,0 | 1411,9 | 98 |
| 0,4 | 40 | 1,4 | 28,0 | 1383,9 | 96 |
| 0,08 | 200 | 6,9 | 134,3 | 1249,6 | 87 |

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Responsable ensayo

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117498 | Nº Copia Copia 1. Igeosuma |

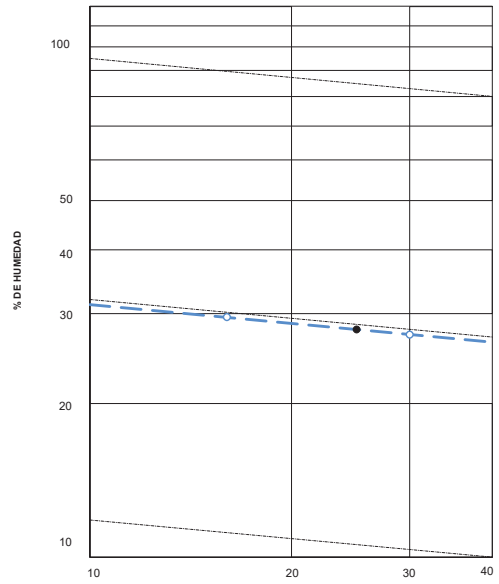
| Referencia Muestra… 214817 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C5 (0,80 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 16 | 30 |
| - | Referencia tara | L 22 | L 18 |
| a=(t+s+a)-(t+s) | Agua | 3,65 | 3,94 |
| t+s+a | Tara + suelo + agua | 45,29 | 47,56 |
| t+s | Tara + suelo | 41,64 | 43,62 |
| t | Tara | 29,29 | 29,19 |
| s=(t+s)-t | Suelo | 12,35 | 14,43 |
| w=100*(a/s) | **% Humedad** | **29,6** | **27,3** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 23 |
| a=(t+s+a)-(t+s) | Agua | 0,81 |
| t+s+a | Tara + suelo + agua | 34,24 |
| t+s | Tara + suelo | 33,43 |
| t | Tara | 28,83 |
| s=(t+s)-t | Suelo | 4,60 |
| w=100*(a/s) | **% Humedad** | **17,6** |




**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| LÍMITE LÍQUIDO = | **28,0** |
| LÍMITE PLÁSTICO = | **17,6** |
| ÍNDICE PLASTICIDAD = | **10,3** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Caspe, a 11 de marzo de 2021

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|---|---|---|
| | Norma | UNE 103201/96 |
| | Acta nº 2117499 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214817 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C5 (0,80 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DATOS ENSAYO**

| | | |
|---|---|---|
| - | Referencia tara | VP 35 |
| % pasa | % suelo pasa tamiz 2 UNE | 98 |
| g | Muestra ensayada (g) | 5,4770 |
| T | Tara crisol (g) | 25,7276 |
| T+R | Tara crisol + Peso residuo (g) | 25,9792 |
| Rc | Corrección de cenizas Papel filtro (g) | |
| Pp=(T+R)-T-Rc | Residuo calcinado en mufla (g) | 0,2516 |
| v | Volumen de solución analizada ($cm^3$) | 250,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

**RESULTADO ENSAYO**

% $SO_3$=[[(Pp*0,34299)/((v/V)*g)]*100]*[% pasa/100]

***$SO_3$ (%)*** = **3,08**

| INCERTIDUMBRE ENSAYO |
|---|
| $SO_3$ (%) δ= 0,17 |

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|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117500 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214818 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C23 (1,60 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

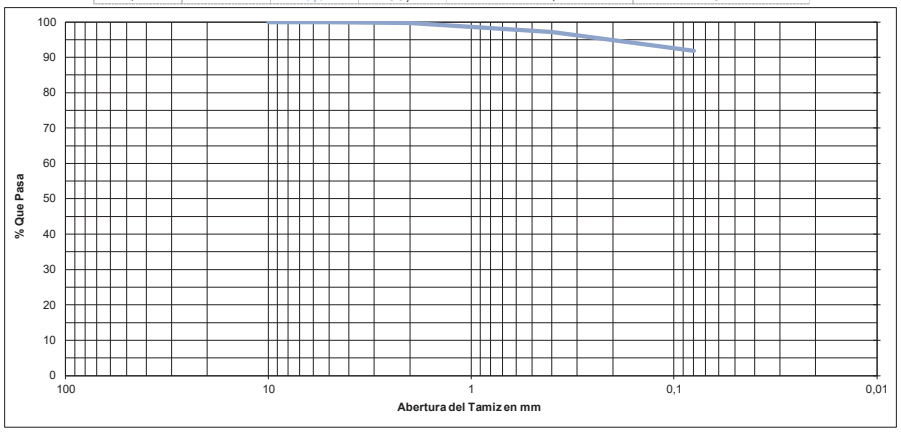
| | | |
|---|---|---|
| A | Muestra total seca al aire | 1617,5 |
| B | Gruesos lavados | 4,5 |
| C = (A - B) * f | Fracción fina seca | 1602,4 |
| D = (B + C) | Muestra total seca | 1606,8 |
| E | Fracción fina ensayada seca al aire | 72,8 |
| F = E * f | Fracción fina ensayada seca | 72,3 |
| C/F | | 22,2 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 0,7 |
| a=(t+s+a)-(t+s) | Agua | 0,3 |
| t+s+a | Tara+suelo+agua | 79,8 |
| t+s | Tara+suelo | 79,4 |
| t | Tara | 28,4 |
| s | Suelo | 51,1 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | 1606,8 | 100 |
| 5 | 4 | | 2,0 | 1604,9 | 100 |
| 2 | 10 | | 2,5 | 1602,4 | 100 |
| 0,4 | 40 | 1,8 | 40,5 | 1561,8 | 97 |
| 0,08 | 200 | 3,9 | 86,4 | 1475,4 | 92 |

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117501 | Nº Copia Copia 1. Igeosuma |

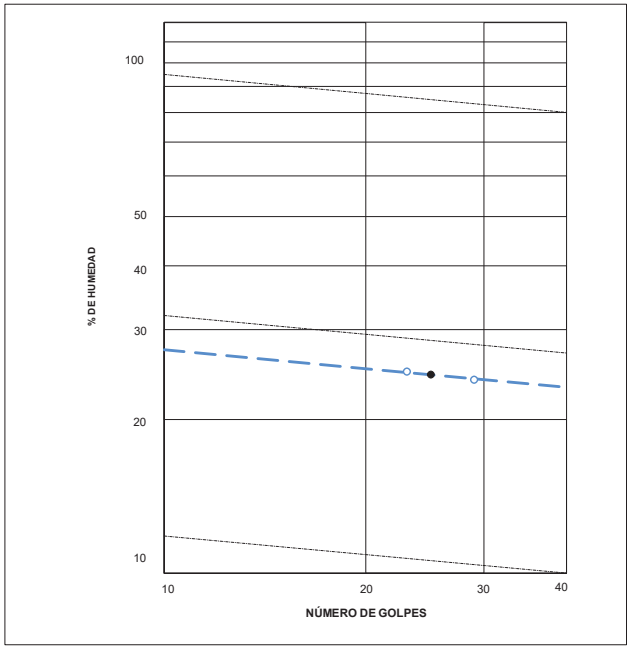
| Referencia Muestra… 214818 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C23 (1,60 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | 23 | 29 |
| - | Referencia tara | L 49 | L 44 |
| a=(t+s+a)-(t+s) | Agua | 3,90 | 3,41 |
| t+s+a | Tara + suelo + agua | 54,59 | 52,42 |
| t+s | Tara + suelo | 50,69 | 49,01 |
| t | Tara | 35,00 | 34,77 |
| s=(t+s)-t | Suelo | 15,69 | 14,24 |
| w=100*(a/s) | ***% Humedad*** | **24,9** | **23,9** |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | L 28 |
| a=(t+s+a)-(t+s) | Agua | 0,90 |
| t+s+a | Tara + suelo + agua | 42,77 |
| t+s | Tara + suelo | 41,87 |
| t | Tara | 36,76 |
| s=(t+s)-t | Suelo | 5,11 |
| w=100*(a/s) | ***% Humedad*** | **17,6** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **24,5** |
| LÍMITE PLÁSTICO = | **17,6** |
| ÍNDICE PLASTICIDAD = | **6,9** |

**INCERTIDUMBRE ENSAYO**

LIMITE PLÁSTICO δ= 0,11

LIMITE LÍQUIDO δ= 0,20

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Caspe, a 11 de marzo de 2021

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|---|---|---|
| | *Norma* | **UNE 103301/94** |
| | *Acta nº* **2117504** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214819** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C19 (2,00 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 155,44 |
| PESO CON PARAFINA (g) = | 162,45 |
| PESO SUMERGIDO (g) = | 86,77 |
| HUMEDAD (%)= | 13,23 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA (g/cm$^3$) =** | **2,29** |
| **DENSIDAD SECA (g/cm$^3$) =** | **2,02** |

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|---|---|---|
| | *Norma* | **UNE 103300/93** |
| | *Acta nº* **2117502** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214819** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C19 (2,00 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 207,84 |
| TARA + SUELO (g) = | 187,85 |
| TARA (g) = | 36,76 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **13,2** |

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117503 | Nº Copia Copia 1. Igeosuma |

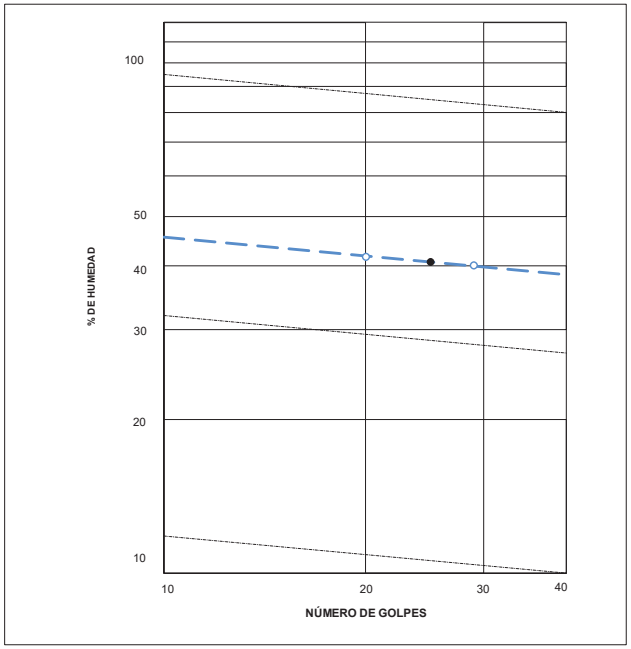
| | |
|---|---|
| **Referencia Muestra… 214819** | Referencia Informe….. EXP 21999 |
| PROCEDENCIA CALICATA | REF. CLIENTE RR-C19 (2,00 m) |
| TIPO DE MUESTRA M. BLOQUE | PETICIONARIO IGEOSUMA |
| FECHA ENTRADA 23 de febrero de 2021 | DEN. OBRA EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | 20 | 29 |
| - | Referencia tara | L 49 | L 19 |
| a=(t+s+a)-(t+s) | Agua | 9,19 | 9,31 |
| t+s+a | Tara + suelo + agua | 66,18 | 62,50 |
| t+s | Tara + suelo | 56,99 | 53,19 |
| t | Tara | 34,97 | 30,00 |
| s=(t+s)-t | Suelo | 22,02 | 23,19 |
| w=100*(a/s) | ***% Humedad*** | **41,7** | **40,1** |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | L 34 |
| a=(t+s+a)-(t+s) | Agua | 8,31 |
| t+s+a | Tara + suelo + agua | 76,96 |
| t+s | Tara + suelo | 68,65 |
| t | Tara | 36,00 |
| s=(t+s)-t | Suelo | 32,65 |
| w=100*(a/s) | ***% Humedad*** | **25,5** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **40,7** |
| LÍMITE PLÁSTICO = | **25,5** |
| ÍNDICE PLASTICIDAD = | **15,3** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

VºBº

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Responsable ensayo

Caspe, a 11 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103602/96 |
| | Acta nº 2117505 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra… 214819** | Referencia Informe….. EXP 21999 |
| PROCEDENCIA CALICATA | REF. CLIENTE RR-C19 (2,00 m) |
| TIPO DE MUESTRA M. BLOQUE | PETICIONARIO IGEOSUMA |
| FECHA ENTRADA 23 de febrero de 2021 | DEN. OBRA EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DESCRIPCIÓN DE LA MUESTRA ENSAYADA:**

M. INALTERADA

HUMEDAD DE ENSAYO (%): 13,23

DENSIDAD SECA ENSAYO (g/cm$^3$): 2,02

**PRESIÓN DE HINCHAMIENTO (kgf/cm$^2$) 0,2**

**PRESIÓN DE HINCHAMIENTO (kPa) 19,61**

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 11 de marzo de 2021

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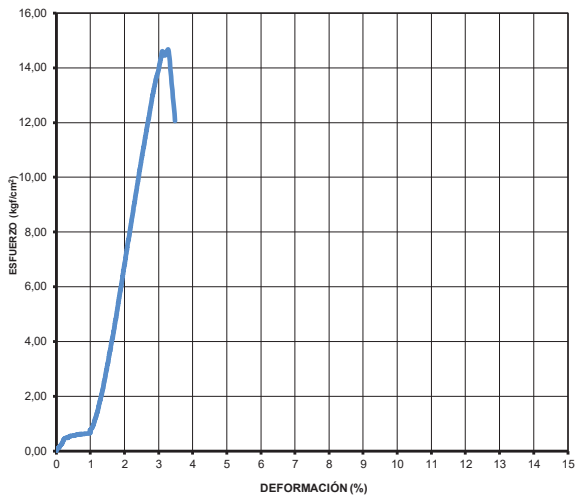
| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO DE COMPRESIÓN SIMPLE EN MUESTRAS DE SUELOS |
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117509 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214820 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C10 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | |
|---|---|---|---|---|---|
| Parcial | | | Probeta | | |
| | Referencia tara | L 12 | P | Suelo húmedo total | 551,94 |
| a=(t+s+a)-(t+s) | Agua | 19,51 | T + S | Tara + suelo seco parcial | 889,74 |
| t+s+a | Tara+suelo+agua | 175,12 | T | Tara | 539,28 |
| t+s | Tara+suelo | 155,61 | S | Suelo seco parcial | 350,46 |
| t | Tara | 28,69 | s1=S+s | Suelo seco total | 477,38 |
| s=(t+s)-t | Suelo | 126,92 | a1=P-s1 | Agua | 74,56 |
| h=(a*100)/s | ***Humedad*** | **15,37** | h1=(a1*100)/s1 | ***Humedad*** | **15,62** |

| TIPO PROBETA | |
|---|---|
| PRISMÁTICA | |
| **DATOS PROBETA** | |
| Lado (mm) | Altura (mm) |
| 51*48 | 101 |
| Área ($cm^2$) | Volumen ($cm^3$) |
| 24,48 | 247,25 |
| Densidad ($g/cm^3$) | |
| **2,23** | |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**

**RESULTADOS**

**R (kgf/cm²)= *14,68***

**Deform. (%) = *3,27***

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 11 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA DENSIDAD DE UN SUELO |
|---|---|---|
| | Norma | UNE 103301/94 |
| | Acta nº 2117508 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214820 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C10 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 158,20 |
| PESO CON PARAFINA (g) = | 164,95 |
| PESO SUMERGIDO (g) = | 87,55 |
| HUMEDAD (%)= | 16,47 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA ($g/cm^3$) =** | **2,26** |
| **DENSIDAD SECA ($g/cm^3$) =** | **1,94** |

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO** |
|---|---|---|
| | *Norma* | UNE 103300/93 |
| | *Acta nº* **2117506** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214820** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C10 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 132,47 |
| TARA + SUELO (g) = | 118,60 |
| TARA (g) = | 34,40 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **16,5** |

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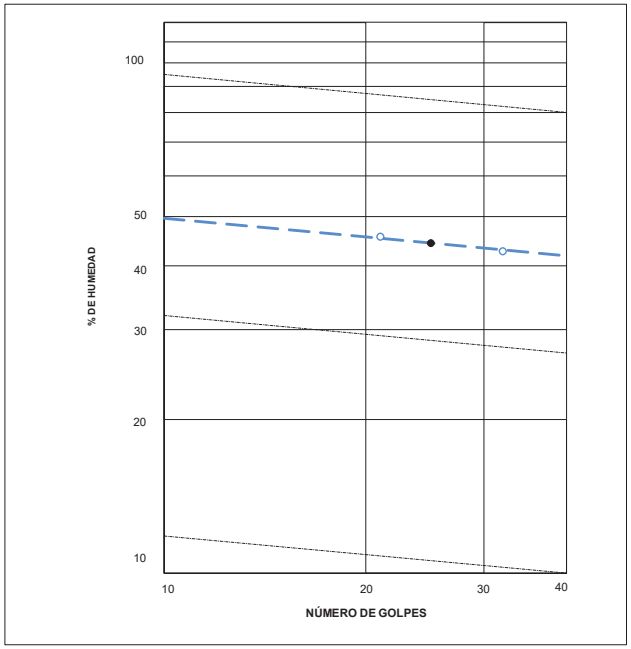
| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LÍMITES DE ATTERBERG** |
|---|---|---|
| | *Norma* | UNE 103103/94 UNE 103104/93 |
| | *Acta nº* **2117507** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214820** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C10 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***CÁLCULO LÍMITE LÍQUIDO*** | | | |
|---|---|---|---|
| - | Nº de golpes | 21 | 32 |
| - | Referencia tara | L 33 | L 35 |
| a=(t+s+a)-(t+s) | Agua | 7,89 | 8,19 |
| t+s+a | Tara + suelo + agua | 59,84 | 63,24 |
| t+s | Tara + suelo | 51,95 | 55,05 |
| t | Tara | 34,67 | 35,91 |
| s=(t+s)-t | Suelo | 17,28 | 19,14 |
| w=100*(a/s) | ***% Humedad*** | **45,7** | **42,8** |

| ***CÁLCULO LÍMITE PLÁSTICO*** | | |
|---|---|---|
| - | Referencia tara | L 28 |
| a=(t+s+a)-(t+s) | Agua | 8,41 |
| t+s+a | Tara + suelo + agua | 74,56 |
| t+s | Tara + suelo | 66,15 |
| t | Tara | 36,75 |
| s=(t+s)-t | Suelo | 29,40 |
| w=100*(a/s) | ***% Humedad*** | **28,6** |




| ***RESULTADOS DEL ENSAYO*** | |
|---|---|
| LÍMITE LÍQUIDO = | **44,4** |
| LÍMITE PLÁSTICO = | **28,6** |
| ÍNDICE PLASTICIDAD = | **15,8** |

| **INCERTIDUMBRE ENSAYO** |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 11 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103602/96 |
| | Acta nº 2117510 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214820** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C10 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DESCRIPCIÓN DE LA MUESTRA ENSAYADA: | |
|---|---|
| M. INALTERADA | |
| HUMEDAD DE ENSAYO (%): | 16,47 |
| DENSIDAD SECA ENSAYO (g/cm$^3$): | 1,94 |

| | |
|---|---|
| **PRESIÓN DE HINCHAMIENTO (kgf/cm$^2$)** | **0,65** |

| | |
|---|---|
| **PRESIÓN DE HINCHAMIENTO (kPa)** | **63,74** |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO DE SULFATOS SOLUBLES EN SUELOS |
|---|---|---|
| | Norma | UNE 103201/96 |
| | Acta nº 2117511 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214820** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | RR-C10 (1,50 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 23 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| *DATOS ENSAYO* | | |
|---|---|---|
| - | Referencia tara | VP 39 |
| % pasa | % suelo pasa tamiz 2 UNE | 100 |
| g | Muestra ensayada (g) | 10,0830 |
| T | Tara crisol (g) | 25,6286 |
| T+R | Tara crisol + Peso residuo (g) | 25,6766 |
| Rc | Corrección de cenizas Papel filtro (g) | |
| Pp=(T+R)-T-Rc | Residuo calcinado en mufla (g) | 0,0480 |
| v | Volumen de solución analizada (cm$^3$) | 250,00 |
| V | Volumen Agua desmineralizada en frasco (cm$^3$) | 500,00 |

***RESULTADO ENSAYO***

% $SO_3$=[[(Pp*0,34299)/((v/V)*g)]*100]*[% pasa/100]

***$SO_3$ (%)*** = **0,33**

| INCERTIDUMBRE ENSAYO |
|---|
| $SO_3$ (%) δ= 0,17 |

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| Terra LABS Control® www.terralabscontrol.es | Ensayo | GRANULOMETRÍA DE SUELOS POR TAMIZADO |
|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117550 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214777 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C3 (2,60 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

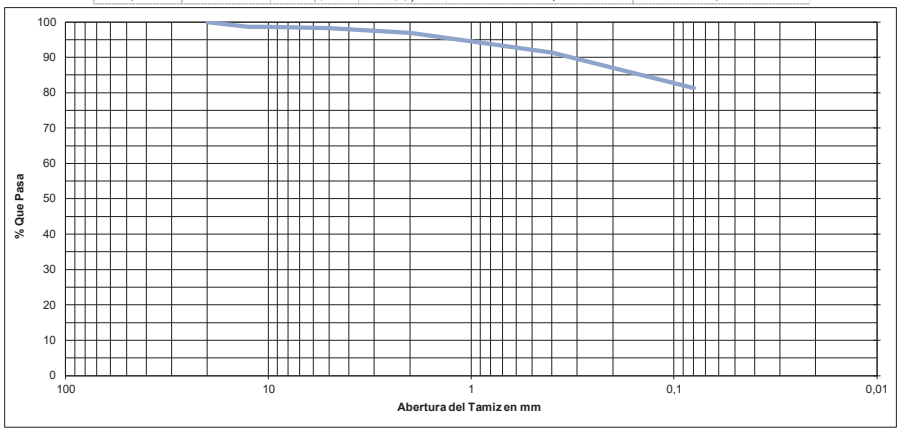
| | | |
|---|---|---|
| A | Muestra total seca al aire | 1604,0 |
| B | Gruesos lavados | 49,4 |
| C = (A - B) * f | Fracción fina seca | 1529,7 |
| D = (B + C) | Muestra total seca | 1579,1 |
| E | Fracción fina ensayada seca al aire | 77,6 |
| F = E * f | Fracción fina ensayada seca | 76,3 |
| C/F | | 20,0 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 1,6 |
| a=(t+s+a)-(t+s) | Agua | 0,9 |
| t+s+a | Tara+suelo+agua | 92,8 |
| t+s | Tara+suelo | 91,8 |
| t | Tara | 34,0 |
| s | Suelo | 57,8 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | 1579,1 | 100 |
| 12,5 | 1/2 | | 22,9 | 1556,3 | 99 |
| 10 | 3/8 | | | 1556,3 | 99 |
| 5 | 4 | | 5,8 | 1550,5 | 98 |
| 2 | 10 | | 20,7 | 1529,7 | 97 |
| 0,4 | 40 | 4,4 | 88,2 | 1441,5 | 91 |
| 0,08 | 200 | 7,8 | 156,1 | 1285,4 | 81 |




OBSERVACIONES:

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Caspe, a 28 de marzo de 2021

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117551 | Nº Copia Copia 1. Igeosuma |

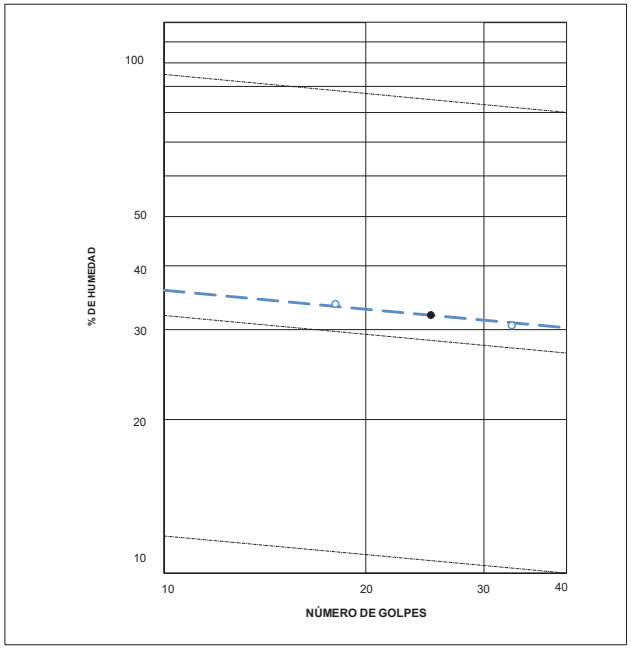
| Referencia Muestra… 214777 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C3 (2,60 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | 18 | 33 |
| - | Referencia tara | RE 14 | RE 2 |
| a=(t+s+a)-(t+s) | Agua | 7,82 | 6,42 |
| t+s+a | Tara + suelo + agua | 43,51 | 40,02 |
| t+s | Tara + suelo | 35,69 | 33,60 |
| t | Tara | 12,52 | 12,63 |
| s=(t+s)-t | Suelo | 23,17 | 20,97 |
| w=100*(a/s) | ***% Humedad*** | **33,8** | **30,6** |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | L 5 |
| a=(t+s+a)-(t+s) | Agua | 4,28 |
| t+s+a | Tara + suelo + agua | 45,35 |
| t+s | Tara + suelo | 41,07 |
| t | Tara | 18,31 |
| s=(t+s)-t | Suelo | 22,76 |
| w=100*(a/s) | ***% Humedad*** | **18,8** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **32,0** |
| LÍMITE PLÁSTICO = | **18,8** |
| ÍNDICE PLASTICIDAD = | **13,2** |

**INCERTIDUMBRE ENSAYO**

LIMITE PLÁSTICO δ= 0,11

LIMITE LÍQUIDO δ= 0,20

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO |
|---|---|---|
| | Norma | UNE 103501/94 |
| | Acta nº 2117552 | Nº Copia Copia 1. Igeosuma |

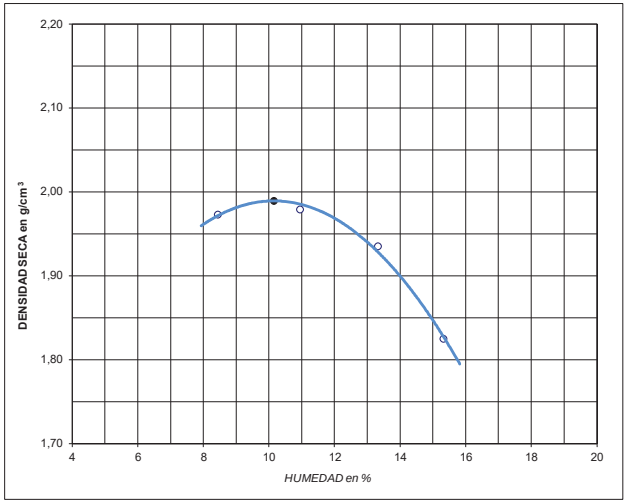
| | | | |
|---|---|---|---|
| **Referencia Muestra… 214777** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C3 (2,60 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DENSIDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | 4,00 | 6,00 | 8,00 | 10,00 | | |
| t+s+a | Molde+suelo+agua | 10391,00 | 10521,50 | 10516,00 | 10310,00 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 4963,50 | 5094,00 | 5088,50 | 4882,50 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 4577,65 | 4591,38 | 4490,37 | 4233,87 | | |
| D=s/v | ***Densidad (g/cm³)*** | **1,97** | **1,98** | **1,94** | **1,82** | | |

***HUMEDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 117,50 | 152,00 | 168,50 | 201,00 | | |
| t+s+a | Tara+suelo+agua | 2050,50 | 2085,00 | 1944,00 | 2051,00 | | |
| t+s | Tara+suelo | 1933,00 | 1933,00 | 1775,50 | 1850,00 | | |
| t | Tara | 539,00 | 544,50 | 510,50 | 538,00 | | |
| s=(t+s)-t | Suelo | 1394,00 | 1388,50 | 1265,00 | 1312,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **8,43** | **10,95** | **13,32** | **15,32** | | |




**CARACTERISTICAS DEL ENSAYO**

| | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

**RESULTADOS COMPACTACION**

| | |
|---|---|
| **Dens máxima (t/m³)** | ***1,99*** |
| **Humedad óptima (%)** | ***10,15*** |

**INCERTIDUMBRE ENSAYO**

DENSIDAD MAXIMA δ= 0,01

HUMEDAD OPTIMA δ= 0,01

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103602/96 |
| | Acta nº 2117553 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214777** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C3 (2,60 m) |
| TIPO DE MUESTRA | M. BLOQUE | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DESCRIPCIÓN DE LA MUESTRA ENSAYADA:**

M. INALTERADA

HUMEDAD DE ENSAYO (%): 13,23

DENSIDAD SECA ENSAYO (g/cm³): 1,91

**PRESIÓN DE HINCHAMIENTO (kgf/cm²) 0,25**

**PRESIÓN DE HINCHAMIENTO (kPa) 24,52**

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| Terra LABS Control® www.terralabscontrol.es | Ensayo | GRANULOMETRÍA DE SUELOS POR TAMIZADO |
|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117554 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214778 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

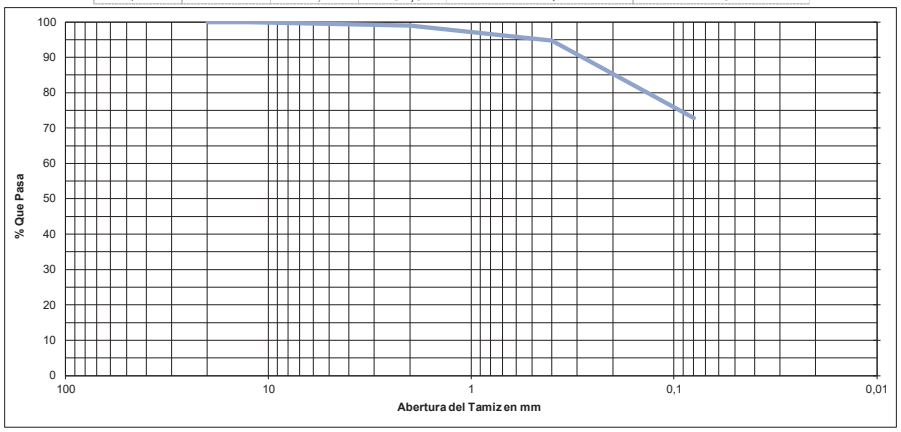
| | | |
|---|---|---|
| A | Muestra total seca al aire | 2256,0 |
| B | Gruesos lavados | 24,3 |
| C = (A - B) * f | Fracción fina seca | 2208,2 |
| D = (B + C) | Muestra total seca | 2232,5 |
| E | Fracción fina ensayada seca al aire | 78,2 |
| F = E * f | Fracción fina ensayada seca | 77,4 |
| C/F | | 28,5 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 1,1 |
| a=(t+s+a)-(t+s) | Agua | 0,8 |
| t+s+a | Tara+suelo+agua | 101,6 |
| t+s | Tara+suelo | 100,9 |
| t | Tara | 29,4 |
| s | Suelo | 71,4 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | 2232,5 | 100 |
| 12,5 | 1/2 | | 2,8 | 2229,7 | 100 |
| 10 | 3/8 | | 1,9 | 2227,8 | 100 |
| 5 | 4 | | 7,3 | 2220,5 | 99 |
| 2 | 10 | | 12,3 | 2208,2 | 99 |
| 0,4 | 40 | 3,3 | 93,6 | 2114,7 | 95 |
| 0,08 | 200 | 17,1 | 487,5 | 1627,1 | 73 |




OBSERVACIONES:

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117555 | Nº Copia Copia 1. Igeosuma |

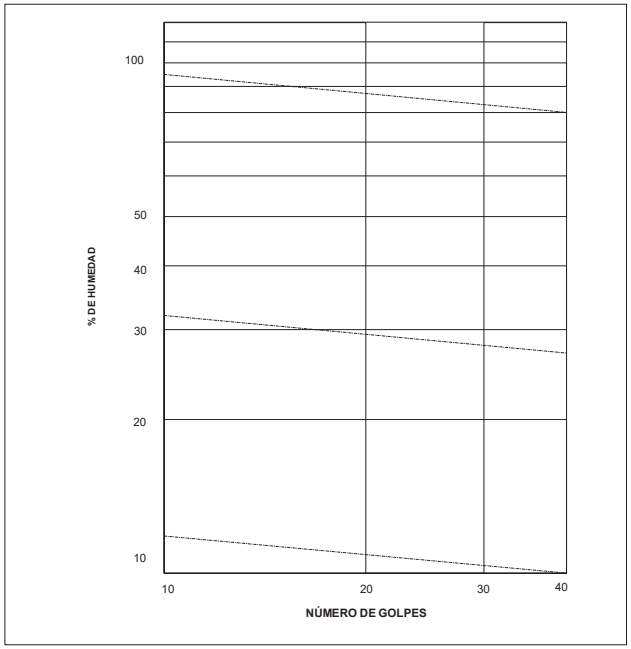
| Referencia Muestra… 214778 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | | |
| - | Referencia tara | | |
| a=(t+s+a)-(t+s) | Agua | | |
| t+s+a | Tara + suelo + agua | | |
| t+s | Tara + suelo | | |
| t | Tara | | |
| s=(t+s)-t | Suelo | | |
| w=100*(a/s) | ***% Humedad*** | | |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | |
| a=(t+s+a)-(t+s) | Agua | |
| t+s+a | Tara + suelo + agua | |
| t+s | Tara + suelo | |
| t | Tara | |
| s=(t+s)-t | Suelo | |
| w=100*(a/s) | ***% Humedad*** | |




| ***RESULTADOS DEL ENSAYO*** | |
|---|---|
| LÍMITE LÍQUIDO = | **N. P.*** |
| LÍMITE PLÁSTICO = | **N. P.*** |
| ÍNDICE PLASTICIDAD = | **N. P.*** |

*N.P. = NO PRESENTA LÍMITE

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO |
|---|---|---|
| | Norma | UNE 103501/94 |
| | Acta nº 2117556 | Nº Copia Copia 1. Igeosuma |

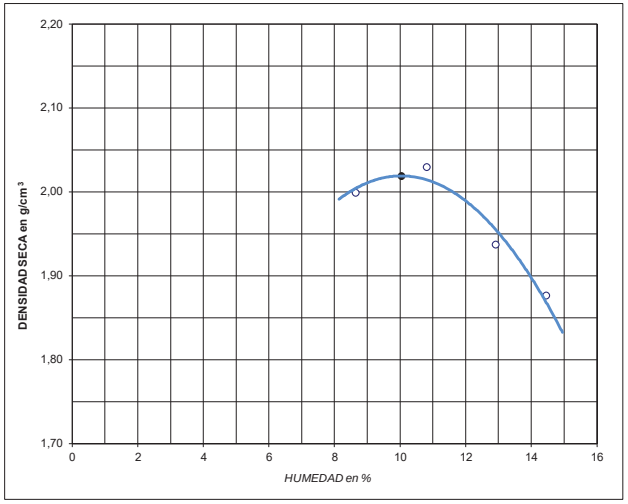
| | | | |
|---|---|---|---|
| **Referencia Muestra… 214778** | | Referencia Informe….. | EXP 21999 |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DENSIDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | 4,00 | 6,00 | 8,00 | 10,00 | | |
| t+s+a | Molde+suelo+agua | 10466,00 | 10644,50 | 10502,00 | 10410,00 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 5038,50 | 5217,00 | 5074,50 | 4982,50 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 4638,01 | 4708,22 | 4494,29 | 4353,44 | | |
| D=s/v | ***Densidad (g/cm³)*** | **2,00** | **2,03** | **1,94** | **1,88** | | |

***HUMEDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 130,00 | 130,00 | 153,50 | 182,50 | | |
| t+s+a | Tara+suelo+agua | 2154,50 | 1879,00 | 1874,00 | 1980,50 | | |
| t+s | Tara+suelo | 2024,50 | 1749,00 | 1720,50 | 1798,00 | | |
| t | Tara | 519,00 | 546,00 | 531,50 | 535,00 | | |
| s=(t+s)-t | Suelo | 1505,50 | 1203,00 | 1189,00 | 1263,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **8,64** | **10,81** | **12,91** | **14,45** | | |




**CARACTERISTICAS DEL ENSAYO**

| | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

**RESULTADOS COMPACTACION**

| | |
|---|---|
| **Dens máxima (t/m³)** | ***2,02*** |
| **Humedad óptima (%)** | ***10,04*** |

| INCERTIDUMBRE ENSAYO |
|---|
| DENSIDAD MAXIMA δ= 0,01 |
| HUMEDAD OPTIMA δ= 0,01 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO EN MATERIA ORGÁNICA EN SUELOS |
|---|---|---|
| | Norma | UNE 103204/93 |
| | Acta nº 2117559 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214778** | | Referencia Informe…… | EXP 21999 |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DATOS ENSAYO***

| | | | |
|---|---|---|---|
| - | Referencia tara | M - 1 | M - 2 |
| % pasa | % suelo pasa tamiz 2 UNE | 99 | 99 |
| f | Factor de normalidad Permanganato | 1,01 | 1,01 |
| g | Total muestra ensayada (g) | 0,2570 | 0,2490 |
| V | Volumen Permanganato potásico valoración (cm³) | 0,70 | 0,80 |

***RESULTADO ENSAYO***

% mat org (f < 2 UNE) =[ [0,1032*V*f]/g]

*Mat. orgánica referida fracción ensayada (f < 2 UNE) (%) =* ***0,31***

***RESULTADO ENSAYO***

% mat org =[ [0,1032*V*f]/g]*%pasa

*Mat. orgánica referida al total de muestra (%) =* ***0,30***

| INCERTIDUMBRE ENSAYO |
|---|
| Mat. Orgánica (%) δ= 0,05 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO DE SALES SOLUBLES EN SUELOS |
|---|---|---|
| | Norma | UNE 103205/06 |
| | Acta nº 2117560 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214778 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | | |
|---|---|---|
| - | Referencia tara | CP 8 |
| % pasa | % suelo pasa tamiz 2 UNE | 99 |
| g | Muestra ensayada (g) | 49,1330 |
| T | Tara crisol (g) | 129,1280 |
| T+R | Tara crisol + Peso residuo (g) | 129,1390 |
| Pp=(T+R)-T | Residuo seco en estufa (g) | 0,0110 |
| v | Volumen de solución analizada ($cm^3$) | 100,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

**RESULTADO ENSAYO**

Sales solubles referido a la fracción ensayada (f < 2 UNE)=[[(Pp*V)/(g*v)]*100]

***Sales Solubles referida fracción ensayada (f < 2 UNE) (%)*** **0,1**

**RESULTADO ENSAYO**

Sales solubles referido al total de la muestra =[[(Pp*V)/(g*v)]*100]*% pasa

***Sales Solubles referida total de la muestra (%)*** **0,1**

| INCERTIDUMBRE ENSAYO |
|---|
| Sales solubles (%) δ= 0,04 |

**OBSERVACIONES:** Muestra ensayada pulverizada < 0,08 UNE (Procedimiento D.G.A.).

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|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117562 | Nº Copia Copia 1. Igeosuma |

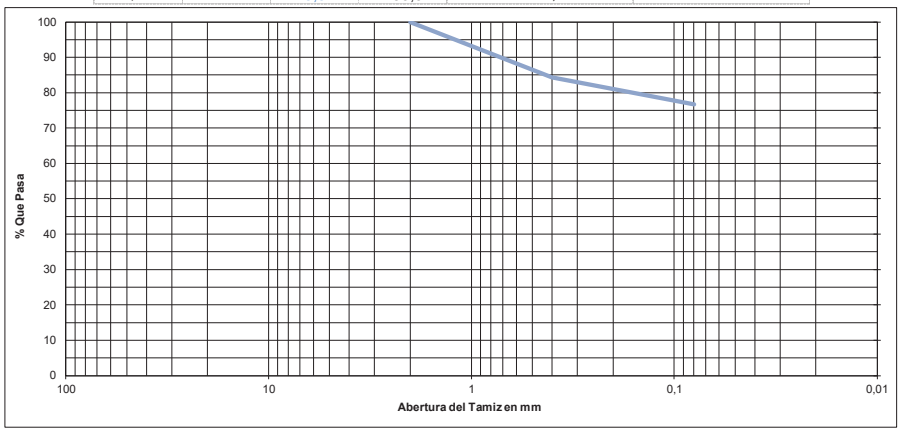
| Referencia Muestra… 214779 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULOS PREVIOS | | |
|---|---|---|
| A | Muestra total seca al aire | 2440,0 |
| B | Gruesos lavados | |
| C = (A - B) * f | Fracción fina seca | 2405,8 |
| D = (B + C) | Muestra total seca | 2405,8 |
| E | Fracción fina ensayada seca al aire | 70,2 |
| F = E * f | Fracción fina ensayada seca | 69,2 |
| C/F | | 34,8 |

| HUMEDAD HIGROSCÓPICA | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 1,4 |
| a=(t+s+a)-(t+s) | Agua | 0,9 |
| t+s+a | Tara+suelo+agua | 95,0 |
| t+s | Tara+suelo | 94,1 |
| t | Tara | 33,0 |
| s | Suelo | 61,1 |

CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | | |
| 5 | 4 | | | | |
| 2 | 10 | | | 2405,8 | 100 |
| 0,4 | 40 | 10,8 | 376,2 | 2029,5 | 84 |
| 0,08 | 200 | 5,3 | 183,3 | 1846,3 | 77 |




OBSERVACIONES:

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117563 | Nº Copia Copia 1. Igeosuma |

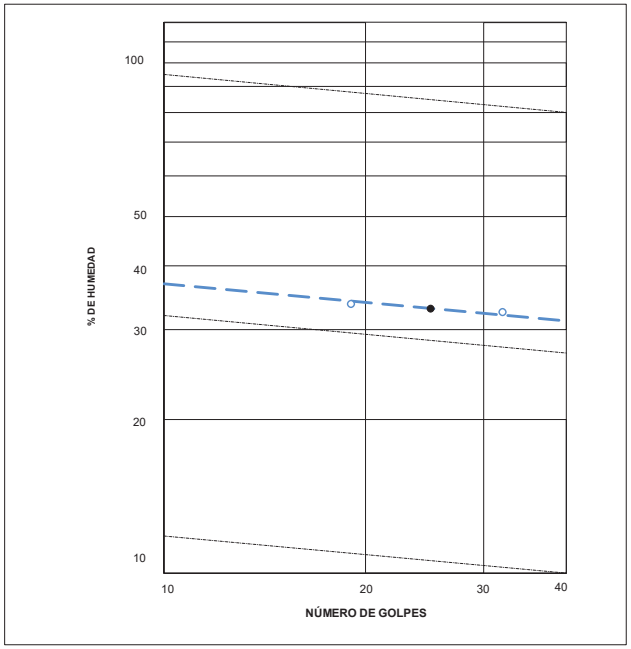
| Referencia Muestra… 214779 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 19 | 32 |
| - | Referencia tara | RE 16 | RE 24 |
| a=(t+s+a)-(t+s) | Agua | 7,97 | 5,36 |
| t+s+a | Tara + suelo + agua | 44,39 | 34,62 |
| t+s | Tara + suelo | 36,42 | 29,26 |
| t | Tara | 12,78 | 12,76 |
| s=(t+s)-t | Suelo | 23,64 | 16,50 |
| w=100*(a/s) | ***% Humedad*** | **33,7** | **32,5** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 1 |
| a=(t+s+a)-(t+s) | Agua | 4,03 |
| t+s+a | Tara + suelo + agua | 42,20 |
| t+s | Tara + suelo | 38,17 |
| t | Tara | 18,29 |
| s=(t+s)-t | Suelo | 19,88 |
| w=100*(a/s) | ***% Humedad*** | **20,3** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **33,0** |
| LÍMITE PLÁSTICO = | **20,3** |
| ÍNDICE PLASTICIDAD = | **12,8** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO |
|---|---|---|
| | Norma | UNE 103501/94 |
| | Acta nº 2117564 | Nº Copia Copia 1. Igeosuma |

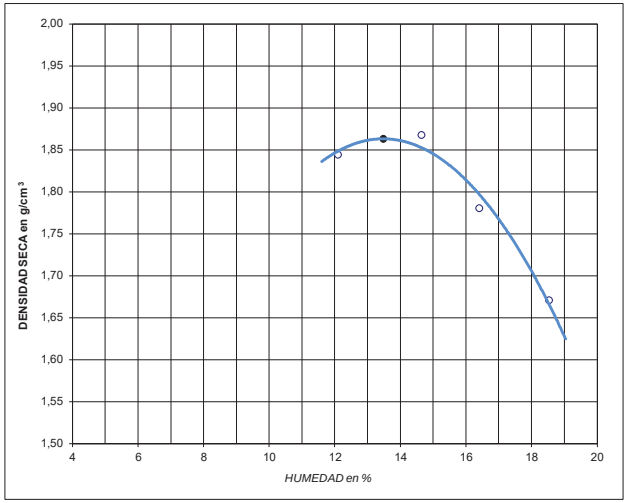
| Referencia Muestra… 214779 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DENSIDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | 6,00 | 8,00 | 10,00 | 12,00 | | |
| t+s+a | Molde+suelo+agua | 10224,50 | 10396,00 | 10236,50 | 10023,00 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 4797,00 | 4968,50 | 4809,00 | 4595,50 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 4279,32 | 4334,11 | 4131,50 | 3876,88 | | |
| D=s/v | ***Densidad (g/cm³)*** | **1,84** | **1,87** | **1,78** | **1,67** | | |

***HUMEDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 169,00 | 172,50 | 188,50 | 195,00 | | |
| t+s+a | Tara+suelo+agua | 2111,50 | 1865,50 | 1874,00 | 1785,00 | | |
| t+s | Tara+suelo | 1942,50 | 1693,00 | 1685,50 | 1590,00 | | |
| t | Tara | 545,50 | 514,50 | 536,00 | 538,00 | | |
| s=(t+s)-t | Suelo | 1397,00 | 1178,50 | 1149,50 | 1052,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **12,10** | **14,64** | **16,40** | **18,54** | | |




**CARACTERISTICAS DEL ENSAYO**

| | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

**RESULTADOS COMPACTACION**

| | |
|---|---|
| **Dens máxima (t/m³)** | ***1,86*** |
| **Humedad óptima (%)** | ***13,48*** |

| INCERTIDUMBRE ENSAYO |
|---|
| DENSIDAD MAXIMA δ= 0,01 |
| HUMEDAD OPTIMA δ= 0,01 |

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DEL HINCHAMIENTO LIBRE DE UN SUELO EN EDÓMETRO** |
|---|---|---|
| | *Norma* | UNE 103601/96 |
| | *Acta nº* **2117565** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214779** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| **DESCRIPCIÓN DE LA MUESTRA ENSAYADA:** | |
|---|---|
| REMOLDEADA AL 98 % DEL | P.M. |

| DATOS ENSAYO | |
|---|---|
| ALTURA INICIAL (mm) | 4,97 |
| ALTURA FINAL (mm) | 5,72 |
| INCREMENTO DE ALTURA (mm) | 0,75 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HINCHAMIENTO (%)** | **3,8** |

| **INCERTIDUMBRE ENSAYO** |
|---|
| HINCHAMIENTO δ= 0,40 |

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **CONTENIDO DE SALES SOLUBLES EN SUELOS** |
|---|---|---|
| | *Norma* | UNE 103205/06 |
| | *Acta nº* **2117567** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214779** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***DATOS ENSAYO*** | | |
|---|---|---|
| - | Referencia tara | CP 9 |
| % pasa | % suelo pasa tamiz 2 UNE | 100 |
| g | Muestra ensayada (g) | 2,0650 |
| T | Tara crisol (g) | 103,0920 |
| T+R | Tara crisol + Peso residuo (g) | 103,1740 |
| Pp=(T+R)-T | Residuo seco en estufa (g) | 0,0820 |
| v | Volumen de solución analizada ($cm^3$) | 100,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

| ***RESULTADO ENSAYO*** | |
|---|---|
| Sales solubles referido a la fracción ensayada (f < 2 UNE)=[[(Pp*V)/(g*v)]*100] | |
| ***Sales Solubles referida fracción ensayada (f < 2 UNE) (%)*** | **19,9** |

| ***RESULTADO ENSAYO*** | |
|---|---|
| Sales solubles referido al total de la muestra =[[(Pp*V)/(g*v)]*100]*% pasa | |
| ***Sales Solubles referida total de la muestra (%)*** | **19,9** |

| **INCERTIDUMBRE ENSAYO** |
|---|
| Sales solubles (%) δ= 0,04 |

**OBSERVACIONES:** Muestra ensayada pulverizada < 0,08 UNE (Procedimiento D.G.A.).

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Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO DE YESO EN SUELOS |
|---|---|---|
| | Norma | UNE 103206/06 |
| | Acta nº 2117568 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214779 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| | DATOS ENSAYO | $SO_4^=$ total | $SO_4^=$ parcial |
|---|---|---|---|
| - | Referencia tara | VP 59 | MA 2 |
| g | Muestra ensayada (g) | 2,0350 | 1,2328 |
| T | Tara crisol (g) | 25,7205 | 26,3247 |
| T+R | Tara crisol + Peso residuo (g) | 26,0042 | 26,3259 |
| Rc | Corrección de cenizas Papel filtro (g) | | |
| Pp=(T+R)-T-Rc | Residuo calcinado en mufla (g) | 0,2837 | 0,0012 |
| v | Volumen de solución analizada ($cm^3$) | 250,00 | 100,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 | 100,00 |
| | ***Iones $SO_4^=$ (%)*** | **11,49** | **0,04** |

***RESULTADO ENSAYO***

CONTENIDO YESO REFERIDO A FRACCIÓN ENSAYADA (%) = 1,792*[(% $SO_4^=$ totales)-(% $SO_4^=$ parciales)]

***Contenido de yeso referido a fracción ensayada (f < 0,08 UNE) (%)*** **20,51**

***RESULTADO ENSAYO***

CONTENIDO YESO REFERIDO AL TOTAL DE LA MUESTRA (%) = (1,792*[(% $SO_4^=$ totales)-(% $SO_4^=$ parciales)])*%pasa

***Contenido de yeso referido al total de la muestra (%)*** **20,51**

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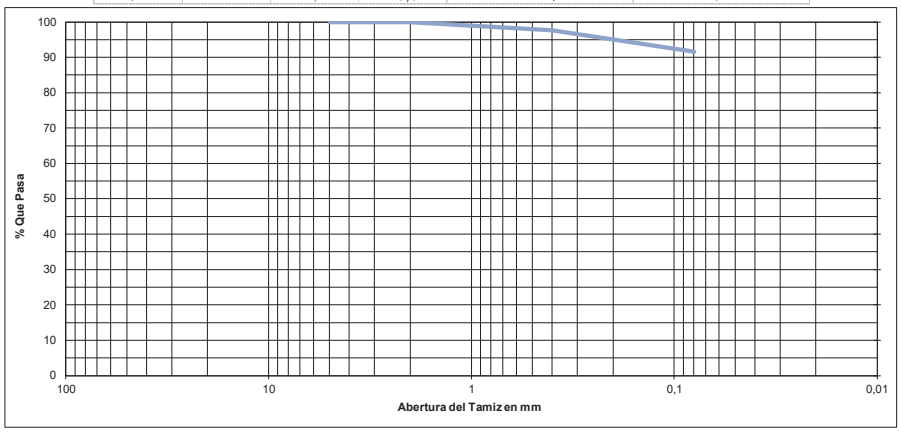
| Terra LABS Control www.terralabscontrol.es | Ensayo | GRANULOMETRÍA DE SUELOS POR TAMIZADO |
|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117569 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214780 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C3 (1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULOS PREVIOS | | | HUMEDAD HIGROSCÓPICA | | |
|---|---|---|---|---|---|
| A | Muestra total seca al aire | 1267,4 | f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| B | Gruesos lavados | 0,8 | h=(a/s)*100 | Humedad higroscópica % | 2,2 |
| C = (A - B) * f | Fracción fina seca | 1239,4 | a=(t+s+a)-(t+s) | Agua | 1,3 |
| D = (B + C) | Muestra total seca | 1240,1 | t+s+a | Tara+suelo+agua | 89,7 |
| E | Fracción fina ensayada seca al aire | 71,3 | t+s | Tara+suelo | 88,4 |
| F = E * f | Fracción fina ensayada seca | 69,8 | t | Tara | 28,0 |
| C/F | | 17,8 | s | Suelo | 60,4 |

CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | | |
| 5 | 4 | | | 1240,1 | 100 |
| 2 | 10 | | 0,8 | 1239,4 | 100 |
| 0,4 | 40 | 1,6 | 27,9 | 1211,5 | 98 |
| 0,08 | 200 | 4,2 | 75,3 | 1136,1 | 92 |




OBSERVACIONES:

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG | |
|---|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 | |
| | Acta nº | 2117570 | Nº Copia: Copia 1. Igeosuma |

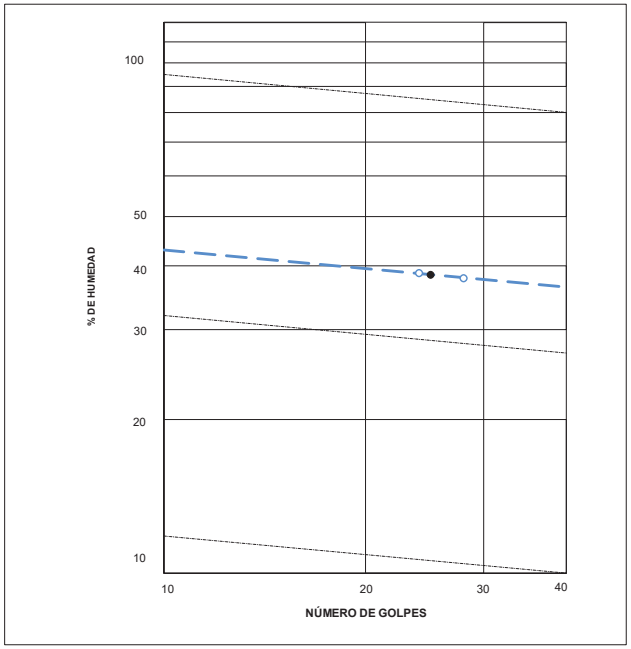
| Referencia Muestra… 214780 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C3 (1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 28 | 24 |
| - | Referencia tara | T 24 | T 16 |
| a=(t+s+a)-(t+s) | Agua | 7,78 | 8,41 |
| t+s+a | Tara + suelo + agua | 44,74 | 46,72 |
| t+s | Tara + suelo | 36,96 | 38,31 |
| t | Tara | 16,41 | 16,62 |
| s=(t+s)-t | Suelo | 20,55 | 21,69 |
| w=100*(a/s) | ***% Humedad*** | **37,9** | **38,8** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 4 |
| a=(t+s+a)-(t+s) | Agua | 4,37 |
| t+s+a | Tara + suelo + agua | 43,33 |
| t+s | Tara + suelo | 38,96 |
| t | Tara | 18,26 |
| s=(t+s)-t | Suelo | 20,70 |
| w=100*(a/s) | ***% Humedad*** | **21,1** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **38,5** |
| LÍMITE PLÁSTICO = | **21,1** |
| ÍNDICE PLASTICIDAD = | **17,4** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO | |
|---|---|---|---|
| | Norma | UNE 103501/94 | |
| | Acta nº | 2117571 | Nº Copia: Copia 1. Igeosuma |

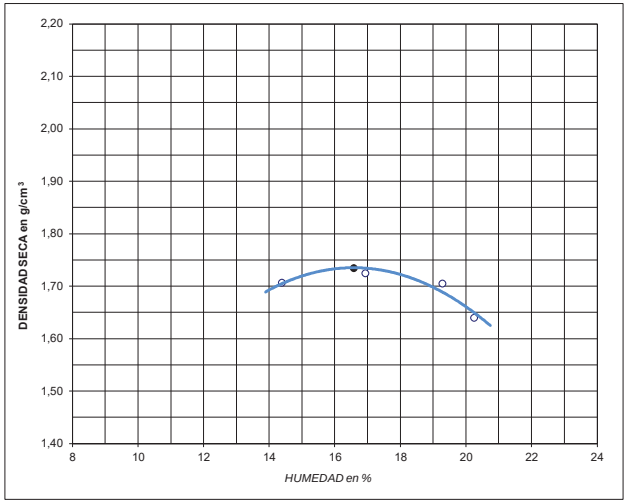
| Referencia Muestra… 214780 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C3 (1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DENSIDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | 4,00 | 6,00 | 8,00 | 10,00 | | |
| t+s+a | Molde+suelo+agua | 9957,50 | 10108,00 | 10146,00 | 10003,50 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 4530,00 | 4680,50 | 4718,50 | 4576,00 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 3960,35 | 4002,83 | 3955,68 | 3805,62 | | |
| D=s/v | ***Densidad (g/cm³)*** | **1,71** | **1,73** | **1,71** | **1,64** | | |

***HUMEDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 136,00 | 177,00 | 215,50 | 233,00 | | |
| t+s+a | Tara+suelo+agua | 1623,50 | 1753,00 | 1880,50 | 1926,00 | | |
| t+s | Tara+suelo | 1487,50 | 1576,00 | 1665,00 | 1693,00 | | |
| t | Tara | 542,00 | 530,50 | 547,50 | 542,00 | | |
| s=(t+s)-t | Suelo | 945,50 | 1045,50 | 1117,50 | 1151,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **14,38** | **16,93** | **19,28** | **20,24** | | |




**CARACTERISTICAS DEL ENSAYO**

| | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

| RESULTADOS COMPACTACION | |
|---|---|
| **Dens máxima (t/m³)** | ***1,74*** |
| **Humedad óptima (%)** | ***16,58*** |

| INCERTIDUMBRE ENSAYO |
|---|
| DENSIDAD MAXIMA δ= 0,01 |
| HUMEDAD OPTIMA δ= 0,01 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO EN MATERIA ORGÁNICA EN SUELOS |
|---|---|---|
| | Norma | UNE 103204/93 |
| | Acta nº 2117572 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214780 | | Referencia Informe…… | EXP 21999 |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE2-C3 (1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DATOS ENSAYO**

| | | | |
|---|---|---|---|
| - | Referencia tara | M - 1 | M - 2 |
| % pasa | % suelo pasa tamiz 2 UNE | 100 | 100 |
| f | Factor de normalidad Permanganato | 1,01 | 1,01 |
| g | Total muestra ensayada (g) | 0,2520 | 0,2600 |
| V | Volumen Permanganato potásico valoración ($cm^3$) | 2,20 | 2,10 |

**RESULTADO ENSAYO**

% mat org (f < 2 UNE) =[ [0,1032*V*f]/g]

*Mat. orgánica referida fracción ensayada (f < 2 UNE) (%) =* **0,87**

**RESULTADO ENSAYO**

% mat org =[ [0,1032*V*f]/g]*%pasa

*Mat. orgánica referida al total de muestra (%) =* **0,87**

| INCERTIDUMBRE ENSAYO |
|---|
| Mat. Orgánica (%) δ= 0,05 |

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|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117580 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214846 | | Referencia Informe….. | EXP 21999 |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (0,60 - 0,90 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

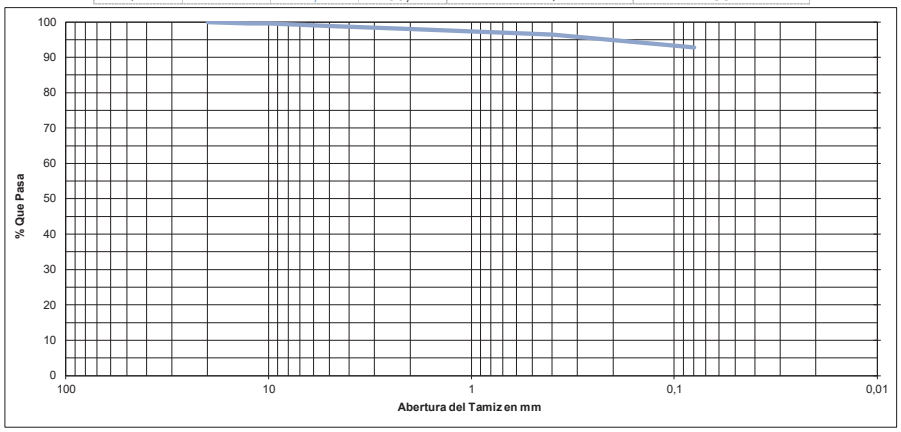
| | | |
|---|---|---|
| A | Muestra total seca al aire | 1601,5 |
| B | Gruesos lavados | 31,3 |
| C = (A - B) * f | Fracción fina seca | 1561,5 |
| D = (B + C) | Muestra total seca | 1592,8 |
| E | Fracción fina ensayada seca al aire | 75,2 |
| F = E * f | Fracción fina ensayada seca | 74,8 |
| C/F | | 20,9 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 0,6 |
| a=(t+s+a)-(t+s) | Agua | 0,4 |
| t+s+a | Tara+suelo+agua | 101,9 |
| t+s | Tara+suelo | 101,5 |
| t | Tara | 28,0 |
| s | Suelo | 73,6 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | 1592,8 | 100 |
| 12,5 | 1/2 | | 6,3 | 1586,5 | 100 |
| 10 | 3/8 | | 1,0 | 1585,5 | 100 |
| 5 | 4 | | 10,5 | 1575,0 | 99 |
| 2 | 10 | | 13,5 | 1561,5 | 98 |
| 0,4 | 40 | 1,2 | 25,9 | 1535,6 | 96 |
| 0,08 | 200 | 2,7 | 56,2 | 1479,4 | 93 |




OBSERVACIONES:

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Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG | |
|---|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 | |
| | Acta nº | 2117581 | Nº Copia: Copia 1. Igeosuma |

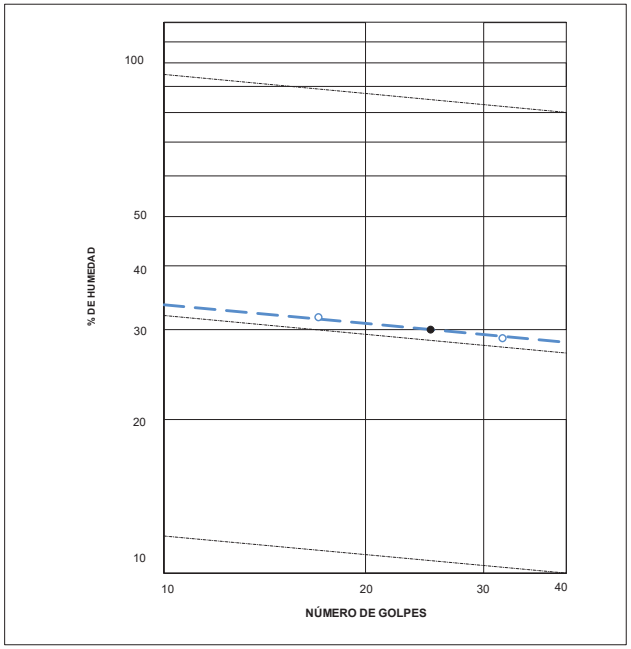
| Referencia Muestra… 214846 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (0,60 - 0,90 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 17 | 32 |
| - | Referencia tara | T 27 | RE 2 |
| a=(t+s+a)-(t+s) | Agua | 7,59 | 6,47 |
| t+s+a | Tara + suelo + agua | 48,19 | 41,48 |
| t+s | Tara + suelo | 40,60 | 35,01 |
| t | Tara | 16,70 | 12,63 |
| s=(t+s)-t | Suelo | 23,90 | 22,38 |
| w=100*(a/s) | *% Humedad* | **31,8** | **28,9** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 5 |
| a=(t+s+a)-(t+s) | Agua | 4,98 |
| t+s+a | Tara + suelo + agua | 49,94 |
| t+s | Tara + suelo | 44,96 |
| t | Tara | 18,32 |
| s=(t+s)-t | Suelo | 26,64 |
| w=100*(a/s) | *% Humedad* | **18,7** |




**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| LÍMITE LÍQUIDO = | **30,0** |
| LÍMITE PLÁSTICO = | **18,7** |
| ÍNDICE PLASTICIDAD = | **11,3** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO | |
|---|---|---|---|
| | Norma | UNE 103501/94 | |
| | Acta nº | 2117582 | Nº Copia: Copia 1. Igeosuma |

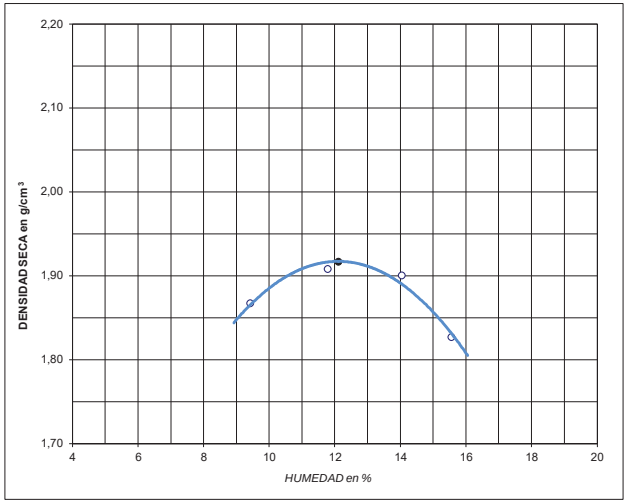
| Referencia Muestra… 214846 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (0,60 - 0,90 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DENSIDAD**

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | 4,00 | 6,00 | 8,00 | 10,00 | | |
| t+s+a | Molde+suelo+agua | 10168,00 | 10376,00 | 10455,50 | 10325,50 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 4740,50 | 4948,50 | 5028,00 | 4898,00 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 4332,46 | 4427,12 | 4409,12 | 4238,81 | | |
| D=s/v | ***Densidad (g/cm³)*** | **1,87** | **1,91** | **1,90** | **1,83** | | |

**HUMEDAD**

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 146,50 | 171,00 | 181,00 | 158,00 | | |
| t+s+a | Tara+suelo+agua | 2233,00 | 2142,00 | 2009,50 | 1684,00 | | |
| t+s | Tara+suelo | 2086,50 | 1971,00 | 1828,50 | 1526,00 | | |
| t | Tara | 531,00 | 519,00 | 539,00 | 510,00 | | |
| s=(t+s)-t | Suelo | 1555,50 | 1452,00 | 1289,50 | 1016,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **9,42** | **11,78** | **14,04** | **15,55** | | |




**CARACTERISTICAS DEL ENSAYO**

| | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

| RESULTADOS COMPACTACION | |
|---|---|
| **Dens máxima (t/m³)** | ***1,92*** |
| **Humedad óptima (%)** | ***12,11*** |

| INCERTIDUMBRE ENSAYO |
|---|
| DENSIDAD MAXIMA δ= 0,01 |
| HUMEDAD OPTIMA δ= 0,01 |

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|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117583 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214847 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

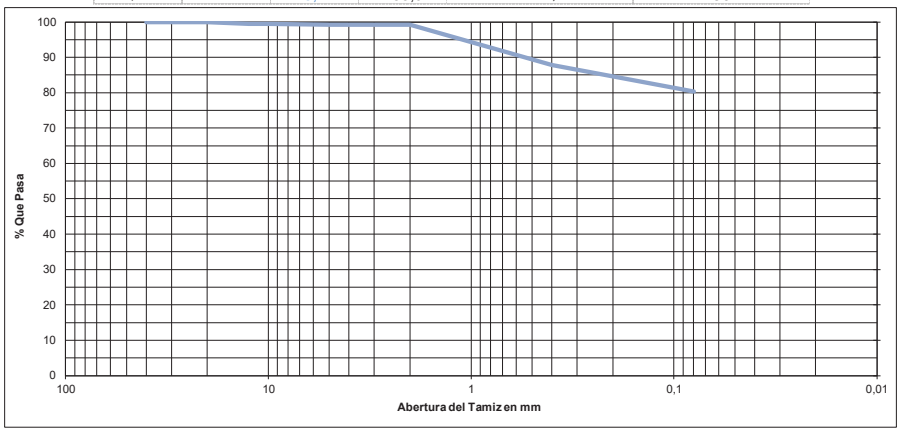
| | | |
|---|---|---|
| A | Muestra total seca al aire | 2472,6 |
| B | Gruesos lavados | 20,6 |
| C = (A - B) * f | Fracción fina seca | 2434,9 |
| D = (B + C) | Muestra total seca | 2455,5 |
| E | Fracción fina ensayada seca al aire | 71,7 |
| F = E * f | Fracción fina ensayada seca | 71,2 |
| C/F | | 34,2 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 0,7 |
| a=(t+s+a)-(t+s) | Agua | 0,6 |
| t+s+a | Tara+suelo+agua | 117,1 |
| t+s | Tara+suelo | 116,4 |
| t | Tara | 29,4 |
| s | Suelo | 87,0 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | 100 |
| 25 | 1 | | | | 100 |
| 20 | 3/4 | | | 2455,5 | 100 |
| 12,5 | 1/2 | | 13,2 | 2442,3 | 99 |
| 10 | 3/8 | | 1,4 | 2440,9 | 99 |
| 5 | 4 | | 5,3 | 2435,6 | 99 |
| 2 | 10 | | 0,7 | 2434,9 | 99 |
| 0,4 | 40 | 8,1 | 278,0 | 2156,9 | 88 |
| 0,08 | 200 | 5,4 | 183,6 | 1973,3 | 80 |




OBSERVACIONES:

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| Terra LABS Control® www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG |
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117584 | Nº Copia Copia 1. Igeosuma |

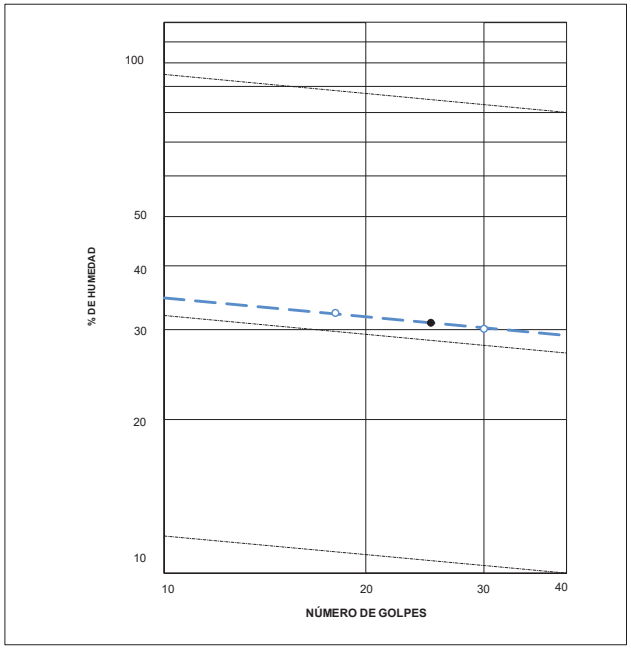
| Referencia Muestra… 214847 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | 18 | 30 |
| - | Referencia tara | T 11 | T 24 |
| a=(t+s+a)-(t+s) | Agua | 7,43 | 6,70 |
| t+s+a | Tara + suelo + agua | 46,99 | 45,36 |
| t+s | Tara + suelo | 39,56 | 38,66 |
| t | Tara | 16,61 | 16,43 |
| s=(t+s)-t | Suelo | 22,95 | 22,23 |
| w=100*(a/s) | **% Humedad** | **32,4** | **30,1** |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | L 1 |
| a=(t+s+a)-(t+s) | Agua | 4,75 |
| t+s+a | Tara + suelo + agua | 47,13 |
| t+s | Tara + suelo | 42,38 |
| t | Tara | 18,29 |
| s=(t+s)-t | Suelo | 24,09 |
| w=100*(a/s) | **% Humedad** | **19,7** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **31,0** |
| LÍMITE PLÁSTICO = | **19,7** |
| ÍNDICE PLASTICIDAD = | **11,2** |

**INCERTIDUMBRE ENSAYO**

LIMITE PLÁSTICO δ= 0,11

LIMITE LÍQUIDO δ= 0,20

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José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO |
|---|---|---|
| | Norma | UNE 103501/94 |
| | Acta nº 2117585 | Nº Copia Copia 1. Igeosuma |

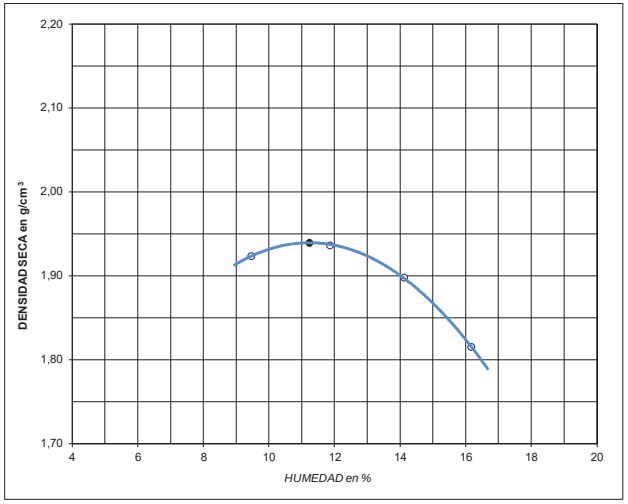
| | | | |
|---|---|---|---|
| **Referencia Muestra… 214847** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DENSIDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | 2,00 | 4,00 | 6,00 | 8,00 | | |
| t+s+a | Molde+suelo+agua | 10311,50 | 10452,00 | 10453,00 | 10320,00 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 4884,00 | 5024,50 | 5025,50 | 4892,50 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 4462,29 | 4492,14 | 4403,70 | 4211,58 | | |
| D=s/v | ***Densidad (g/cm³)*** | **1,92** | **1,94** | **1,90** | **1,82** | | |

***HUMEDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 129,00 | 141,50 | 146,00 | 194,50 | | |
| t+s+a | Tara+suelo+agua | 2041,50 | 1878,50 | 1724,50 | 1912,50 | | |
| t+s | Tara+suelo | 1912,50 | 1737,00 | 1578,50 | 1718,00 | | |
| t | Tara | 547,50 | 543,00 | 544,50 | 515,00 | | |
| s=(t+s)-t | Suelo | 1365,00 | 1194,00 | 1034,00 | 1203,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **9,45** | **11,85** | **14,12** | **16,17** | | |




| CARACTERISTICAS DEL ENSAYO | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

| RESULTADOS COMPACTACION | |
|---|---|
| **Dens máxima (t/m³)** | ***1,94*** |
| **Humedad óptima (%)** | ***11,24*** |

| INCERTIDUMBRE ENSAYO |
|---|
| DENSIDAD MAXIMA δ= 0,01 |
| HUMEDAD OPTIMA δ= 0,01 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DEL HINCHAMIENTO LIBRE DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103601/96 |
| | Acta nº 2117586 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214847** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DESCRIPCIÓN DE LA MUESTRA ENSAYADA: | |
|---|---|
| REMOLDEADA AL 98 % DEL | P.M. |

| DATOS ENSAYO | |
|---|---|
| ALTURA INICIAL (mm) | 4,96 |
| ALTURA FINAL (mm) | 6,13 |
| INCREMENTO DE ALTURA (mm) | 1,17 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HINCHAMIENTO (%)** | **5,9** |

| INCERTIDUMBRE ENSAYO |
|---|
| HINCHAMIENTO δ= 0,40 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO DE SALES SOLUBLES EN SUELOS |
|---|---|---|
| | Norma | UNE 103205/06 |
| | Acta nº 2117588 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214847** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***DATOS ENSAYO*** | | |
|---|---|---|
| - | Referencia tara | CP 7 |
| % pasa | % suelo pasa tamiz 2 UNE | 99 |
| g | Muestra ensayada (g) | 2,8690 |
| T | Tara crisol (g) | 142,1100 |
| T+R | Tara crisol + Peso residuo (g) | 142,1310 |
| Pp=(T+R)-T | Residuo seco en estufa (g) | 0,0210 |
| v | Volumen de solución analizada ($cm^3$) | 100,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

***RESULTADO ENSAYO***

Sales solubles referido a la fracción ensayada (f < 2 UNE)=[[(Pp*V)/(g*v)]*100]

***Sales Solubles referida fracción ensayada (f < 2 UNE) (%)*** **3,7**

***RESULTADO ENSAYO***

Sales solubles referido al total de la muestra =[[(Pp*V)/(g*v)]*100]*% pasa

***Sales Solubles referida total de la muestra (%)*** **3,6**

| INCERTIDUMBRE ENSAYO |
|---|
| Sales solubles (%) δ= 0,04 |

**OBSERVACIONES:** Muestra ensayada pulverizada < 0,08 UNE (Procedimiento D.G.A.).

VºBº

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| Terra LABS Control www.terralabscontrol.es | Ensayo | CONTENIDO DE YESO EN SUELOS |
|---|---|---|
| | Norma | UNE 103206/06 |
| | Acta nº 2117589 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214847** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| | ***DATOS ENSAYO*** | *$SO_4^=$ total* | *$SO_4^=$ parcial* |
|---|---|---|---|
| - | Referencia tara | VP 42 | ER 1 |
| g | Muestra ensayada (g) | 1,4847 | 1,0062 |
| T | Tara crisol (g) | 25,6473 | 24,6611 |
| T+R | Tara crisol + Peso residuo (g) | 25,6817 | 24,6638 |
| Rc | Corrección de cenizas Papel filtro (g) | | |
| Pp=(T+R)-T-Rc | Residuo calcinado en mufla (g) | 0,0344 | 0,0027 |
| v | Volumen de solución analizada ($cm^3$) | 250,00 | 100,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 | 100,00 |
| | ***Iones $SO_4^=$ (%)*** | **1,91** | **0,11** |

***RESULTADO ENSAYO***

CONTENIDO YESO REFERIDO A FRACCIÓN ENSAYADA (%) = 1,792*[(% $SO_4^=$ totales)-(% $SO_4^=$ parciales)]

***Contenido de yeso referido a fracción ensayada (f < 0,08 UNE) (%)*** **3,22**

***RESULTADO ENSAYO***

CONTENIDO YESO REFERIDO AL TOTAL DE LA MUESTRA (%) = (1,792*[(% $SO_4^=$ totales)-(% $SO_4^=$ parciales)])*%pasa

***Contenido de yeso referido al total de la muestra (%)*** **3,20**

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| Terra LABS Control® www.terralabscontrol.es | Ensayo | GRANULOMETRÍA DE SUELOS POR TAMIZADO |
|---|---|---|
| | Norma | UNE 103101/95 |
| | Acta nº 2117573 | Nº Copia Copia 1. Igeosuma |

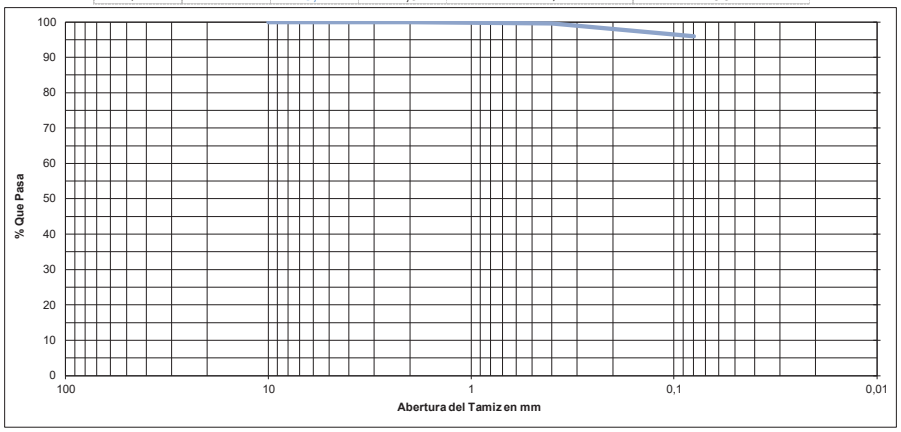
| Referencia Muestra… 214857 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 19 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULOS PREVIOS | | |
|---|---|---|
| A | Muestra total seca al aire | 2125,1 |
| B | Gruesos lavados | 1,4 |
| C = (A - B) * f | Fracción fina seca | 2121,7 |
| D = (B + C) | Muestra total seca | 2123,2 |
| E | Fracción fina ensayada seca al aire | 84,1 |
| F = E * f | Fracción fina ensayada seca | 84,0 |
| C/F | | 25,3 |

| HUMEDAD HIGROSCÓPICA | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 0,1 |
| a=(t+s+a)-(t+s) | Agua | 0,1 |
| t+s+a | Tara+suelo+agua | 122,7 |
| t+s | Tara+suelo | 122,7 |
| t | Tara | 34,0 |
| s | Suelo | 88,7 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | 2123,2 | 100 |
| 5 | 4 | | 1,0 | 2122,2 | 100 |
| 2 | 10 | | 0,4 | 2121,7 | 100 |
| 0,4 | 40 | 0,3 | 7,3 | 2114,4 | 100 |
| 0,08 | 200 | 3,1 | 77,6 | 2036,9 | 96 |




OBSERVACIONES:

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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|---|---|---|
| | Norma | UNE 103204/93 |
| | Acta nº 2117577 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214857 | | Referencia Informe…… | EXP 21999 |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 19 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DATOS ENSAYO**

| - | Referencia tara | M - 1 | M - 2 |
|---|---|---|---|
| % pasa | % suelo pasa tamiz 2 UNE | 100 | 100 |
| f | Factor de normalidad Permanganato | 1,01 | 1,01 |
| g | Total muestra ensayada (g) | 0,2570 | 0,2510 |
| V | Volumen Permanganato potásico valoración ($cm^3$) | 2,50 | 2,40 |

**RESULTADO ENSAYO**

% mat org (f < 2 UNE) =[ [0,1032*V*f]/g]

*Mat. orgánica referida fracción ensayada (f < 2 UNE) (%) =* **1,00**

**RESULTADO ENSAYO**

% mat org =[ [0,1032*V*f]/g]*%pasa

*Mat. orgánica referida al total de muestra (%) =* **1,00**

| INCERTIDUMBRE ENSAYO |
|---|
| Mat. Orgánica (%) δ= 0,05 |

VºBº

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103205/06 |
| | Acta nº 2117578 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra… 214857** | Referencia Informe….. EXP 21999 |
| PROCEDENCIA CALICATA | REF. CLIENTE BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA M. ALTERADA | PETICIONARIO IGEOSUMA |
| FECHA ENTRADA 19 de marzo de 2021 | DEN. OBRA EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DATOS ENSAYO***

| | | |
|---|---|---|
| - | Referencia tara | CP 9 |
| % pasa | % suelo pasa tamiz 2 UNE | 100 |
| g | Muestra ensayada (g) | 47,7776 |
| T | Tara crisol (g) | 124,1240 |
| T+R | Tara crisol + Peso residuo (g) | 124,1280 |
| Pp=(T+R)-T | Residuo seco en estufa (g) | 0,0040 |
| v | Volumen de solución analizada ($cm^3$) | 100,00 |
| V | Volumen Agua desmineralizada en frasco ($cm^3$) | 500,00 |

***RESULTADO ENSAYO***

Sales solubles referido a la fracción ensayada (f < 2 UNE)=[[(Pp*V)/(g*v)]*100]

***Sales Solubles referida fracción ensayada (f < 2 UNE) (%)*** **< 0,1**

***RESULTADO ENSAYO***

Sales solubles referido al total de la muestra =[[(Pp*V)/(g*v)]*100]*% pasa

***Sales Solubles referida total de la muestra (%)*** **< 0,1**

| INCERTIDUMBRE ENSAYO |
|---|
| Sales solubles (%) δ= 0,04 |

**OBSERVACIONES:** Muestra ensayada pulverizada < 0,08 UNE (Procedimiento D.G.A.).

VºBº

Eduardo Baquer Barriendos
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Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control | Ensayo | ENSAYO DE CORTE DIRECTO |
|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103401/98 |
| | Acta nº 2117576 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra…. 214857** | Referencia Informe…… EXP 21999 |
| PROCEDENCIA CALICATA | REF. CLIENTE BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA M. ALTERADA | PETICIONARIO IGEOSUMA |
| FECHA ENTRADA 19 de marzo de 2021 | DEN. OBRA EG MODERNIZACION DE REGADIO CR SANTA ANA |

| TIPO DE ENSAYO | VELOCIDAD CORTE |
|---|---|
| CONSOLIDADO Y DRENADO | 0,015 mm/min |

| DIAMETRO ANILLO (mm) | ALTURA ANILLO (mm) | AREA ANILLO ($cm^2$) |
|---|---|---|
| 50 | 30,5 | 19,63 |

**DATOS PROBETA**

| CARGA AXIAL PROBETA | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|
| Altura inicial de la probeta (en mm) | 30,50 | 30,50 | 30,50 |
| Altura final de la probeta (en mm) | 29,37 | 28,86 | 28,72 |
| Referencia de Tara nº 1 | Anillo 1 | Anillo 1 | Anillo 1 |
| Peso Tara 1 (en g) | 64,04 | 64,64 | 60,86 |
| Tara 1 + Peso húmedo inicial (en g) | 189,10 | 189,53 | 185,84 |
| Referencia de Tara nº 2 | A | B | C |
| Peso Tara 2 (en g) | 35,98 | 28,38 | 33,99 |
| Tara 2 + Peso húmedo final (en g) | 166,86 | 159,41 | 164,07 |
| Tara 2 + Peso probeta seca (en g) | 145,67 | 138,40 | 143,15 |
| Peso específico partículas (en g) | 2,70 | 2,70 | 2,70 |

**RESULTADOS PROBETA**

| CARGA AXIAL PROBETA | | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|---|
| Dens. humeda inicial (en g/$cm^3$) | gn | 2,09 | 2,09 | 2,09 |
| Dens. humeda final (en g/$cm^3$) | gf | 2,27 | 2,31 | 2,31 |
| Dens. seca inicial (en g/$cm^3$) | gd | 1,83 | 1,84 | 1,82 |
| Den seca final (en g/$cm^3$) | gdt | 1,90 | 1,94 | 1,94 |
| Humedad inicial (en %) | W0 | 14,01 | 13,52 | 14,49 |
| Humedad final (en %) | Wf | 19,32 | 19,10 | 19,16 |
| Saturación inicial (en %) | S0 | 79,86 | 77,76 | 81,37 |
| Saturación final (en %) | Sf | 100,00 | 100,00 | 100,00 |
| Indice de huecos inicial | e0 | 0,47 | 0,47 | 0,48 |
| Indice de huecos final | ef | 0,42 | 0,39 | 0,39 |

**LECTURAS FASE CORTE**

| CARGA 1 100 kPa Sh (mm) | F (N) | CARGA 2 200 kPa Sh (mm) | F (N) | CARGA 3 300 kPa Sh (mm) | F (N) |
|---|---|---|---|---|---|
| 0,75 | 25,88 | 0,36 | 22,35 | 0,04 | 29,41 |
| 0,87 | 55,30 | 0,43 | 97,65 | 0,07 | 97,65 |
| 1,10 | 71,77 | 0,75 | 154,12 | 0,16 | 142,35 |
| 1,40 | 97,65 | 1,03 | 189,41 | 0,33 | 194,12 |
| 1,61 | 114,12 | 1,20 | 204,71 | 0,59 | 236,48 |
| 1,83 | 122,35 | 1,40 | 214,12 | 0,79 | 264,71 |
| 2,21 | 124,71 | 1,60 | 218,83 | 1,10 | 281,18 |
| 2,23 | 123,53 | 1,84 | 223,53 | 1,40 | 287,07 |
| | | 2,08 | 223,53 | 1,73 | 288,24 |
| | | 2,26 | 225,89 | 2,06 | 294,12 |
| | | 2,28 | 224,71 | 2,36 | 298,83 |
| | | | | 2,73 | 304,71 |
| | | | | 3,28 | 305,89 |
| | | | | 3,86 | 309,42 |
| | | | | 3,87 | 309,42 |

**LECTURAS FASE CONSOLIDACION**

| CARGA 1 100 kPa dt (min) | dH (mm) | CARGA 2 200 kPa dt (min) | dH (mm) | CARGA 3 300 kPa dt (min) | dH (mm) |
|---|---|---|---|---|---|
| 0,13 | 0,268 | 0,13 | 0,486 | 0,13 | 0,507 |
| 0,19 | 0,275 | 0,19 | 0,500 | 0,19 | 0,663 |
| 0,29 | 0,282 | 0,29 | 0,515 | 0,29 | 0,670 |
| 0,43 | 0,282 | 0,43 | 0,522 | 0,43 | 0,670 |
| 0,64 | 0,282 | 0,64 | 0,522 | 0,64 | 0,677 |
| 0,96 | 0,282 | 0,96 | 0,522 | 0,96 | 0,677 |
| 1,45 | 0,289 | 1,45 | 0,529 | 1,45 | 0,684 |
| 2,17 | 0,296 | 2,17 | 0,529 | 2,17 | 0,691 |
| 3,26 | 0,303 | 3,26 | 0,536 | 3,26 | 0,698 |
| 4,88 | 0,317 | 4,88 | 0,557 | 4,88 | 0,712 |
| 7,32 | 0,345 | 7,32 | 0,620 | 7,32 | 0,719 |
| 10,99 | 0,367 | 10,99 | 0,733 | 10,99 | 0,726 |
| 16,48 | 0,395 | 16,48 | 0,818 | 16,48 | 0,733 |
| 24,72 | 0,416 | 24,72 | 0,867 | 24,72 | 0,775 |
| 37,08 | 0,437 | 37,08 | 0,902 | 37,08 | 0,888 |
| 55,61 | 0,451 | 55,61 | 0,973 | 55,61 | 1,001 |
| 83,42 | 0,472 | 83,42 | 1,015 | 83,42 | 1,050 |
| 125,13 | 0,500 | 125,13 | 1,057 | 125,13 | 1,093 |
| 187,69 | 0,564 | 187,69 | 1,198 | 187,69 | 1,297 |
| 281,54 | 0,987 | 281,54 | 1,579 | 281,54 | 1,706 |
| 422,31 | 1,100 | 422,31 | 1,628 | 422,31 | 1,769 |
| 633,46 | 1,121 | 633,46 | 1,642 | 633,46 | 1,783 |
| 950,19 | 1,128 | 950,19 | 1,642 | 950,19 | 1,783 |
| 1430,00 | 1,130 | 1430,00 | 1,642 | 1430,00 | 1,783 |

**RESULTADOS FASE CONSOLIDACION**

| Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 |
|---|---|---|---|---|---|
| 30,50 | | 30,50 | | 30,50 | |

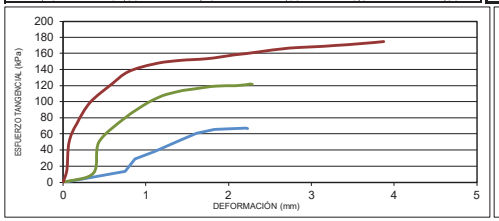
**RESULTADOS FASE CORTE**

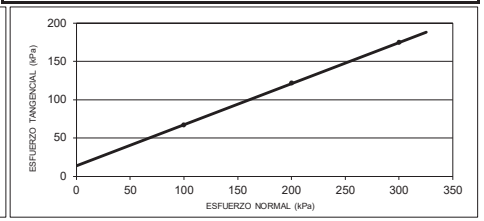
| Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) |
|---|---|---|---|---|---|
| 2,23 | 67,30 | 2,28 | 122,08 | 3,87 | 174,80 |

**RESULTADOS DEL ENSAYO**

COHESIÓN en kPa ..... **13,89**

ANGULO ROZAMIENTO INTERNO en º ..... **28,26**




VºBº

REMOLDEADO 98 % DMPM

Fdo.

Eduardo Baquer Barriendos
Director Técnico

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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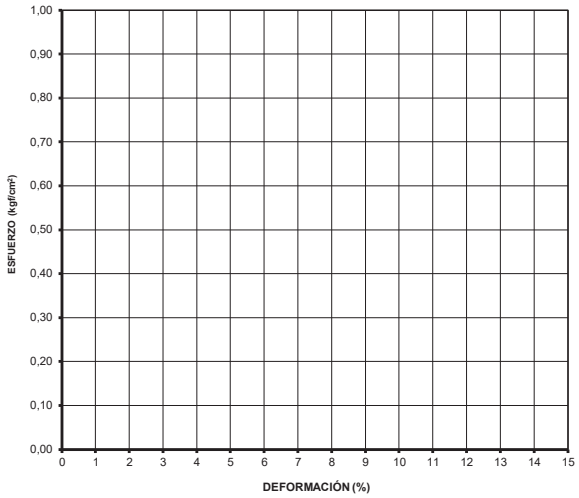
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117655 | Nº Copia Copia 1. Igeosuma |

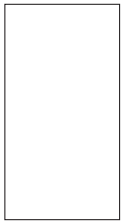
| Referencia Muestra… 214873 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE2-S1 MI (1,00 - 1,60 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | | P | Suelo húmedo total | | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | | T + S | Tara + suelo seco parcial | | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | | T | Tara | | |
| t+s | Tara+suelo | | S | Suelo seco parcial | | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | | s1=S+s | Suelo seco total | | |
| s=(t+s)-t | Suelo | | a1=P-s1 | Agua | | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | | h1=(a1*100)/s1 | ***Humedad*** | | |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

R ($kgf/cm^2$)=

Deform. (%) =

OBSERVACIONES. LA MUESTRA SALE ROTA DE LA CAMISA DE PVC Y NO SE PUEDE TALLAR UNA PROBETA PARA ENSAYARLA

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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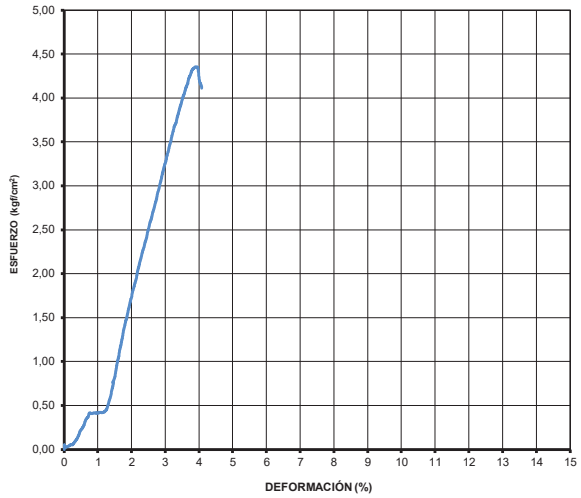
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117657 | Nº Copia Copia 1. Igeosuma |

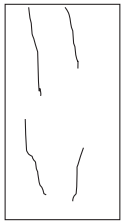
| Referencia Muestra… 214874 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE2-S1 TP (4,90 - 5,10 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | L 18 | P | Suelo húmedo total | 1583,41 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 28,34 | T + S | Tara + suelo seco parcial | 1694,29 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 211,60 | T | Tara | 518,68 | 79 / 144 |
| t+s | Tara+suelo | 183,26 | S | Suelo seco parcial | 1175,61 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 29,24 | s1=S+s | Suelo seco total | 1329,63 | 48,99 / 705,48 |
| s=(t+s)-t | Suelo | 154,02 | a1=P-s1 | Agua | 253,78 | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | **18,40** | h1=(a1*100)/s1 | ***Humedad*** | **19,09** | **2,24** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

R ($kgf/cm^2$)= ***4,36***

Deform. (%) = ***3,92***

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117656 | Nº Copia Copia 1. Igeosuma |

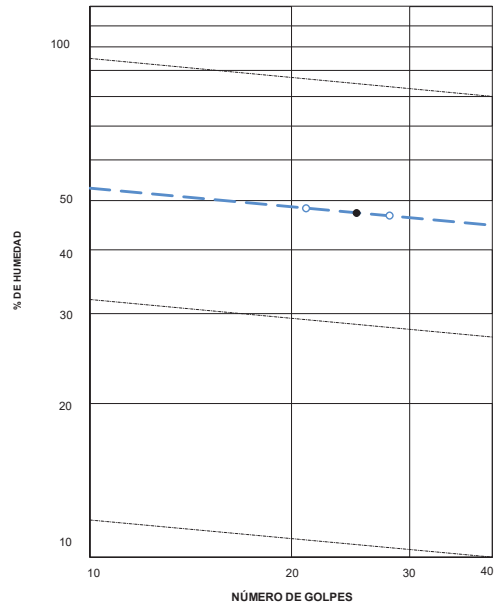
| Referencia Muestra… 214874 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE2-S1 TP (4,90 - 5,10 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 28 | 21 |
| - | Referencia tara | L 47 | L 23 |
| a=(t+s+a)-(t+s) | Agua | 7,71 | 7,94 |
| t+s+a | Tara + suelo + agua | 59,59 | 53,22 |
| t+s | Tara + suelo | 51,88 | 45,28 |
| t | Tara | 35,38 | 28,84 |
| s=(t+s)-t | Suelo | 16,50 | 16,44 |
| w=100*(a/s) | **% Humedad** | **46,7** | **48,3** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 10 |
| a=(t+s+a)-(t+s) | Agua | 4,09 |
| t+s+a | Tara + suelo + agua | 51,38 |
| t+s | Tara + suelo | 47,29 |
| t | Tara | 30,05 |
| s=(t+s)-t | Suelo | 17,24 |
| w=100*(a/s) | **% Humedad** | **23,7** |




**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| LÍMITE LÍQUIDO = | **47,3** |
| LÍMITE PLÁSTICO = | **23,7** |
| ÍNDICE PLASTICIDAD = | **23,6** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO DE COMPRESIÓN SIMPLE EN MUESTRAS DE SUELOS |
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117658 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214875 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE1-S1 MI (2,00 - 2,60 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CALCULO DE LA HUMEDAD**

| Parcial | | | Probeta | | |
|---|---|---|---|---|---|
| | Referencia tara | L 8 | P | Suelo húmedo total | 1162,39 |
| a=(t+s+a)-(t+s) | Agua | 21,56 | T + S | Tara + suelo seco parcial | 1402,89 |
| t+s+a | Tara+suelo+agua | 206,47 | T | Tara | 544,31 |
| t+s | Tara+suelo | 184,91 | S | Suelo seco parcial | 858,58 |
| t | Tara | 29,61 | s1=S+s | Suelo seco total | 1013,88 |
| s=(t+s)-t | Suelo | 155,30 | a1=P-s1 | Agua | 148,51 |
| h=(a*100)/s | **Humedad** | **13,88** | h1=(a1*100)/s1 | **Humedad** | **14,65** |

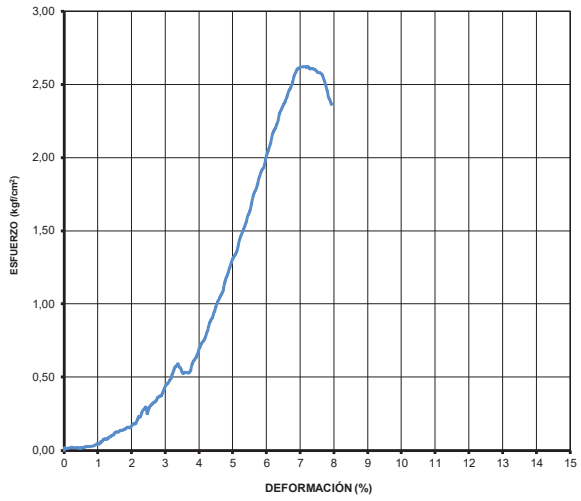
**TIPO PROBETA**

CILINDRICA

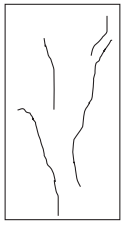
**DATOS PROBETA**

| Diámetro (mm) | Altura (mm) |
|---|---|
| 68 | 149 |
| Área ($cm^2$) | Volumen ($cm^3$) |
| 36,30 | 540,85 |
| Densidad ($g/cm^3$) | |
| **2,15** | |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

| | |
|---|---|
| R ($kgf/cm^2$)= | ***2,62*** |
| Deform. (%) = | ***7,11*** |

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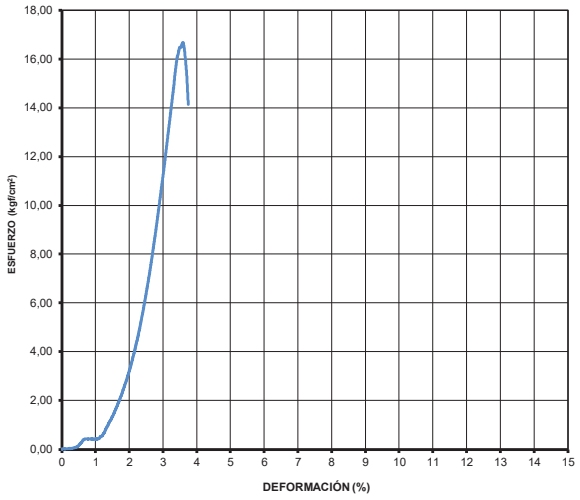
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117660 | Nº Copia Copia 1. Igeosuma |

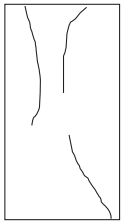
| Referencia Muestra… 214876 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE1-S1 TP (4,70 - 5,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | L 40 | P | Suelo húmedo total | 1430,78 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 15,53 | T + S | Tara + suelo seco parcial | 1698,83 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 190,78 | T | Tara | 545,81 | 72 / 150 |
| t+s | Tara+suelo | 175,25 | S | Suelo seco parcial | 1153,02 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 35,62 | s1=S+s | Suelo seco total | 1292,65 | 40,69 / 610,42 |
| s=(t+s)-t | Suelo | 139,63 | a1=P-s1 | Agua | 138,13 | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | **11,12** | h1=(a1*100)/s1 | ***Humedad*** | **10,69** | **2,34** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

R (kgf/cm²)= ***16,69***

Deform. (%) = ***3,59***

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Director Técnico

Fdo.

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Responsable ensayo

Caspe, a 9 de abril de 2021

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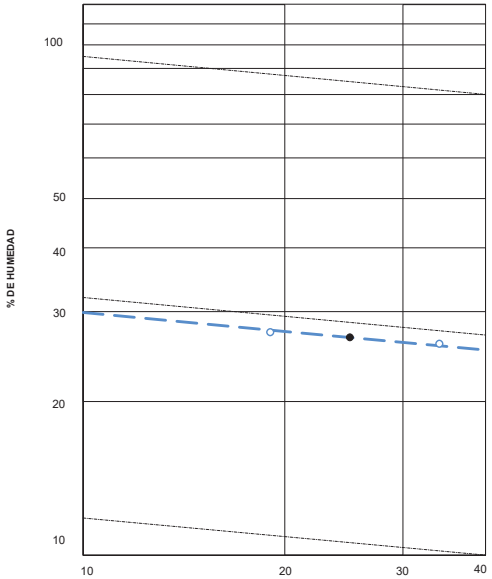
| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG |
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117659 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214876 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE1-S1 TP (4,70 - 5,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CÁLCULO LÍMITE LÍQUIDO | | | | CÁLCULO LÍMITE PLÁSTICO | | |
|---|---|---|---|---|---|---|
| - | Nº de golpes | 19 | 34 | - | Referencia tara | L 9 |
| - | Referencia tara | L 46 | L 17 | a=(t+s+a)-(t+s) | Agua | 4,79 |
| a=(t+s+a)-(t+s) | Agua | 6,38 | 5,71 | t+s+a | Tara + suelo + agua | 56,39 |
| t+s+a | Tara + suelo + agua | 64,41 | 55,04 | t+s | Tara + suelo | 51,60 |
| t+s | Tara + suelo | 58,03 | 49,33 | t | Tara | 28,86 |
| t | Tara | 34,71 | 27,37 | s=(t+s)-t | Suelo | 22,74 |
| s=(t+s)-t | Suelo | 23,32 | 21,96 | | | |
| w=100*(a/s) | ***% Humedad*** | **27,4** | **26,0** | w=100*(a/s) | ***% Humedad*** | **21,1** |




| RESULTADOS DEL ENSAYO | |
|---|---|
| LÍMITE LÍQUIDO = | **26,7** |
| LÍMITE PLÁSTICO = | **21,1** |
| ÍNDICE PLASTICIDAD = | **5,7** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103602/96 |
| | Acta nº 2117661 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214876** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE1-S1 TP (4,70 - 5,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DESCRIPCIÓN DE LA MUESTRA ENSAYADA:**

M. INALTERADA

HUMEDAD DE ENSAYO (%): 11,58

DENSIDAD SECA ENSAYO (g/cm$^3$): 2,03

**PRESIÓN DE HINCHAMIENTO (kgf/cm$^2$) 0,1**

**PRESIÓN DE HINCHAMIENTO (kPa) 9,81**

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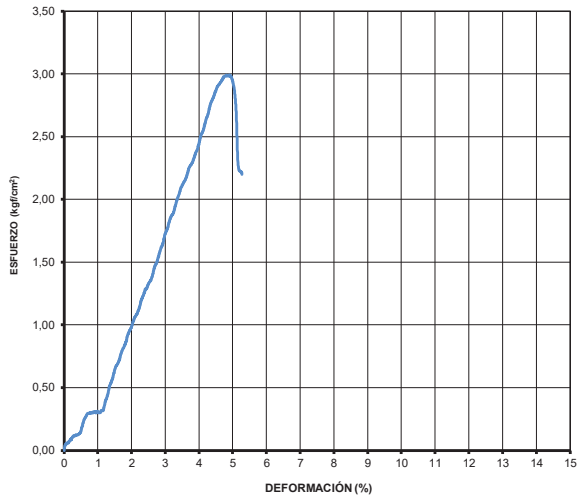
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117658 | Nº Copia Copia 1. Igeosuma |

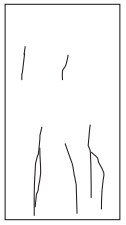
| | | | |
|---|---|---|---|
| **Referencia Muestra… 214877** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BE1-S1 TP (7,80 - 8,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***CALCULO DE LA HUMEDAD*** | | | | | | ***TIPO PROBETA*** | |
|---|---|---|---|---|---|---|---|
| ***Parcial*** | | | ***Probeta*** | | | *CILINDRICA* | |
| | Referencia tara | L 27 | P | Suelo húmedo total | 1375,37 | ***DATOS PROBETA*** | |
| a=(t+s+a)-(t+s) | Agua | 22,49 | T + S | Tara + suelo seco parcial | 1573,73 | Diámetro (mm) | Altura (mm) |
| t+s+a | Tara+suelo+agua | 232,29 | T | Tara | 536,30 | 72 | 150 |
| t+s | Tara+suelo | 209,80 | S | Suelo seco parcial | 1037,43 | Área (cm$^2$) | Volumen (cm$^3$) |
| t | Tara | 35,38 | s1=S+s | Suelo seco total | 1211,85 | 40,69 | 610,42 |
| s=(t+s)-t | Suelo | 174,42 | a1=P-s1 | Agua | 163,52 | Densidad (g/cm$^3$) | |
| h=(a*100)/s | ***Humedad*** | **12,89** | h1=(a1*100)/s1 | ***Humedad*** | **13,49** | **2,25** | |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

**R (kgf/cm$^2$)= *2,99***

**Deform. (%) = *4,88***

VºBº

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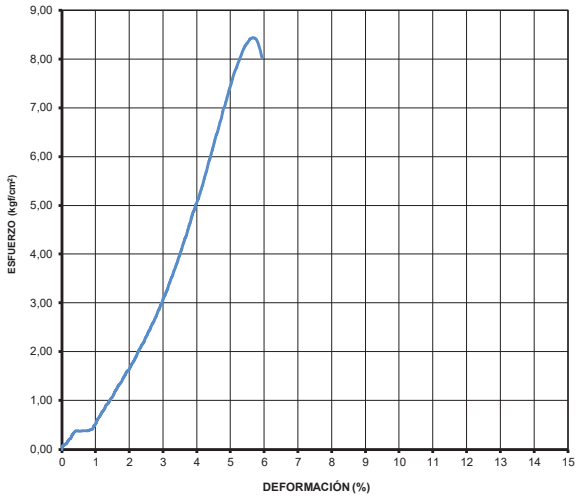
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117665 | Nº Copia Copia 1. Igeosuma |

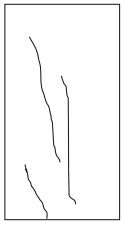
| Referencia Muestra… 214878 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S1 TP (2,80 - 3,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | L 36 | P | Suelo húmedo total | 1389,33 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 16,94 | T + S | Tara + suelo seco parcial | 1620,78 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 192,79 | T | Tara | 531,42 | 71 / 150 |
| t+s | Tara+suelo | 175,85 | S | Suelo seco parcial | 1089,36 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 35,48 | s1=S+s | Suelo seco total | 1229,73 | 39,57 / 593,58 |
| s=(t+s)-t | Suelo | 140,37 | a1=P-s1 | Agua | 159,60 | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | **12,07** | h1=(a1*100)/s1 | ***Humedad*** | **12,98** | **2,34** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

| | |
|---|---|
| **R ($kgf/cm^2$)=** | ***8,44*** |
| **Deform. (%) =** | ***5,66*** |

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Responsable ensayo

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|---|---|---|
| | Norma | UNE 103301/94 |
| | Acta nº 2117664 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214878 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S1 TP (2,80 - 3,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 197,24 |
| PESO CON PARAFINA (g) = | 206,80 |
| PESO SUMERGIDO (g) = | 110,51 |
| HUMEDAD (%)= | 9,78 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA ($g/cm^3$) =** | **2,30** |
| **DENSIDAD SECA ($g/cm^3$) =** | **2,09** |

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| Terra LABS Control | Ensayo | DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO |
|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103300/93 |
| | Acta nº 2117663 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214878 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S1 TP (2,80 - 3,00 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 218,54 |
| TARA + SUELO (g) = | 201,74 |
| TARA (g) = | 30,03 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **9,8** |

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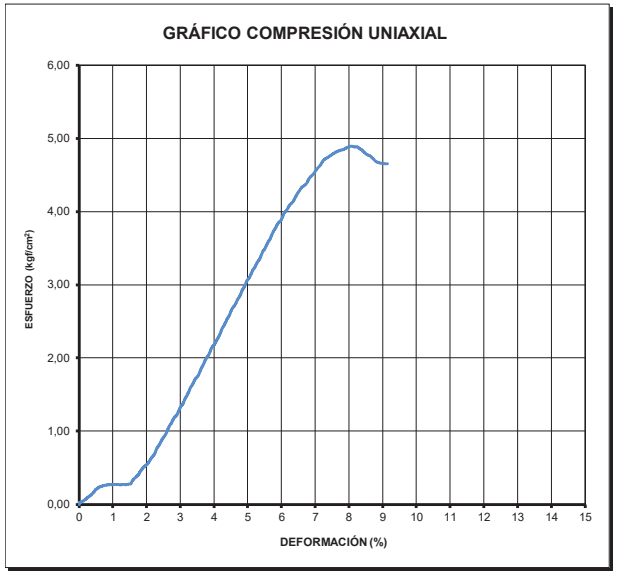
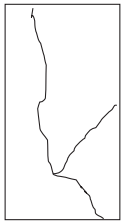
|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103400/93 |
| | Acta nº 2117669 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214879 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S1 TP (5,00 - 5,20 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | L 11 | P | Suelo húmedo total | 809,79 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 26,42 | T + S | Tara + suelo seco parcial | 1090,79 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 199,02 | T | Tara | 544,60 | 71 / 93 |
| t+s | Tara+suelo | 172,60 | S | Suelo seco parcial | 546,19 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 27,96 | s1=S+s | Suelo seco total | 690,83 | 39,57 / 368,02 |
| s=(t+s)-t | Suelo | 144,64 | a1=P-s1 | Agua | 118,96 | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | **18,27** | h1=(a1*100)/s1 | ***Humedad*** | **17,22** | **2,20** |




FORMA DE LA ROTURA



| RESULTADOS | |
|---|---|
| R ($kgf/cm^2$)= | ***4,90*** |
| Deform. (%) = | ***8,06*** |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA DENSIDAD DE UN SUELO** |
|---|---|---|
| | *Norma* | **UNE 103301/94** |
| | *Acta nº* **2117668** | *Nº Copia* **Copia 1. Igeosuma** |

| | | | |
|---|---|---|---|
| **Referencia Muestra…** | **214879** | Referencia Informe….. | EXP 21999 |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S1 TP (5,00 - 5,20 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 82,89 |
| PESO CON PARAFINA (g) = | 88,87 |
| PESO SUMERGIDO (g) = | 44,44 |
| HUMEDAD (%)= | 16,02 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA (g/cm$^3$) =** | **2,19** |
| **DENSIDAD SECA (g/cm$^3$) =** | **1,89** |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO** |
|---|---|---|
| | *Norma* | **UNE 103300/93** |
| | *Acta nº* **2117666** | *Nº Copia* **Copia 1. Igeosuma** |

| | | | |
|---|---|---|---|
| **Referencia Muestra…** | **214879** | Referencia Informe….. | EXP 21999 |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S1 TP (5,00 - 5,20 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 141,27 |
| TARA + SUELO (g) = | 126,45 |
| TARA (g) = | 33,95 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **16,0** |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG |
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117667 | Nº Copia Copia 1. Igeosuma |

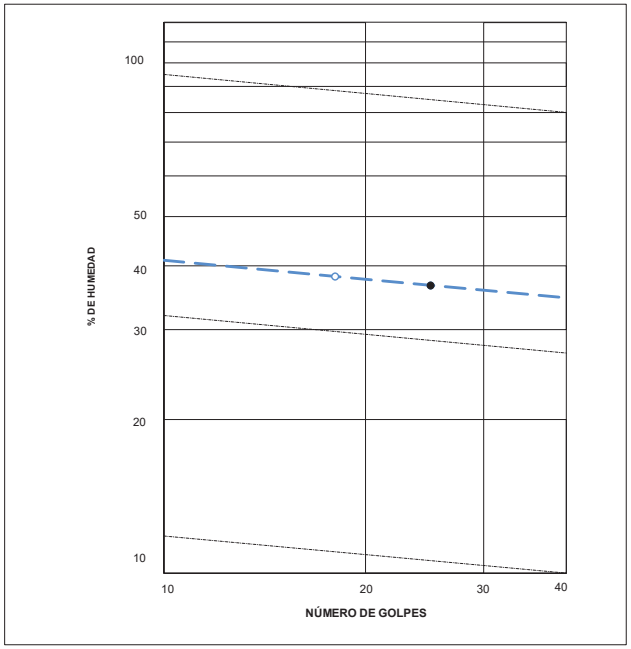
| | |
|---|---|
| **Referencia Muestra… 214879** | Referencia Informe….. EXP 21999 |
| PROCEDENCIA SONDEO | REF. CLIENTE BP-S1 TP (5,00 - 5,20 m) |
| TIPO DE MUESTRA T. PLASTIFICADO | PETICIONARIO IGEOSUMA |
| FECHA ENTRADA 25 de marzo de 2021 | DEN. OBRA EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | 18 | 25 |
| - | Referencia tara | T 27 | L 14 |
| a=(t+s+a)-(t+s) | Agua | 6,00 | 6,44 |
| t+s+a | Tara + suelo + agua | 38,42 | 52,38 |
| t+s | Tara + suelo | 32,42 | 45,94 |
| t | Tara | 16,71 | 28,38 |
| s=(t+s)-t | Suelo | 15,71 | 17,56 |
| w=100*(a/s) | ***% Humedad*** | **38,2** | **36,7** |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | L 23 |
| a=(t+s+a)-(t+s) | Agua | 6,19 |
| t+s+a | Tara + suelo + agua | 63,44 |
| t+s | Tara + suelo | 57,25 |
| t | Tara | 28,84 |
| s=(t+s)-t | Suelo | 28,41 |
| w=100*(a/s) | ***% Humedad*** | **21,8** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **36,7** |
| LÍMITE PLÁSTICO = | **21,8** |
| ÍNDICE PLASTICIDAD = | **14,9** |

| **INCERTIDUMBRE ENSAYO** |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO |
|---|---|---|
| | Norma | UNE 103602/96 |
| | Acta nº 2117670 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra… 214879** | Referencia Informe….. EXP 21999 |
| PROCEDENCIA SONDEO | REF. CLIENTE BP-S1 TP (5,00 - 5,20 m) |
| TIPO DE MUESTRA T. PLASTIFICADO | PETICIONARIO IGEOSUMA |
| FECHA ENTRADA 25 de marzo de 2021 | DEN. OBRA EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DESCRIPCIÓN DE LA MUESTRA ENSAYADA:**

M .INALTERADA

HUMEDAD DE ENSAYO (%): 16,02

DENSIDAD SECA ENSAYO (g/cm$^3$): 1,89

| | |
|---|---|
| **PRESIÓN DE HINCHAMIENTO (kgf/cm$^2$)** | **0,2** |

| | |
|---|---|
| **PRESIÓN DE HINCHAMIENTO (kPa)** | **19,61** |

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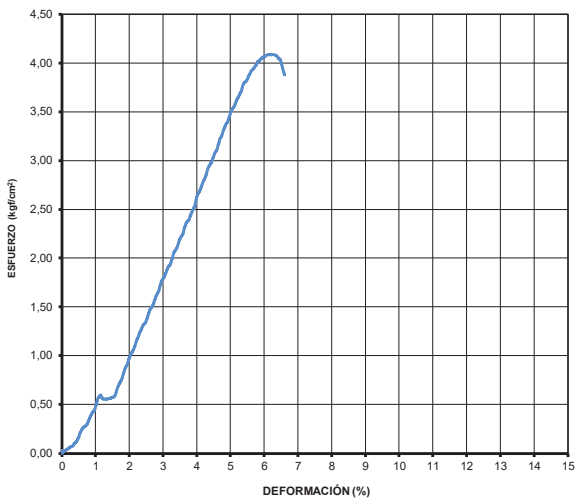
| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO DE COMPRESIÓN SIMPLE EN MUESTRAS DE SUELOS |
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117674 | Nº Copia Copia 1. Igeosuma |

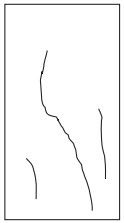
| Referencia Muestra… 214880 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | L 20 | P | Suelo húmedo total | 1215,24 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 32,07 | T + S | Tara + suelo seco parcial | 1409,70 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 234,06 | T | Tara | 519,29 | 68 / 150 |
| t+s | Tara+suelo | 201,99 | S | Suelo seco parcial | 890,41 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 29,41 | s1=S+s | Suelo seco total | 1062,99 | 36,30 / 544,48 |
| s=(t+s)-t | Suelo | 172,58 | a1=P-s1 | Agua | 152,25 | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | **18,58** | h1=(a1*100)/s1 | ***Humedad*** | **14,32** | **2,23** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

**R ($kgf/cm^2$)= *4,09***

**Deform. (%) = *6,23***

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Responsable ensayo

Caspe, a 9 de abril de 2021

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|---|---|---|
| | Norma | UNE 103301/94 |
| | Acta nº 2117673 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214880 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 205,75 |
| PESO CON PARAFINA (g) = | 214,68 |
| PESO SUMERGIDO (g) = | 109,60 |
| HUMEDAD (%)= | 10,20 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA ($g/cm^3$) =** | **2,16** |
| **DENSIDAD SECA ($g/cm^3$) =** | **1,96** |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO |
|---|---|---|
| | Norma | UNE 103300/93 |
| | Acta nº 2117671 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214880** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 200,11 |
| TARA + SUELO (g) = | 184,80 |
| TARA (g) = | 34,70 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **10,2** |

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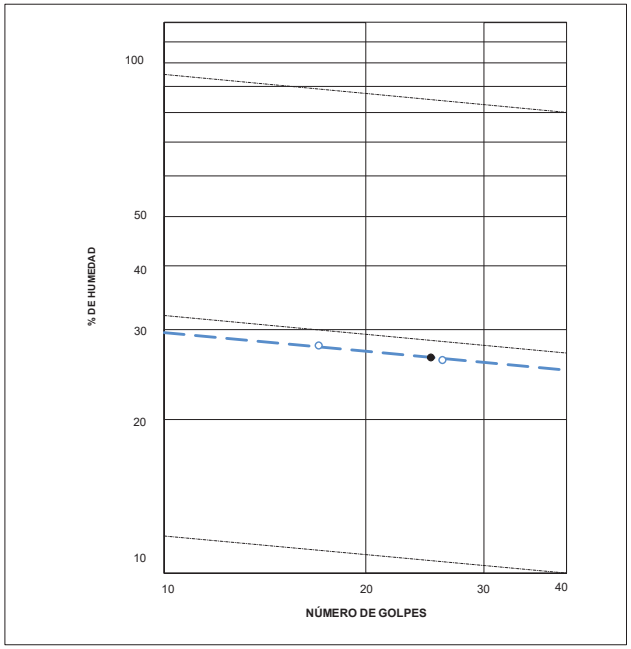
| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG |
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117672 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214880** | | Referencia Informe….. EXP 21999 | |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BP-S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| *CÁLCULO LÍMITE LÍQUIDO* | | | |
|---|---|---|---|
| - | Nº de golpes | 17 | 26 |
| - | Referencia tara | T 24 | RE 2 |
| a=(t+s+a)-(t+s) | Agua | 6,15 | 7,26 |
| t+s+a | Tara + suelo + agua | 44,57 | 47,80 |
| t+s | Tara + suelo | 38,42 | 40,54 |
| t | Tara | 16,44 | 12,79 |
| s=(t+s)-t | Suelo | 21,98 | 27,75 |
| w=100*(a/s) | ***% Humedad*** | **28,0** | **26,2** |

| *CÁLCULO LÍMITE PLÁSTICO* | | |
|---|---|---|
| - | Referencia tara | L 4 |
| a=(t+s+a)-(t+s) | Agua | 4,43 |
| t+s+a | Tara + suelo + agua | 43,91 |
| t+s | Tara + suelo | 39,48 |
| t | Tara | 18,27 |
| s=(t+s)-t | Suelo | 21,21 |
| w=100*(a/s) | ***% Humedad*** | **20,9** |




| *RESULTADOS DEL ENSAYO* | |
|---|---|
| LÍMITE LÍQUIDO = | **26,5** |
| LÍMITE PLÁSTICO = | **20,9** |
| ÍNDICE PLASTICIDAD = | **5,6** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Responsable ensayo

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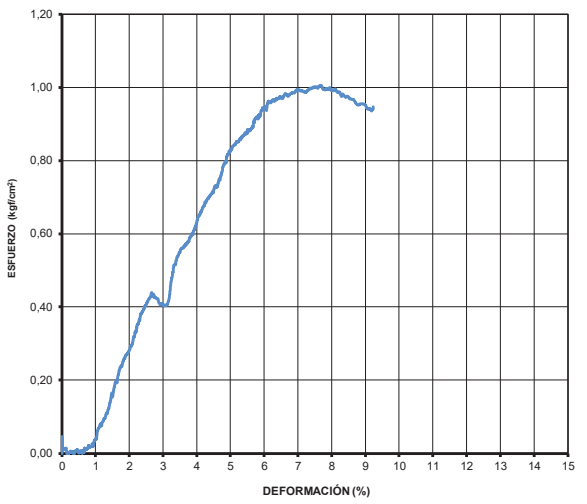
|---|---|---|
| | *Norma* | UNE 103400/93 |
| | *Acta nº* **2117679** | *Nº Copia* **Copia 1. Igeosuma** |

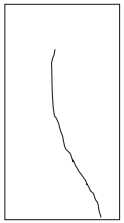
| **Referencia Muestra… 214881** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S1 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| ***CALCULO DE LA HUMEDAD*** | | | | | | ***TIPO PROBETA*** | |
|---|---|---|---|---|---|---|---|
| ***Parcial*** | | | ***Probeta*** | | | *CILINDRICA* | |
| | Referencia tara | L 43 | P | Suelo húmedo total | 1093,28 | ***DATOS PROBETA*** | |
| a=(t+s+a)-(t+s) | Agua | 27,34 | T + S | Tara + suelo seco parcial | 1333,90 | Diámetro (mm) | Altura (mm) |
| t+s+a | Tara+suelo+agua | 202,44 | T | Tara | 545,80 | 68 | 149 |
| t+s | Tara+suelo | 175,10 | S | Suelo seco parcial | 788,10 | Área ($cm^2$) | Volumen ($cm^3$) |
| t | Tara | 34,21 | s1=S+s | Suelo seco total | 928,99 | 36,30 | 540,85 |
| s=(t+s)-t | Suelo | 140,89 | a1=P-s1 | Agua | 164,29 | Densidad ($g/cm^3$) | |
| h=(a*100)/s | ***Humedad*** | **19,41** | h1=(a1*100)/s1 | ***Humedad*** | **17,68** | **2,02** | |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

**R ($kgf/cm^2$)= *1,01***

**Deform. (%) = *7,68***

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Responsable ensayo

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|---|---|---|
| | *Norma* | UNE 103301/94 |
| | *Acta nº* **2117678** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214881** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S1 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 224,50 |
| PESO CON PARAFINA (g) = | 234,92 |
| PESO SUMERGIDO (g) = | 110,03 |
| HUMEDAD (%)= | 20,72 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA ($g/cm^3$) =** | **1,98** |
| **DENSIDAD SECA ($g/cm^3$) =** | **1,64** |

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| Terra LABS Control | Ensayo | GRANULOMETRÍA DE SUELOS POR TAMIZADO |
|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103101/95 |
| | Acta nº 2117676 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214881 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S1 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

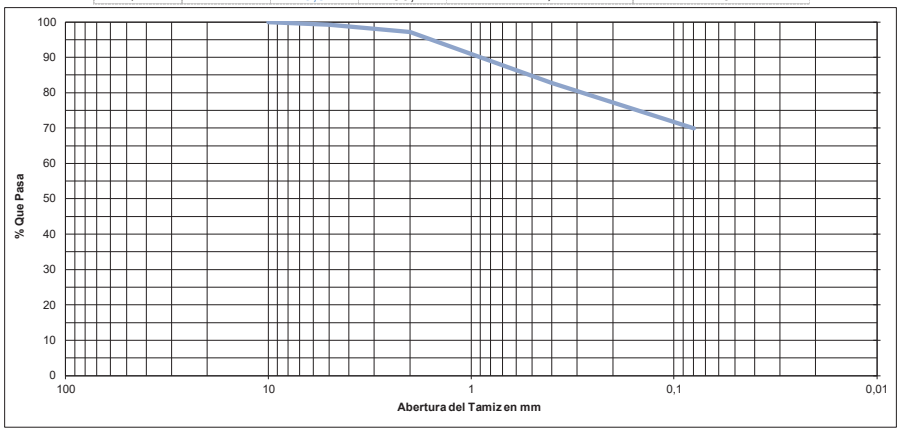
| | | |
|---|---|---|
| A | Muestra total seca al aire | 1235,0 |
| B | Gruesos lavados | 35,7 |
| C = (A - B) * f | Fracción fina seca | 1188,5 |
| D = (B + C) | Muestra total seca | 1224,1 |
| E | Fracción fina ensayada seca al aire | 73,0 |
| F = E * f | Fracción fina ensayada seca | 72,4 |
| C/F | | 16,4 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 0,9 |
| a=(t+s+a)-(t+s) | Agua | 0,8 |
| t+s+a | Tara+suelo+agua | 129,6 |
| t+s | Tara+suelo | 128,7 |
| t | Tara | 35,7 |
| s | Suelo | 93,0 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | 1224,1 | 100 |
| 5 | 4 | | 10,0 | 1214,2 | 99 |
| 2 | 10 | | 25,7 | 1188,5 | 97 |
| 0,4 | 40 | 10,7 | 175,4 | 1013,1 | 83 |
| 0,08 | 200 | 9,5 | 156,2 | 856,9 | 70 |




OBSERVACIONES:

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103300/93 |
| | Acta nº 2117675 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214881 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S1 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 251,39 |
| TARA + SUELO (g) = | 214,34 |
| TARA (g) = | 35,50 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **20,7** |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG | |
|---|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 | |
| | Acta nº | 2117677 | Nº Copia: Copia 1. Igeosuma |

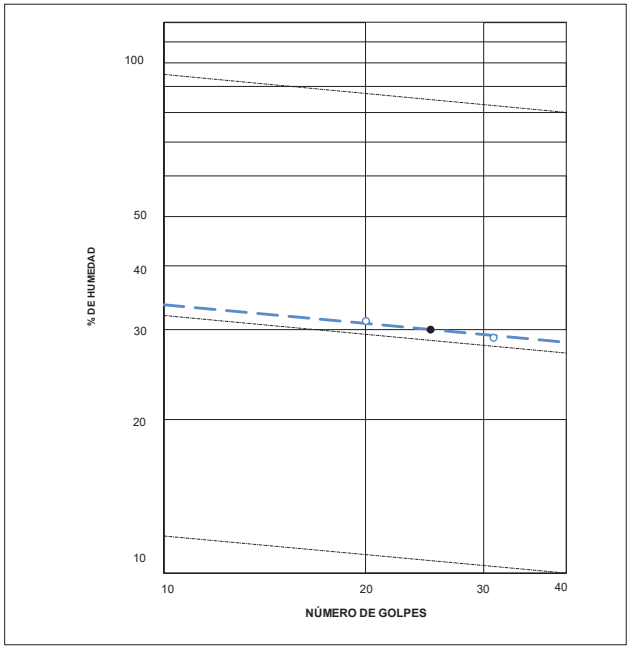
| Referencia Muestra… 214881 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S1 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 20 | 31 |
| - | Referencia tara | L 12 | L 42 |
| a=(t+s+a)-(t+s) | Agua | 5,20 | 4,86 |
| t+s+a | Tara + suelo + agua | 50,53 | 57,15 |
| t+s | Tara + suelo | 45,33 | 52,29 |
| t | Tara | 28,66 | 35,51 |
| s=(t+s)-t | Suelo | 16,67 | 16,78 |
| w=100*(a/s) | **% Humedad** | **31,2** | **29,0** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 30 |
| a=(t+s+a)-(t+s) | Agua | 5,55 |
| t+s+a | Tara + suelo + agua | 69,33 |
| t+s | Tara + suelo | 63,78 |
| t | Tara | 35,81 |
| s=(t+s)-t | Suelo | 27,97 |
| w=100*(a/s) | **% Humedad** | **19,8** |




**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| LÍMITE LÍQUIDO = | **30,0** |
| LÍMITE PLÁSTICO = | **19,8** |
| ÍNDICE PLASTICIDAD = | **10,2** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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|---|---|---|---|
| | Norma | UNE 103400/93 | |
| | Acta nº | 2117680 | Nº Copia: Copia 1. Igeosuma |

| Referencia Muestra… 214882 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S1 TP (4,20 - 4,50 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CALCULO DE LA HUMEDAD**

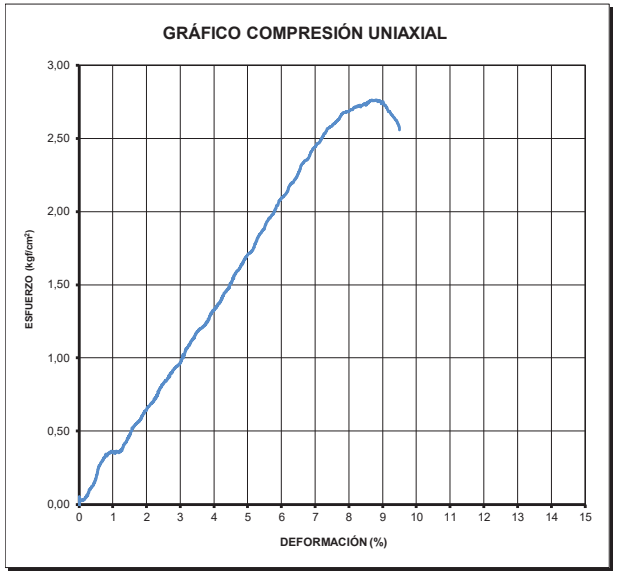
| Parcial | | | Probeta | | |
|---|---|---|---|---|---|
| | Referencia tara | L 26 | P | Suelo húmedo total | 1343,79 |
| a=(t+s+a)-(t+s) | Agua | 26,52 | T + S | Tara + suelo seco parcial | 1519,82 |
| t+s+a | Tara+suelo+agua | 200,42 | T | Tara | 530,56 |
| t+s | Tara+suelo | 173,90 | S | Suelo seco parcial | 989,26 |
| t | Tara | 28,93 | s1=S+s | Suelo seco total | 1134,23 |
| s=(t+s)-t | Suelo | 144,97 | a1=P-s1 | Agua | 209,56 |
| h=(a*100)/s | ***Humedad*** | **18,29** | h1=(a1*100)/s1 | ***Humedad*** | **18,48** |

**TIPO PROBETA**: CILINDRICA

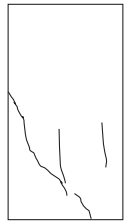
**DATOS PROBETA**

| Diámetro (mm) | Altura (mm) |
|---|---|
| 72 | 150 |
| Área ($cm^2$) | Volumen ($cm^3$) |
| 40,69 | 610,42 |

Densidad ($g/cm^3$): **2,20**




**FORMA DE LA ROTURA**



**RESULTADOS**

| | |
|---|---|
| R ($kgf/cm^2$)= | ***2,76*** |
| Deform. (%) = | ***8,68*** |

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Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| | |
|---|---|
| *Ensayo* | **ENSAYO DE CORTE DIRECTO** |
| *Norma* | **UNE 103401/98** |
| *Acta nº* **2117685** | *Nº Copia* **Copia 1. Igeosuma** |

| | | | |
|---|---|---|---|
| **Referencia Muestra….** | **214883** | Referencia Informe…… | EXP 21999 |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| TIPO DE ENSAYO | VELOCIDAD CORTE |
|---|---|
| CONSOLIDADO Y SIN DRENAR | |

| DIAMETRO ANILLO (mm) | ALTURA ANILLO (mm) | AREA ANILLO ($cm^2$) |
|---|---|---|
| 50 | 30,5 | 19,63 |

**DATOS PROBETA**

| CARGA AXIAL PROBETA | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|
| Altura inicial de la probeta (en mm) | 30,50 | 30,50 | 30,50 |
| Altura final de la probeta (en mm) | 29,67 | 27,92 | 27,69 |
| Referencia de Tara nº 1 | Anillo 1 | Anillo 1 | Anillo 1 |
| Peso Tara 1 (en g) | 64,00 | 57,61 | 61,46 |
| Tara 1 + Peso húmedo inicial (en g) | 182,62 | 170,61 | 179,16 |
| Referencia de Tara nº 2 | A | B | C |
| Peso Tara 2 (en g) | 30,02 | 36,77 | 36,78 |
| Tara 2 + Peso húmedo final (en g) | 150,50 | 151,35 | 156,62 |
| Tara 2 + Peso probeta seca (en g) | 126,71 | 129,40 | 134,16 |
| Peso específico partículas (en g) | 2,70 | 2,70 | 2,70 |

**RESULTADOS PROBETA**

| CARGA AXIAL PROBETA | | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|---|
| Dens. humeda inicial (en g/cm³) | gn | 1,98 | 1,89 | 1,97 |
| Dens. humeda final (en g/cm³) | gf | 2,07 | 2,09 | 2,20 |
| Dens. seca inicial (en g/cm³) | gd | 1,61 | 1,55 | 1,63 |
| Den seca final (en g/cm³) | gdf | 1,66 | 1,69 | 1,79 |
| Humedad inicial (en %) | W0 | 22,68 | 21,99 | 20,87 |
| Humedad final (en %) | Wf | 24,60 | 23,70 | 23,06 |
| Saturación inicial (en %) | S0 | 91,15 | 79,68 | 85,36 |
| Saturación final (en %) | Sf | 100,00 | 100,00 | 100,00 |
| Indice de huecos inicial | e0 | 0,67 | 0,75 | 0,66 |
| Indice de huecos final | ef | 0,63 | 0,60 | 0,51 |

**LECTURAS FASE CORTE**

| CARGA 1 | 100 kPa | CARGA 2 | 200 kPa | CARGA 3 | 300 kPa |
|---|---|---|---|---|---|
| Sh (mm) | F (N) | Sh (mm) | F (N) | Sh (mm) | F (N) |
| 0,31 | 37,11 | 0,22 | 58,65 | 0,19 | 53,86 |
| 0,59 | 84,99 | 0,42 | 126,88 | 0,32 | 150,82 |
| 0,99 | 144,83 | 0,99 | 204,68 | 0,94 | 274,11 |
| 1,57 | 189,12 | 1,77 | 245,38 | 1,43 | 320,79 |
| 2,14 | 214,26 | 2,63 | 269,32 | 2,00 | 348,32 |
| 2,71 | 221,44 | 3,29 | 278,90 | 2,35 | 357,90 |
| 3,01 | 220,24 | 3,86 | 283,68 | 2,72 | 361,49 |
| | | 4,08 | 283,68 | 3,07 | 360,29 |

**LECTURAS FASE CONSOLIDACION**

| CARGA 1 | 100 kPa | CARGA 2 | 200 kPa | CARGA 3 | 300 kPa |
|---|---|---|---|---|---|
| dt (min) | dH (mm) | dt (min) | dH (mm) | dt (min) | dH (mm) |
| 0,13 | 0,096 | 0,13 | 1,237 | 0,13 | 1,498 |
| 0,19 | 0,110 | 0,19 | 1,381 | 0,19 | 1,540 |
| 0,29 | 0,117 | 0,29 | 1,478 | 0,29 | 1,595 |
| 0,43 | 0,117 | 0,43 | 1,540 | 0,43 | 1,663 |
| 0,64 | 0,117 | 0,64 | 1,629 | 0,64 | 1,753 |
| 0,96 | 0,131 | 0,96 | 1,711 | 0,96 | 1,835 |
| 1,45 | 0,144 | 1,45 | 1,801 | 1,45 | 1,945 |
| 2,17 | 0,151 | 2,17 | 1,876 | 2,17 | 2,076 |
| 3,26 | 0,165 | 3,26 | 1,959 | 3,26 | 2,247 |
| 4,88 | 0,179 | 4,88 | 2,041 | 4,88 | 2,447 |
| 7,32 | 0,192 | 7,32 | 2,124 | 7,32 | 2,557 |
| 10,99 | 0,220 | 10,99 | 2,192 | 10,99 | 2,625 |
| 16,48 | 0,337 | 16,48 | 2,247 | 16,48 | 2,653 |
| 24,72 | 0,467 | 24,72 | 2,316 | 24,72 | 2,680 |
| 37,08 | 0,577 | 37,08 | 2,385 | 37,08 | 2,694 |
| 55,61 | 0,660 | 55,61 | 2,440 | 55,61 | 2,708 |
| 83,42 | 0,694 | 83,42 | 2,467 | 83,42 | 2,722 |
| 125,13 | 0,722 | 125,13 | 2,502 | 125,13 | 2,742 |
| 187,69 | 0,770 | 187,69 | 2,502 | 187,69 | 2,749 |
| 281,54 | 0,811 | 281,54 | 2,509 | 281,54 | 2,763 |
| 422,31 | 0,818 | 422,31 | 2,557 | 422,31 | 2,777 |
| 633,46 | 0,832 | 633,46 | 2,564 | 633,46 | 2,811 |
| 950,19 | 0,832 | 950,19 | 2,577 | 950,19 | 2,804 |
| 1430,00 | 0,832 | 1430,00 | 2,579 | 1430,00 | 2,806 |

**RESULTADOS FASE CONSOLIDACION**

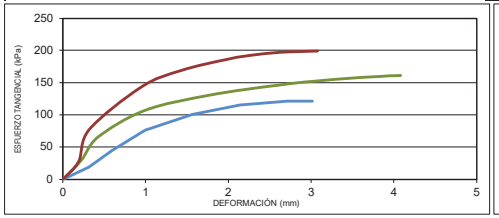
| Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 |
|---|---|---|---|---|---|
| 30,50 | | 30,50 | | 30,50 | |

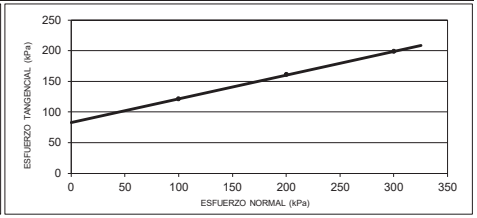
**RESULTADOS FASE CORTE**

| Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) |
|---|---|---|---|---|---|
| 3,01 | 121,48 | 4,08 | 161,19 | 3,07 | 199,07 |

**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| COHESIÓN en kPa ..... | **82,99** |
| ANGULO ROZAMIENTO INTERNO en º ..... | **21,20** |

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Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| | |
|---|---|
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| *Norma* | **UNE 103301/94** |
| *Acta nº* **2117684** | *Nº Copia* **Copia 1. Igeosuma** |

| | | | |
|---|---|---|---|
| **Referencia Muestra… 214883** | | Referencia Informe….. | EXP 21999 |
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 170,47 |
| PESO CON PARAFINA (g) = | 179,40 |
| PESO SUMERGIDO (g) = | 86,27 |
| HUMEDAD (%)= | 19,57 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA (g/cm³) =** | **2,05** |
| **DENSIDAD SECA (g/cm³) =** | **1,71** |

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|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103101/95 |
| | Acta nº 2117682 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214883 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULOS PREVIOS**

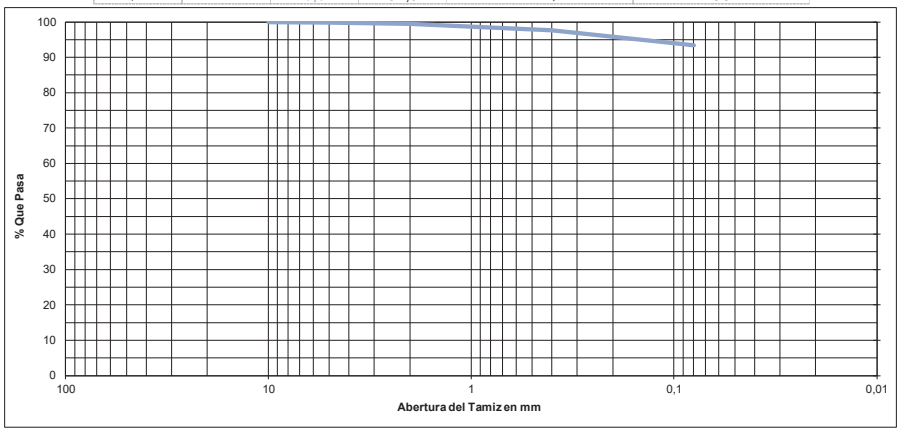
| | | |
|---|---|---|
| A | Muestra total seca al aire | 1238,2 |
| B | Gruesos lavados | 6,1 |
| C = (A - B) * f | Fracción fina seca | 1217,6 |
| D = (B + C) | Muestra total seca | 1223,7 |
| E | Fracción fina ensayada seca al aire | 79,7 |
| F = E * f | Fracción fina ensayada seca | 78,7 |
| C/F | | 15,5 |

**HUMEDAD HIGROSCÓPICA**

| | | |
|---|---|---|
| f=(100/(100+h)) | F/correc. hum. higroscópica | 1,0 |
| h=(a/s)*100 | Humedad higroscópica % | 1,2 |
| a=(t+s+a)-(t+s) | Agua | 0,8 |
| t+s+a | Tara+suelo+agua | 98,4 |
| t+s | Tara+suelo | 97,6 |
| t | Tara | 29,6 |
| s | Suelo | 68,0 |

**CÁLCULO CURVA GRANULOMÉTRICA POR TAMIZADO**

| Tamiz U.N.E. | Tamiz ASTM | Retenido entre tamices: g en parte fina ensayada | Retenido entre tamices: g en Muestra total | Pasa en muestra total: Gramos | Pasa en muestra total: % |
|---|---|---|---|---|---|
| 125 | 5 | | | | |
| 100 | 4 | | | | |
| 80 | 3 | | | | |
| 63 | 2,5 | | | | |
| 50 | 2 | | | | |
| 40 | 1,5 | | | | |
| 25 | 1 | | | | |
| 20 | 3/4 | | | | |
| 12,5 | 1/2 | | | | |
| 10 | 3/8 | | | 1223,7 | 100 |
| 5 | 4 | | 1,6 | 1222,1 | 100 |
| 2 | 10 | | 4,5 | 1217,6 | 100 |
| 0,4 | 40 | 1,5 | 23,0 | 1194,6 | 98 |
| 0,08 | 200 | 3,3 | 51,0 | 1143,6 | 93 |




OBSERVACIONES:

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|---|---|---|
| www.terralabscontrol.es | Norma | UNE 103300/93 |
| | Acta nº 2117681 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214883 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 168,19 |
| TARA + SUELO (g) = | 145,35 |
| TARA (g) = | 28,67 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **19,6** |

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|---|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 | |
| | Acta nº | 2117683 | Nº Copia: Copia 1. Igeosuma |

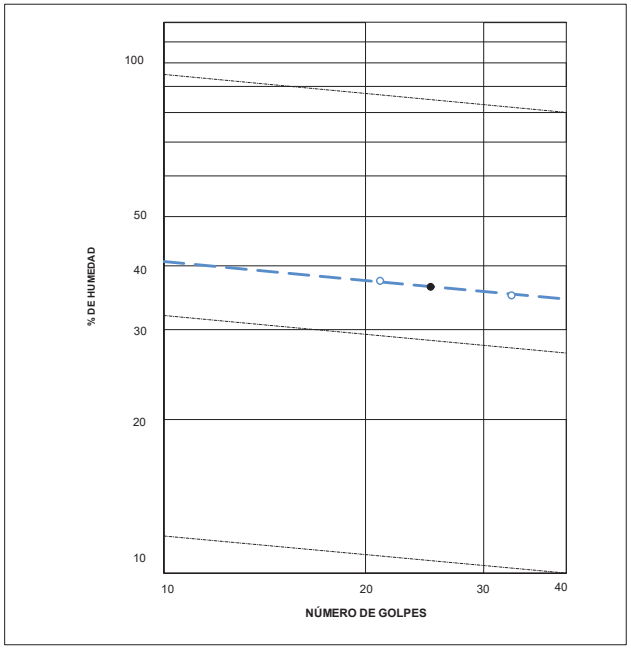
| Referencia Muestra… 214883 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**CÁLCULO LÍMITE LÍQUIDO**

| | | | |
|---|---|---|---|
| - | Nº de golpes | 21 | 33 |
| - | Referencia tara | L 33 | L 38 |
| a=(t+s+a)-(t+s) | Agua | 3,60 | 5,37 |
| t+s+a | Tara + suelo + agua | 47,94 | 56,81 |
| t+s | Tara + suelo | 44,34 | 51,44 |
| t | Tara | 34,73 | 36,12 |
| s=(t+s)-t | Suelo | 9,61 | 15,32 |
| w=100*(a/s) | **% Humedad** | **37,5** | **35,1** |

**CÁLCULO LÍMITE PLÁSTICO**

| | | |
|---|---|---|
| - | Referencia tara | L 48 |
| a=(t+s+a)-(t+s) | Agua | 6,84 |
| t+s+a | Tara + suelo + agua | 73,39 |
| t+s | Tara + suelo | 66,55 |
| t | Tara | 34,39 |
| s=(t+s)-t | Suelo | 32,16 |
| w=100*(a/s) | **% Humedad** | **21,3** |




**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| LÍMITE LÍQUIDO = | **36,5** |
| LÍMITE PLÁSTICO = | **21,3** |
| ÍNDICE PLASTICIDAD = | **15,2** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO DE COMPRESIÓN SIMPLE EN MUESTRAS DE SUELOS | |
|---|---|---|---|
| | Norma | UNE 103400/93 | |
| | Acta nº | 2117688 | Nº Copia: Copia 1. Igeosuma |

| Referencia Muestra… 214884 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (2,80 - 3,40 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

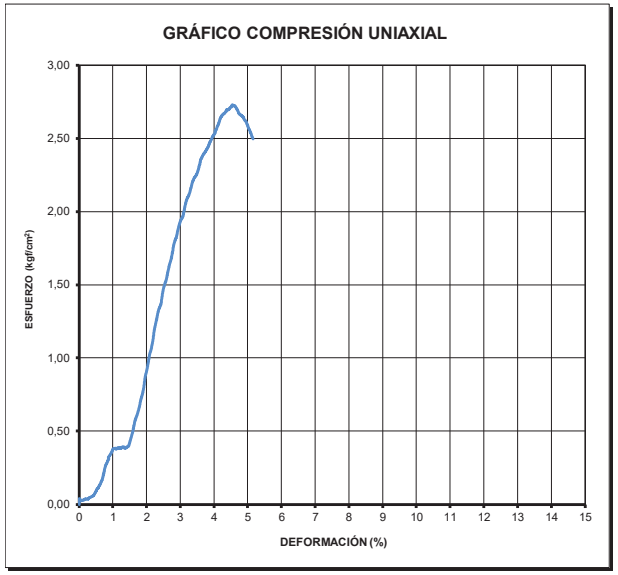
**CALCULO DE LA HUMEDAD**

| Parcial | | | Probeta | | |
|---|---|---|---|---|---|
| | Referencia tara | L 25 | P | Suelo húmedo total | 1182,02 |
| a=(t+s+a)-(t+s) | Agua | 21,80 | T + S | Tara + suelo seco parcial | 1417,01 |
| t+s+a | Tara+suelo+agua | 221,79 | T | Tara | 546,37 |
| t+s | Tara+suelo | 199,99 | S | Suelo seco parcial | 870,64 |
| t | Tara | 29,50 | s1=S+s | Suelo seco total | 1041,13 |
| s=(t+s)-t | Suelo | 170,49 | a1=P-s1 | Agua | 140,89 |
| h=(a*100)/s | ***Humedad*** | **12,79** | h1=(a1*100)/s1 | ***Humedad*** | **13,53** |

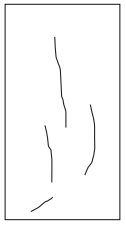
**TIPO PROBETA**: CILINDRICA

**DATOS PROBETA**

| Diámetro (mm) | Altura (mm) |
|---|---|
| 68 | 150 |
| Área ($cm^2$) | Volumen ($cm^3$) |
| 36,30 | 544,48 |
| Densidad ($g/cm^3$) | |
| **2,17** | |




**FORMA DE LA ROTURA**



**RESULTADOS**

| | |
|---|---|
| R ($kgf/cm^2$)= | ***2,73*** |
| Deform. (%) = | ***4,54*** |

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Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA DENSIDAD DE UN SUELO** |
|---|---|---|
| | *Norma* | UNE 103301/94 |
| | *Acta nº* **2117687** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214884** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (2,80 - 3,40 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 226,24 |
| PESO CON PARAFINA (g) = | 236,51 |
| PESO SUMERGIDO (g) = | 117,36 |
| HUMEDAD (%)= | 11,61 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA (g/cm$^3$) =** | **2,10** |
| **DENSIDAD SECA (g/cm$^3$) =** | **1,88** |

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO** |
|---|---|---|
| | *Norma* | UNE 103300/93 |
| | *Acta nº* **2117686** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214884** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 MI (2,80 - 3,40 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 219,86 |
| TARA + SUELO (g) = | 200,57 |
| TARA (g) = | 34,39 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **11,6** |

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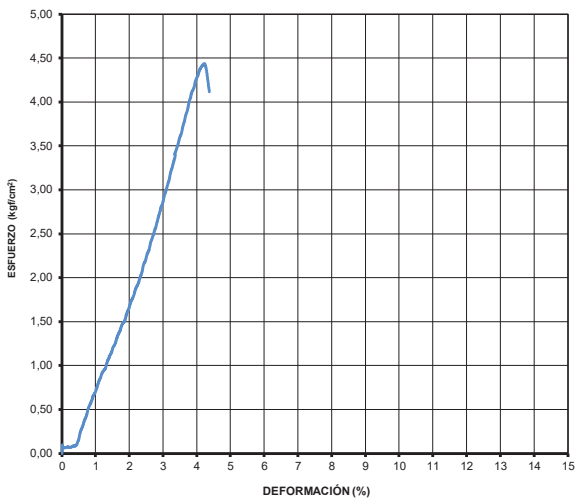
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2117692 | Nº Copia Copia 1. Igeosuma |

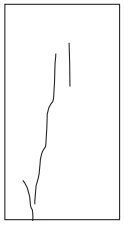
| Referencia Muestra… 214885 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 TP (6,20 - 6,50 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | L 18 | P | Suelo húmedo total | 1331,04 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 44,08 | T + S | Tara + suelo seco parcial | 1454,86 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 291,07 | T | Tara | 543,99 | 72 / 150 |
| t+s | Tara+suelo | 246,99 | S | Suelo seco parcial | 910,87 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 29,24 | s1=S+s | Suelo seco total | 1128,62 | 40,69 / 610,42 |
| s=(t+s)-t | Suelo | 217,75 | a1=P-s1 | Agua | 202,42 | Densidad ($g/cm^3$) |
| h=(a*100)/s | ***Humedad*** | **20,24** | h1=(a1*100)/s1 | ***Humedad*** | **17,94** | **2,18** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

| | |
|---|---|
| **R ($kgf/cm^2$)=** | ***4,44*** |
| **Deform. (%) =** | ***4,21*** |

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Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA DENSIDAD DE UN SUELO |
|---|---|---|
| | Norma | UNE 103301/94 |
| | Acta nº 2117691 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214885 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 TP (6,20 - 6,50 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| PESO MUESTRA HÚMEDA (g) = | 236,81 |
| PESO CON PARAFINA (g) = | 247,24 |
| PESO SUMERGIDO (g) = | 130,21 |
| HUMEDAD (%)= | 16,37 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **DENSIDAD HÚMEDA ($g/cm^3$) =** | **2,24** |
| **DENSIDAD SECA ($g/cm^3$) =** | **1,93** |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LA HUMEDAD NATURAL DE UN SUELO |
|---|---|---|
| | Norma | UNE 103300/93 |
| | Acta nº 2117689 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214885 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 TP (6,20 - 6,50 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DATOS ENSAYO | |
|---|---|
| TARA + SUELO + AGUA (g) = | 208,50 |
| TARA + SUELO (g) = | 184,15 |
| TARA (g) = | 35,37 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **HUMEDAD NATURAL (%)** | **16,4** |

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Caspe, a 9 de abril de 2021

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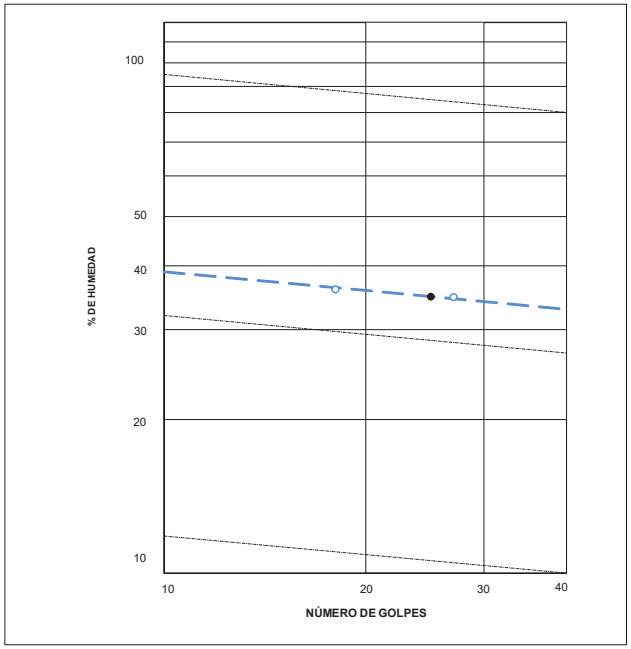
| Terra LABS Control www.terralabscontrol.es | Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG |
|---|---|---|
| | Norma | UNE 103103/94 UNE 103104/93 |
| | Acta nº 2117690 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214885 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 TP (6,20 - 6,50 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| *CÁLCULO LÍMITE LÍQUIDO* | | | |
|---|---|---|---|
| - | Nº de golpes | 18 | 27 |
| - | Referencia tara | L 34 | L 51 |
| a=(t+s+a)-(t+s) | Agua | 8,17 | 5,77 |
| t+s+a | Tara + suelo + agua | 66,87 | 57,14 |
| t+s | Tara + suelo | 58,70 | 51,37 |
| t | Tara | 36,03 | 34,77 |
| s=(t+s)-t | Suelo | 22,67 | 16,60 |
| w=100*(a/s) | ***% Humedad*** | **36,0** | **34,8** |

| *CÁLCULO LÍMITE PLÁSTICO* | | |
|---|---|---|
| - | Referencia tara | L 47 |
| a=(t+s+a)-(t+s) | Agua | 6,26 |
| t+s+a | Tara + suelo + agua | 70,32 |
| t+s | Tara + suelo | 64,06 |
| t | Tara | 35,43 |
| s=(t+s)-t | Suelo | 28,63 |
| w=100*(a/s) | ***% Humedad*** | **21,9** |




| *RESULTADOS DEL ENSAYO* | |
|---|---|
| LÍMITE LÍQUIDO = | **34,9** |
| LÍMITE PLÁSTICO = | **21,9** |
| ÍNDICE PLASTICIDAD = | **13,0** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

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Director Técnico

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Responsable ensayo

Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | *Ensayo* | **DETERMINACIÓN DE LA PRESIÓN DE HINCHAMIENTO DE UN SUELO EN EDÓMETRO** |
|---|---|---|
| | *Norma* | **UNE 103602/96** |
| | *Acta nº* **2117693** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214885** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S2 TP (6,20 - 6,50 m) |
| TIPO DE MUESTRA | T. PLASTIFICADO | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 25 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| **DESCRIPCIÓN DE LA MUESTRA ENSAYADA:** | |
|---|---|
| M. INALTERADA | |
| HUMEDAD DE ENSAYO (%): | 16,37 |
| DENSIDAD SECA ENSAYO (g/cm$^3$): | 1,93 |

| | |
|---|---|
| **PRESIÓN DE HINCHAMIENTO (kgf/cm$^2$)** | **0,25** |

| | |
|---|---|
| **PRESIÓN DE HINCHAMIENTO (kPa)** | **24,52** |

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| Terra LABS Control www.terralabscontrol.es | | ***AGRESIVIDAD DEL AGUA AL HORMIGÓN*** |
|---|---|---|
| | *Norma* | **ANEJO 5º EHE** |
| | *Acta nº* **2117786** | *Nº Copia* **Copia 1. Igeosuma** |

| **Referencia Muestra… 214820** | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | BPV10 S-1 (AGUA) |
| TIPO DE MUESTRA | AGUA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 30 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

## ANALISIS DEL AGUA

| **PARÁMETRO** | **RESULTADO ENSAYO** |
|---|---|
| Valor de pH | |
| Magnesio [$Mg^{2+}$](mg/l) | |
| Amonio [$NH_4^+$](mg/l) | |
| Sulfato ($SO_4^{2-}$) (mg/l) | **1838** |
| $CO_2$ Agresivo (mg/l) | |
| Residuo seco (mg/l) | |

**GRADO DE AGRESIVIDAD**

| **DEBIL** | **MEDIO** | **FUERTE** |
|---|---|---|
| 6,5 - 5,5 | 5,5 - 4,5 | < 4,5 |
| 300 - 1000 | 1000 - 3000 | > 3000 |
| 15 - 30 | 30 - 60 | > 60 |
| 200 - 600 | 600 - 3000 | > 3000 |
| 15 - 40 | 40 - 100 | > 100 |
| > 150 | 150 - 50 | < 50 |

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Caspe, a 9 de abril de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO DE COLAPSO DE SUELOS |
|---|---|---|
| | Norma | NLT-254/99 |
| | Acta nº 2117557 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra…** | **214778** | Referencia Informe….. | EXP 21999 |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DESCRIPCIÓN DE LA MUESTRA ENSAYADA:**

REMOLDEADA AL 98 % DEL P.M.

| DATOS ENSAYO | |
|---|---|
| ALTURA INICIAL (mm) | 4,99 |
| ALTURA FINAL S/INUNDAR (mm) | 4,68 |
| CARGA MÁXIMA (kg/cm$^2$) | **2,00** |
| ALTURA FINAL INUNDADA (mm) | 4,60 |

| RESULTADO DEL ENSAYO | |
|---|---|
| **INDICE DE COLAPSO, I =** | **0,4** |
| **Potencial porcentual de colapso, Ic = (%)** | **0,4** |

| INCERTIDUMBRE ENSAYO |
|---|
| ÍNDICE DE COLAPSO δ= 0,26 |

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO DE CORTE DIRECTO |
|---|---|---|
| | Norma | UNE 103401/98 |
| | Acta nº 2117558 | Nº Copia Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra….** | **214778** | Referencia Informe…… | EXP 21999 |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BE1-C2 (1,20 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 22 de febrero de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| TIPO DE ENSAYO | VELOCIDAD CORTE |
|---|---|
| CONSOLIDADO Y DRENADO | 0,015 mm/min |

| DIAMETRO ANILLO (mm) | ALTURA ANILLO (mm) | AREA ANILLO (cm$^2$) |
|---|---|---|
| 50 | 30,5 | 19,63 |

**DATOS PROBETA**

| CARGA AXIAL PROBETA | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|
| Altura inicial de la probeta (en mm) | 30,50 | 30,50 | 30,50 |
| Altura final de la probeta (en mm) | 30,37 | 29,72 | 29,77 |
| Referencia de Tara nº 1 | Anillo 1 | Anillo 1 | Anillo 1 |
| Peso Tara 1 (en g) | 64,10 | 60,89 | 63,83 |
| Tara 1 + Peso húmedo inicial (en g) | 193,99 | 190,68 | 193,66 |
| Referencia de Tara nº 2 | A | B | C |
| Peso Tara 2 (en g) | 34,79 | 29,46 | 27,31 |
| Tara 2 + Peso húmedo final (en g) | 169,31 | 162,13 | 162,48 |
| Tara 2 + Peso probeta seca (en g) | 151,93 | 144,71 | 144,02 |
| Peso específico partículas (en g) | 2,70 | 2,70 | 2,70 |

**RESULTADOS PROBETA**

| CARGA AXIAL PROBETA | | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|---|
| Dens. humeda inicial (en g/cm$^3$) | gn | 2,17 | 2,17 | 2,17 |
| Dens. humeda final (en g/cm$^3$) | gf | 2,26 | 2,27 | 2,31 |
| Dens. seca inicial (en g/cm$^3$) | gd | 1,96 | 1,92 | 1,95 |
| Den seca final (en g/cm$^3$) | gdt | 1,96 | 1,98 | 2,00 |
| Humedad inicial (en %) | W0 | 10,88 | 12,62 | 11,24 |
| Humedad final (en %) | Wf | 14,84 | 15,11 | 15,82 |
| Saturación inicial (en %) | S0 | 77,34 | 84,60 | 78,82 |
| Saturación final (en %) | Sf | 100,00 | 100,00 | 100,00 |
| Indice de huecos inicial | e0 | 0,38 | 0,40 | 0,39 |
| Indice de huecos final | ef | 0,37 | 0,37 | 0,35 |

**LECTURAS FASE CORTE**

| CARGA 1 | 100 kPa | CARGA 2 | 200 kPa | CARGA 3 | 300 kPa |
|---|---|---|---|---|---|
| Sh (mm) | F (N) | Sh (mm) | F (N) | Sh (mm) | F (N) |
| 0,26 | 31,12 | 0,33 | 39,50 | 0,26 | 13,17 |
| 0,33 | 75,41 | 0,45 | 65,20 | 0,31 | 99,35 |
| 0,47 | 106,53 | 0,62 | 111,32 | 0,35 | 173,56 |
| 0,67 | 144,83 | 0,79 | 209,47 | 0,44 | 246,58 |
| 0,87 | 163,98 | 1,07 | 264,53 | 0,63 | 338,75 |
| 1,09 | 172,36 | 1,31 | 281,29 | 0,83 | 391,41 |
| 1,24 | 171,17 | 1,55 | 281,29 | 1,04 | 410,56 |
| 0,80 | 8,00 | 1,78 | 269,32 | 1,29 | 424,93 |
| 0,90 | 9,00 | | | 1,49 | 429,72 |
| 1,00 | 10,00 | | | 1,62 | 424,93 |
| 1,10 | 11,00 | | | | |
| 1,20 | 12,00 | | | | |
| 1,30 | 13,00 | | | | |
| 1,40 | 14,00 | | | | |
| 1,50 | 15,00 | | | | |
| 1,60 | 16,00 | | | | |
| 1,70 | 17,00 | | | | |
| 1,80 | 18,00 | | | | |
| 1,90 | 19,00 | | | | |
| 2,00 | 20,00 | | | | |
| 2,10 | 21,00 | | | | |
| 2,20 | 22,00 | | | | |
| 2,30 | 23,00 | | | | |
| 2,40 | 24,00 | | | | |
| 2,50 | 25,00 | | | | |
| 2,60 | 26,00 | | | | |
| 2,70 | 27,00 | | | | |
| 2,80 | 28,00 | | | | |
| 2,90 | 29,00 | | | | |
| 3,00 | 30,00 | | | | |
| 3,10 | 31,00 | | | | |

**LECTURAS FASE CONSOLIDACION**

| CARGA 1 | 100 kPa | CARGA 2 | 200 kPa | CARGA 3 | 300 kPa |
|---|---|---|---|---|---|
| dt (min) | dH (mm) | dt (min) | dH (mm) | dt (min) | dH (mm) |
| 0,13 | 0,014 | 0,13 | 0,261 | 0,13 | 0,467 |
| 0,19 | 0,014 | 0,19 | 0,268 | 0,19 | 0,495 |
| 0,29 | 0,014 | 0,29 | 0,275 | 0,29 | 0,495 |
| 0,43 | 0,014 | 0,43 | 0,275 | 0,43 | 0,502 |
| 0,64 | 0,014 | 0,64 | 0,275 | 0,64 | 0,502 |
| 0,96 | 0,014 | 0,96 | 0,282 | 0,96 | 0,495 |
| 1,45 | 0,014 | 1,45 | 0,282 | 1,45 | 0,495 |
| 2,17 | 0,021 | 2,17 | 0,275 | 2,17 | 0,495 |
| 3,26 | 0,021 | 3,26 | 0,275 | 3,26 | 0,502 |
| 4,88 | 0,021 | 4,88 | 0,282 | 4,88 | 0,502 |
| 7,32 | 0,021 | 7,32 | 0,405 | 7,32 | 0,502 |
| 10,99 | 0,062 | 10,99 | 0,557 | 10,99 | 0,536 |
| 16,48 | 0,124 | 16,48 | 0,612 | 16,48 | 0,722 |
| 24,72 | 0,124 | 24,72 | 0,639 | 24,72 | 0,729 |
| 37,08 | 0,137 | 37,08 | 0,680 | 37,08 | 0,729 |
| 55,61 | 0,124 | 55,61 | 0,715 | 55,61 | 0,729 |
| 83,42 | 0,124 | 83,42 | 0,742 | 83,42 | 0,735 |
| 125,13 | 0,124 | 125,13 | 0,756 | 125,13 | 0,735 |
| 187,69 | 0,131 | 187,69 | 0,770 | 187,69 | 0,735 |
| 281,54 | 0,131 | 281,54 | 0,770 | 281,54 | 0,735 |
| 422,31 | 0,124 | 422,31 | 0,770 | 422,31 | 0,735 |
| 633,46 | 0,124 | 633,46 | 0,777 | 633,46 | 0,735 |
| 950,19 | 0,131 | 950,19 | 0,777 | 950,19 | 0,735 |
| 1430,00 | 0,131 | 1430,00 | 0,777 | 1430,00 | 0,735 |

**RESULTADOS FASE CONSOLIDACION**

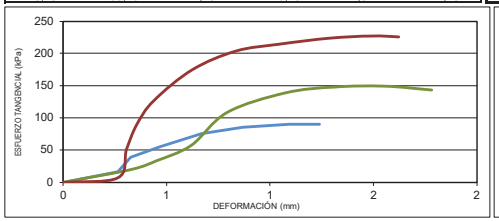
| Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 |
|---|---|---|---|---|---|
| 30,50 | | 30,50 | | 30,50 | |

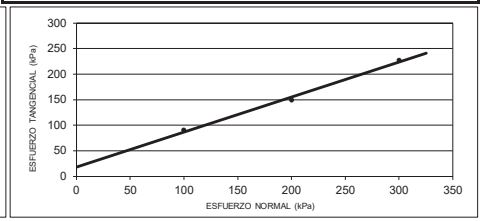
**RESULTADOS FASE CORTE**

| Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) |
|---|---|---|---|---|---|
| 3,10 | 90,29 | 1,78 | 149,15 | 1,62 | 227,48 |

**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| COHESIÓN en kPa ..... | **18,46** |
| ANGULO ROZAMIENTO INTERNO en º ..... | **34,45** |




VºBº

OBSERVACIONES: MUESTRA 98 % DN

Fdo.

Eduardo Baquer Barriendos
Director Técnico

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Ensayo | DISPERSABILIDAD POR TUBIFICACIÓN (PINHOLE) |
|---|---|
| Norma | NLT-207/91 |
| Acta nº 2117561 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra… 214778** | |
| PROCEDENCIA | CALICATA |
| TIPO DE MUESTRA | M. ALTERADA |
| FECHA ENTRADA | 22 de febrero de 2021 |

| | |
|---|---|
| Referencia Informe….. | EXP 21999 |
| REF. CLIENTE | BE1-C2 (1,20 m) |
| PETICIONARIO | IGEOSUMA |
| DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

**DETERMINACIÓN DE LA HUMEDAD DE LA MUESTRA**

| | |
|---|---|
| TARA + SUELO + AGUA (g) = | 72,38 |
| TARA + SUELO (g) = | 66,07 |
| TARA (g) = | 29,62 |

**HUMEDAD MUESTRA (%) 17,3**

**DATOS DEL ENSAYO**

| ALTURA DE AGUA | TIEMPO (min) | TURBIDEZ | VOLUMEN (ml) | CAUDAL (ml/s) | DIAMETRO ORIFICIO en mm | CLASIFICACIÓN |
|---|---|---|---|---|---|---|
| 50 | 2 | Turbia | 190 | 1,58 | > 1,50 | D1 |
| | 4 | | 190 | 1,58 | | |
| | 5 | | 130 | 2,17 | | |
| | 6 | | 140 | 2,33 | | |
| | 8 | | 270 | 2,25 | | |
| | 10 | | 270 | 2,25 | | |
| 180 | 2 | | | | | |
| | 4 | | | | | |
| | 5 | | | | | |
| | 6 | | | | | |
| | 8 | | | | | |
| | 10 | | | | | |
| 380 | 2 | | | | | |
| | 4 | | | | | |
| | 5 | | | | | |
| | 6 | | | | | |
| | 8 | | | | | |
| | 10 | | | | | |
| 1.029 | 2 | | | | | |
| | 4 | | | | | |
| | 5 | | | | | |
| | 6 | | | | | |
| | 8 | | | | | |
| | 10 | | | | | |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Ensayo | ENSAYO DE CORTE DIRECTO |
|---|---|
| Norma | UNE 103401/98 |
| Acta nº 2117566 | Nº Copia Copia 1. Igeosuma |

| | |
|---|---|
| **Referencia Muestra…. 214779** | |
| PROCEDENCIA | CALICATA |
| TIPO DE MUESTRA | M. ALTERADA |
| FECHA ENTRADA | 22 de febrero de 2021 |

| | |
|---|---|
| Referencia Informe…… | EXP 21999 |
| REF. CLIENTE | BE2-C1 (0,80 - 1,00 m) |
| PETICIONARIO | IGEOSUMA |
| DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| TIPO DE ENSAYO | VELOCIDAD CORTE |
|---|---|
| CONSOLIDADO Y DRENADO | 0,015 mm/min |

| DIAMETRO ANILLO (mm) | ALTURA ANILLO (mm) | AREA ANILLO ($cm^2$) |
|---|---|---|
| 50 | 30,5 | 19,63 |

**DATOS PROBETA**

| CARGA AXIAL PROBETA | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|
| Altura inicial de la probeta (en mm) | 30,50 | 30,50 | 30,50 |
| Altura final de la probeta (en mm) | 29,49 | 29,05 | 27,97 |
| Referencia de Tara nº 1 | Anillo 1 | Anillo 1 | Anillo 1 |
| Peso Tara 1 (en g) | 64,00 | 57,61 | 61,41 |
| Tara 1 + Peso húmedo inicial (en g) | 187,55 | 180,99 | 184,94 |
| Referencia de Tara nº 2 | A | B | C |
| Peso Tara 2 (en g) | 34,18 | 28,77 | 35,15 |
| Tara 2 + Peso húmedo final (en g) | 161,20 | 154,62 | 163,14 |
| Tara 2 + Peso probeta seca (en g) | 141,29 | 134,00 | 143,23 |
| Peso específico partículas (en g) | 2,70 | 2,70 | 2,70 |

**RESULTADOS PROBETA**

| CARGA AXIAL PROBETA | | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|---|
| Dens. humeda inicial (en g/$cm^3$) | gn | 2,06 | 2,06 | 2,06 |
| Dens. humeda final (en g/$cm^3$) | gf | 2,19 | 2,21 | 2,33 |
| Dens. seca inicial (en g/$cm^3$) | gd | 1,79 | 1,76 | 1,81 |
| Den seca final (en g/$cm^3$) | gdt | 1,85 | 1,85 | 1,97 |
| Humedad inicial (en %) | W0 | 15,35 | 17,25 | 14,29 |
| Humedad final (en %) | Wf | 18,59 | 19,60 | 18,42 |
| Saturación inicial (en %) | S0 | 81,38 | 86,85 | 77,87 |
| Saturación final (en %) | Sf | 100,00 | 100,00 | 100,00 |
| Indice de huecos inicial | e0 | 0,51 | 0,54 | 0,50 |
| Indice de huecos final | ef | 0,46 | 0,46 | 0,37 |

**LECTURAS FASE CORTE**

| CARGA 1 100 kPa Sh (mm) | F (N) | CARGA 2 200 kPa Sh (mm) | F (N) | CARGA 3 300 kPa Sh (mm) | F (N) |
|---|---|---|---|---|---|
| 0,46 | 20,00 | 0,08 | 35,18 | 0,38 | 17,65 |
| 0,67 | 48,24 | 0,24 | 97,42 | 0,43 | 61,18 |
| 0,89 | 67,06 | 0,43 | 131,24 | 0,55 | 91,77 |
| 1,19 | 88,24 | 0,65 | 151,54 | 0,74 | 124,71 |
| 1,40 | 101,18 | 0,89 | 179,94 | 0,88 | 167,06 |
| 1,76 | 122,35 | 1,12 | 207,00 | 1,01 | 200,00 |
| 1,85 | 125,88 | 1,33 | 219,18 | 1,13 | 222,36 |
| 2,08 | 130,59 | 1,53 | 230,00 | 1,31 | 249,42 |
| 2,34 | 135,29 | 1,85 | 243,54 | 1,53 | 269,42 |
| 2,68 | 140,00 | 1,94 | 240,83 | 1,81 | 290,60 |
| 2,82 | 142,35 | | | 2,04 | 303,54 |
| 3,00 | 142,35 | | | 2,31 | 316,48 |
| | | | | 2,51 | 320,01 |
| | | | | 2,69 | 323,54 |
| | | | | 2,72 | 320,01 |

**LECTURAS FASE CONSOLIDACION**

| CARGA 1 100 kPa dt (min) | dH (mm) | CARGA 2 200 kPa dt (min) | dH (mm) | CARGA 3 300 kPa dt (min) | dH (mm) |
|---|---|---|---|---|---|
| 0,13 | 0,303 | 0,13 | 0,902 | 0,13 | 0,606 |
| 0,19 | 0,317 | 0,19 | 0,944 | 0,19 | 1,184 |
| 0,29 | 0,331 | 0,29 | 0,966 | 0,29 | 1,226 |
| 0,43 | 0,338 | 0,43 | 0,987 | 0,43 | 1,255 |
| 0,64 | 0,345 | 0,64 | 0,994 | 0,64 | 1,269 |
| 0,96 | 0,359 | 0,96 | 1,008 | 0,96 | 1,290 |
| 1,45 | 0,388 | 1,45 | 1,015 | 1,45 | 1,311 |
| 2,17 | 0,430 | 2,17 | 1,029 | 2,17 | 1,332 |
| 3,26 | 0,472 | 3,26 | 1,043 | 3,26 | 1,353 |
| 4,88 | 0,522 | 4,88 | 1,057 | 4,88 | 1,374 |
| 7,32 | 0,550 | 7,32 | 1,064 | 7,32 | 1,396 |
| 10,99 | 0,585 | 10,99 | 1,078 | 10,99 | 1,424 |
| 16,48 | 0,613 | 16,48 | 1,085 | 16,48 | 1,438 |
| 24,72 | 0,613 | 24,72 | 1,093 | 24,72 | 1,473 |
| 37,08 | 0,656 | 37,08 | 1,100 | 37,08 | 1,515 |
| 55,61 | 0,663 | 55,61 | 1,114 | 55,61 | 1,565 |
| 83,42 | 0,663 | 83,42 | 1,128 | 83,42 | 1,670 |
| 125,13 | 0,677 | 125,13 | 1,163 | 125,13 | 1,981 |
| 187,69 | 0,719 | 187,69 | 1,226 | 187,69 | 2,347 |
| 281,54 | 0,811 | 281,54 | 1,346 | 281,54 | 2,460 |
| 422,31 | 0,959 | 422,31 | 1,424 | 422,31 | 2,502 |
| 633,46 | 1,001 | 633,46 | 1,438 | 633,46 | 2,523 |
| 950,19 | 1,008 | 950,19 | 1,445 | 950,19 | 2,530 |
| 1430,00 | 1,009 | 1430,00 | 1,448 | 1430,00 | 2,533 |

**RESULTADOS FASE CONSOLIDACION**

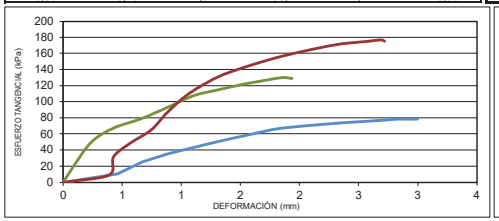
| Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 |
|---|---|---|---|---|---|
| 30,50 | | 30,50 | | 30,50 | |

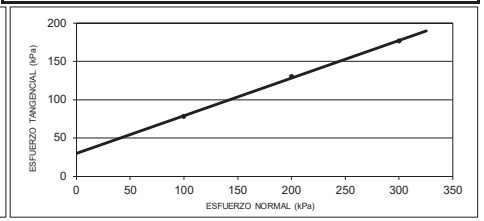
**RESULTADOS FASE CORTE**

| Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) |
|---|---|---|---|---|---|
| 3,00 | 78,49 | 1,94 | 130,17 | 2,72 | 176,89 |

**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| COHESIÓN en kPa ..... | 30,11 |
| ANGULO ROZAMIENTO INTERNO en º ..... | 26,20 |




VºBº

Eduardo Baquer Barriendos
Director Técnico

OBSERVACIONES: MUESTRA 98 % D1

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Ensayo | ENSAYO DE CORTE DIRECTO |
|---|---|
| Norma | UNE 103401/98 |
| Acta nº | 2117587 |
| Nº Copia | Copia 1. Igeosuma |

| | | | |
|---|---|---|---|
| **Referencia Muestra….** | **214847** | Referencia Informe…… | EXP 21999 |
| PROCEDENCIA | CALICATA | REF. CLIENTE | STABP-C2 (1,70 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 17 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| TIPO DE ENSAYO | VELOCIDAD CORTE |
|---|---|
| CONSOLIDADO Y DRENADO | 0,015 mm/min |

| DIAMETRO ANILLO (mm) | ALTURA ANILLO (mm) | AREA ANILLO (cm²) |
|---|---|---|
| 50 | 30,5 | 19,63 |

**DATOS PROBETA**

| CARGA AXIAL PROBETA | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|
| Altura inicial de la probeta (en mm) | 30,50 | 30,50 | 30,50 |
| Altura final de la probeta (en mm) | 30,31 | 29,42 | 29,46 |
| Referencia de Tara nº 1 | Anillo 1 | Anillo 1 | Anillo 1 |
| Peso Tara 1 (en g) | 59,52 | 64,63 | 60,88 |
| Tara 1 + Peso húmedo inicial (en g) | 185,93 | 191,07 | 187,34 |
| Referencia de Tara nº 2 | A | B | C |
| Peso Tara 2 (en g) | 35,67 | 35,93 | 30,02 |
| Tara 2 + Peso húmedo final (en g) | 168,56 | 168,93 | 161,98 |
| Tara 2 + Peso probeta seca (en g) | 148,70 | 149,48 | 142,82 |
| Peso específico partículas (en g) | 2,70 | 2,70 | 2,70 |

**RESULTADOS PROBETA**

| CARGA AXIAL PROBETA | | 100 kPa | 200 kPa | 300 kPa |
|---|---|---|---|---|
| Dens. humeda inicial (en g/cm³) | gn | 2,11 | 2,11 | 2,11 |
| Dens. humeda final (en g/cm³) | gf | 2,23 | 2,30 | 2,28 |
| Dens. seca inicial (en g/cm³) | gd | 1,89 | 1,90 | 1,88 |
| Den seca final (en g/cm³) | gdf | 1,90 | 1,97 | 1,95 |
| Humedad inicial (en %) | W0 | 11,84 | 11,35 | 12,11 |
| Humedad final (en %) | Wf | 17,57 | 17,13 | 16,99 |
| Saturación inicial (en %) | S0 | 74,30 | 72,35 | 75,50 |
| Saturación final (en %) | Sf | 100,00 | 100,00 | 100,00 |
| Indice de huecos inicial | e0 | 0,43 | 0,42 | 0,43 |
| Indice de huecos final | ef | 0,42 | 0,37 | 0,38 |

**LECTURAS FASE CORTE**

| CARGA 1 | 100 kPa | CARGA 2 | 200 kPa | CARGA 3 | 300 kPa |
|---|---|---|---|---|---|
| Sh (mm) | F (N) | Sh (mm) | F (N) | Sh (mm) | F (N) |
| 0,13 | 31,99 | 0,13 | 19,65 | 0,07 | 53,95 |
| 0,22 | 85,17 | 0,19 | 87,48 | 0,13 | 123,70 |
| 0,41 | 132,18 | 0,24 | 123,70 | 0,17 | 183,44 |
| 0,63 | 157,23 | 0,35 | 168,79 | 0,26 | 250,88 |
| 0,78 | 164,56 | 0,48 | 196,54 | 0,41 | 294,82 |
| 0,95 | 166,10 | 0,56 | 220,44 | 0,60 | 319,10 |
| 1,12 | 166,87 | 0,73 | 235,85 | 0,80 | 335,67 |
| 1,15 | 167,25 | 1,02 | 252,04 | 0,99 | 348,00 |
| | | 1,21 | 253,19 | 1,19 | 348,77 |
| | | 1,34 | 250,88 | 1,25 | 347,23 |

**LECTURAS FASE CONSOLIDACION**

| CARGA 1 | 100 kPa | CARGA 2 | 200 kPa | CARGA 3 | 300 kPa |
|---|---|---|---|---|---|
| dt (min) | dH (mm) | dt (min) | dH (mm) | dt (min) | dH (mm) |
| 0,13 | 0,238 | 0,13 | 0,813 | 0,13 | 0,476 |
| 0,19 | 0,238 | 0,19 | 0,829 | 0,19 | 0,484 |
| 0,29 | 0,238 | 0,29 | 0,846 | 0,29 | 0,501 |
| 0,43 | 0,238 | 0,43 | 0,862 | 0,43 | 0,501 |
| 0,64 | 0,238 | 0,64 | 0,862 | 0,64 | 0,501 |
| 0,96 | 0,238 | 0,96 | 0,862 | 0,96 | 0,501 |
| 1,45 | 0,238 | 1,45 | 0,862 | 1,45 | 0,509 |
| 2,17 | 0,238 | 2,17 | 0,870 | 2,17 | 0,501 |
| 3,26 | 0,238 | 3,26 | 0,878 | 3,26 | 0,501 |
| 4,88 | 0,238 | 4,88 | 0,903 | 4,88 | 0,509 |
| 7,32 | 0,238 | 7,32 | 0,911 | 7,32 | 0,509 |
| 10,99 | 0,238 | 10,99 | 0,920 | 10,99 | 0,517 |
| 16,48 | 0,238 | 16,48 | 0,920 | 16,48 | 0,525 |
| 24,72 | 0,238 | 24,72 | 0,920 | 24,72 | 0,525 |
| 37,08 | 0,238 | 37,08 | 0,920 | 37,08 | 0,534 |
| 55,61 | 0,238 | 55,61 | 0,920 | 55,61 | 0,534 |
| 83,42 | 0,238 | 83,42 | 0,920 | 83,42 | 0,542 |
| 125,13 | 0,222 | 125,13 | 0,920 | 125,13 | 0,575 |
| 187,69 | 0,197 | 187,69 | 0,969 | 187,69 | 0,624 |
| 281,54 | 0,197 | 281,54 | 1,018 | 281,54 | 0,673 |
| 422,31 | 0,189 | 422,31 | 1,043 | 422,31 | 0,821 |
| 633,46 | 0,189 | 633,46 | 1,067 | 633,46 | 0,961 |
| 950,19 | 0,189 | 950,19 | 1,076 | 950,19 | 1,034 |
| 1430,00 | 0,189 | 1430,00 | 1,077 | 1430,00 | 1,036 |

**RESULTADOS FASE CONSOLIDACION**

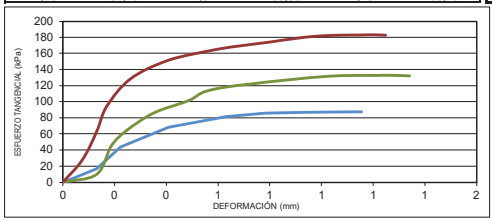
| Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 | Alt. Inic. (mm) | Valor t100 |
|---|---|---|---|---|---|
| 30,50 | | 30,50 | | 30,50 | |

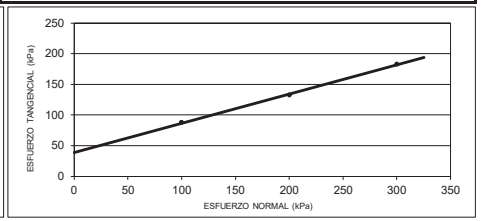
**RESULTADOS FASE CORTE**

| Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) | Sh (mm) | $\tau_{max}$ (KPa) |
|---|---|---|---|---|---|
| 1,15 | 87,76 | 1,34 | 133,05 | 1,25 | 183,19 |

**RESULTADOS DEL ENSAYO**

| | |
|---|---|
| COHESIÓN en kPa ..... | **39,24** |
| ANGULO ROZAMIENTO INTERNO en º ..... | **25,51** |




VºBº OBSERVACIONES: MUESTRA 98 % DMPM Fdo.

Eduardo Baquer Barriendos
Director Técnico

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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www.terralabscontrol.es

| Ensayo | DETERMINACIÓN DE LÍMITES DE ATTERBERG |
|---|---|
| Norma | UNE 103103/94 UNE 103104/93 |
| Acta nº | 2117574 |
| Nº Copia | Copia 1. Igeosuma |

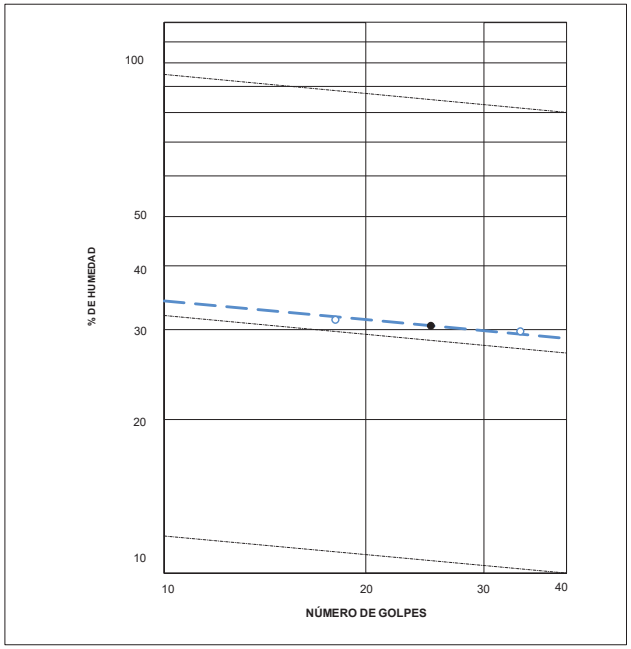
| | | | |
|---|---|---|---|
| **Referencia Muestra… 214857** | | Referencia Informe….. | EXP 21999 |
| PROCEDENCIA | CALICATA | REF. CLIENTE | BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 19 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***CÁLCULO LÍMITE LÍQUIDO***

| | | | |
|---|---|---|---|
| - | Nº de golpes | 18 | 34 |
| - | Referencia tara | T 16 | T 69 |
| a=(t+s+a)-(t+s) | Agua | 6,91 | 5,67 |
| t+s+a | Tara + suelo + agua | 45,51 | 41,31 |
| t+s | Tara + suelo | 38,60 | 35,64 |
| t | Tara | 16,61 | 16,62 |
| s=(t+s)-t | Suelo | 21,99 | 19,02 |
| w=100*(a/s) | ***% Humedad*** | **31,4** | **29,8** |

***CÁLCULO LÍMITE PLÁSTICO***

| | | |
|---|---|---|
| - | Referencia tara | L 4 |
| a=(t+s+a)-(t+s) | Agua | 4,68 |
| t+s+a | Tara + suelo + agua | 46,73 |
| t+s | Tara + suelo | 42,05 |
| t | Tara | 18,33 |
| s=(t+s)-t | Suelo | 23,72 |
| w=100*(a/s) | ***% Humedad*** | **19,7** |




***RESULTADOS DEL ENSAYO***

| | |
|---|---|
| LÍMITE LÍQUIDO = | **30,6** |
| LÍMITE PLÁSTICO = | **19,7** |
| ÍNDICE PLASTICIDAD = | **10,8** |

| INCERTIDUMBRE ENSAYO |
|---|
| LIMITE PLÁSTICO δ= 0,11 |
| LIMITE LÍQUIDO δ= 0,20 |

VºBº Fdo.

Eduardo Baquer Barriendos
Director Técnico

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | DISPERSABILIDAD POR TUBIFICACIÓN (PINHOLE) |
|---|---|---|
| | Norma | NLT-207/91 |
| | Acta nº 2117579 | Nº Copia Copia 1. Igeosuma |

| Referencia Muestra… 214857 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 19 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| DETERMINACIÓN DE LA HUMEDAD DE LA MUESTRA | |
|---|---|
| TARA + SUELO + AGUA (g) = | 75,84 |
| TARA + SUELO (g) = | 67,36 |
| TARA (g) = | 29,81 |

| HUMEDAD MUESTRA (%) | 22,6 |
|---|---|

**DATOS DEL ENSAYO**

| ALTURA DE AGUA | TIEMPO (min) | TURBIDEZ | VOLUMEN (ml) | CAUDAL (ml/s) | DIAMETRO ORIFICIO en mm | CLASIFICACIÓN |
|---|---|---|---|---|---|---|
| 50 | 2 | Ligeramente turbia | 60 | 0,50 | | |
| | 4 | | 90 | 0,75 | | |
| | 5 | | 40 | 0,67 | | |
| | 6 | | 30 | 0,50 | | |
| | 8 | | 70 | 0,58 | | |
| | 10 | | 80 | 0,67 | | |
| 180 | 2 | Turbia | 130 | 1,08 | > 2,0 | D2 |
| | 4 | | 140 | 1,17 | | |
| | 5 | | 75 | 1,25 | | |
| | 6 | | 85 | 1,42 | | |
| | 8 | | 140 | 1,17 | | |
| | 10 | | 140 | 1,17 | | |
| 380 | 2 | | | | | |
| | 4 | | | | | |
| | 5 | | | | | |
| | 6 | | | | | |
| | 8 | | | | | |
| | 10 | | | | | |
| 1.029 | 2 | | | | | |
| | 4 | | | | | |
| | 5 | | | | | |
| | 6 | | | | | |
| | 8 | | | | | |
| | 10 | | | | | |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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| Terra LABS Control www.terralabscontrol.es | Ensayo | ENSAYO COMPACTACIÓN PROCTOR MODIFICADO |
|---|---|---|
| | Norma | UNE 103501/94 |
| | Acta nº 2117575 | Nº Copia Copia 1. Igeosuma |

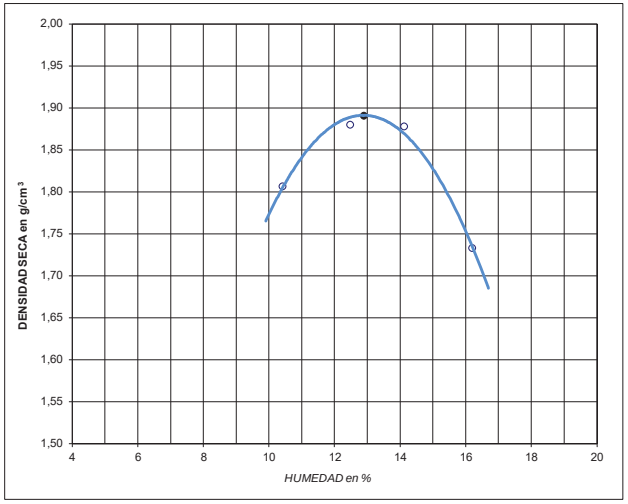
| Referencia Muestra… 214857 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | CALICATA | REF. CLIENTE | BPV10-C1 (0,80 - 1,50 m) |
| TIPO DE MUESTRA | M. ALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 19 de marzo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

***DENSIDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | % agua añadida | | 2,00 | 4,00 | 6,00 | | |
| t+s+a | Molde+suelo+agua | 10054,50 | 10332,50 | 10400,05 | 10100,00 | | |
| t | Molde | 5427,50 | 5427,50 | 5427,50 | 5427,50 | | |
| s+a=(t+s+a)-t | Suelo+agua | 4627,00 | 4905,00 | 4972,55 | 4672,50 | | |
| s=[(s+a)*100]/(100+h) | Suelo | 4190,98 | 4361,38 | 4357,50 | 4021,34 | | |
| D=s/v | ***Densidad (g/cm³)*** | **1,81** | **1,88** | **1,88** | **1,73** | | |

***HUMEDAD***

| | Punto nº | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|
| | Referencia tara | | | | | | |
| a=(t+s+a)-(t+s) | Agua | 100,50 | 153,50 | 171,00 | 193,50 | | |
| t+s+a | Tara+suelo+agua | 1610,50 | 1903,50 | 1929,00 | 1923,50 | | |
| t+s | Tara+suelo | 1510,00 | 1750,00 | 1758,00 | 1730,00 | | |
| t | Tara | 544,00 | 518,50 | 546,50 | 535,00 | | |
| s=(t+s)-t | Suelo | 966,00 | 1231,50 | 1211,50 | 1195,00 | | |
| h=(a*100)/s | ***Humedad (%)*** | **10,40** | **12,46** | **14,11** | **16,19** | | |




**CARACTERISTICAS DEL ENSAYO**

| | |
|---|---|
| Volumen del Molde (cm³): | 2320 |
| Peso de la Maza (g): | 4540 |
| Altura de caída (cm): | 45,7 |
| Número de capas: | 5 |
| Número de golpes: | 60 |

| RESULTADOS COMPACTACION | |
|---|---|
| **Dens máxima (t/m³)** | ***1,89*** |
| **Humedad óptima (%)** | ***12,88*** |

| INCERTIDUMBRE ENSAYO |
|---|
| DENSIDAD MAXIMA δ= 0,01 |
| HUMEDAD OPTIMA δ= 0,01 |

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 28 de marzo de 2021

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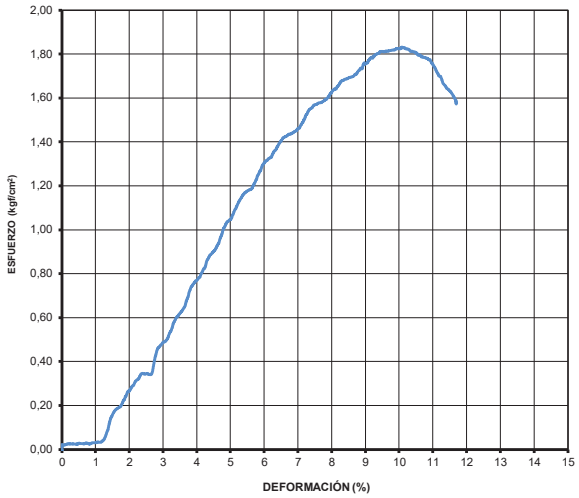
| Terra LABS Control© www.terralabscontrol.es | Ensayo | ENSAYO DE COMPRESIÓN SIMPLE EN MUESTRAS DE SUELOS |
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2118145 | Nº Copia Copia 1. Igeosuma |

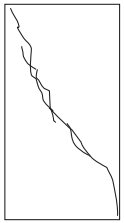
| Referencia Muestra… 215031 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | EBS1 (1,20 - 1,80 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 7 de mayo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | PS 6 | P | Suelo húmedo total | 1266,44 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 40,62 | T + S | Tara + suelo seco parcial | 1409,57 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 280,96 | T | Tara | 537,04 | 69 / 154 |
| t+s | Tara+suelo | 240,34 | S | Suelo seco parcial | 872,53 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 35,85 | s1=S+s | Suelo seco total | 1077,02 | 37,37 / 575,56 |
| s=(t+s)-t | Suelo | 204,49 | a1=P-s1 | Agua | 189,42 | Densidad ($g/cm^3$) |
| h=(a*100)/s | **Humedad** | **19,86** | h1=(a1*100)/s1 | **Humedad** | **17,59** | **2,20** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

R ($kgf/cm^2$)= ***1,83***

Deform. (%) = ***10,07***

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 10 de mayo de 2021

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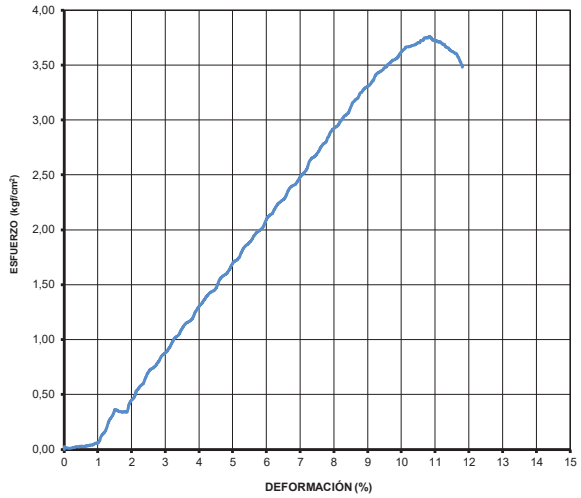
|---|---|---|
| | Norma | UNE 103400/93 |
| | Acta nº 2118146 | Nº Copia Copia 1. Igeosuma |

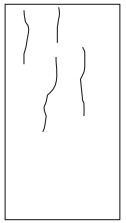
| Referencia Muestra… 215032 | | Referencia Informe….. EXP 21999 | |
|---|---|---|---|
| PROCEDENCIA | SONDEO | REF. CLIENTE | EBS1 (4,50 - 4,85 m) |
| TIPO DE MUESTRA | M. INALTERADA | PETICIONARIO | IGEOSUMA |
| FECHA ENTRADA | 7 de mayo de 2021 | DEN. OBRA | EG MODERNIZACION DE REGADIO CR SANTA ANA |

| CALCULO DE LA HUMEDAD | | | | | | TIPO PROBETA |
|---|---|---|---|---|---|---|
| Parcial | | | Probeta | | | CILINDRICA |
| | Referencia tara | PS 6 | P | Suelo húmedo total | 1297,65 | DATOS PROBETA |
| a=(t+s+a)-(t+s) | Agua | 40,61 | T + S | Tara + suelo seco parcial | 1435,67 | Diámetro (mm) / Altura (mm) |
| t+s+a | Tara+suelo+agua | 286,44 | T | Tara | 542,39 | 69 / 154 |
| t+s | Tara+suelo | 245,83 | S | Suelo seco parcial | 893,28 | Área ($cm^2$) / Volumen ($cm^3$) |
| t | Tara | 36,06 | s1=S+s | Suelo seco total | 1103,05 | 37,37 / 575,56 |
| s=(t+s)-t | Suelo | 209,77 | a1=P-s1 | Agua | 194,60 | Densidad ($g/cm^3$) |
| h=(a*100)/s | **Humedad** | **19,36** | h1=(a1*100)/s1 | **Humedad** | **17,64** | **2,25** |

**GRÁFICO COMPRESIÓN UNIAXIAL**




**FORMA DE LA ROTURA**



**RESULTADOS**

R ($kgf/cm^2$)= ***3,76***

Deform. (%) = ***10,83***

VºBº

Eduardo Baquer Barriendos
Director Técnico

Fdo.

José A. Ballesteros Estela
Responsable ensayo

Caspe, a 10 de mayo de 2021

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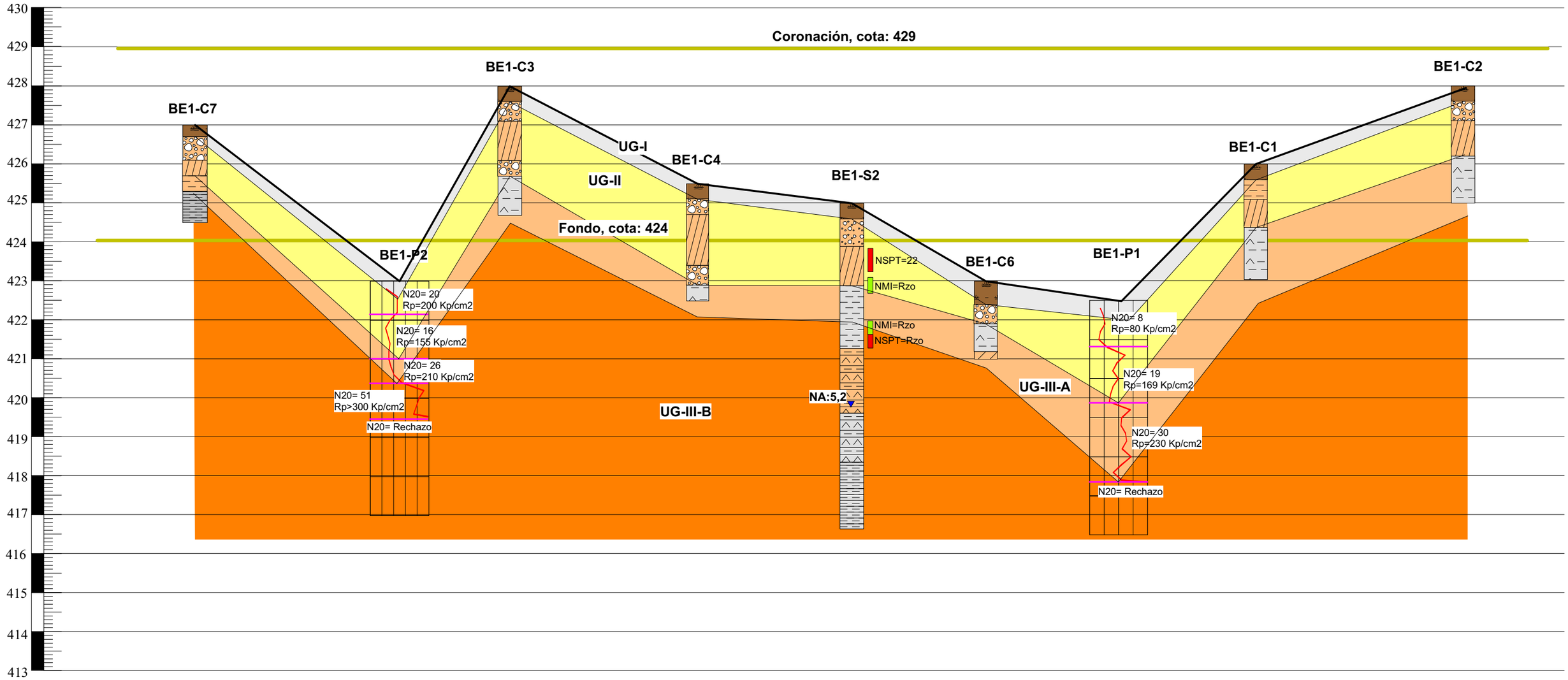
# VI.- PERFILES DE CORRELACIÓN BALSAS Y ESTACIÓN DE BOMBEO

# VI.A.- BALSA ELEVADA 1

IGEOSUMA, S.L.

# BALSA ELEVADA 1

## PERFIL DE CORRELACIÓN - I. MODELO GEOLÓGICO-GEOTÉCNICO




Escala Horizontal en metros:
0 20 40

## LEYENDA

UNIDAD I. TIERRA DE LABOR-SUELO VEGETAL

UNIDAD II. RECUBRIMIENTO CUATERNARIO. SUELOS FINOS: Limos arcillosos, arcillas limosas. Arenas-Limos con arcillas

UNIDAD III. SUSTRATO TERCIARIO.
Arcillas a argilitas marrones-grisáceas con yesos.

UNIDAD III-A. Sustrato Terciario alterado.

UNIDAD III-B. Sustrato Terciario más sano.

**INFORME:** ***ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)***

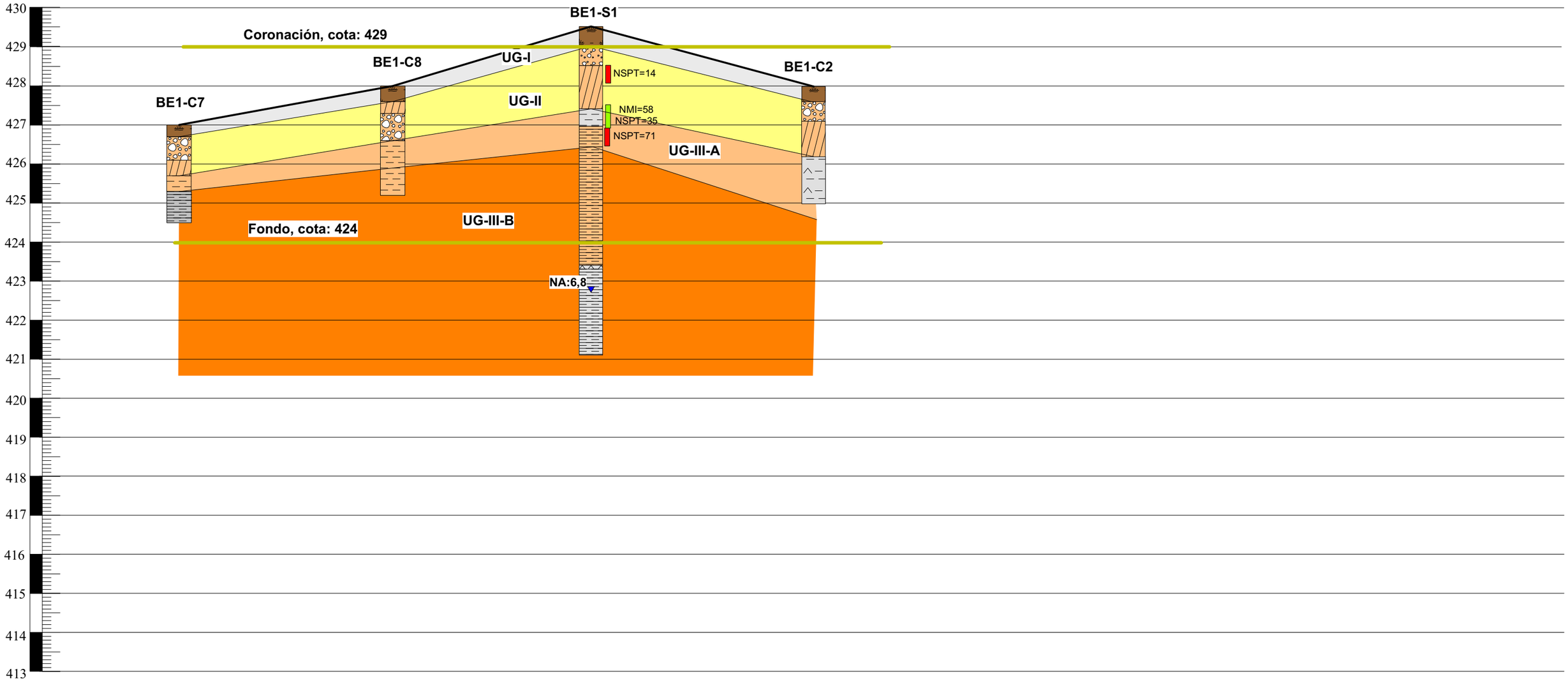
**REFERENCIA:** *0673*

**FECHA:** *Abril de 2021*

IGEOSUMA, S.L.

# BALSA ELEVADA 1

## PERFIL DE CORRELACIÓN - II. MODELO GEOLÓGICO-GEOTÉCNICO




Escala Horizontal en metros:
0 20 40

### LEYENDA

UNIDAD I. TIERRA DE LABOR-SUELO VEGETAL

UNIDAD II. RECUBRIMIENTO CUATERNARIO. SUELOS FINOS: Limos arcillosos, arcillas limosas. Arenas-Limos con arcillas

UNIDAD III. SUSTRATO TERCIARIO.
Arcillas a argilitas marrones-grisáceas con yesos.

UNIDAD III-A. Sustrato Terciario alterado.

UNIDAD III-B. Sustrato Terciario más sano.

**INFORME:** ***ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)***

**REFERENCIA:** *0673*

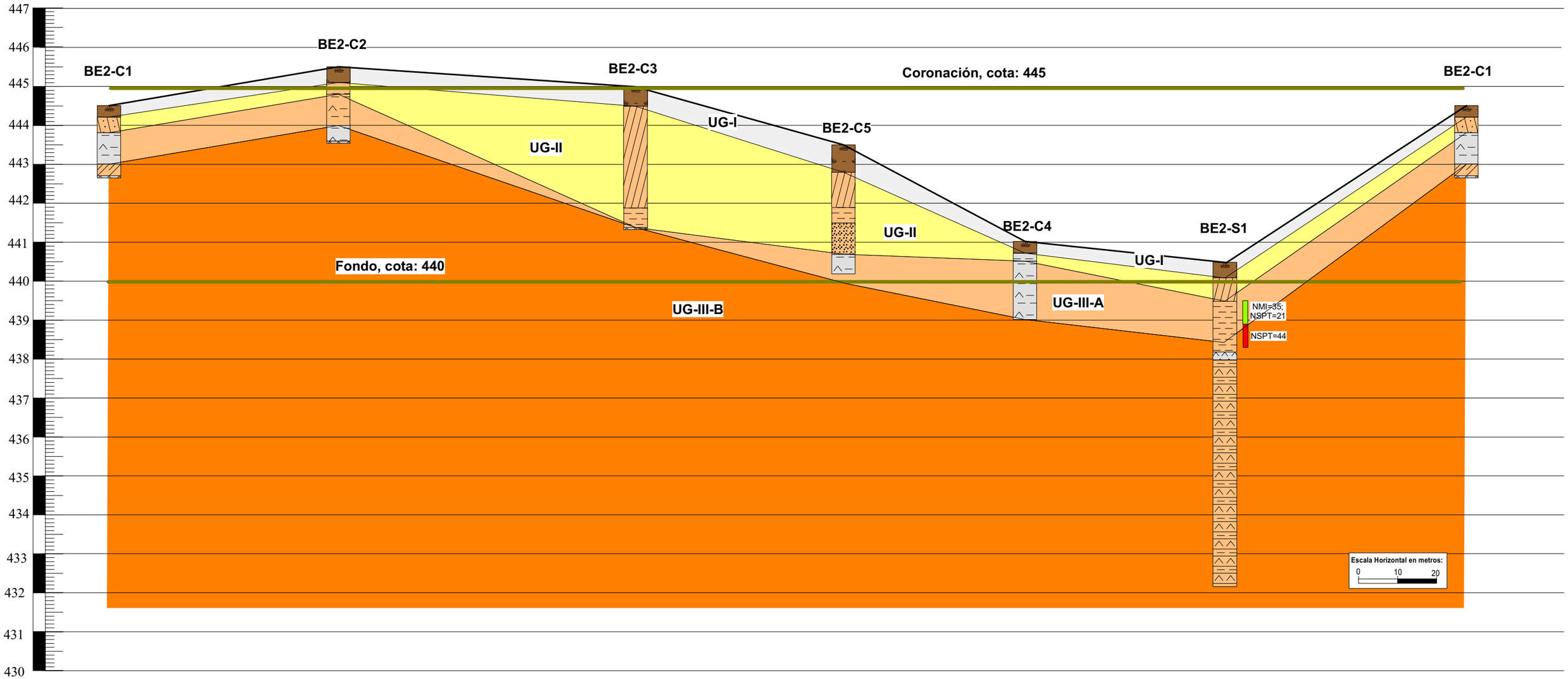
**FECHA:** *Abril de 2021*

# VI.B.- BALSA ELEVADA 2

IGEOSUMA, S.L.

# BALSA ELEVADA 2

## PERFIL DE CORRELACIÓN. MODELO GEOLÓGICO-GEOTÉCNICO




### LEYENDA

- UNIDAD I. TIERRA DE LABOR-SUELO VEGETAL
- UNIDAD II. RECUBRIMIENTO CUATERNARIO. SUELOS FINOS: Limos arcillosos, arcillas limosas. Arenas-Limos con arcillas
- UNIDAD III. SUSTRATO TERCIARIO. Arcillas a argilitas marrones-grisáceas con yesos.
  - UNIDAD III-A. Sustrato Terciario alterado.
  - UNIDAD III-B. Sustrato Terciario más sano.

**INFORME:** ***ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)***

**REFERENCIA:** *0673*

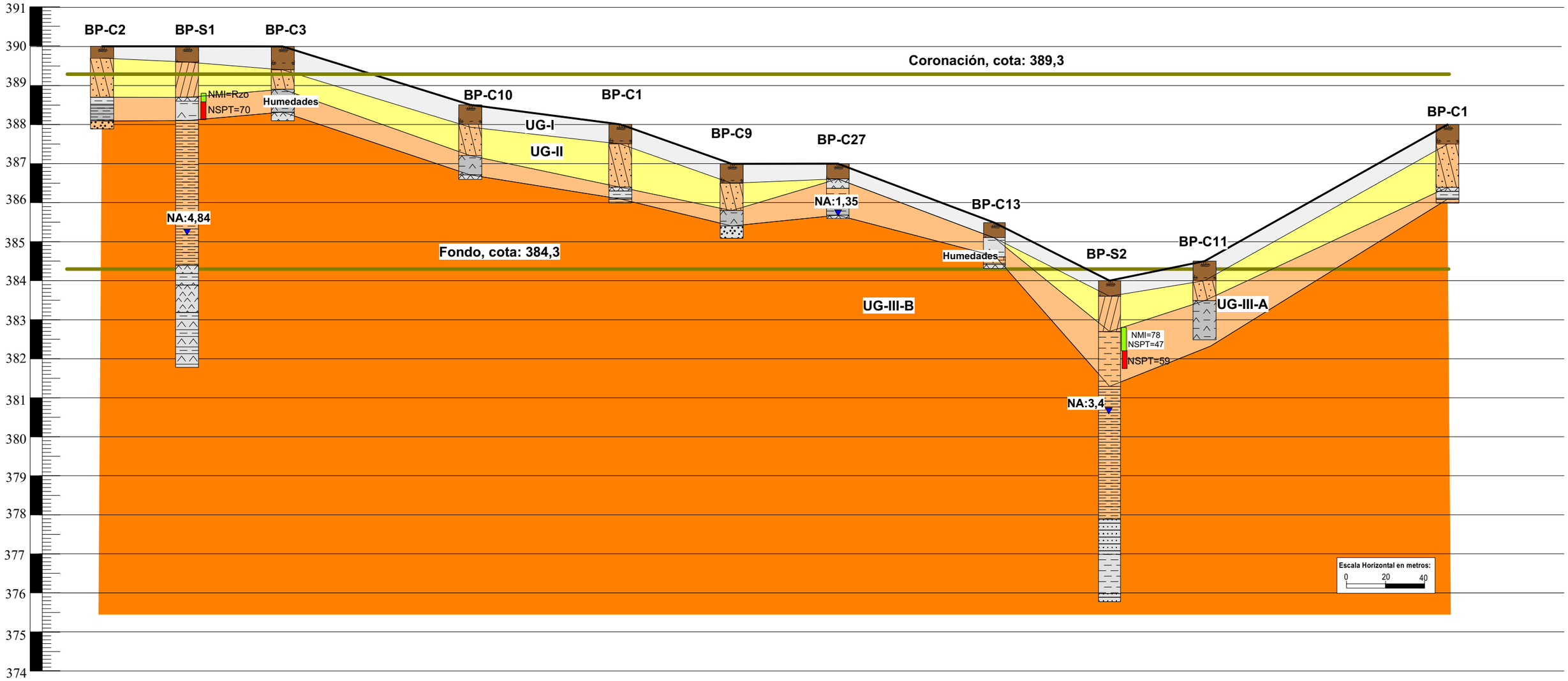
**FECHA:** *Abril de 2021*

# VI.C.- BALSA PIE DE CANAL V4

IGEOSUMA, S.L.

# BALSA PIE DE CANAL V4

## PERFIL DE CORRELACIÓN. MODELO GEOLÓGICO-GEOTÉCNICO




### LEYENDA

UNIDAD I. TIERRA DE LABOR-SUELO VEGETAL

UNIDAD II. RECUBRIMIENTO CUATERNARIO. SUELOS FINOS: Limos arcillosos, arcillas limosas. Arenas-Limos con arcillas

UNIDAD III. SUSTRATO TERCIARIO.
Arcillas a argilitas marrones-grisáceas con yesos e intercalaciones de calizas y areniscas.

UNIDAD III-A. Sustrato Terciario alterado.

UNIDAD III-B. Sustrato Terciario más sano.

**INFORME:** *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

**REFERENCIA:** *0673*

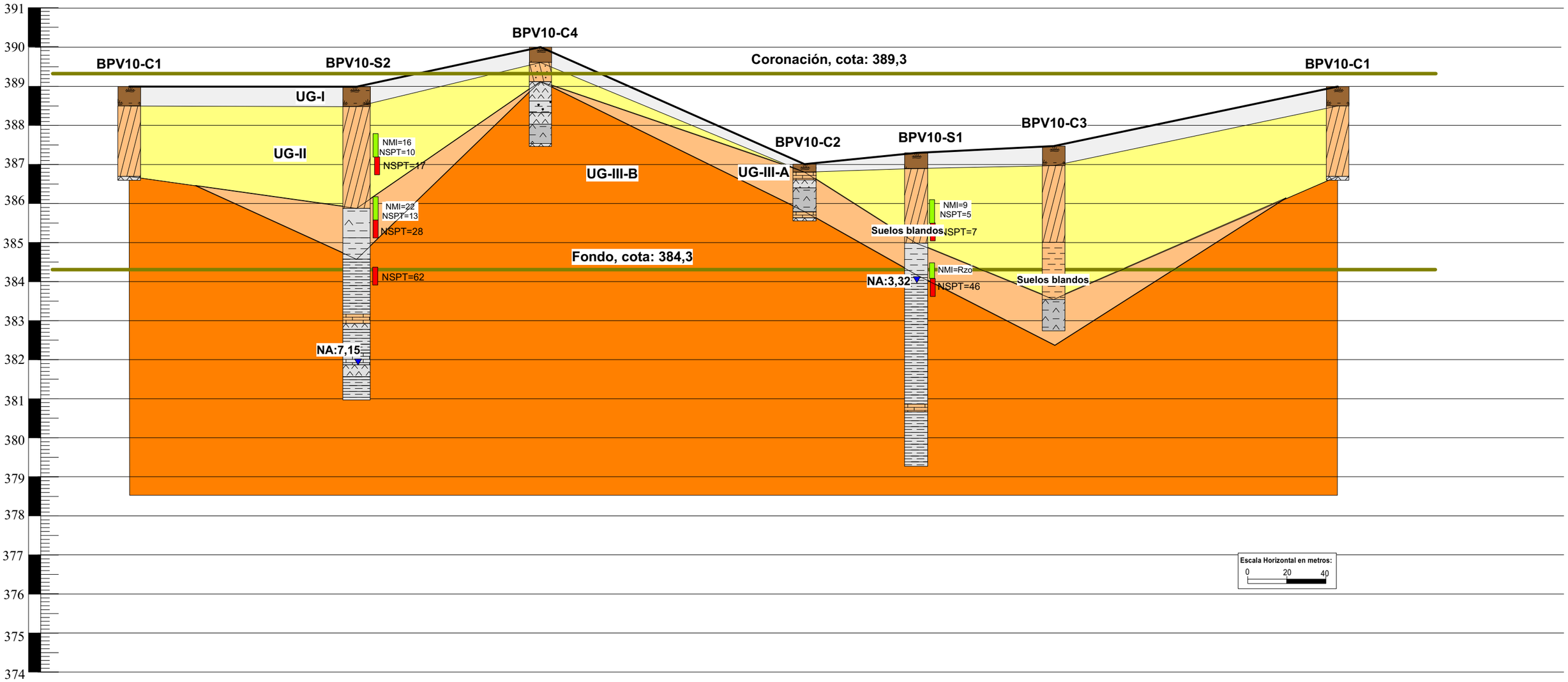
**FECHA:** *Abril de 2021*

# VI.D.- BALSA PIE DE CANAL V10

# BALSA PIE DE CANAL V10

IGEOSUMA, S.L.

## PERFIL DE CORRELACIÓN. MODELO GEOLÓGICO-GEOTÉCNICO




### LEYENDA

- UNIDAD I. TIERRA DE LABOR-SUELO VEGETAL
- UNIDAD II. RECUBRIMIENTO CUATERNARIO. SUELOS FINOS: Limos arcillosos, arcillas limosas. Arenas-Limos con arcillas
- UNIDAD III. SUSTRATO TERCIARIO. Arcillas a argilitas marrones-grisáceas con yesos e intercalaciones de calizas y areniscas.
  - UNIDAD III-A. Sustrato Terciario alterado.
  - UNIDAD III-B. Sustrato Terciario más sano.

**INFORME:** *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

**REFERENCIA:** *0673*

**FECHA:** *Abril de 2021*

# VI.E—ESTACIÓN DE BOMBEO Y ARQUETA

# ESTACIÓN DE BOMBEO

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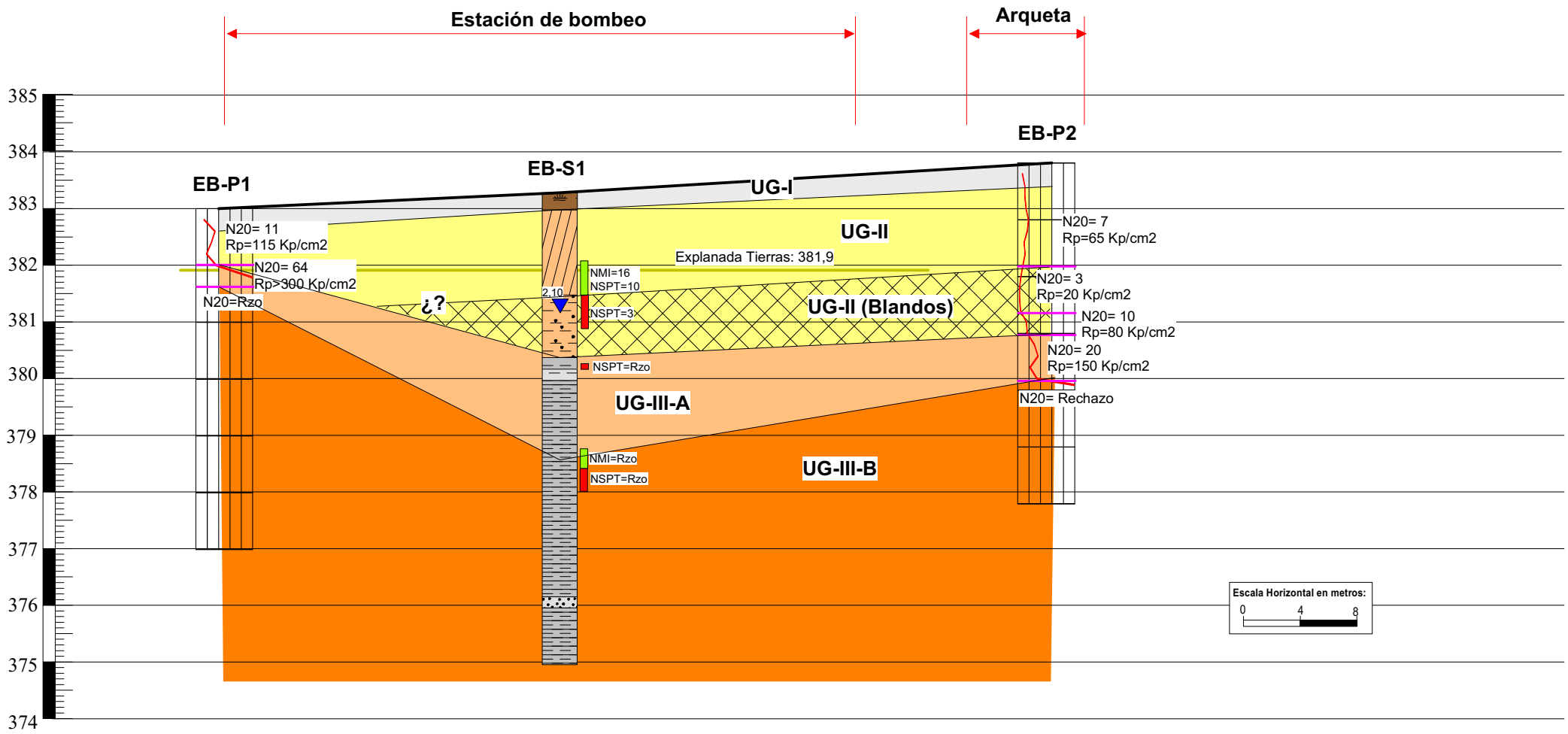


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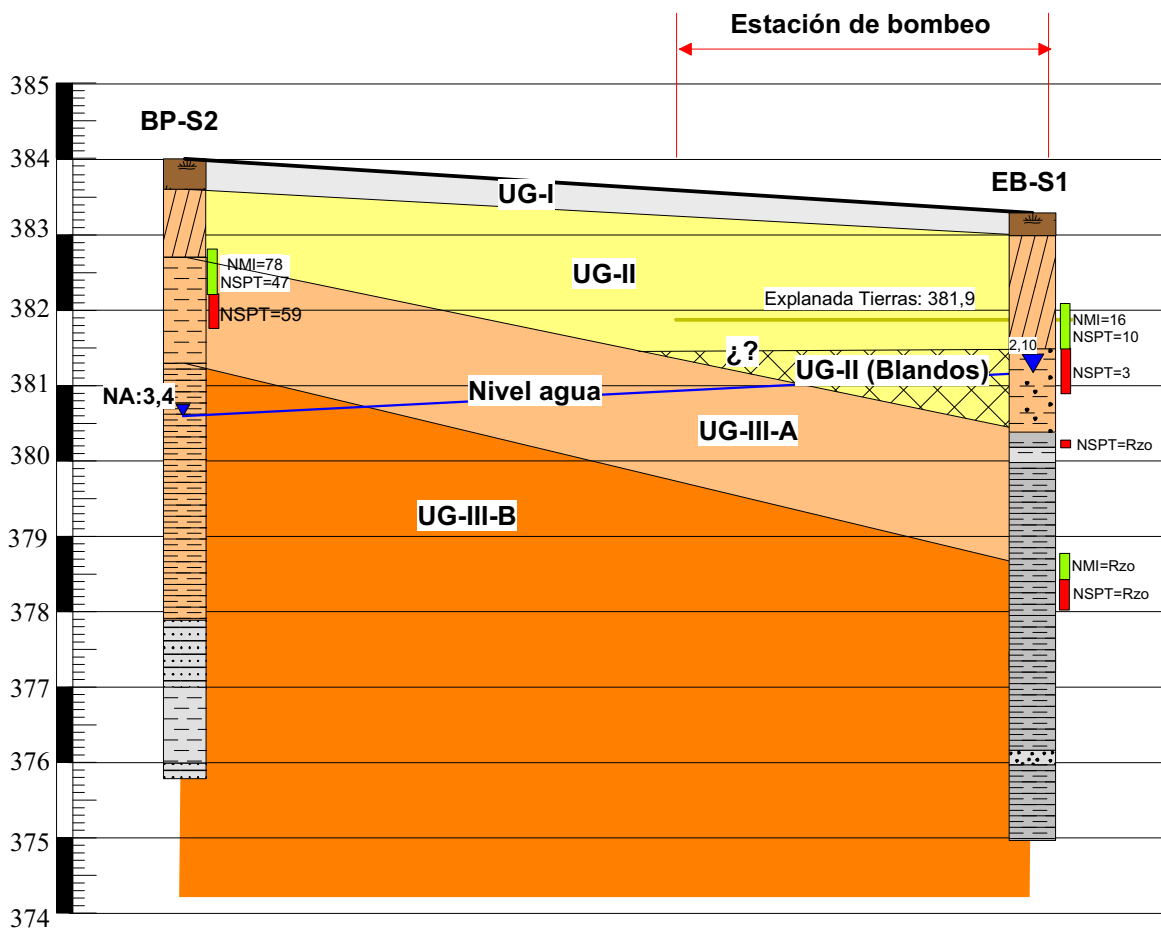


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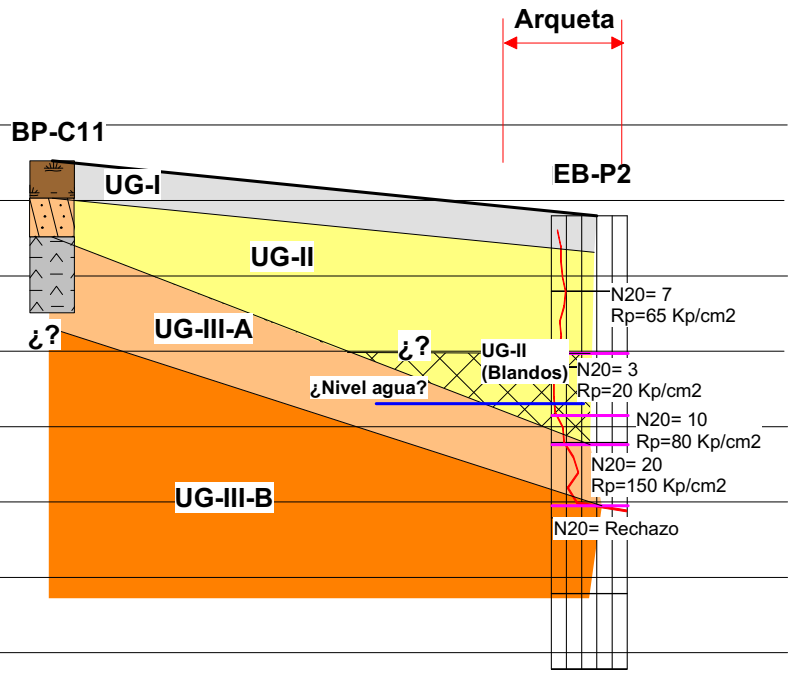


### LEYENDA

- UNIDAD I. TIERRA DE LABOR-SUELO VEGETAL
- UNIDAD II. RECUBRIMIENTO CUATERNARIO. SUELOS FINOS: Limos arcillosos, arcillas limosas. Arenas-Limos con arcillas
  - UNIDAD II. Con características de suelos blandos-saturados
- UNIDAD III. SUSTRATO TERCIARIO. Arcillas a argilitas marrones-grisáceas con yesos.
  - UNIDAD III-A. Sustrato Terciario alterado.
  - UNIDAD III-B. Sustrato Terciario más sano.

**INFORME:** *ESTUDIO GEOTÉCNICO PARA PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)*

**REFERENCIA:** *0673*

**FECHA:** *Abril de 2021*

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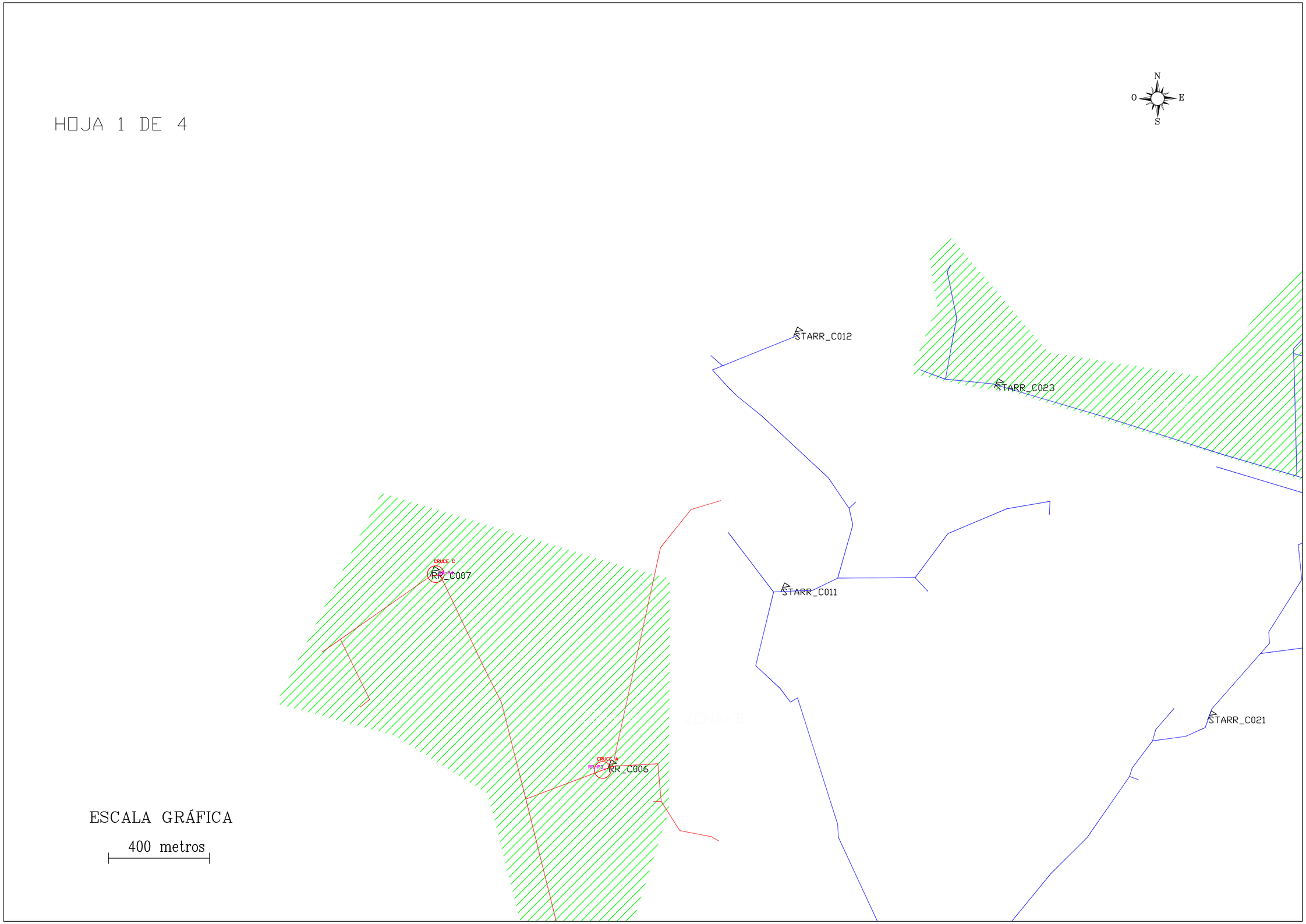
HOJA 1 DE 4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O
E
S
STARR_C012
STARR_C023
CRUCE C
RR_C007
STARR_C011
ZONA-B
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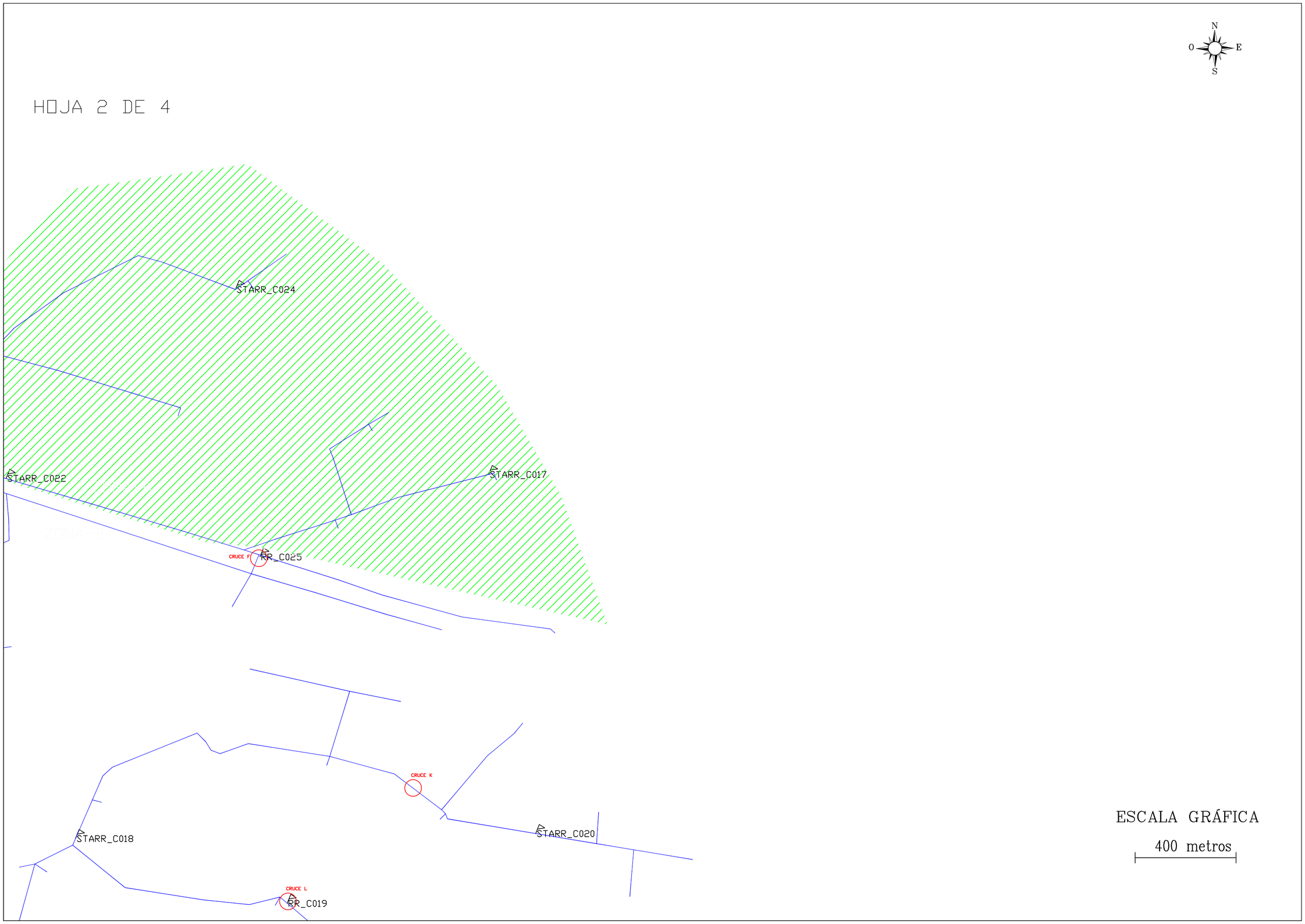
CRUCE A
RR_C006
ESCALA GRÁFICA
400 metros

HOJA 2 DE 4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O
E
S
STARR_C024
STARR_C022
STARR_C017
ZONA-D
CRUCE F
RR_C025
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STARR_C020
CRUCE L
RR_C019
ESCALA GRÁFICA
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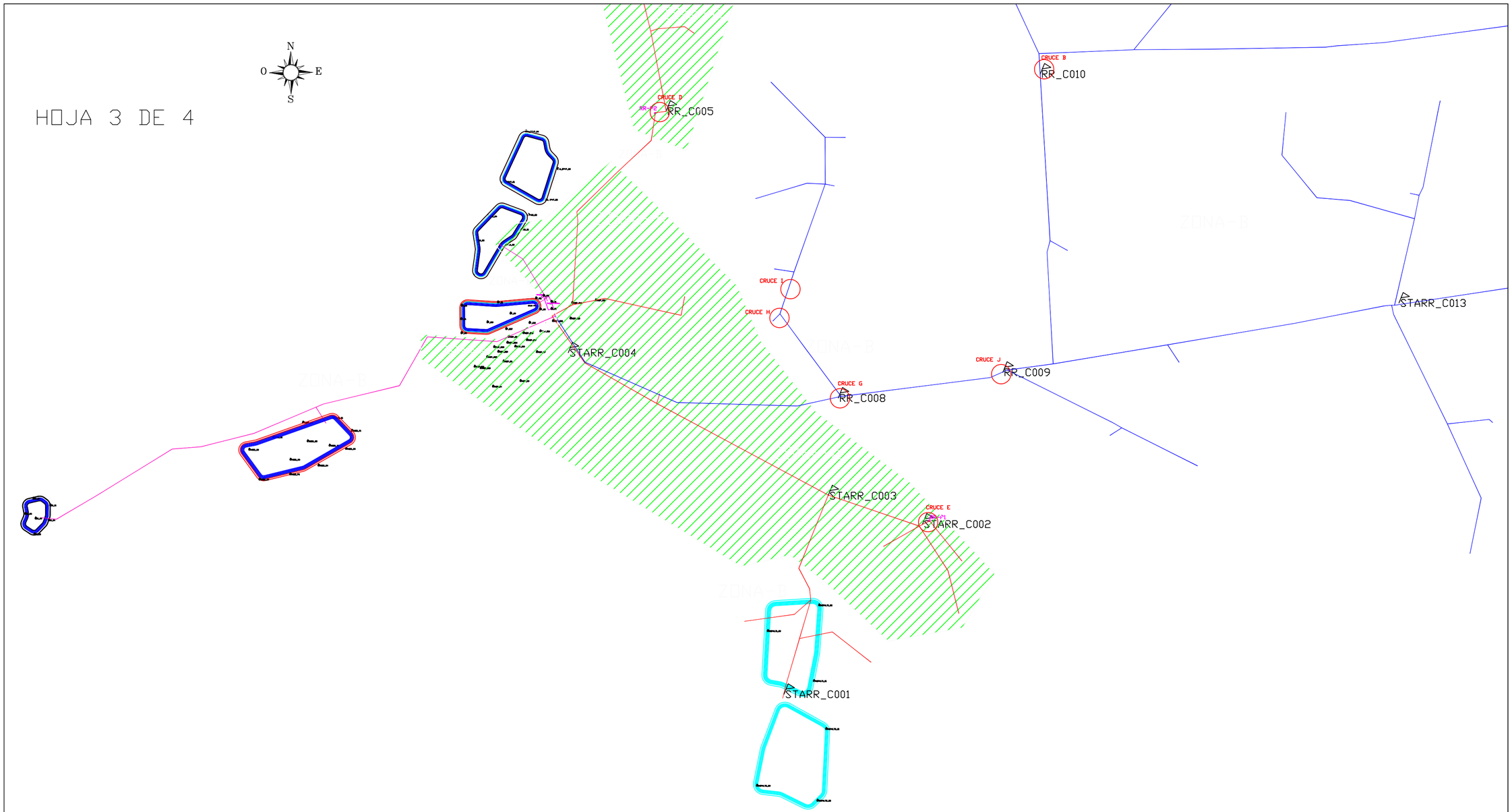
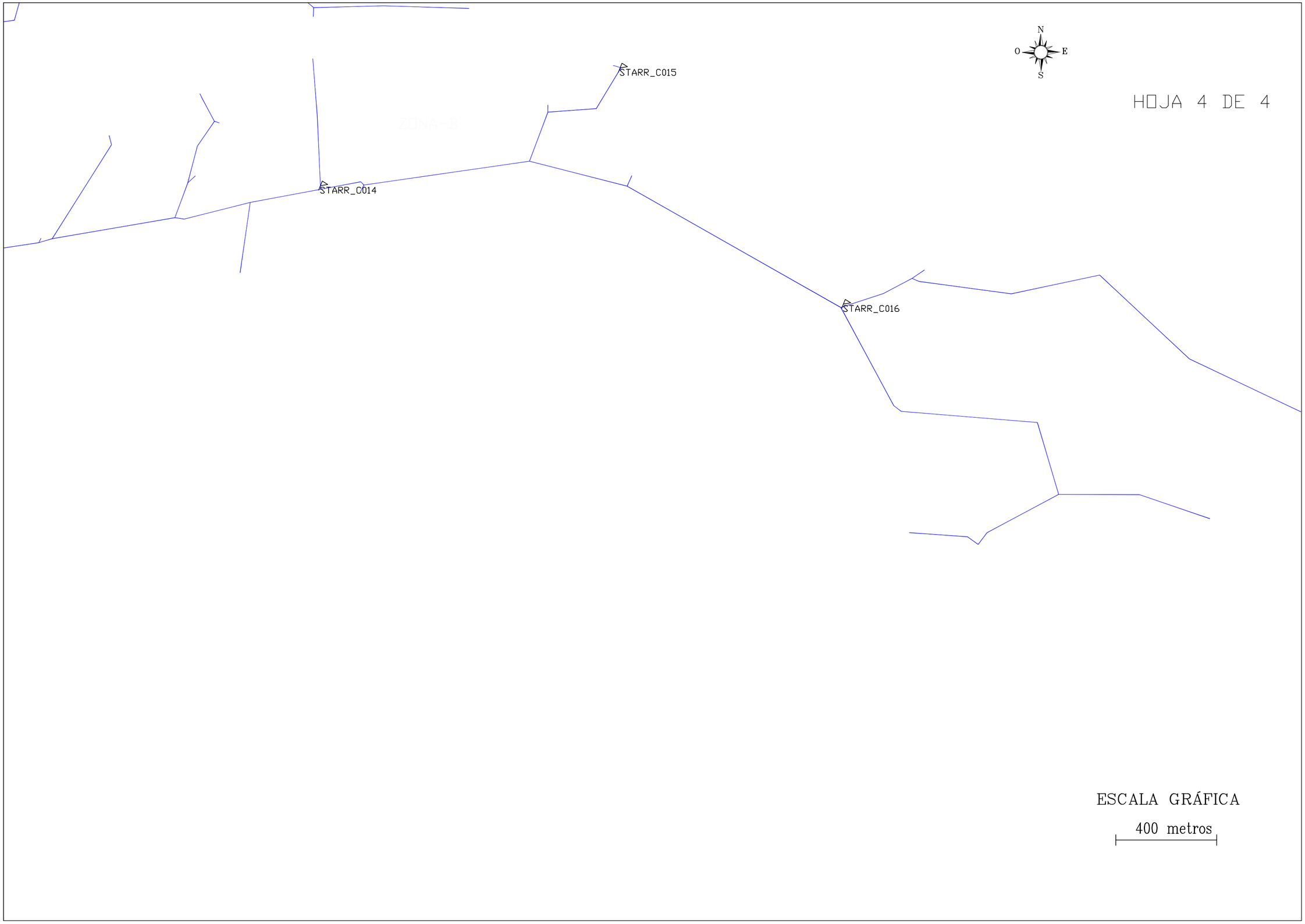
HOJA 3 DE 4




ESCALA GRÁFICA

400 metros


N
O
E
S
HOJA 4 DE 4
STARR_C015
STARR_C014
STARR_C016
ESCALA GRÁFICA
400 metros

# VIII.- ANÁLISIS DE ESTABILIDAD. SALIDAS GRÁFICAS

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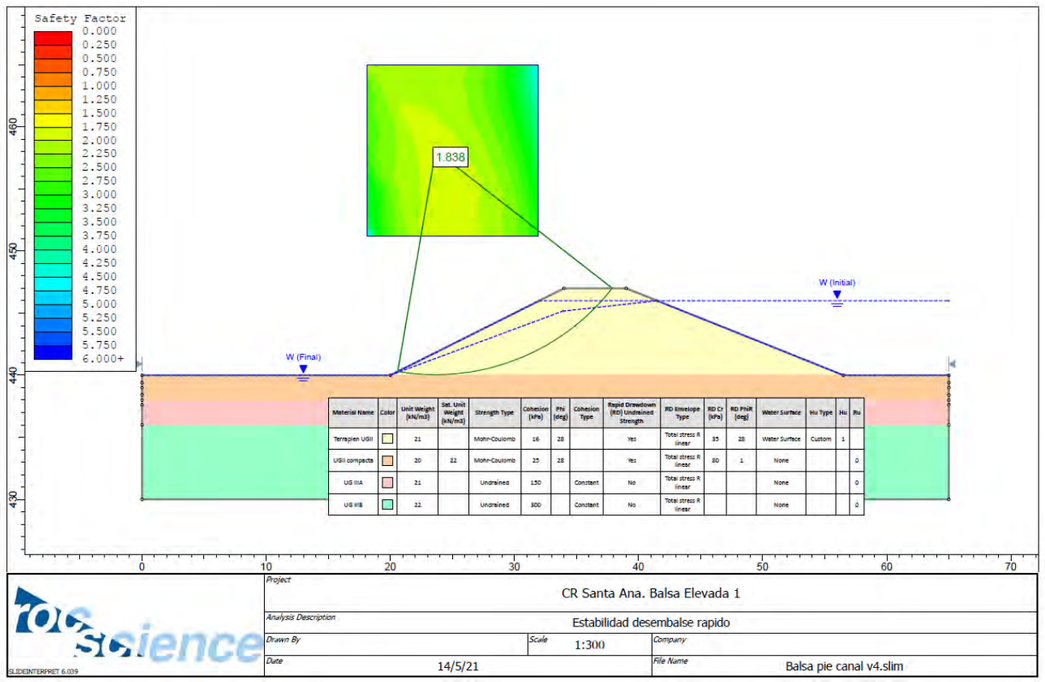


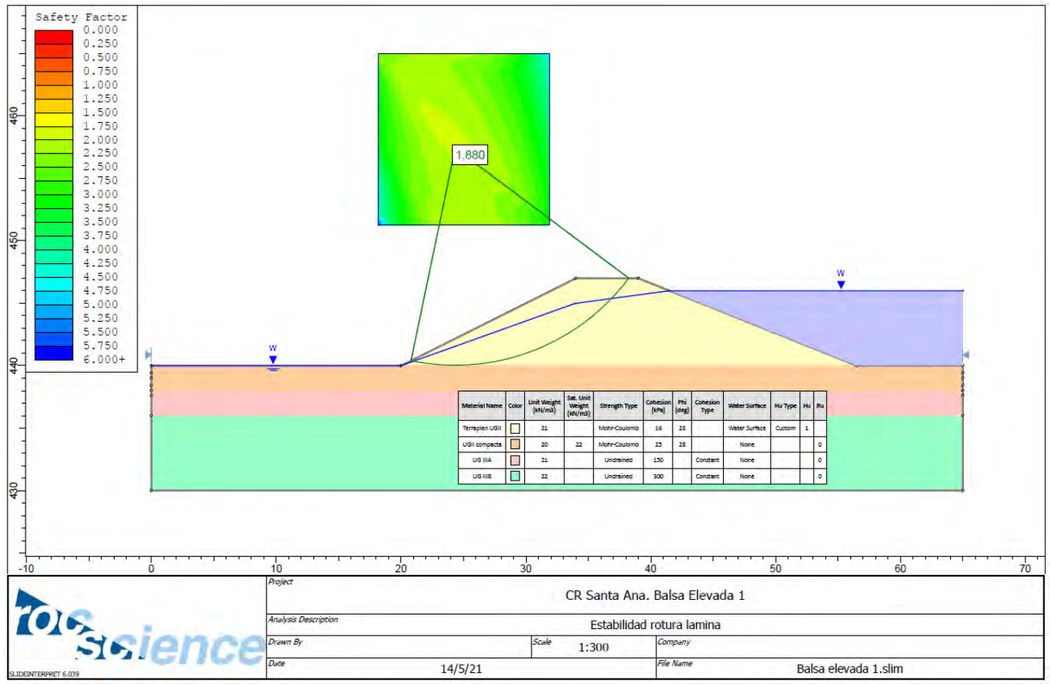


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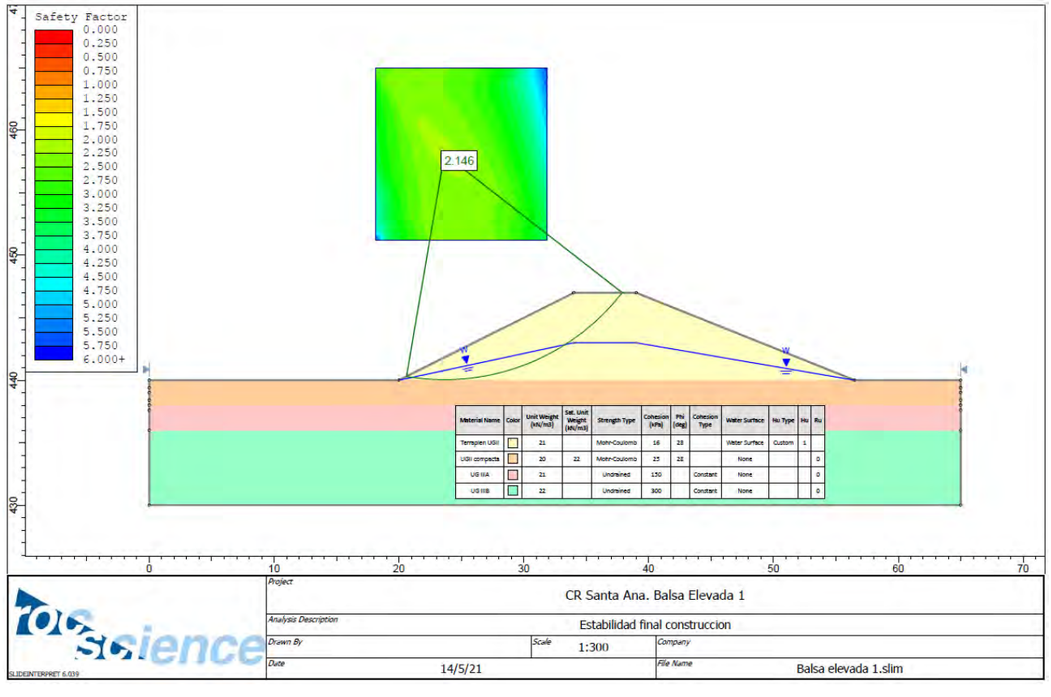
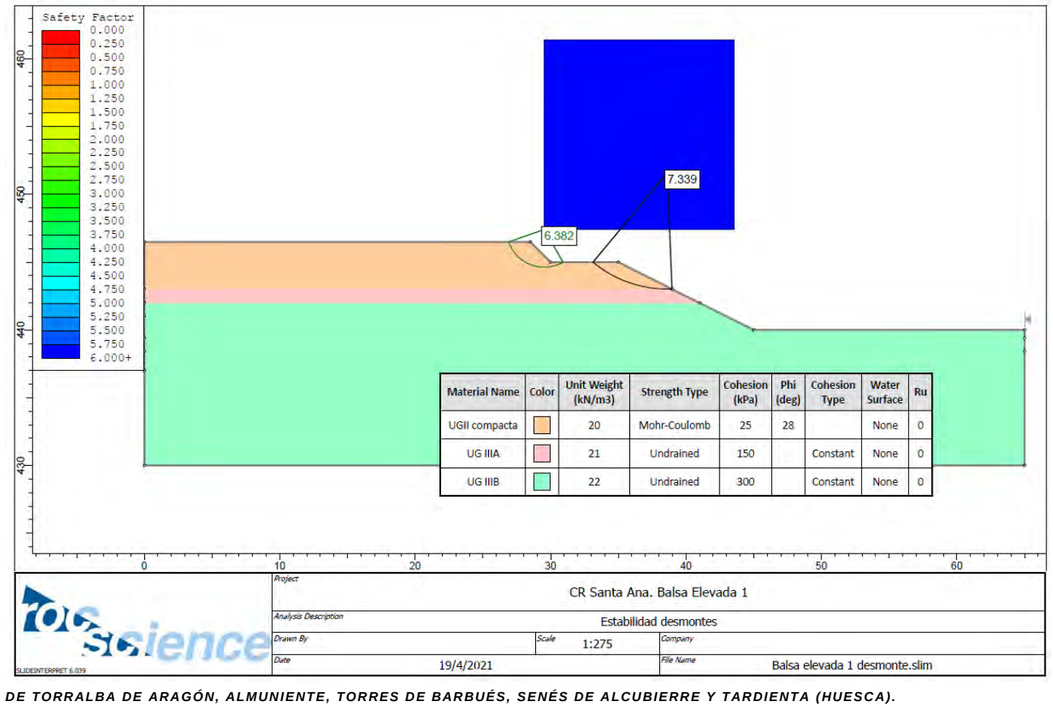



**Figura 3**

**Figura 4**



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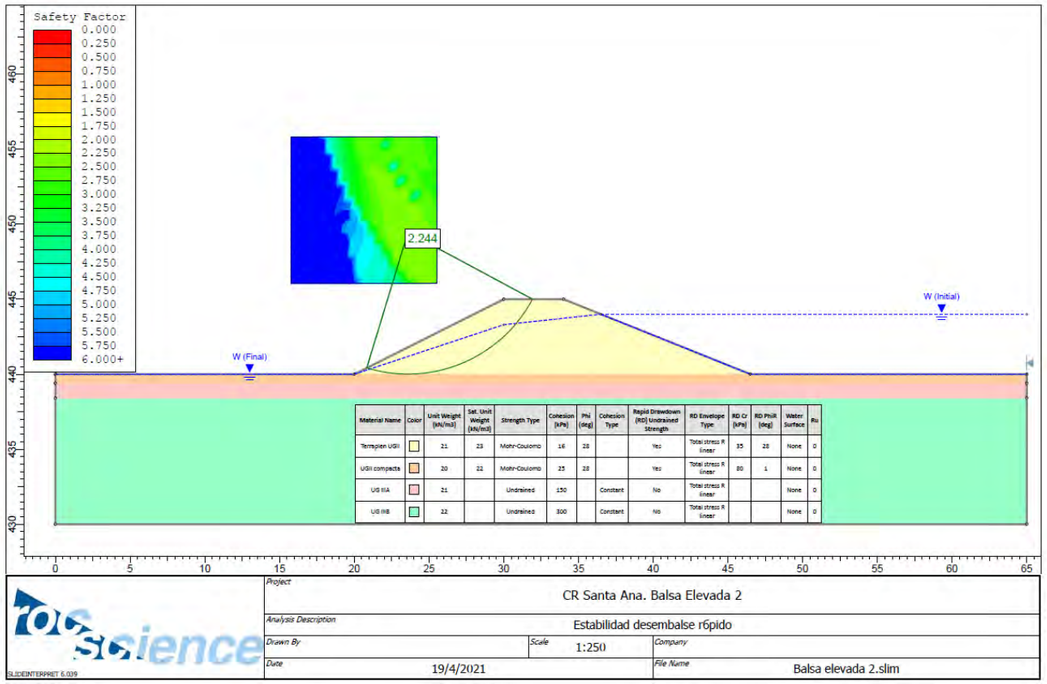


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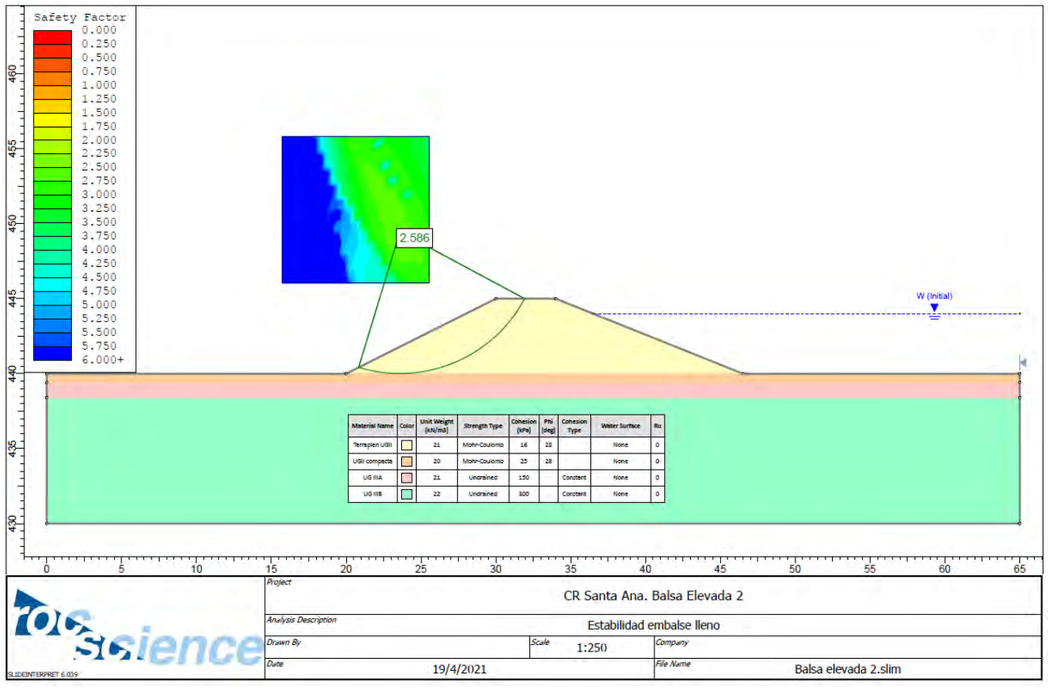


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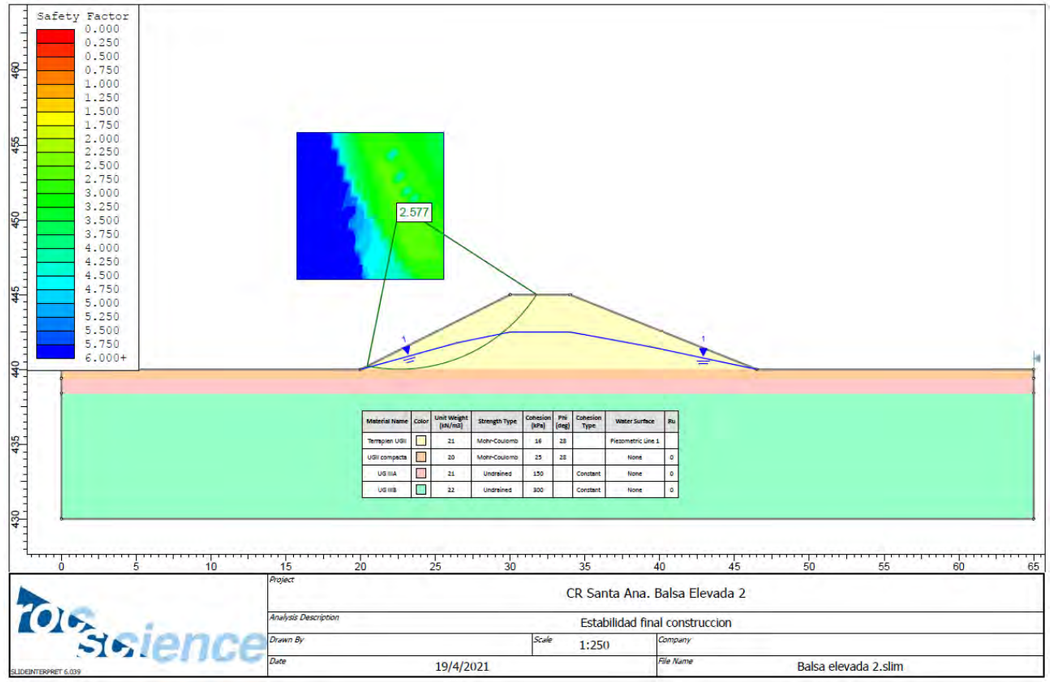


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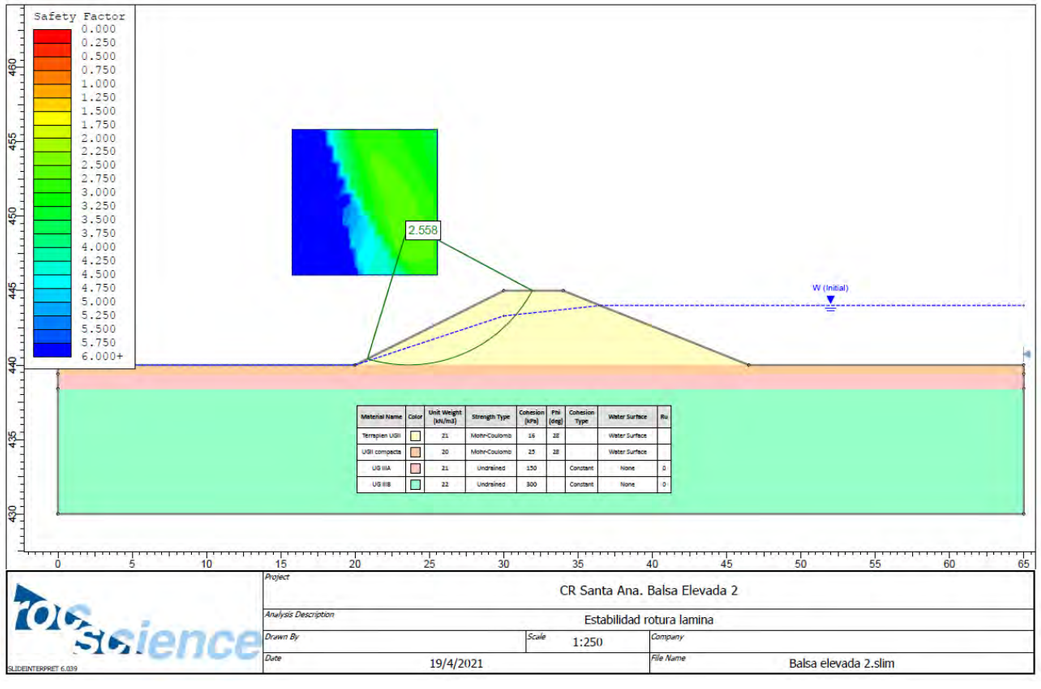

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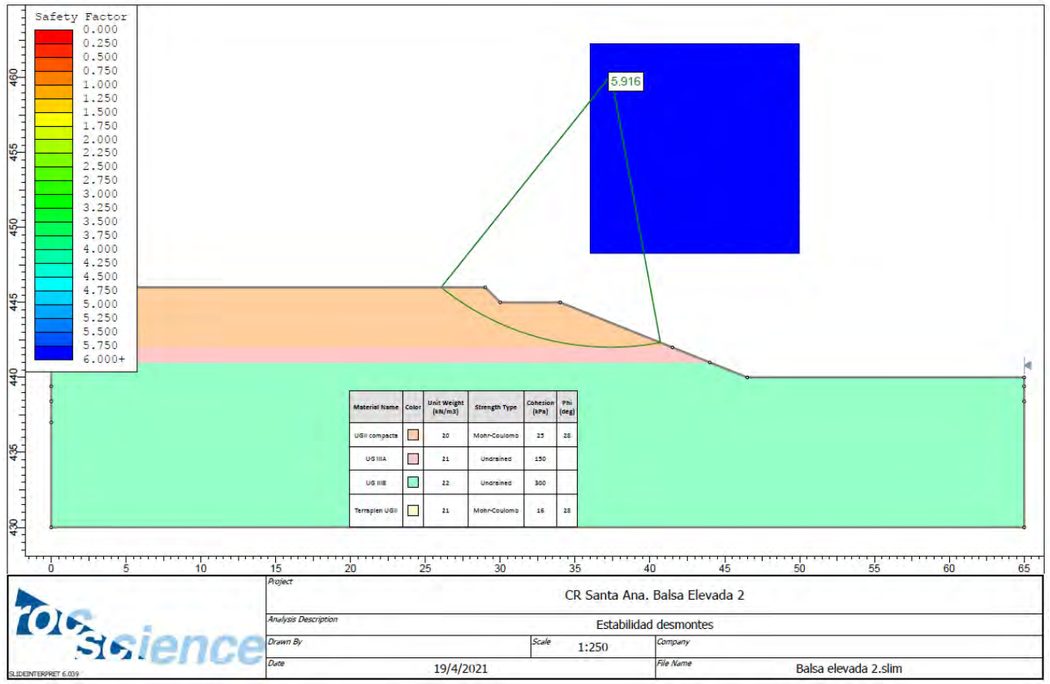


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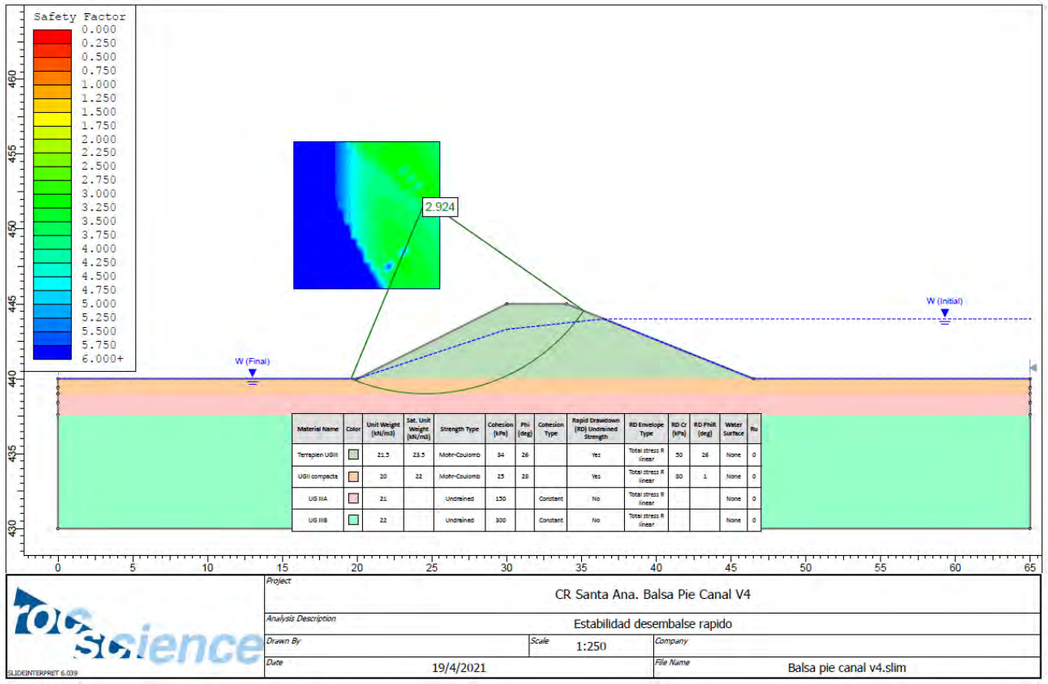


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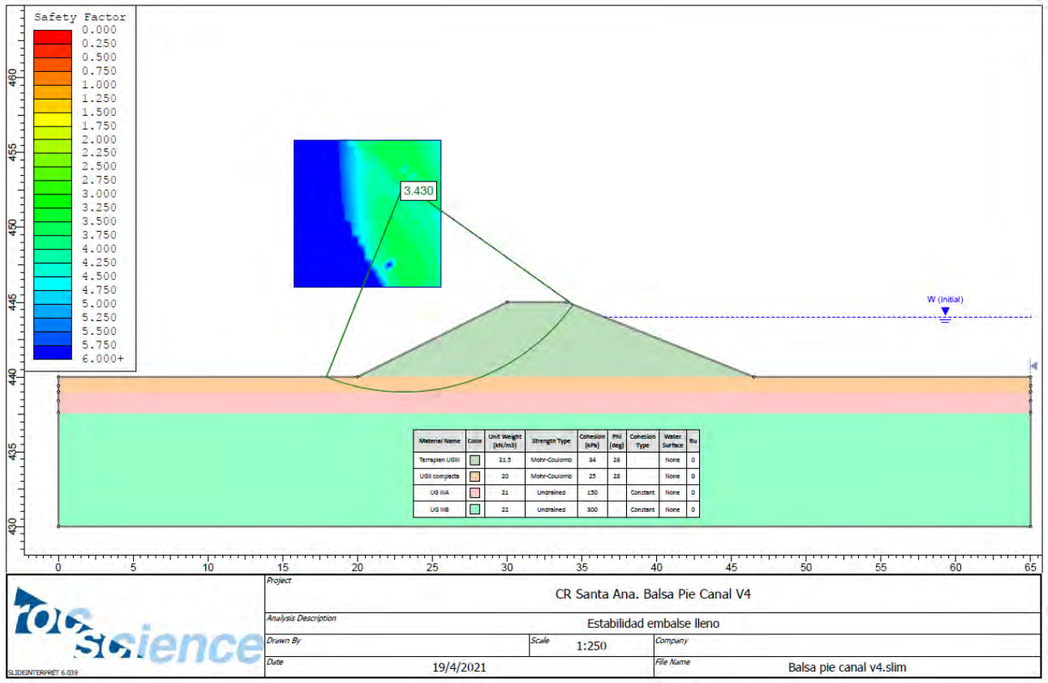


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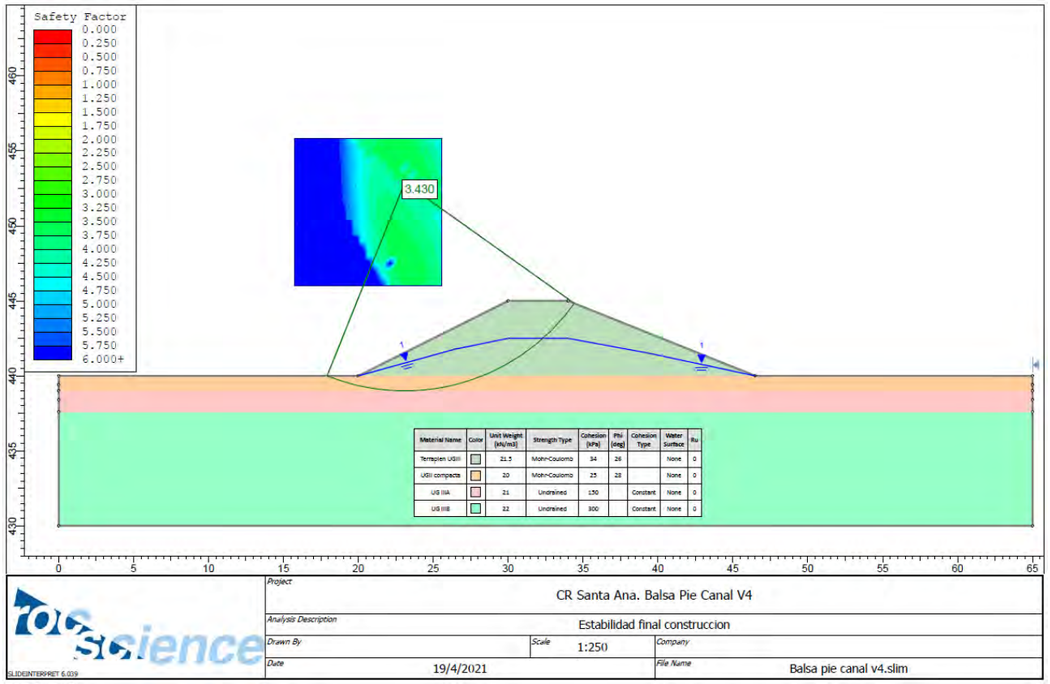

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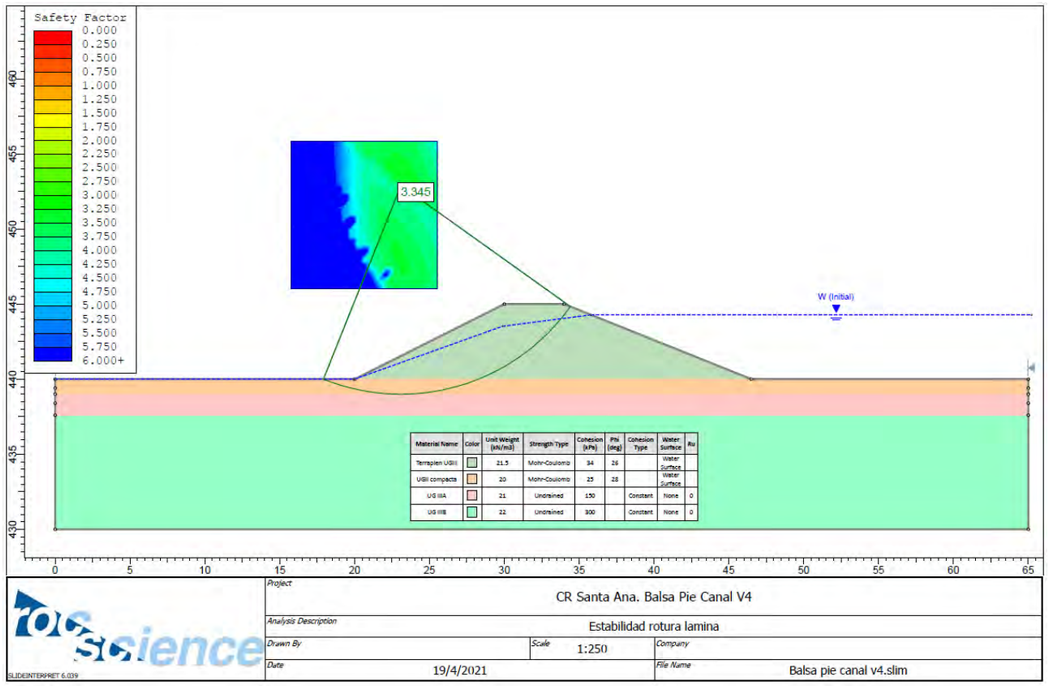


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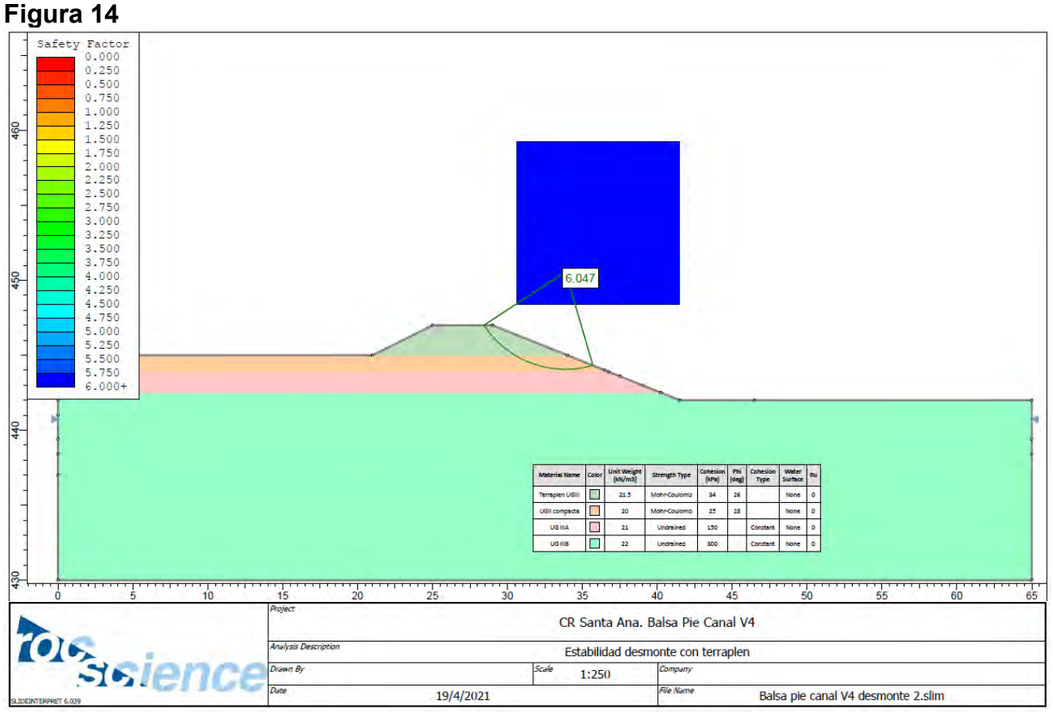


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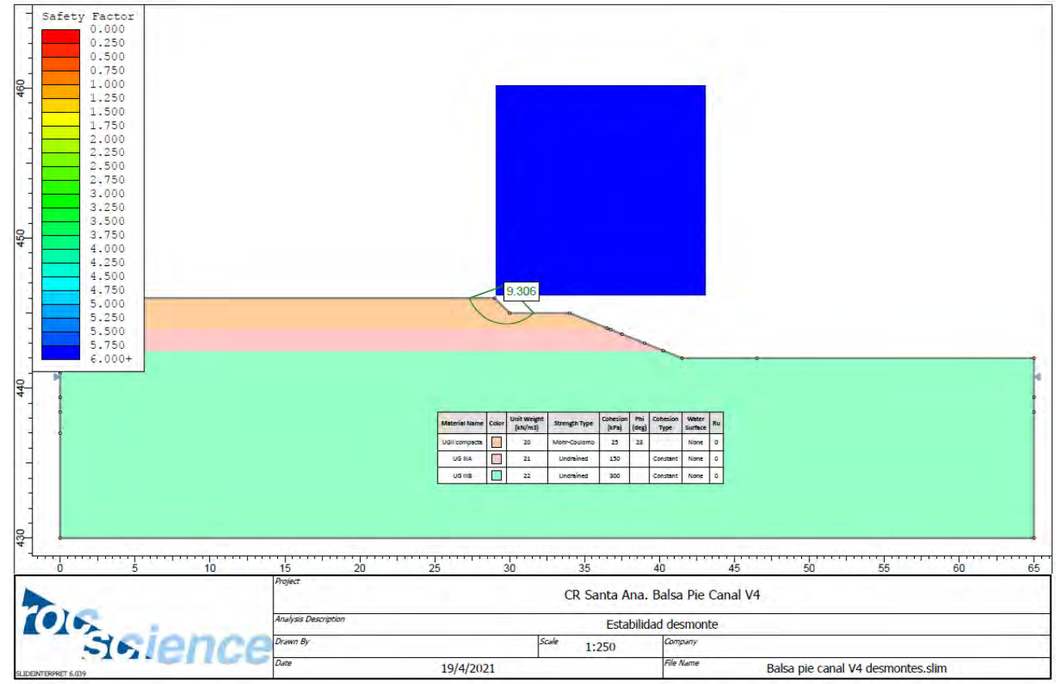


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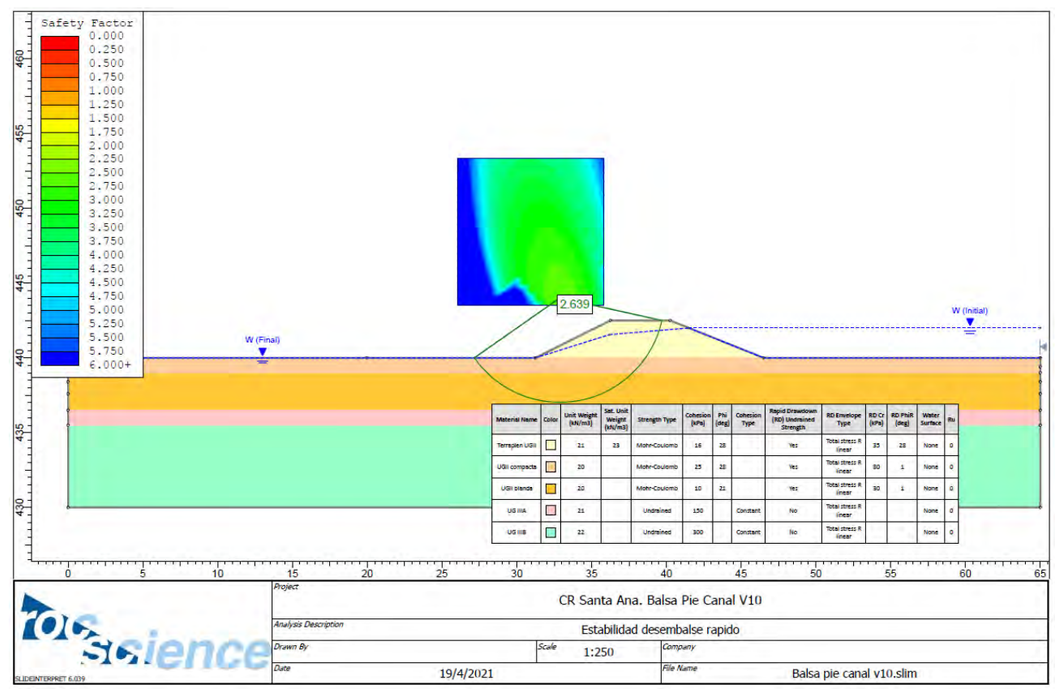

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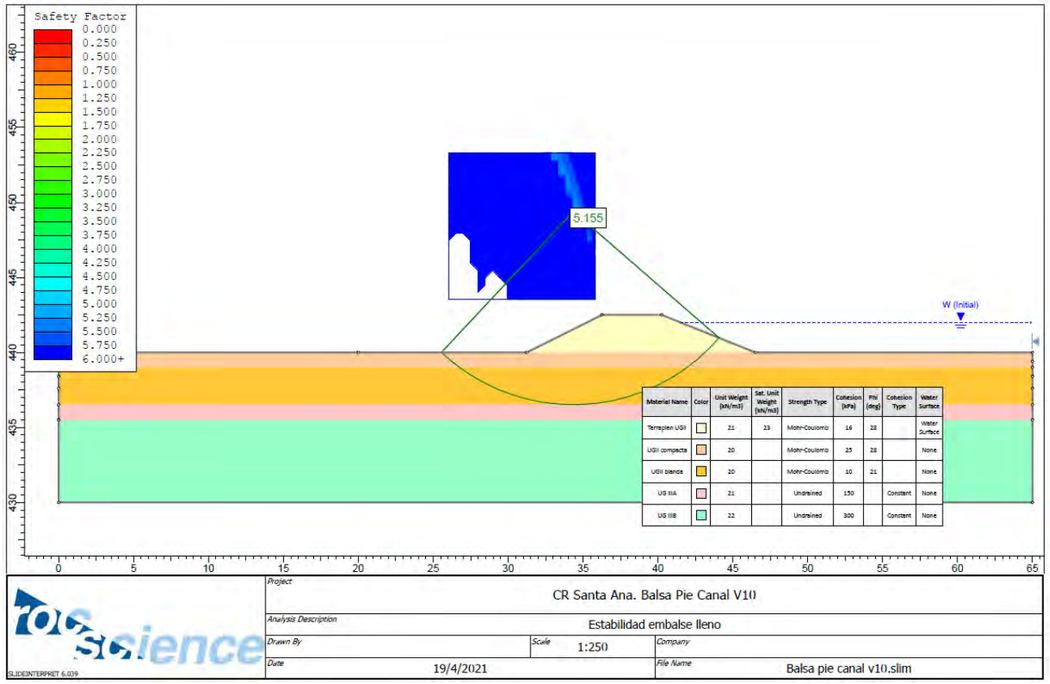


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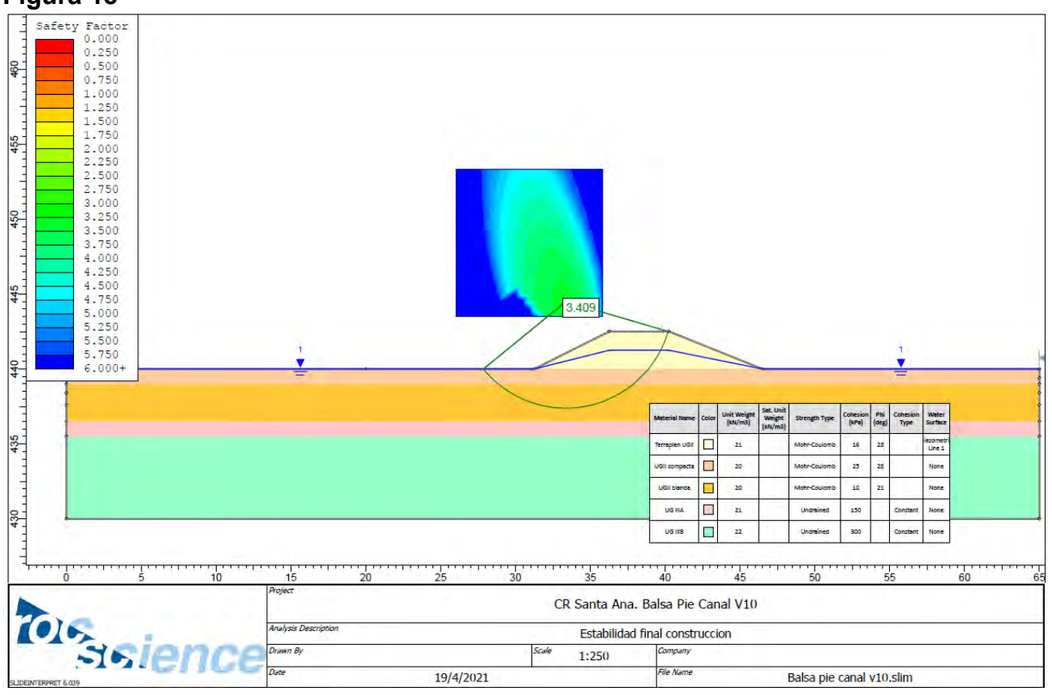


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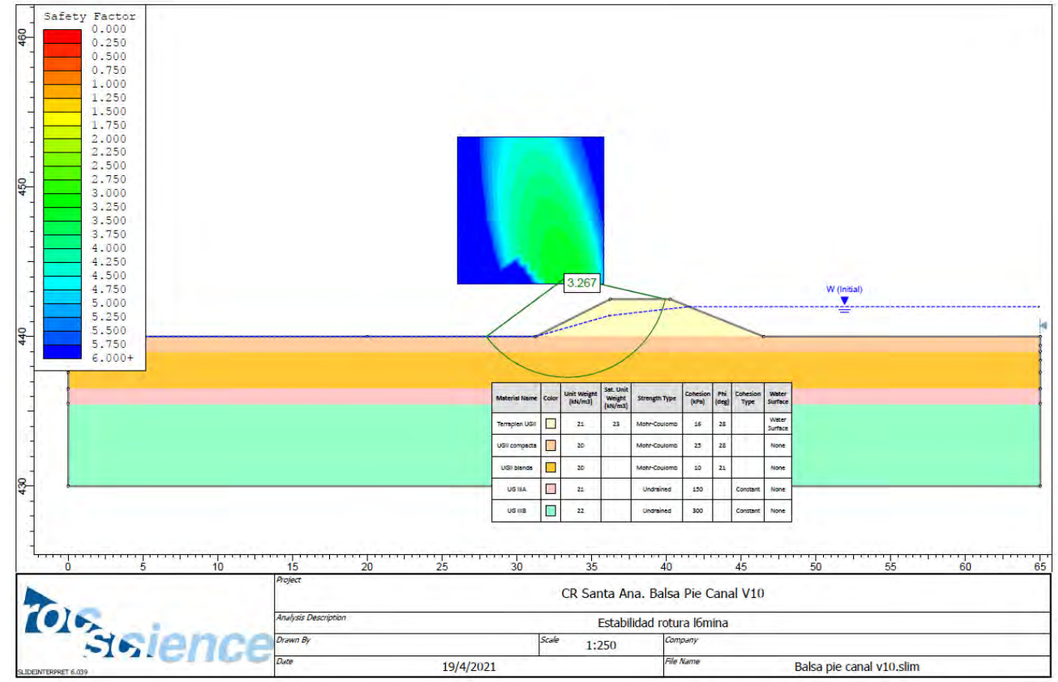


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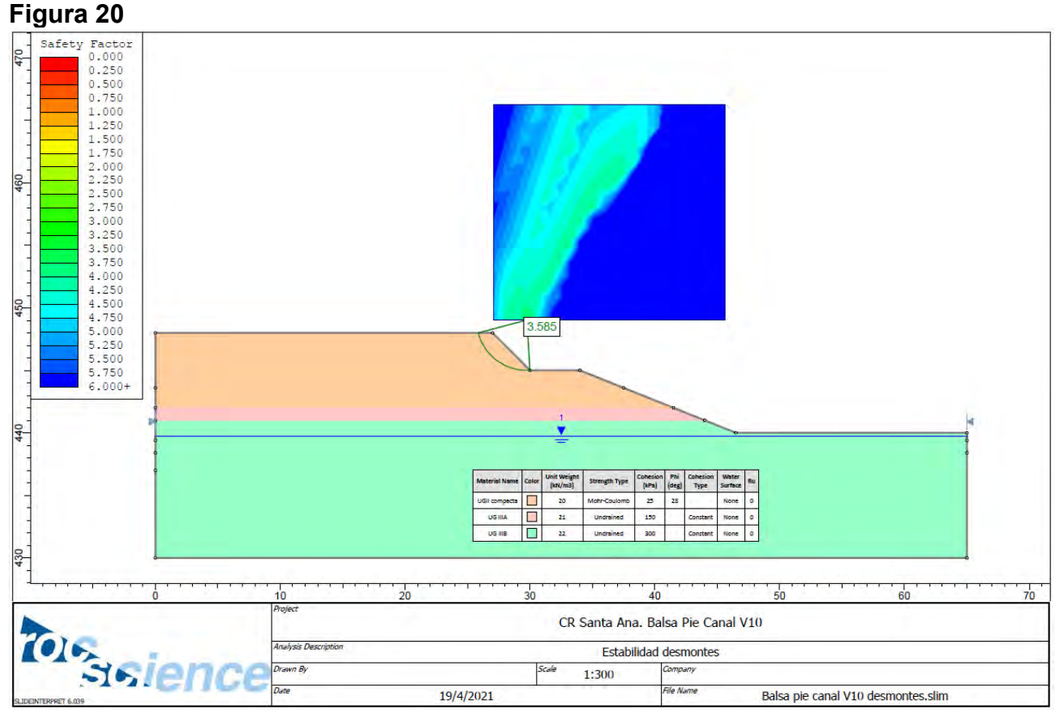

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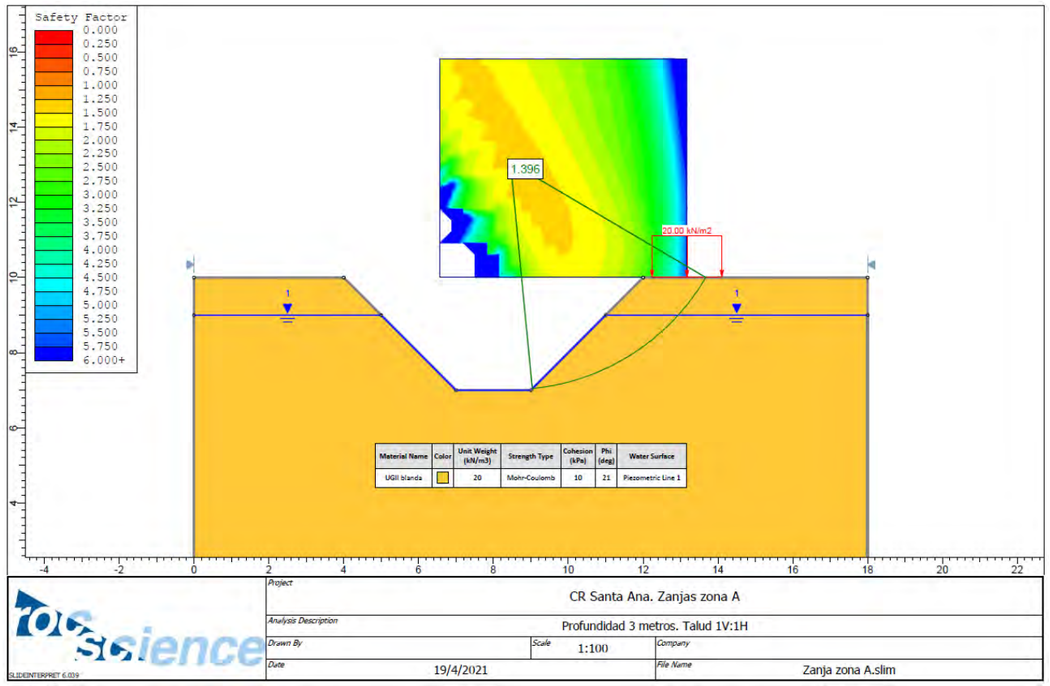


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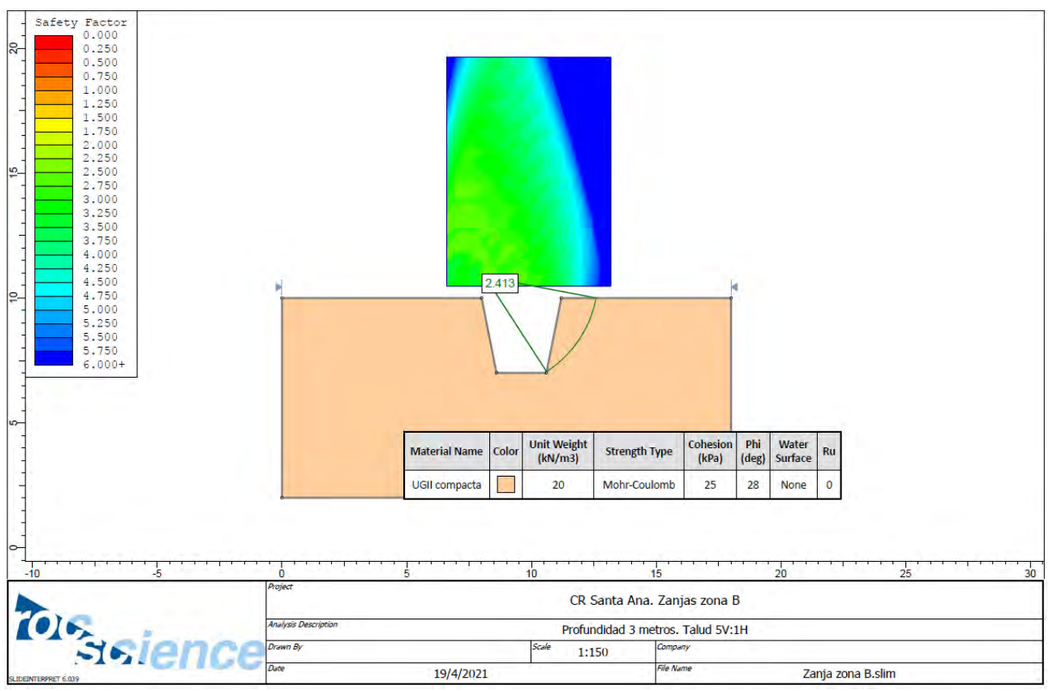
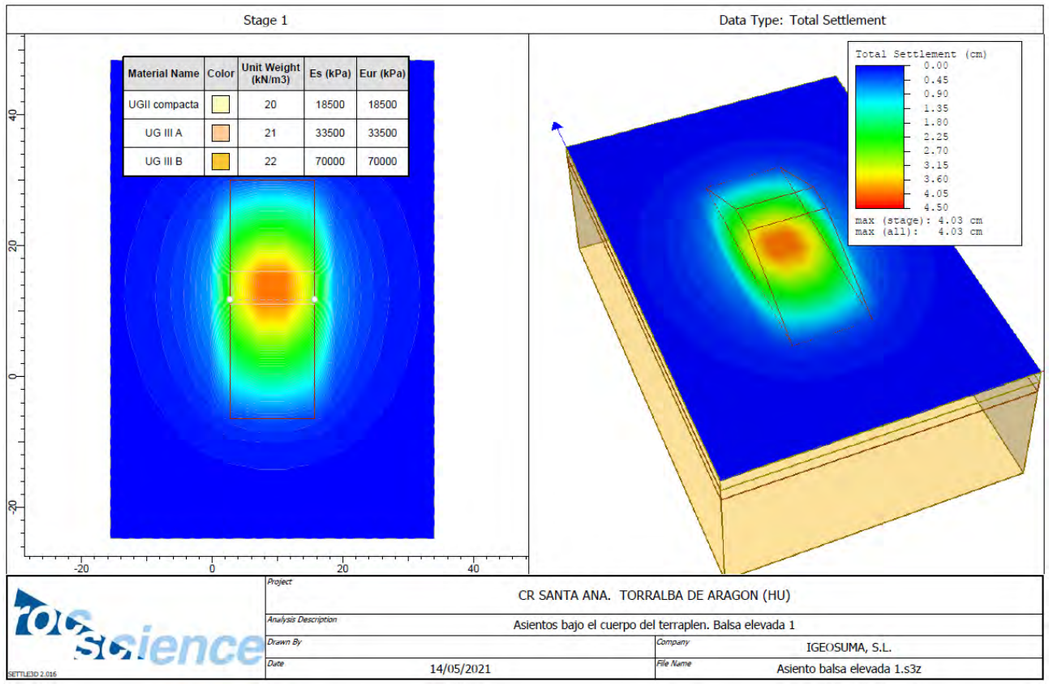
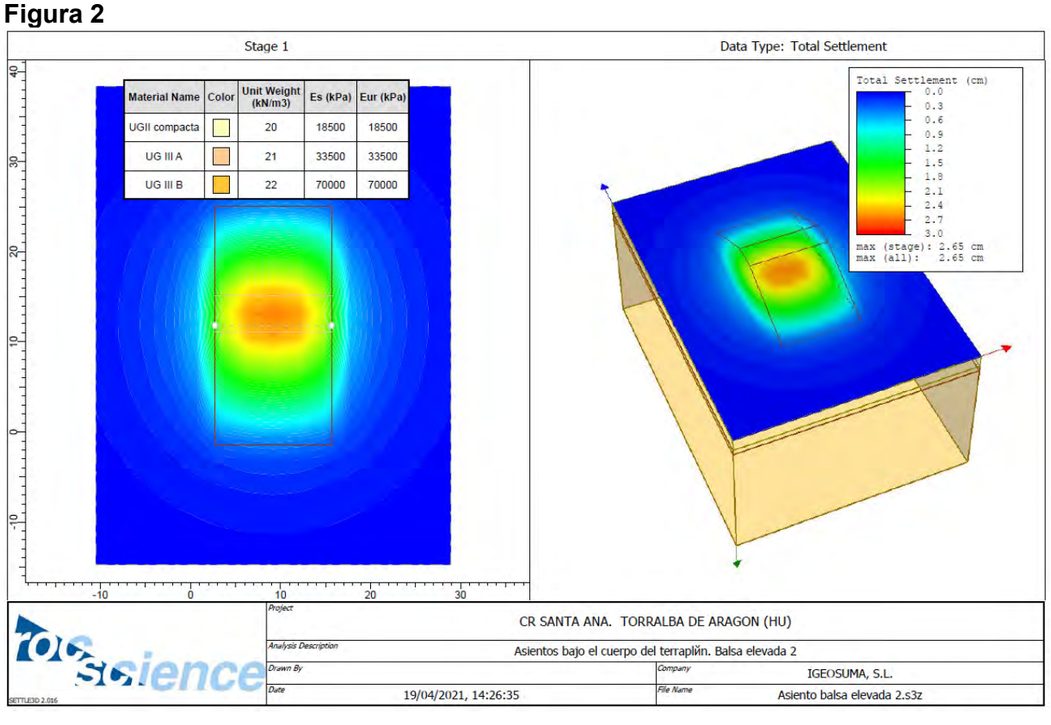


# IX.- ANÁLISIS DE ASIENTOS. SALIDAS GRÁFICAS

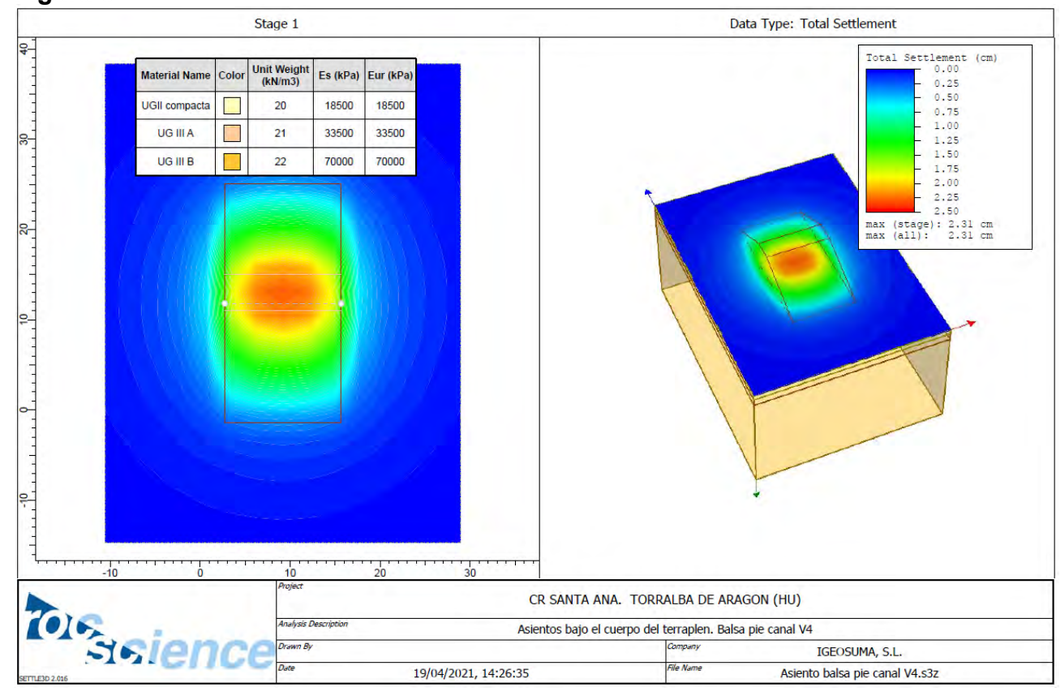
## Figura 1



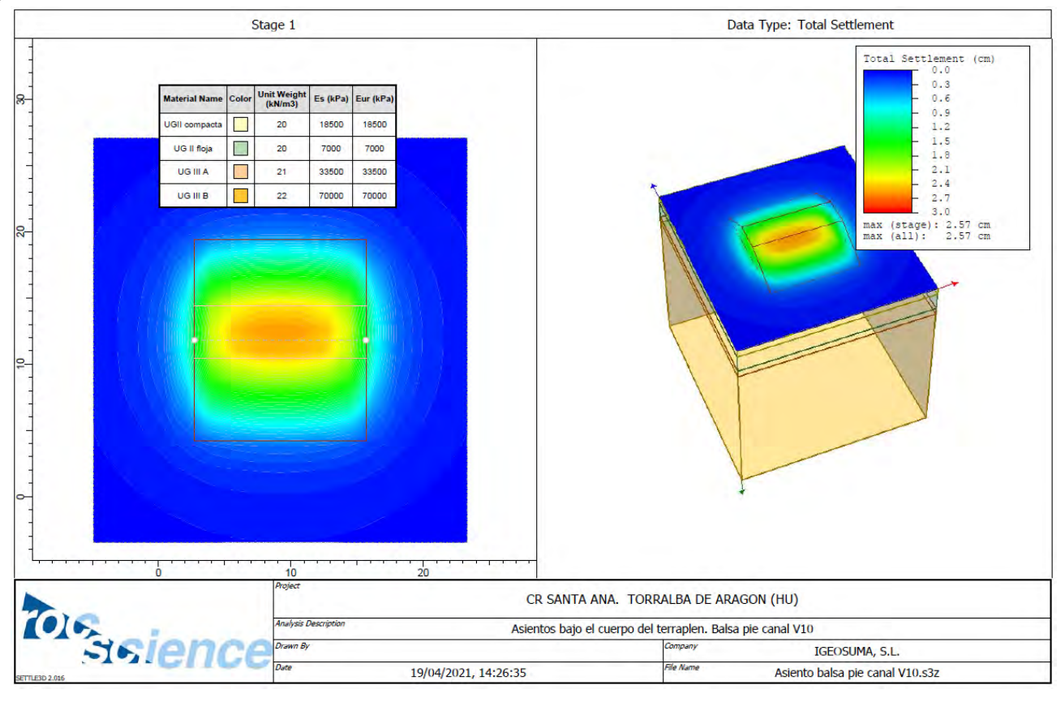

## Figura 2




## Figura 3




## Figura 4



# ANEJO Nº 8.- CÁLCULO HIDRÁULICOS Y MECÁNICOS DE LA RED DE RIEGO

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# ANEJO 8.- CÁLCULOS HIDRÁULICOS Y MECÁNICOS DE LA RED DE RIEGO

## 1 INTRODUCCIÓN Y OBJETO DEL PRESENTE ANEJO

En las parcelas objeto del proyecto se pretende la modernización de la infraestructura de regadío existente mediante la implantación de un sistema de tuberías a presión enterradas, alimentadas desde 2 balsas de nueva ejecución que se alimentan desde el Canal de Monegros.

En el presente anejo se exponen las características técnicas generales de la solución adoptada, así como de las obras necesarias para su ejecución.

## 2 NECESIDADES HÍDRICAS DE LA ALTERNATIVA

Las necesidades hídricas se han determinado en el Anejo nº 3, "Estudio Agronómico", siendo estas las siguientes:

- Superficie considerada. 2.714,53 ha
- Mes de máximas necesidades: Julio. Necesidades brutas: 1.796 $m^3$/ha y mes.
- Caudal continuo ficticio por hectárea se considerará de 0,67 l/s y ha.
- Volumen medio de agua consumido al año: 7.088 $m^3$/ha y año.

## 3 PARÁMETROS BÁSICOS DE RIEGO

### 3.1 AGRUPACIONES DE RIEGO

Para establecer unos criterios acordes con la realidad de la zona de puesta en riego, se ha realizado un minucioso análisis del grado de parcelación y la estructura de la propiedad. Cabe destacar que una parte de la superficie dominada por la C.R. "Santa Ana", se encuentra en proceso de Concentración Parcelaria.

De esta forma, para la asignación de hidrantes se ha recurrido a los planos del Proyecto de Concentración, realizando agrupaciones de varios propietarios hasta alcanzar una superficie tipo, salvo en aquellos propietarios en los que la dimensión de su explotación le permita contar con un hidrante unitario.

Para conformar las agrupaciones de riego se ha partido de la relación de parcelas y superficies, que se recogen en el anejo nº 2.

A partir de estas parcelas se trazan agrupaciones de cultivo en las que se engloban diferentes propietarios para, en un posterior amueblamiento, facilitar la instalación de los sistemas planteados.

Como norma general se han establecido agrupaciones según los siguientes criterios:

- Como norma general, se han realizado agrupaciones de propietarios de forma que el hidrante "tipo" tenga una superficie aproximada comprendida entre 6 y 8 Ha y un número máximo de 5 propietarios. Únicamente en el caso de las zonas de huerta por el reducido tamaño de las parcelas, se han agrupado más propietarios.
- Se han agrupado las parcelas próximas que corresponden a un mismo propietario. En general, cuando la superficie próxima de un mismo propietario es superior a 4 Ha, se le ha asignado un único hidrante, salvo excepciones por optimización de diseño.

### 3.2 DOTACIONES Y GRADO DE LIBERTAD

Utilizamos la formula general de cálculo de dotaciones en función de la superficie, necesidades, rendimiento del sistema y grado de libertad deseado.

$$Q_{dot} = \frac{q_{fc} \cdot S_p}{10^3 \cdot r} \cdot GL$$

A partir de la fórmula anterior se busca un grado de libertad mínimo de 1,5, partiendo de los siguientes datos:

- duración de la jornada efectiva: 20 horas
- número máximo de sectores de riego o posturas: 10

Además, se establece una dotación mínima de 18 l/s en hidrantes con superficie comprendida entre 6 y 10 ha y de 15 l/s en hidrantes con superficie inferior a 6 ha, dado que las parcelas pequeñas necesitan un caudal mínimo para poder establecer un correcto funcionamiento de los sectores de riego.

### 3.3 CAUDAL FICTICIO CONTINUO

En el Anejo nº3 Estudio Agronómico se ha obtenido una demanda máxima de 0,67 l/s y ha, en el mes de julio.

### 3.4 PRESIÓN DE CONSIGNA DE LOS HIDRANTES

A nivel general se puede decir que las presiones en hidrante vienen definidas por los sistemas de riego a utilizar a posteriori. Esta peculiaridad implica la adecuación de las presiones en la instalación a las necesidades de los sistemas de riego.

Así pues, se establece de forma general que la presión a garantizar antes de cada hidrante va a ser de 40 m.c.a, más el desnivel de la finca, presión suficiente para el riego por aspersión. Para el caso del riego por goteo, la presión mínima antes de hidrante será de 25 mca.

En algunos puntos se ha ajustado la presión requerida por los emisores por exigencia de la topografía de la zona y para maximizar la superficie abastecida sin necesidad de aumentar la altura de bombeo y reducir los costes energéticos, considerando para dichas zonas la posibilidad de instalar emisores de baja presión o sistemas de riego por pivot o goteros.

### 3.5 DURACIÓN DIARIA DEL RIEGO

Para las redes de presión se prevé una duración diaria de riego de 24 horas diarias con un rendimiento de la red del 80%.

El bombeo previsto a realizar es a las balsas elevadas, y desde cada una de ellas, se distribuye el agua a los hidrantes. Por ello, el horario de bombeo no afecta a la posibilidad de realizar en riego en parcela.

### 3.6 CAUDAL UNITARIO POR HIDRANTE

En las tablas que se incluyen en el apartado de resultados, incluido en el presente anejo, se indican los caudales y superficies de diseño para cada uno de los hidrantes que componen la red de riego.

## 4 CARACTERÍSTICAS GENERALES

### 4.1 PLANTEAMIENTO GENERAL

Las obras planteadas en el presente proyecto consistirán en:

- Obra de toma en el Canal de Monegros
- 2 Balsas Inferiores con un volumen total de 146.309 $m^3$.
- Estación bombeo junto a las Balsas Inferiores
- Balsa Intermedia de 180.792,81 $m^3$.
- Red de riego por gravedad desde Balsa Intermedia al Piso de Riego 1.
- Balsa Elevada de 28.540 $m^3$.
- Red de riego por gravedad desde Balsa Elevada al Piso de Riego 2.

La solución definitiva por la que se ha optado está basada en dos redes de tuberías enterradas, tanto las principales como las secundarias, que darán servicio a todas y cada una de las parcelas a transformar.

### 4.2 ORGANIZACIÓN DEL RIEGO

El sistema de riego será a la demanda entre hidrantes y en aquellos hidrantes compartidos, el riego de parcelas será a turnos (organizándose dichos turnos).

A la entrada de cada una de las unidades de riego se instalará un hidrante. Este hidrante estará compuesto por:

- Una válvula de seccionamiento, tipo compuerta.
- Un filtro en L, con malla de 2 mm
- Una ventosa.
- Un contador woltman con corrector de flujo
- Una válvula hidráulica con limitador de caudal y de presión.

En el caso de hidrantes compartidos, la configuración será similar a la anterior, eliminando el contador general y añadiendo para cada toma:

- Un contador de woltman con corrector de flujo
- Una válvula hidráulica
- Una válvula de seccionamiento, tipo compuerta.

## 5 CÁLCULO DE LA RED.

### 5.1 PROCEDIMIENTO SEGUIDO EN EL CÁLCULO HIDRÁULICO.

***Modelo de R. Clement***

En una distribución a la demanda, el cálculo de los caudales a transportar por los diferentes tramos de la red es más complejo que en el riego por turnos. Dos modelos han sido propuestos por R. Clément para esquematizar el fenómeno de solicitud de caudales en una red.

El modelo que se ha utilizado en este caso es el primero de los dos, el más comúnmente utilizado, que nos conduce a la denominada *primera fórmula de la demanda*.

***Primera fórmula de la demanda.***

En riego a la demanda, el caudal asignado a cada toma es superior al caudal ficticio continuo necesario. Cada usuario utilizará efectivamente su toma durante un período que, de media, será inferior a 24 horas por día. De aquí resulta que la probabilidad de que todas las tomas se abran al mismo tiempo es mínima y, por tanto, no es razonable calcular la red para transportar el caudal acumulado.

El cálculo de caudales en este tipo de red se apoya en un razonamiento de probabilidades. El caudal de la cabecera de la red de riego establecido de acuerdo con la primera fórmula de CLEMENT para redes de riego se ajusta a la siguiente fórmula:

$$Q = \Sigma R_i * p_i * d_i + U(P_q) * \sqrt{(\Sigma R_i * p_i * q_i * d_i^2)}$$

donde:

Ri = Nº de tomas con una probabilidad de funcionamiento pi.

pi = Probabilidad de funcionamiento de una toma.

di = Caudal de la toma en l/s.

U (Pq) = Función de la calidad de funcionamiento de la red que toma los siguientes valores:

**Tabla 1.-** Función de calidad según nº de hidrantes

| nº hidrantes | Calidad función (Pq) | U(Pq) |
|---|---|---|
| 1-4 | 100% | |
| 5-10 | 95% | 1,645 |
| 11-20 | 92% | 1,427 |
| >20 | 90% | 1,282 |

### 5.2 DIMENSIONADO DE LAS TUBERIAS

Las tuberías se han calculado a partir de los caudales reales obtenidos en el punto anterior mediante la fórmula de Darcy-Weisbach de expresión:

$$H_f = f * \frac{L}{D} * \frac{V^2}{2 * g}$$

donde:

Hf = Pérdida de carga en mca.

f = Factor de fricción (adimensional).

L = Longitud del tramo en m.

D = Diámetro interior de la tubería en m.

V = Velocidad de la tubería en m/s.

g = Aceleración de la gravedad 9,8 m/s$^2$.

El factor de fricción se ha calculado por la fórmula de White Colebrook, de expresión:

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{2{,}51}{\mathrm{Re}\sqrt{f}} + \frac{Ka}{3{,}71D}\right)$$

donde:

Re = Nº de Reynolds.

Ka = Coeficiente de rugosidad absoluta. Se ha considerado Ka = 0,01 mm para las tuberías de PVC y PRFV.

Se han dimensionado las tuberías estableciendo que la velocidad máxima de la tubería será de 2,00 m/s y la mínima de 0,5 m/s.

Para la realización de este cálculo se ha recurrido al programa de simulación avanzada de riego por ordenador GESTAR 2014, que nos permite barajar diferentes hipótesis y opciones de riego con el fin de encontrar la más adecuada. El programa GESTAR 2014 incluye un módulo desarrollado por la Universidad Politécnica de Valencia llamado DIOPCAL que permite el cálculo de los caudales circulantes mediante Clement y la asignación de los correspondientes diámetros con el método del diámetro óptimo económico.

## 5.3 ESTUDIO DEL ESTADO PIEZOMÉTRICO DE LA RED

Se ha determinado la presión disponible en cada una de las tomas de riego suponiendo que la cota de agua en la balsa que abastece a la red, es la correspondiente a la balsa en su nivel medio.

Se considera que, como norma general, la presión mínima necesaria y acordada con la Comunidad de Regantes será de 40 m.c.a. antes de hidrante, considerando el desnivel de las parcelas que componen el hidrante.

En este sentido cabe indicar que hay una agrupación (H105) situada a una cota elevada pero alejada de la zona de riego correspondiente a la red alta en la que se ha admitido una presión inferior para no perjudicar al conjunto del proyecto. En esta parcela la C.R. asume que deberán instalarse equipamientos de parcelas de trabajo con bajas pérdidas.

Del mismo modo, las zonas más altas de algunos hidrantes deberán optar por sistemas de riego de baja presión. Es el caso de algunas zonas de los hidrantes H152 o H71.

## 5.4 DESCRIPCIÓN DE LA RED Y RESULTADOS

Toda la red de riego se realiza con tuberías de PVC y PRFV, en diámetros comprendidos entre 125 y 1400 mm. En cuanto a los timbrajes, nos encontramos desde PN10 hasta PN16.

Mediante la simulación de GESTAR se han obtenido, para los tramos de tubería definidos anteriormente, valores de caudal, velocidad, y presión en el nodo.

En el apéndice 1, se muestra un listado completo de las tuberías de la red de riego, así como un esquema de la misma. En el apéndice 2 se recoge el resumen de presiones finales en los hidrantes, considerando las pérdidas de carga que se producen en el hidrante (seccionamiento, filtro, válvula hidráulica, etc).

En la siguiente tabla se presenta el resumen de longitudes totales por cada tipo de tubería en cada una de las redes:

| MATERIAL | DN | PN | LONGITUD (m) |
|---|---|---|---|
| PRFV | 500 | 10 | 4.924 |
| PRFV | 600 | 10 | 1.338 |
| PRFV | 700 | 10 | 317 |
| PRFV | 800 | 10 | 492 |
| PRFV | 900 | 10 | 1.191 |
| PRFV | 1000 | 10 | 1.339 |
| PRFV | 1200 | 6 | 875 |
| PRFV | 1400 | 6 | 856 |
| PRFV | 1400 | 10 | 264 |
| PVC | 125 | 10 | 4.118 |

| MATERIAL | DN | PN | LONGITUD (m) |
|---|---|---|---|
| PVC | 140 | 10 | 843 |
| PVC | 140 | 16 | 375 |
| PVC | 160 | 10 | 4.801 |
| PVC | 200 | 10 | 7.169 |
| PVC | 200 | 16 | 372 |
| PVC | 250 | 10 | 7.167 |
| PVC | 250 | 16 | 523 |
| PVC | 315 | 10 | 6.868 |
| PVC | 400 | 10 | 4.903 |
| PVC | 500 | 10 | 3.581 |
| **TOTAL RED 1** | | | **52.317** |

| MATERIAL | DN | PN | LONGITUD (m) |
|---|---|---|---|
| PRFV | 500 | 6 | 1.757 |
| PVC | 125 | 10 | 382 |
| PVC | 140 | 10 | 342 |
| PVC | 160 | 10 | 136 |
| PVC | 200 | 10 | 1.397 |
| PVC | 250 | 10 | 813 |
| PVC | 315 | 10 | 1.559 |
| PVC | 400 | 10 | 3.385 |
| **TOTAL RED 2** | | | **9.769** |

# 6 CÁLCULOS MECÁNICOS DE LAS TUBERÍAS

Para la correcta comprobación de los cálculos mecánicos de las tuberías a instalar en el presente proyecto, se ha utilizado el software disponible en ASETUB (herramienta de cálculo basada en la norma ATV-A127) para las tuberías de PVC y el software AMI TOOLS – AMIANTIT, de acuerdo a la norma ATV-DVWK-A 127 para las tuberías de PRFV.

Se presentan los cálculos para 2 situaciones:

- Recubrimiento mínimo de 1,1 m sobre la generatriz superior de la tubería
- Recubrimiento mínimo de 3 m sobre la generatriz superior de la tubería

Como conclusión, indicar que los resultados de los cálculos mecánicos de todas las tuberías previstas en el presente proyecto cumplen con la normativa actual.

A continuación, se procederá a recoger los criterios generales de los cálculos, para un mayor detalle consultar el Apéndice 3.- Cálculos Mecánicos de las Tuberías.

## 6.1 CONDICIONES DE LA INSTALACIÓN

### 6.1.1 APOYO

La norma UNE 53.331 IN, *"Plásticos. Tuberías de poli(cloruro de vinilo) (PVC) no plastificado y polietileno (PE) de alta y media densidad. Criterio para la comprobación de los tubos a utilizar en conducciones con y sin presión sometidos a cargas externas. especifica dos formas de apoyar los tubos en la zanja"*, especifica dos formas de apoyar los tubos en la zanja:

- Apoyo tipo A: Este tipo de apoyo consiste, esencialmente, en una cama continua de material granular compactado sobre la que descansa el tubo. La cama de apoyo debe tener una compactación uniforme en toda su longitud y envolver el tubo según el ángulo de apoyo 2 alfa previsto. La relación de proyección para este tipo de apoyo es Pj=1.
- Apoyo tipo B: En este tipo de apoyo el tubo descansa directamente sobre el fondo de la zanja o sobre el suelo natural, cuando se trata de una instalación bajo terraplén. Se utilizará únicamente en suelos arenosos exentos de terrones y piedras.

Para el cálculo mecánico de la red de riego <u>se opta por un apoyo tipo A.</u>

### 6.1.2 RELLENO

Se distinguen dos zonas en el relleno:

- La zona de relleno seleccionado, constituida por la cama y el relleno hasta cubrir la generatriz superior del tubo.
- La zona de relleno procedente de la excavación (hasta el terreno natural)

La zona de relleno seleccionado condiciona la estabilidad y la protección de la conducción. La zona de relleno procedente de la excavación varía según sea la zona.

### 6.1.3 COMPACTACIÓN

En cuanto a la compactación del relleno, se definen cuatro niveles de compactado en la zona de recubrimiento.

- Nula. No se compacta.
- Ligera. No realiza uso de medios de compactado apropiado, o no realiza ningún control o verificación.
- Moderada. Se controlan los medios de compactado en obra, verificándose que los resultados obtenidos son 85-90% del Proctor y 40-70% de Densidad relativa.
- Alta. Como el anterior, y además con la verificación de que los resultados obtenidos son >95% Proctor y >70% de Densidad relativa.

En el caso de la red proyectada se ha optado por una compactación alta en la zona de relleno seleccionado y compactación moderada en la zona de relleno procedente de excavación.

### 6.1.4 NATURALEZA DEL SUELO

Por último, respecto a la naturaleza del suelo, el programa de cálculo ASETUB tiene en cuenta cuatro grupos de suelo:

- G1. No cohesivo: se incluyen en este grupo las gravas y arenas sueltas. Porcentaje de fino (Di<= 0.06 mm) inferior al 5%
- G2. Poco cohesivo: se incluyen en este grupo las gravas y arenas poco arcillosas o limosas. Porcentaje de fino (Di<= 0.06 mm) entre el 5% y el 15%
- G3. Medianamente cohesivo: se incluyen en este grupo las gravas y arenas poco arcillosas o limosas. Porcentaje de fino (Di<= 0.06 mm) entre el 15% y el 40% y limos poco plásticos.
- G4. Cohesivo: se incluyen en este grupo las arcillas, los limos y los suelos con mezcla de compuestos orgánicos.

En nuestro caso tenemos un suelo tipo G4 en la zona A y suelo tipo G3 en la zona B.

### 6.1.5 MÓDULOS DE COMPRESIÓN DEL TERRENO

En función del tipo de compactación y de la naturaleza del suelo, se obtiene el módulo de compresión del terreno, tal y como se observa en la siguiente tabla:

Tabla de módulos de compresión Es (N/mm2)
Compactación proctor normal en %

| TIPO DE SUELO | 85 | 90 | 92 | 95 | 97 | 100 |
|---|---|---|---|---|---|---|
| G1. No cohesivo | 2.5 | 6 | 9 | 16 | 23 | 40 |
| G2. Poco cohesivo | 1.2 | 3 | 4 | 8 | 11 | 20 |
| G3. Medianamente Cohesivo | 0.8 | 2 | 3 | 5 | 8 | 14 |
| G4. Cohesivos | 0.6 | 1.5 | 2 | 4 | 6 | 10 |

### 6.1.6 SOBRECARGAS

Se han considerado como sobrecargas verticales las cargas concentradas originadas principalmente, por las cargas de tráfico puntuales, que vienen determinadas por los siguientes datos:

- Pc: Sobrecarga concentrada (kN). En el caso de vehículos, se considera la carga máxima por rueda.
- a: Distancia entre ruedas (m)
- b: Distancia entre ejes (m)
- c: Longitud de la diagonal existente entre ruedas de distinto eje y distinto lado del vehículo (m)
- Número de ejes de los vehículos

Los valores de a, b, c y número de ejes dependen del tipo de vehículo considerado en el cálculo. A continuación, puede verse un resumen de los anteriores datos para cada tipo de vehículo:

| N° | Símbolo | Carga total | N° ejes | a | b | R. delantera | R. trasera |
|---|---|---|---|---|---|---|---|
| | | (Tm) | | (m) | (m) | Pc (kN) | Pc (kN) |
| 1 | LT 12 | 12 | 2 | 2 | 3 | 20 | 40 |
| 2 | HT 26 | 26 | 2 | 2 | 3 | 65 | 65 |
| 3 | HT 39 | 39 | 3 | 2 | 1.5 | 65 | 65 |
| 4 | HT 60 | 60 | 3 | 2 | 1.5 | 100 | 100 |

En el caso de la red proyectada se ha optado por una sobrecarga debida a vehículos de 2 ejes tipo (HT26)

## 6.2 METODOLOGÍA

Una vez se han introducido todos los datos de tipo de tubería y condiciones de instalación, se procede al cálculo de acciones. El programa calcula las acciones a corto y a largo plazo automáticamente.

En primer lugar, se determinan las presiones verticales y laterales de las tierras y, se comprueba las tensiones y deformaciones producidas, verificando que tanto el esfuerzo tangencial (coeficiente de seguridad a rotura) como la estabilidad (coeficiente de seguridad al aplastamiento) son admisibles.

### 6.2.1 ZONAS GEOTÉCNICAS

Según se puede ver en los planos de proyecto, se ha adoptado una zanja tipo con distinto ángulo de inclinación (talud) en función de la zonificación geológico-geotécnica establecida en el Anejo 7 "Estudio Geotécnico". De esta forma, para la zona A se establece un talud general 1H:1V, mientras que en el caso de la zona B se establece un talud general 1H:5V. Como se ha mencionado anteriormente, también la naturaleza del terreno cambia según las zonas. El resto de criterios considerados para el cálculo mecánicos serán los mismos en todas las zonas.

### 6.2.2 TUBERÍAS DE PVC

Los criterios generales de los cálculos mecánicos para tuberías de PVC han sido los siguientes:

- Presión de timbraje de las tuberías: 10-16 Atm.
- Carga de tráfico: media (26 Tm).
- Ángulo de inclinación de la zanja:
  - 45º en zona A (Talud 1H:1V)
  - 78,7º en zona B (Talud 1H:5V)
- Tipo de suelo del terreno (y relleno):
  - Tipo G3 en zona A
  - Tipo G4 en zona B
- Grado de compactación del relleno: 95% P. N.

Dada la variabilidad de situaciones que se van a encontrar en la red, se ha calculado para cada zona geológica las situaciones más desfavorables en cuando a diámetro, relleno de zanja y carga de tráfico.

En el apéndice 3 se presentan los resultados del cálculo mecánico.

### 6.2.3 TUBERÍAS DE PRFV

Los criterios generales de los cálculos mecánicos para tuberías de PRFV han sido los siguientes:

- Presión de timbraje de las tuberías: 6-10 Atm.
- Carga de tráfico: media (26 Tm).
- Ángulo de inclinación de la zanja:
  - 45º en zona A (Talud 1H:1V)
  - 78,7º en zona B (Talud 1H:5V)

- Tipo de suelo del terreno (y relleno):
  - Tipo G3 en zona A
  - Tipo G4 en zona B
- Grado de compactación del relleno: 95% P. N.

Dada la variabilidad de situaciones que se van a encontrar en la red, se ha calculado para cada zona geológica las situaciones más desfavorables en cuando a diámetro, relleno de zanja y carga de tráfico.

En el apéndice 3 se presentan los resultados del cálculo mecánico.

# 7 CÁLCULO DE ANCLAJES

La circulación del agua por la tubería, en los cambios de alineación, genera unos empujes hidráulicos que deben ser absorbidos por el terreno para asegurar la estabilidad de la misma y evitar pérdidas de agua por desplazamientos de las juntas. Los elementos intermedios entre tuberías y terreno son los anclajes, encargados de trasmitir al terreno los empujes producidos por la tubería.

## 7.1 CRITERIOS BÁSICOS

Para el cálculo de los anclajes se han considerado los siguientes criterios básicos:

- Se deberán colocar macizos de anclajes en los codos, cambios de dirección, reducciones, piezas de derivación, válvulas, desagües y en general todos aquellos elementos sometidos a esfuerzos que no deban soportar la propia tubería.
- Los macizos de anclaje deben disponerse de tal forma que las uniones queden al descubierto, debiendo haber obtenido la resistencia de proyecto antes de realizar las pruebas de la tubería instalada.
- Se considera un bloque de anclaje con forma cúbica y dimensiones L X h1 X H

## 7.2 METODOLOGÍA

Se considera el empuje radial en las curvas de ángulos de 90º y 45º, en Tes y en reducciones. El anclaje proyectado será de HM-35 Qc, sin armadura. La ecuación que rige el cálculo de dicho empuje es:

$$FD = 2 * 1000 * P * A * \text{sen}(\alpha/2)$$

Siendo:

- FD = Empuje total hacia fuera, en kilogramos.
- P= Altura hidrostática, en metros.
- A = área de la sección del tubo, en metros cuadrados.
- α = ángulo del codo, en grados.

Una vez calculado el empuje provocado por el fluido, es necesario dimensionar un anclaje que estabilice la unión. Para ello, en el diseño se ha considerado

$$\mathbf{F_{RP} + F_{RTA} / F_D > 1{,}10}$$

Siendo,

- $F_{RP}$: Fuerza de resistencia por peso. Tiene en cuenta el peso ejercido por la tubería.
- $F_{RTA}$: Fuerza de resistencia lateral del suelo. Factor que considera el esfuerzo realizado debido al rozamiento del suelo con el concreto.
- $F_D$: Fuerza de deslizamiento, obtenida mediante la fórmula anterior.

## 7.3 RESULTADOS

En las siguientes tablas se adjuntan los resultados obtenidos para los elementos estudiados. Las características de los anclajes se pueden observar en los planos 12.06. Se realiza el cálculo sin tener en cuenta la reacción lateral de la zanja.

***CODOS <45º***

| Diámetro | 0 - 60 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | 12.914,69 | 108.134,91 | 98.968,02 | 3,50 | 1,00 | 2,50 | 1,22 |
| **1200** | 9.089,60 | 80.080,17 | 72.711,20 | 3,00 | 1,00 | 2,25 | 1,23 |
| **1000** | 5.976,01 | 56.845,91 | 50.493,89 | 2,50 | 1,00 | 2,00 | 1,24 |
| **900** | 5.335,45 | 47.576,53 | 40.900,05 | 2,50 | 1,00 | 1,75 | 1,29 |
| **800** | 4.714,53 | 38.925,33 | 32.316,09 | 2,50 | 1,00 | 1,50 | 1,35 |
| **700** | 2.554,70 | 31.140,26 | 24.742,01 | 2,00 | 0,50 | 1,50 | 1,36 |
| **600** | 2.163,28 | 23.487,91 | 18.177,80 | 2,00 | 0,50 | 1,20 | 1,41 |
| **500** | 1.379,45 | 18.535,39 | 12.623,47 | 1,50 | 0,50 | 1,25 | 1,58 |
| **400** | 1.172,41 | 14.086,49 | 8.079,02 | 1,50 | 0,50 | 1,00 | 1,89 |
| **315** | 503,97 | 7.196,28 | 5.010,26 | 1,00 | 0,50 | 0,80 | 1,54 |
| **250** | 399,54 | 4.200,95 | 3.155,87 | 1,00 | 0,50 | 0,50 | 1,46 |
| **200** | 168,24 | 2.940,66 | 2.019,76 | 0,70 | 0,20 | 0,50 | 1,54 |
| **<160** | 151,70 | 2.297,14 | 1.292,64 | 0,70 | 0,20 | 0,40 | 1,84 |

***CODOS <45º***

| Diámetro | 60 - 100 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | 20.722,51 | 180.189,49 | 164.946,71 | 4,50 | 1,00 | 3,00 | 1,22 |
| **1200** | 17.502,41 | 139.030,60 | 121.185,33 | 4,50 | 1,00 | 2,50 | 1,29 |
| **1000** | 9.187,33 | 92.687,07 | 84.156,48 | 3,00 | 1,00 | 2,50 | 1,21 |
| **900** | 8.224,18 | 77.647,81 | 68.166,75 | 3,00 | 1,00 | 2,20 | 1,26 |
| **800** | 7.531,03 | 68.215,09 | 53.860,15 | 3,00 | 1,00 | 2,00 | 1,41 |
| **700** | 4.209,38 | 49.460,58 | 41.236,68 | 2,70 | 0,50 | 1,70 | 1,30 |
| **600** | 3.379,35 | 38.925,33 | 30.296,33 | 2,50 | 0,50 | 1,50 | 1,40 |
| **500** | 2.366,20 | 31.140,26 | 21.039,12 | 2,00 | 0,50 | 1,50 | 1,59 |
| **400** | 1.295,63 | 17.615,94 | 13.465,04 | 1,50 | 0,50 | 1,20 | 1,40 |
| **315** | 786,27 | 11.269,19 | 8.350,43 | 1,20 | 0,50 | 1,00 | 1,44 |
| **250** | 642,19 | 7.389,93 | 5.259,78 | 1,20 | 0,50 | 0,70 | 1,53 |
| **200** | 370,35 | 5.041,14 | 3.366,26 | 1,20 | 0,20 | 0,50 | 1,60 |
| **<160** | 279,02 | 4.200,95 | 2.154,41 | 1,00 | 0,20 | 0,50 | 2,08 |

***CODOS 45-90º***

| Diámetro | 0 - 60 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | 24.021,28 | 200.210,55 | 182.869,06 | 5,00 | 1,00 | 3,00 | 1,23 |
| **1200** | 17.502,41 | 139.030,60 | 134.352,78 | 4,50 | 1,00 | 2,50 | 1,16 |
| **1000** | 11.595,23 | 108.134,91 | 93.300,54 | 3,50 | 1,00 | 2,50 | 1,28 |
| **900** | 9.761,65 | 79.584,27 | 75.573,44 | 3,50 | 1,00 | 2,00 | 1,18 |
| **800** | 7.531,03 | 68.215,09 | 59.712,35 | 3,00 | 1,00 | 2,00 | 1,27 |
| **700** | 5.475,32 | 56.845,91 | 45.717,27 | 2,50 | 1,00 | 2,00 | 1,36 |
| **600** | 3.845,33 | 40.301,21 | 33.588,20 | 2,20 | 1,00 | 1,70 | 1,31 |
| **500** | 2.366,20 | 31.140,26 | 23.325,14 | 2,00 | 0,50 | 1,50 | 1,44 |
| **400** | 1.572,33 | 19.964,73 | 14.928,09 | 1,70 | 0,50 | 1,20 | 1,44 |
| **315** | 1.136,61 | 14.086,49 | 9.257,75 | 1,50 | 0,50 | 1,00 | 1,64 |
| **250** | 642,19 | 7.389,93 | 5.831,28 | 1,20 | 0,50 | 0,70 | 1,37 |
| **200** | 450,71 | 6.158,28 | 3.732,02 | 1,00 | 0,50 | 0,70 | 1,77 |
| **<160** | 257,51 | 3.281,63 | 2.388,49 | 1,00 | 0,20 | 0,40 | 1,48 |

***CODOS 45-90º***

| Diámetro | 60 - 100 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | 34.495,98 | 301.065,74 | 304.781,77 | 6,00 | 1,00 | 3,50 | 1,10 |
| **1200** | 25.689,97 | 250.888,12 | 223.921,30 | 5,00 | 1,00 | 3,50 | 1,24 |
| **1000** | 16.036,50 | 160.168,44 | 155.500,90 | 4,00 | 1,00 | 3,00 | 1,13 |
| **900** | 12.906,51 | 140.147,38 | 125.955,73 | 3,50 | 1,00 | 3,00 | 1,22 |
| **800** | 11.100,42 | 108.134,91 | 99.520,58 | 3,50 | 1,00 | 2,50 | 1,20 |
| **700** | 8.586,50 | 92.687,07 | 76.195,44 | 3,00 | 1,00 | 2,50 | 1,33 |
| **600** | 7.201,16 | 68.215,09 | 55.980,33 | 3,00 | 1,00 | 2,00 | 1,35 |
| **500** | 4.694,87 | 45.796,83 | 38.875,23 | 2,50 | 1,00 | 1,70 | 1,30 |
| **400** | 2.825,66 | 31.140,26 | 24.880,14 | 2,00 | 1,00 | 1,50 | 1,37 |
| **315** | 1.715,54 | 19.964,73 | 15.429,58 | 1,70 | 1,00 | 1,20 | 1,41 |
| **250** | 1.114,98 | 14.086,49 | 9.718,81 | 1,50 | 0,50 | 1,00 | 1,56 |
| **200** | 700,67 | 8.340,42 | 6.220,04 | 1,25 | 0,50 | 0,75 | 1,45 |
| **<160** | 460,05 | 6.672,33 | 3.980,82 | 1,00 | 0,50 | 0,75 | 1,79 |

***TES***

| Diámetro | 0 - 60 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | 21.013,61 | 139.030,60 | 129.307,95 | 4,50 | 1,00 | 2,50 | 1,24 |
| **1200** | 17.394,69 | 102.322,63 | 95.001,76 | 4,50 | 1,00 | 2,00 | 1,26 |
| **1000** | 11.078,10 | 68.215,09 | 65.973,45 | 3,00 | 1,00 | 2,00 | 1,20 |
| **900** | 9.774,26 | 54.956,20 | 53.438,49 | 3,00 | 1,00 | 1,70 | 1,21 |
| **800** | 7.978,32 | 45.796,83 | 42.223,01 | 2,50 | 1,00 | 1,70 | 1,27 |
| **700** | 3.856,06 | 38.925,33 | 32.326,99 | 2,50 | 0,50 | 1,50 | 1,32 |
| **600** | 2.982,74 | 31.140,26 | 23.750,44 | 2,00 | 0,50 | 1,50 | 1,44 |
| **500** | 2.155,90 | 19.964,73 | 16.493,36 | 1,70 | 0,50 | 1,20 | 1,34 |
| **400** | 1.669,25 | 14.086,49 | 10.555,75 | 1,50 | 0,50 | 1,00 | 1,49 |
| **315** | 1.363,45 | 9.237,41 | 6.546,22 | 1,50 | 0,50 | 0,70 | 1,62 |
| **250** | 929,45 | 5.041,14 | 4.123,34 | 1,20 | 0,50 | 0,50 | 1,45 |
| **200** | 315,71 | 4.200,95 | 2.638,94 | 1,00 | 0,20 | 0,50 | 1,71 |
| **<160** | 217,04 | 2.940,66 | 1.688,92 | 0,70 | 0,20 | 0,50 | 1,87 |

***REDUCCIÓN***

| Diámetro | | 0 - 60 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | **1200** | 7.659,38 | 39.504,76 | 34.306,19 | 2,00 | 1,00 | 1,80 | 1,37 |
| **1200** | **1000** | 6.093,88 | 30.464,37 | 29.028,32 | 1,80 | 1,00 | 1,60 | 1,26 |
| **1000** | **900** | 3.825,78 | 16.441,54 | 12.534,95 | 1,40 | 1,00 | 1,20 | 1,62 |
| **900** | **800** | 3.299,51 | 13.712,00 | 11.215,49 | 1,30 | 1,00 | 1,10 | 1,52 |
| **800** | **700** | 2.821,59 | 11.269,19 | 9.896,02 | 1,20 | 1,00 | 1,00 | 1,42 |
| **700** | **600** | 1.242,42 | 9.390,99 | 8.576,55 | 1,00 | 0,50 | 1,00 | 1,24 |
| **600** | **500** | 1.131,37 | 8.273,86 | 7.257,08 | 1,00 | 0,50 | 0,90 | 1,30 |
| **500** | **400** | 1.028,17 | 7.196,28 | 5.937,61 | 1,00 | 0,50 | 0,80 | 1,38 |
| **400** | **315** | 698,27 | 4.127,86 | 4.009,54 | 0,80 | 0,50 | 0,60 | 1,20 |
| **315** | **250** | 583,17 | 2.625,31 | 2.422,87 | 0,80 | 0,50 | 0,40 | 1,32 |
| **250** | **200** | 193,58 | 1.681,31 | 1.484,40 | 0,70 | 0,20 | 0,30 | 1,26 |
| **200** | **<160** | 153,42 | 1.186,10 | 950,02 | 0,60 | 0,20 | 0,25 | 1,41 |

***TES***

| Diámetro | 60 - 100 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|
| | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | 37.888,61 | 225.799,31 | 215.513,26 | 4,50 | 1,50 | 3,50 | 1,22 |
| **1200** | 29.261,95 | 160.168,44 | 158.336,27 | 4,00 | 1,50 | 3,00 | 1,20 |
| **1000** | 21.849,45 | 108.134,91 | 109.955,74 | 3,00 | 1,50 | 2,50 | 1,18 |
| **900** | 18.438,30 | 79.584,27 | 89.064,15 | 3,50 | 1,50 | 2,00 | 1,10 |
| **800** | 10.653,98 | 68.215,09 | 70.371,68 | 3,00 | 1,00 | 2,00 | 1,12 |
| **700** | 9.429,54 | 61.393,58 | 53.878,31 | 2,70 | 1,00 | 2,00 | 1,31 |
| **600** | 4.028,43 | 45.796,83 | 39.584,07 | 2,50 | 0,50 | 1,70 | 1,26 |
| **500** | 3.185,98 | 34.254,29 | 27.488,94 | 2,20 | 0,50 | 1,50 | 1,36 |
| **400** | 2.465,66 | 23.487,91 | 17.592,92 | 2,00 | 0,50 | 1,20 | 1,48 |
| **315** | 1.851,24 | 15.964,69 | 10.910,36 | 1,70 | 0,50 | 1,00 | 1,63 |
| **250** | 558,82 | 9.237,41 | 6.872,23 | 1,50 | 0,20 | 0,70 | 1,43 |
| **200** | 436,45 | 7.389,93 | 4.398,23 | 1,20 | 0,20 | 0,70 | 1,78 |
| **<160** | 310,05 | 4.200,95 | 2.814,87 | 1,00 | 0,20 | 0,50 | 1,60 |

***REDUCCIÓN***

| Diámetro | | 60 - 100 m.c.a. | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Frp (Kg) | Frta (Kg) | Fd (Kg) | L (m) | h1 (m) | H (m) | coef seg |
| **1400** | **1200** | 9.339,38 | 61.791,38 | 57.176,99 | 2,00 | 1,00 | 2,50 | 1,24 |
| **1200** | **1000** | 7.821,88 | 52.533,17 | 48.380,53 | 1,80 | 1,00 | 2,40 | 1,25 |
| **1000** | **900** | 4.564,32 | 20.767,66 | 20.891,59 | 1,60 | 1,00 | 1,30 | 1,21 |
| **900** | **800** | 4.167,13 | 19.469,68 | 18.692,48 | 1,50 | 1,00 | 1,30 | 1,26 |
| **800** | **700** | 3.627,86 | 16.441,54 | 16.493,36 | 1,40 | 1,00 | 1,20 | 1,22 |
| **700** | **600** | 1.771,15 | 15.267,14 | 14.294,25 | 1,30 | 0,50 | 1,20 | 1,19 |
| **600** | **500** | 1.573,65 | 14.092,75 | 12.095,13 | 1,20 | 0,50 | 1,20 | 1,30 |
| **500** | **400** | 1.262,99 | 10.330,09 | 9.896,02 | 1,10 | 0,50 | 1,00 | 1,17 |
| **400** | **315** | 890,27 | 7.512,79 | 6.682,56 | 0,80 | 0,50 | 1,00 | 1,26 |
| **315** | **250** | 679,17 | 4.127,86 | 4.038,12 | 0,80 | 0,50 | 0,60 | 1,19 |
| **250** | **200** | 227,18 | 2.940,66 | 2.474,00 | 0,70 | 0,20 | 0,50 | 1,28 |
| **200** | **<160** | 175,02 | 1.968,98 | 1.583,36 | 0,60 | 0,20 | 0,40 | 1,35 |

# 8 ELEMENTOS MECÁNICOS E HIDRÁULICOS

En el presente anejo, se pretende dar a conocer las características, pérdidas de carga y criterios seguidos para el dimensionado de cada uno de los elementos mecánicos e hidráulicos que conforman la red de riego, como son:

- La unidad hidrante.
- Las ventosas.
- Válvulas de seccionamiento
- Desagües

## 8.1 ELEMENTOS DEL HIDRANTE.

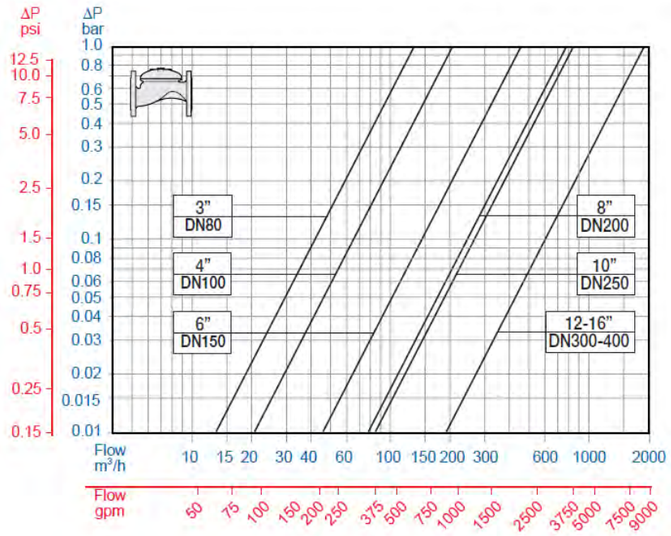
Los hidrantes constarán de válvula de compuerta, ventosa, filtro en L de 2 mm, contador woltman con corrector de flujo y válvula hidráulica con limitador de caudal y reductor de presión.

El Apéndice 2 del presente anejo incluye una relación de los hidrantes de la red, con la presión disponible en a la llegada al hidrante. Dicha presión inicial ha sido obtenida mediante simulación con el paquete informático GESTAR.

Las pérdidas de carga de la válvula hidráulica, el filtro, la válvula de seccionamiento y el contador se pueden obtener introduciendo los datos de caudal en las gráficas de las figuras y tablas que se presentan a continuación. Estas gráficas son de equipos estándar o de casas comerciales concretas, pudiendo producirse variaciones en las pérdidas reales en función del modelo y marca comercial de los elementos instalados en obra, debiendo revisarse por parte de la dirección de obra las pérdidas estimadas de los elementos concretos a instalar.

Concretamente en el Apéndice 2 se incluyen unas tablas en las que aparece una columna que define la pérdida de carga total del conjunto hidrante, la pérdida de carga de los filtros y la pérdida de carga en las válvulas de seccionamiento.

**Figura 1.-** Pérdidas de carga en la válvula hidráulica.




Los filtros del hidrante serán filtros cazapiedras en "L", con malla de acero inoxidable de 2 mm. La filtración se produce por retención física de las partículas de tamaño mayor al de la malla. El filtro instalado tendrá la posibilidad de implementar, posteriormente, valvulería para un sistema de lavado.

Se muestra a continuación las pérdidas del filtro en función del DN del mismo para diferentes caudales:

**Figura 2.-** Pérdidas de carga en el filtro de 2 mm

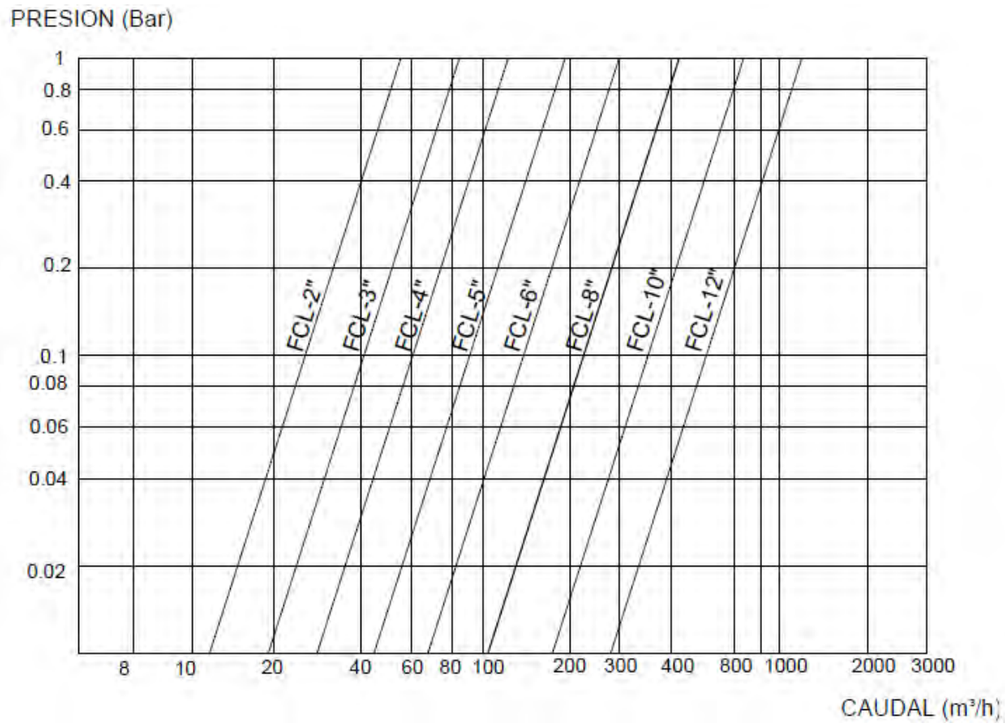



**Figura 3.-** Pérdidas de carga en válvula de seccionamiento.

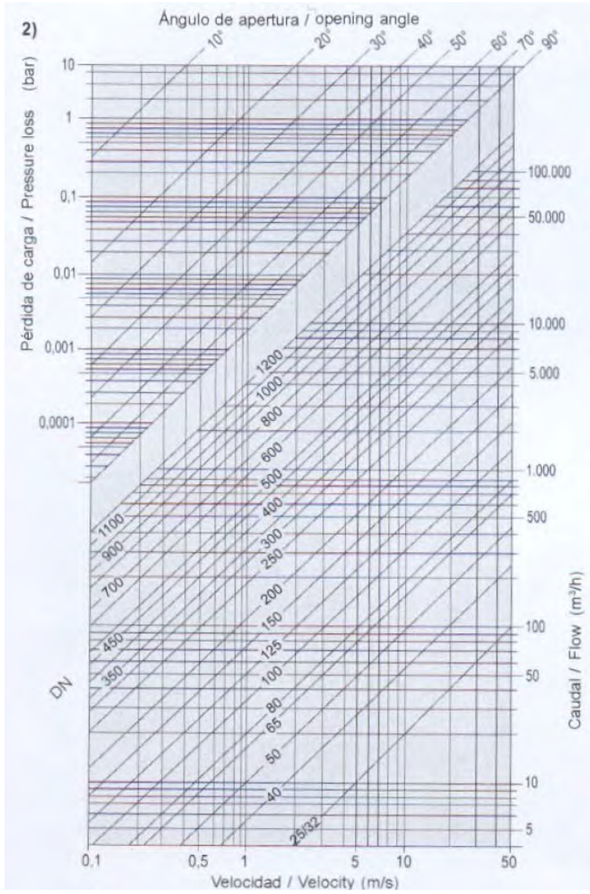
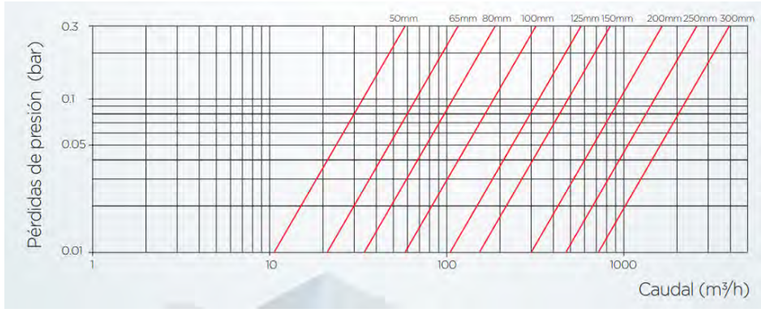



**Figura 4.-** Pérdidas de carga en contador woltman



Tal como se ha mencionado anteriormente, se presenta una tabla en el Apéndice 2 del presente anejo, con las pérdidas de carga obtenidas en cada uno de los hidrantes, según el caudal de cada uno de ellos, calculadas a través de las figuras anteriores y contabilizando además las pérdidas de carga de la calderería correspondiente. De esta forma se establece en esa misma tabla la presión final que se obtendrá después de las pérdidas del hidrante, pérdidas en el filtraje y el desnivel de la parcela.

## 8.2 CÁLCULO DE LAS VENTOSAS.

A lo largo de toda la red se colocarán ventosas, en los puntos más elevados de ésta, para que realicen sus funciones durante el llenado, vaciado y funcionamiento de la tubería. Éstas serán de triple efecto con la finalidad de:

- Eliminar el aire durante el llenado.
- Introducir aire en el vaciado, evitando plegamientos.
- Eliminar aire y gases disueltos, durante el funcionamiento.

Las ventosas tienen dos funciones principales: expulsión de aire en el llenado de la tubería y protección de la tubería en operaciones de vaciado o rotura mediante introducción de aire en la misma.

Debemos tener cuidado si la cantidad de aire a introducir en la línea es muy superior a la cantidad de aire a expulsar, ya que estaremos sobredimensionando la ventosa. Esto puede dar lugar a velocidades de llenado demasiado rápidas.

En el cálculo de protección en operaciones de vaciado, el caudal de aire a introducir es equivalente al caudal de vaciado o al caudal generado por gravedad en un descenso. Por tanto, las ventosas se han calculado considerando como criterio limitante el vaciado de las tuberías. La cantidad de aire a introducir en una línea descendente puede ser determinada por la siguiente ecuación:

$$Q(m3/\min) = 0{,}133576\ \sqrt{S\,\frac{D^5}{25{,}4^5}}$$

siendo:

S: pendiente, en cm/cm.

D: Diámetro de la tubería, en mm.

En el cálculo de expulsiones de aire durante el llenado, la cantidad de aire a evacuar es igual al caudal que impulsa la bomba o al caudal de agua que se introduzca en la conducción.

Debido a lo comentado anteriormente, es preferible seleccionar la ventosa en función de la capacidad de evacuación, escogiendo válvulas trifuncionales que permitan introducir aire en el vaciado, y el posible caudal suplementario introducirlo por mediación de válvulas de entrada de aire.

Conocido el caudal a expulsar y considerando una presión de llenado relativamente alta, por ejemplo, 0,28 bares, para que no existan problemas de expulsión de aire, se han consultado tablas de obtención de diámetros en bibliografía técnica especializada. La máxima depresión admitida es de 1,4 mca en las tuberías plásticas.

| **CAUDAL MÁXIMO DE LLENADO (l/seg)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ΔP (bar) | DN 1/2" | DN 3/4" | DN 1" | DN 2" | DN 3" | DN 4" | DN 6" | DN 8" |
| 0,07 | 8,7 | 19,6 | 34,7 | 138,8 | 312,3 | 555 | 1249 | 2221 |
| 0,14 | 11,5 | 26 | 46,1 | 184,9 | 415,2 | 738 | 1660 | 2953 |
| 0,21 | 13,3 | 30 | 53,3 | 213,3 | 480 | 852 | 1918 | 3414 |
| 0,28 | 14,5 | 32,8 | 58,3 | 232,8 | 524,4 | 934 | 2101 | 3729 |
| 0,35 | 15,5 | 34,8 | 61,8 | 247,4 | 556,5 | 990 | 2227 | 3956 |
| 0,42 | 16,1 | 36,2 | 64,3 | 258 | 580,5 | 1035 | 2322 | 4127 |
| 0,49 | 16,6 | 37,4 | 66,3 | 265,6 | 598,2 | 1060 | 2391 | 4253 |
| 0,56 | 16,9 | 38,2 | 68,2 | 271,3 | 610,8 | 1085 | 2442 | 4347 |
| 0,63 | 17,2 | 39 | 68,8 | 275,7 | 621 | 1104 | 2486 | 4417 |
| 0,7 | 17,4 | 39,3 | 70 | 278,9 | 627,8 | 1117 | 2511 | 4467 |
| 1 | 17,5 | 39,5 | 71,3 | 284 | 637,3 | 1136 | 2555 | 4499 |

Los valores de ΔP son los datos de la presión de llenado. Son diferentes según el agua. Hasta ΔP de 0,14 bares (ver zona sombreada) son valores recomendados para aguas residuales. Hasta ΔP de 0,35 bares son valores recomendados para aguas limpias.

Este dato de ΔP es importante, ya que valores de presión de llenado bajos pueden dar problemas, como ya se ha indicado. Valores superiores no son necesarios.

Con estos datos entramos en la tabla y según el caudal circulante por la tubería obtenemos un diámetro de ventosa.

Tras estudiar los valores obtenidos, y aunque se podrían haber instalado diámetros de ventosa menores, para mayor seguridad únicamente se han instalado ventosas de 2”, 3”, 4”, 6” y 8”. Su localización concreta podemos verla en los planos, realizada a partir de la topografía y los ejes definidos en planos.

## 8.3 VÁLVULAS DE SECCIONAMIENTO

Las válvulas de seccionamiento serán válvulas de mariposa de eje centrado y de acero inoxidable para todos los seccionamientos de diámetro igual o superior a 350 mm, y para los de inferior diámetro se instalarán válvulas de compuerta. Los seccionamientos se distribuyen en nudos de entidad en los que se dispongan ramificaciones de consideración, el planteamiento es en caso de averías, roturas, etc. poder aislar una zona de la red de riego y continuar utilizando el resto de la instalación.

Se proyectan 4 seccionamientos en la red del piso alto y 10 en la red del piso bajo. A la salida de las balsas de riego, tanto las elevadas como las inferiores, se instalarán válvulas de mariposa para el seccionamiento de las conducciones, y servir para aislar las balsas del resto de infraestructura.

Se puede observar la posición de los seccionamientos en la planta de la red de riego, plano 13.01 del documento nº2

Para los hidrantes de riego, se colocarán igualmente válvulas de compuerta con cierre elástico.

## 8.4 CARRETES DE DESMONTAJE

Siempre que la válvula de seccionamiento tenga un diámetro superior a 200 mm (8”), se dispondrá un carrete para facilitar el desmontaje de la misma.

Para las redes de tuberías los carretes irán instaladas aguas abajo de las válvulas de compuerta y de mariposa. El carrete interior irá al lado de la válvula y el carrete exterior irá al lado de la pieza especial acoplada a la tubería.

En la Estación de Bombeo, los carretes irán aguas arriba de las válvulas de mariposa, es decir, entre estas y las válvulas de retención. El carrete exterior irá al lado de la válvula y el carrete interior a la pieza especial acoplada a la tubería.

## 8.5 DESAGÜES

A lo largo de toda la red de riego y coincidiendo con los puntos bajos de la misma se disponen desagües para el vaciado de las tuberías en los momentos en los que la comunidad de regantes lo requiera para mantenimientos y conservación de las instalaciones. Los desagües estarán conformados por una válvula de compuerta enterrada y con el accionamiento alojado en una arqueta de tubo prefabricado. La tubería del desagüe se conectará con el fondo de la tubería a la que se une, ya sea tangencialmente desde la zona de evacuación o por el fondo. Se incluirá un macizo de anclaje en la unión con la tubería principal. El desagüe se conectará con un barranco o acequia existente en la zona.

En la obra existirán tres tipos de desagües:

- Tipo I. Salida a cauce natural.

  Seccionamiento enterrado con accionamiento mediante eje telescópico, relleno de grava 6/12 y arqueta DN 1000 de tubo machihembrado con tapa de acero galvanizado en caliente. Tubería de PVC hasta cauce natural, con sección tipo según planos.

- Tipo II. Sin salida a cauce natural. Doble pozo.

  Seccionamiento enterrado con accionamiento mediante eje telescópico, relleno de grava 6/12 y arqueta DN 1000 de tubo machihembrado con tapa de acero galvanizado en caliente. Tubería de PVC hasta cauce segundo pozo. Segundo pozo, compuesto por anillos de tubo machihembrado DN1000, de hasta 3 metros de profundidad. Ver planos.

Se emplearán 2 tipologías de desagüe, 4" y 8" en función del diámetro de la tubería a la que se conectan y por tanto del volumen de agua que se debe eliminar de la red para su vaciado.

| DIÁMETRO DE LAS VÁLVULAS DE DESAGÜE | | |
|---|---|---|
| **DN TUBERÍA** | **Ø VÁLVULA (mm.)** | **TIPO** |
| DN < 400 | 100 | Compuerta. |
| DN ≥ 400 | 200 | Compuerta. |

Se puede observar la posición de los desagües en la planta de la red de riego, plano 13.01 del documento nº2.

# APÉNDICE 1.- RESULTADOS Y ESQUEMA DE LA RED

**APÉNDICE 1.- RESULTADOS DE LA RED DE RIEGO..... 1**

**1 RED DE RIEGO ..... 1**

**2 ESQUEMA DE LA RED DE RIEGO ..... 4**

# APÉNDICE 1.- RESULTADOS DE LA RED DE RIEGO

## 1 RED DE RIEGO

Se presenta a continuación el listado completo de tuberías de la red de riego, indicando para cada tramo:

- Nodo inicial y final
- Tubería (material, DN y timbraje)
- Longitud
- Caudal de diseño (l/s)
- Velocidad al caudal de diseño (m/s)

**Tabla 1.-** Resultados de la red del Piso 1

| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| DER_24 | NU8 | 24 | 140 PVC-10 | 27,989 | 24,0 | 1,83 |
| DER_5 | NU26 | 5 | 140 PVC-10 | 20,93 | 24,0 | 1,83 |
| DER_62 | NU72 | 62 | 140 PVC-10 | 16,964 | 25,0 | 1,91 |
| IMP1 | 0 | NU5 | 1400 PRFV-10 | 930,98 | 2543,5 | 1,72 |
| R1-10-TR01 | NU19 | 102 | 250 PVC-10 | 23,339 | 60,0 | 1,43 |
| R1-10-TR02 | 102 | 104 | 140 PVC-10 | 136,06 | 23,0 | 1,75 |
| R1-11-1-TR01 | NU40 | 154 | 200 PVC-10 | 277,75 | 36,0 | 1,35 |
| R1-11-1-TR02 | 154 | 155 | 160 PVC-10 | 315,52 | 21,0 | 1,23 |
| R1-11-2 | NU41 | 151 | 125 PVC-10 | 6,4473 | 18,0 | 1,72 |
| R1-11-TR01 | NU38 | NU41 | 315 PVC-10 | 327,72 | 99,6 | 1,50 |
| R1-11-TR02 | NU41 | NU40 | 315 PVC-10 | 663,96 | 99,0 | 1,49 |
| R1-11-TR03 | NU40 | 152 | 315 PVC-10 | 430,92 | 63,0 | 0,95 |
| R1-11-TR04 | 152 | 153 | 200 PVC-10 | 348,68 | 18,0 | 0,67 |
| R1-12-1-TR01 | 173 | 174 | 250 PVC-10 | 138,49 | 71,0 | 1,70 |
| R1-12-1-TR02 | 174 | 175 | 250 PVC-10 | 458,44 | 71,0 | 1,70 |
| R1-12-1-TR03 | 175 | 176 | 200 PVC-10 | 169,28 | 36,0 | 1,35 |
| R1-12-1-TR04 | 176 | 178 | 125 PVC-10 | 286,41 | 18,0 | 1,72 |
| R1-12-2 | 175 | 177 | 125 PVC-10 | 21,416 | 20,0 | 1,91 |
| R1-12-TR01 | NU38 | 172 | 315 PVC-10 | 727,63 | 101,3 | 1,52 |
| R1-12-TR02 | 172 | 173 | 315 PVC-10 | 251,44 | 94,7 | 1,43 |
| R1-12-TR03 | 173 | 179 | 250 PVC-10 | 296,7 | 64,0 | 1,53 |
| R1-12-TR04 | 179 | 180 | 200 PVC-10 | 180,08 | 49,0 | 1,83 |
| R1-12-TR05 | 180 | 181 | 160 PVC-10 | 625,76 | 30,0 | 1,75 |
| R1-12-TR06 | 181 | 182 | 125 PVC-10 | 172,91 | 15,0 | 1,43 |
| R1-14-1 | 165 | 161 | 125 PVC-10 | 20,499 | 18,0 | 1,72 |
| R1-14-3-TR01 | NU44 | 162 | 200 PVC-10 | 17,924 | 39,0 | 1,46 |
| R1-14-3-TR02 | 162 | 163 | 125 PVC-10 | 44,153 | 18,0 | 1,72 |
| R1-14-5 | NU43 | 164 | 160 PVC-10 | 19,734 | 34,0 | 1,99 |
| R1-14-7 | NU42 | 167 | 125 PVC-10 | 18,873 | 15,0 | 1,43 |
| R1-14-TR01 | NU45 | 165 | 315 PVC-10 | 255,65 | 126,3 | 1,90 |
| R1-14-TR02 | 165 | NU44 | 315 PVC-10 | 302,63 | 105,9 | 1,59 |
| R1-14-TR03 | NU44 | NU1 | 315 PVC-10 | 43,896 | 82,2 | 1,24 |
| R1-14-TR04 | NU1 | NU43 | 250 PVC-10 | 339,75 | 82,2 | 1,96 |
| R1-14-TR05 | NU43 | 166 | 250 PVC-10 | 277,88 | 69,0 | 1,65 |
| R1-14-TR06 | 166 | NU42 | 200 PVC-10 | 243,18 | 51,0 | 1,91 |
| R1-14-TR07 | NU42 | 169 | 200 PVC-10 | 182,19 | 36,0 | 1,35 |
| R1-14-TR08 | 169 | 170 | 160 PVC-10 | 23,534 | 18,0 | 1,05 |
| R1-16 | NU46 | 160 | 140 PVC-10 | 21,443 | 22,0 | 1,68 |
| R1-1-TR01 | NU28 | 2 | 200 PVC-10 | 36,624 | 30,0 | 1,12 |
| R1-1-TR02 | 2 | NU32 | 160 PVC-10 | 10,023 | 15,0 | 0,88 |
| R1-1-TR03 | NU32 | 1 | 160 PVC-10 | 53,492 | 15,0 | 0,88 |
| R1-2-1 | NU23 | 3 | 125 PVC-10 | 8,9656 | 18,0 | 1,72 |
| R1-2-TR01 | NU29 | NU23 | 250 PVC-10 | 221,91 | 33,0 | 0,79 |
| R1-2-TR02 | NU23 | 4 | 160 PVC-10 | 264,06 | 15,0 | 0,88 |
| R1-3-1 | NU33 | 6 | 140 PVC-10 | 173 | 15,0 | 1,14 |
| R1-3-2-TR01 | NU22 | 11 | 200 PVC-10 | 49,685 | 51,0 | 1,91 |
| R1-3-2-TR02 | 11 | 12 | 200 PVC-10 | 111,79 | 36,0 | 1,35 |
| R1-3-3 | 9 | 10 | 200 PVC-10 | 311,11 | 15,0 | 0,56 |
| R1-3-TR01 | NU26 | NU33 | 400 PVC-10 | 230,87 | 113,7 | 1,06 |
| R1-3-TR02 | NU33 | 7 | 400 PVC-10 | 37,127 | 109,1 | 1,02 |
| R1-3-TR03 | 7 | 8 | 400 PVC-10 | 273,98 | 99,1 | 0,92 |
| R1-3-TR04 | 8 | 9 | 315 PVC-10 | 49,473 | 95,0 | 1,43 |
| R1-3-TR05 | 9 | NU22 | 250 PVC-10 | 158,75 | 66,0 | 1,58 |
| R1-3-TR06 | NU22 | 13 | 160 PVC-10 | 273 | 15,0 | 0,88 |
| R1-4-10-TR01 | NU69 | 68 | 315 PVC-10 | 392,88 | 77,0 | 1,16 |
| R1-4-10-TR02 | 68 | 69 | 200 PVC-10 | 337,53 | 18,0 | 0,67 |
| R1-4-11 | NU67 | 53 | 125 PVC-10 | 28,72 | 15,0 | 1,43 |
| R1-4-1-1-TR01 | NU59 | 20 | 250 PVC-10 | 190,76 | 73,0 | 1,74 |
| R1-4-1-1-TR02 | 20 | 21 | 250 PVC-10 | 75,478 | 55,0 | 1,31 |
| R1-4-1-1-TR03 | 21 | 22 | 200 PVC-10 | 593,19 | 37,0 | 1,38 |
| R1-4-13-2 | NU3 | 63 | 140 PVC-16 | 111,33 | 19,0 | 1,59 |
| R1-4-13-TR01 | NU68 | NU2 | 250 PVC-16 | 431,05 | 56,0 | 1,47 |
| R1-4-13-TR01B | NU2 | NU3 | 250 PVC-16 | 54,478 | 56,0 | 1,47 |

| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| R1-4-13-TR02 | NU3 | 64 | 200 PVC-16 | 409,44 | 37,0 | 1,52 |
| R1-4-13-TR03 | NU70 | 65 | 140 PVC-16 | 217,38 | 19,0 | 1,59 |
| R1-4-13-TR03A | 64 | NU70 | 140 PVC-16 | 212,03 | 19,0 | 1,59 |
| R1-4-1-TR01 | NU31 | 19 | 400 PVC-10 | 299,18 | 153,5 | 1,43 |
| R1-4-1-TR02 | 19 | NU59 | 400 PVC-10 | 233,66 | 141,5 | 1,32 |
| R1-4-1-TR03 | NU59 | 23 | 315 PVC-10 | 519,36 | 98,0 | 1,48 |
| R1-4-1-TR04 | 23 | 26 | 315 PVC-10 | 158,71 | 93,0 | 1,40 |
| R1-4-1-TR05 | 26 | 27 | 315 PVC-10 | 101,44 | 84,7 | 1,28 |
| R1-4-1-TR06 | 27 | NU8 | 315 PVC-10 | 148,71 | 84,0 | 1,26 |
| R1-4-1-TR07 | NU8 | 28 | 250 PVC-10 | 81,113 | 60,0 | 1,43 |
| R1-4-1-TR08 | 28 | 29 | 200 PVC-10 | 286,04 | 42,0 | 1,57 |
| R1-4-1-TR09 | 29 | 30 | 160 PVC-10 | 20,789 | 27,0 | 1,58 |
| R1-4-2 | 18 | 17 | 250 PVC-10 | 32,198 | 50,0 | 1,20 |
| R1-4-3-1-TR01 | 34 | 33 | 160 PVC-10 | 19,515 | 33,0 | 1,93 |
| R1-4-3-1-TR02 | 33 | 35 | 125 PVC-10 | 113,86 | 18,0 | 1,72 |
| R1-4-3-TR01 | NU25 | 34 | 250 PVC-10 | 382,15 | 69,0 | 1,65 |
| R1-4-3-TR02 | 34 | 36 | 125 PVC-10 | 603,47 | 18,0 | 1,72 |
| R1-4-4 | NU60 | 25 | 250 PVC-10 | 51,944 | 83,0 | 1,98 |
| R1-4-5-1-TR01 | NU7 | 44 | 160 PVC-10 | 153,37 | 34,0 | 1,99 |
| R1-4-5-1-TR02 | 44 | 37 | 125 PVC-10 | 35,589 | 19,0 | 1,82 |
| R1-4-5-2 | NU62 | 40 | 125 PVC-10 | 18,436 | 18,0 | 1,72 |
| R1-4-5-TR01 | 38 | 41 | 250 PVC-10 | 478,3 | 68,8 | 1,64 |
| R1-4-5-TR02 | 41 | NU62 | 250 PVC-10 | 34,175 | 67,0 | 1,60 |
| R1-4-5-TR03 | NU62 | NU7 | 250 PVC-10 | 241 | 67,0 | 1,60 |
| R1-4-5-TR04 | NU7 | 42 | 160 PVC-10 | 68,613 | 33,0 | 1,93 |
| R1-4-5-TR05 | 42 | 43 | 125 PVC-10 | 369,14 | 15,0 | 1,43 |
| R1-4-6 | NU61 | 60 | 800 PRFV-10 | 200,52 | 860,0 | 1,79 |
| R1-4-7-1 | NU63 | 46 | 125 PVC-10 | 17,133 | 18,0 | 1,72 |
| R1-4-7-TR01 | 48 | NU63 | 200 PVC-10 | 92,221 | 48,0 | 1,79 |
| R1-4-7-TR02 | NU63 | 47 | 160 PVC-10 | 20,658 | 30,0 | 1,75 |
| R1-4-8 | NU71 | 61 | 140 PVC-10 | 94,897 | 21,0 | 1,60 |
| R1-4-9-1 | NU66 | 50 | 125 PVC-10 | 72,986 | 15,0 | 1,43 |
| R1-4-9-2 | NU65 | 54 | 125 PVC-10 | 63,754 | 18,0 | 1,72 |
| R1-4-9-TR01 | NU64 | NU65 | 250 PVC-10 | 299,3 | 66,0 | 1,58 |
| R1-4-9-TR02 | NU65 | 49 | 200 PVC-10 | 16,375 | 48,0 | 1,79 |
| R1-4-9-TR03 | 49 | NU66 | 160 PVC-10 | 146,33 | 30,0 | 1,75 |
| R1-4-9-TR04 | NU66 | 51 | 125 PVC-10 | 162,04 | 15,0 | 1,43 |
| R1-4-TR01 | NU10 | 14 | 1200 PRFV-10 | 425,42 | 1544,0 | 1,42 |
| R1-4-TR02 | 14 | NU31 | 1200 PRFV-10 | 449,2 | 1509,5 | 1,39 |
| R1-4-TR03 | NU31 | 18 | 1000 PRFV-10 | 325,43 | 1406,7 | 1,86 |
| R1-4-TR04 | 18 | NU60 | 1000 PRFV-10 | 468,49 | 1365,3 | 1,81 |
| R1-4-TR05 | NU60 | NU61 | 1000 PRFV-10 | 545,55 | 1322,3 | 1,75 |

| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| R1-4-TR06 | NU61 | 31 | 500 PRFV-10 | 97,148 | 384,6 | 1,92 |
| R1-4-TR07 | 31 | 32 | 500 PRFV-10 | 205,81 | 381,9 | 1,91 |
| R1-4-TR08 | 32 | NU25 | 500 PRFV-10 | 155,34 | 372,9 | 1,86 |
| R1-4-TR09 | NU25 | 38 | 500 PRFV-10 | 396,26 | 347,1 | 1,73 |
| R1-4-TR10 | 38 | 39 | 500 PVC-10 | 33,689 | 297,4 | 1,78 |
| R1-4-TR11 | 39 | 45 | 500 PVC-10 | 314,72 | 288,1 | 1,72 |
| R1-4-TR12 | 45 | 48 | 500 PVC-10 | 644,84 | 286,3 | 1,71 |
| R1-4-TR13 | 48 | 52 | 500 PVC-10 | 417,91 | 251,9 | 1,50 |
| R1-4-TR14 | 52 | NU64 | 500 PVC-10 | 152,05 | 241,4 | 1,44 |
| R1-4-TR15 | NU64 | NU67 | 500 PVC-10 | 547,81 | 214,4 | 1,28 |
| R1-4-TR16 | NU67 | NU68 | 400 PVC-10 | 965,42 | 211,9 | 1,98 |
| R1-4-TR17 | NU68 | NU71 | 400 PVC-10 | 273,65 | 193,2 | 1,80 |
| R1-4-TR18 | NU71 | NU72 | 400 PVC-10 | 259,02 | 181,6 | 1,69 |
| R1-4-TR19 | NU72 | 66 | 400 PVC-10 | 293,97 | 167,2 | 1,56 |
| R1-4-TR20 | 66 | NU73 | 400 PVC-10 | 205,69 | 155,4 | 1,45 |
| R1-4-TR20B | NU73 | 67 | 400 PVC-10 | 79,619 | 155,4 | 1,45 |
| R1-4-TR21 | 67 | NU69 | 400 PVC-10 | 187,82 | 136,0 | 1,27 |
| R1-4-TR22 | NU69 | 70 | 250 PVC-10 | 573,42 | 59,0 | 1,41 |
| R1-4-TR23 | 70 | 71 | 160 PVC-10 | 791,89 | 24,0 | 1,40 |
| R1-5-1 | NU18 | 80 | 315 PVC-10 | 214,79 | 65,0 | 0,98 |
| R1-5-2-TR01 | NU17 | NU11 | 315 PVC-10 | 457,39 | 51,0 | 0,77 |
| R1-5-2-TR02 | NU11 | 81 | 250 PVC-10 | 3,0912 | 51,0 | 1,22 |
| R1-5-3 | NU16 | 83 | 140 PVC-10 | 12,878 | 24,0 | 1,83 |
| R1-5-4-2 | NU24 | 86 | 250 PVC-10 | 57,051 | 43,0 | 1,03 |
| R1-5-4-TR01 | NU14 | NU24 | 315 PVC-10 | 290,44 | 81,0 | 1,22 |
| R1-5-4-TR02 | NU24 | 88 | 200 PVC-10 | 704,55 | 38,0 | 1,42 |
| R1-5-4-TR03 | 88 | 87 | 140 PVC-10 | 197,75 | 18,0 | 1,37 |
| R1-5-5 | NU15 | 84 | 200 PVC-10 | 342,42 | 43,0 | 1,61 |
| R1-5-6-1 | NU13 | 90 | 200 PVC-10 | 17,589 | 38,0 | 1,42 |
| R1-5-6-TR01 | NU12 | NU13 | 400 PVC-10 | 358,55 | 102,0 | 0,95 |
| R1-5-6-TR02 | NU13 | 85 | 250 PVC-10 | 37,254 | 64,0 | 1,53 |
| R1-5-7-TR01 | NU34 | 91 | 250 PVC-10 | 207,94 | 33,0 | 0,79 |
| R1-5-7-TR02 | 91 | 92 | 125 PVC-10 | 17,32 | 15,0 | 1,43 |
| R1-5-9 | NU35 | 94 | 125 PVC-10 | 163,26 | 15,0 | 1,43 |
| R1-5-TR01 | NU9 | NU18 | 600 PRFV-10 | 475,52 | 333,5 | 1,23 |
| R1-5-TR02 | NU18 | NU17 | 500 PRFV-10 | 118,02 | 290,8 | 1,45 |
| R1-5-TR03 | NU17 | 82 | 500 PRFV-10 | 526,32 | 258,5 | 1,29 |
| R1-5-TR04 | 82 | NU16 | 500 PRFV-10 | 210,14 | 230,6 | 1,15 |
| R1-5-TR05 | NU16 | NU15 | 500 PRFV-10 | 290,92 | 217,5 | 1,09 |
| R1-5-TR06 | NU15 | NU14 | 500 PRFV-10 | 262,85 | 190,4 | 0,95 |
| R1-5-TR07 | NU14 | NU12 | 500 PVC-10 | 276,23 | 151,6 | 0,91 |
| R1-5-TR08 | NU12 | 89 | 315 PVC-10 | 35,275 | 65,1 | 0,98 |

| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| R1-5-TR09 | 89 | NU34 | 250 PVC-10 | 683,48 | 47,2 | 1,13 |
| R1-5-TR10 | NU34 | NU35 | 200 PVC-10 | 150,16 | 45,0 | 1,68 |
| R1-5-TR11 | NU35 | 93 | 160 PVC-10 | 168,72 | 30,0 | 1,75 |
| R1-5-TR12 | 93 | 95 | 125 PVC-10 | 87,123 | 15,0 | 1,43 |
| R1-6 | 15 | 16 | 125 PVC-10 | 117,05 | 18,0 | 1,72 |
| R1-7 | NU20 | 105 | 125 PVC-10 | 91,9 | 15,0 | 1,43 |
| R1-8-1 | NU49 | 112 | 125 PVC-10 | 238,93 | 18,0 | 1,72 |
| R1-8-10 | NU57 | 137 | 125 PVC-10 | 72,585 | 18,0 | 1,72 |
| R1-8-11 | NU30 | 132 | 200 PVC-10 | 180,23 | 44,0 | 1,64 |
| R1-8-13 | NU58 | 140 | 125 PVC-10 | 44,081 | 20,0 | 1,91 |
| R1-8-2-1 | NU48 | 142 | 125 PVC-10 | 16,988 | 18,0 | 1,72 |
| R1-8-2-2 | NU47 | 146 | 140 PVC-10 | 23,474 | 15,0 | 1,14 |
| R1-8-2--3 | 143 | 144 | 140 PVC-10 | 17,96 | 25,0 | 1,91 |
| R1-8-2-TR01 | NU39 | 141 | 315 PVC-10 | 452,35 | 112,9 | 1,70 |
| R1-8-2-TR02 | 141 | NU48 | 315 PVC-10 | 55,885 | 99,6 | 1,50 |
| R1-8-2-TR03 | NU48 | 143 | 315 PVC-10 | 599,93 | 89,9 | 1,35 |
| R1-8-2-TR04 | 143 | 145 | 250 PVC-10 | 422,12 | 62,0 | 1,48 |
| R1-8-2-TR05 | 145 | NU47 | 200 PVC-10 | 68,361 | 42,0 | 1,57 |
| R1-8-2-TR06 | NU47 | 147 | 160 PVC-10 | 290,71 | 27,0 | 1,58 |
| R1-8-3-1 | NU27 | 117 | 200 PVC-10 | 129,08 | 18,0 | 0,67 |
| R1-8-3-2 | 115 | 122 | 125 PVC-10 | 22,283 | 18,0 | 1,72 |
| R1-8-3-TR01 | NU51 | 115 | 315 PVC-10 | 120,17 | 63,0 | 0,95 |
| R1-8-3-TR02 | 115 | 116 | 315 PVC-10 | 90,354 | 63,0 | 0,95 |
| R1-8-3-TR03 | 116 | NU27 | 250 PVC-10 | 83,855 | 48,0 | 1,15 |
| R1-8-3-TR04 | NU27 | 118 | 160 PVC-10 | 261,59 | 30,0 | 1,75 |
| R1-8-3-TR05 | 118 | 119 | 125 PVC-10 | 167,18 | 15,0 | 1,43 |
| R1-8-4-TR01 | NU50 | 120 | 200 PVC-10 | 32,485 | 50,0 | 1,87 |
| R1-8-4-TR02 | 120 | 121 | 160 PVC-10 | 514,81 | 30,0 | 1,75 |
| R1-8-5 | NU54 | 123 | 125 PVC-10 | 109,77 | 15,0 | 1,43 |
| R1-8-6 | NU55 | 129 | 160 PVC-10 | 115,64 | 33,0 | 1,93 |
| R1-8-7-2 | NU52 | 127 | 125 PVC-10 | 149,09 | 15,0 | 1,43 |
| R1-8-7-4 | NU53 | 126 | 125 PVC-10 | 289,26 | 18,0 | 1,72 |
| R1-8-7-TR01 | NU54 | NU52 | 250 PVC-10 | 20,432 | 69,0 | 1,65 |
| R1-8-7-TR02 | NU52 | NU53 | 250 PVC-10 | 72,159 | 54,0 | 1,29 |
| R1-8-7-TR03 | NU53 | 124 | 200 PVC-10 | 229,99 | 36,0 | 1,35 |
| R1-8-7-TR04 | 124 | 125 | 125 PVC-10 | 118,58 | 18,0 | 1,72 |
| R1-8-8-1 | NU6 | 135 | 125 PVC-10 | 9,3753 | 15,0 | 1,43 |
| R1-8-8-TR01 | 133 | NU6 | 200 PVC-10 | 416,55 | 36,0 | 1,35 |
| R1-8-8-TR02 | NU6 | 136 | 140 PVC-10 | 21,154 | 21,0 | 1,60 |
| R1-8-9-1 | NU56 | 130 | 125 PVC-10 | 48,73 | 18,0 | 1,72 |
| R1-8-9-TR01 | NU55 | 128 | 200 PVC-10 | 19,757 | 53,0 | 1,98 |
| R1-8-9-TR02 | 128 | NU56 | 200 PVC-10 | 73,297 | 38,0 | 1,42 |

| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| R1-8-9-TR03 | NU56 | 131 | 125 PVC-10 | 101,39 | 20,0 | 1,91 |
| R1-8-TR01 | NU21 | 110 | 500 PRFV-10 | 508,62 | 368,5 | 1,84 |
| R1-8-TR02 | 110 | 111 | 500 PRFV-10 | 354,99 | 362,1 | 1,81 |
| R1-8-TR03 | 111 | NU39 | 500 PRFV-10 | 477,56 | 347,7 | 1,74 |
| R1-8-TR04 | NU39 | NU49 | 500 PVC-10 | 309,67 | 272,3 | 1,63 |
| R1-8-TR05 | NU49 | 113 | 500 PVC-10 | 185,56 | 265,0 | 1,58 |
| R1-8-TR06 | 113 | 114 | 500 PVC-10 | 252,26 | 258,7 | 1,54 |
| R1-8-TR07 | 114 | NU50 | 500 PVC-10 | 128 | 249,4 | 1,49 |
| R1-8-TR08 | NU50 | NU51 | 500 PVC-10 | 319,94 | 221,0 | 1,32 |
| R1-8-TR09 | NU51 | NU54 | 400 PVC-10 | 389,24 | 192,4 | 1,79 |
| R1-8-TR10 | NU54 | NU55 | 400 PVC-10 | 413,36 | 166,6 | 1,55 |
| R1-8-TR11 | NU55 | 133 | 315 PVC-10 | 495,24 | 132,5 | 1,99 |
| R1-8-TR12 | 133 | NU30 | 315 PVC-10 | 181,8 | 109,2 | 1,64 |
| R1-8-TR13 | NU30 | 134 | 250 PVC-10 | 153,64 | 73,0 | 1,74 |
| R1-8-TR14 | 134 | NU57 | 250 PVC-10 | 160,45 | 73,0 | 1,74 |
| R1-8-TR15 | NU57 | 138 | 250 PVC-10 | 335,73 | 55,0 | 1,31 |
| R1-8-TR16 | 138 | NU58 | 200 PVC-10 | 252,76 | 35,0 | 1,31 |
| R1-8-TR17 | NU58 | 139 | 125 PVC-10 | 172,22 | 15,0 | 1,43 |
| R1-9 | NU36 | 107 | 140 PVC-10 | 13,493 | 22,0 | 1,68 |
| R1-TR01 | NU5 | NU29 | 1400 PRFV-6 | 529,85 | 2543,5 | 1,72 |
| R1-TR02 | NU29 | NU28 | 1400 PRFV-6 | 130,2 | 2535,5 | 1,72 |
| R1-TR03 | NU28 | NU26 | 1400 PRFV-6 | 196,05 | 2527,8 | 1,71 |
| R1-TR04 | NU26 | NU10 | 1400 PRFV-10 | 263,63 | 2452,8 | 1,66 |
| R1-TR05 | NU10 | 15 | 900 PRFV-10 | 549,4 | 1039,2 | 1,70 |
| R1-TR06 | 15 | NU9 | 900 PRFV-10 | 653,24 | 1020,4 | 1,67 |
| R1-TR07 | NU9 | NU21 | 800 PRFV-10 | 316,52 | 756,6 | 1,57 |
| R1-TR08 | NU21 | 100 | 700 PRFV-10 | 316,86 | 436,3 | 1,18 |
| R1-TR09 | 100 | 101 | 600 PRFV-10 | 360,53 | 418,3 | 1,54 |
| R1-TR10 | 101 | NU19 | 600 PRFV-10 | 250,04 | 407,7 | 1,50 |
| R1-TR11 | NU19 | 103 | 600 PRFV-10 | 231,49 | 374,0 | 1,38 |
| R1-TR12 | 103 | NU20 | 500 PRFV-10 | 94,405 | 362,4 | 1,81 |
| R1-TR13 | NU20 | 106 | 500 PRFV-10 | 165,95 | 358,4 | 1,79 |
| R1-TR14 | 106 | NU36 | 500 PRFV-10 | 462,94 | 348,4 | 1,74 |
| R1-TR15 | NU36 | 108 | 500 PRFV-10 | 315,41 | 339,4 | 1,69 |
| R1-TR16 | 108 | NU37 | 500 PRFV-10 | 25,109 | 330,9 | 1,65 |
| R1-TR17 | NU37 | 109 | 500 PRFV-10 | 78,07 | 330,9 | 1,65 |
| R1-TR18 | 109 | NU38 | 500 PRFV-10 | 171,35 | 321,9 | 1,61 |
| R1-TR19 | NU38 | 171 | 400 PVC-10 | 73,103 | 190,8 | 1,78 |
| R1-TR20 | 171 | 150 | 400 PVC-10 | 149,01 | 182,8 | 1,70 |
| R1-TR21 | 150 | NU45 | 400 PVC-10 | 247,23 | 163,4 | 1,52 |
| R1-TR22 | NU45 | 156 | 250 PVC-10 | 365,02 | 82,0 | 1,96 |
| R1-TR23 | 156 | 157 | 250 PVC-10 | 33,76 | 82,0 | 1,96 |

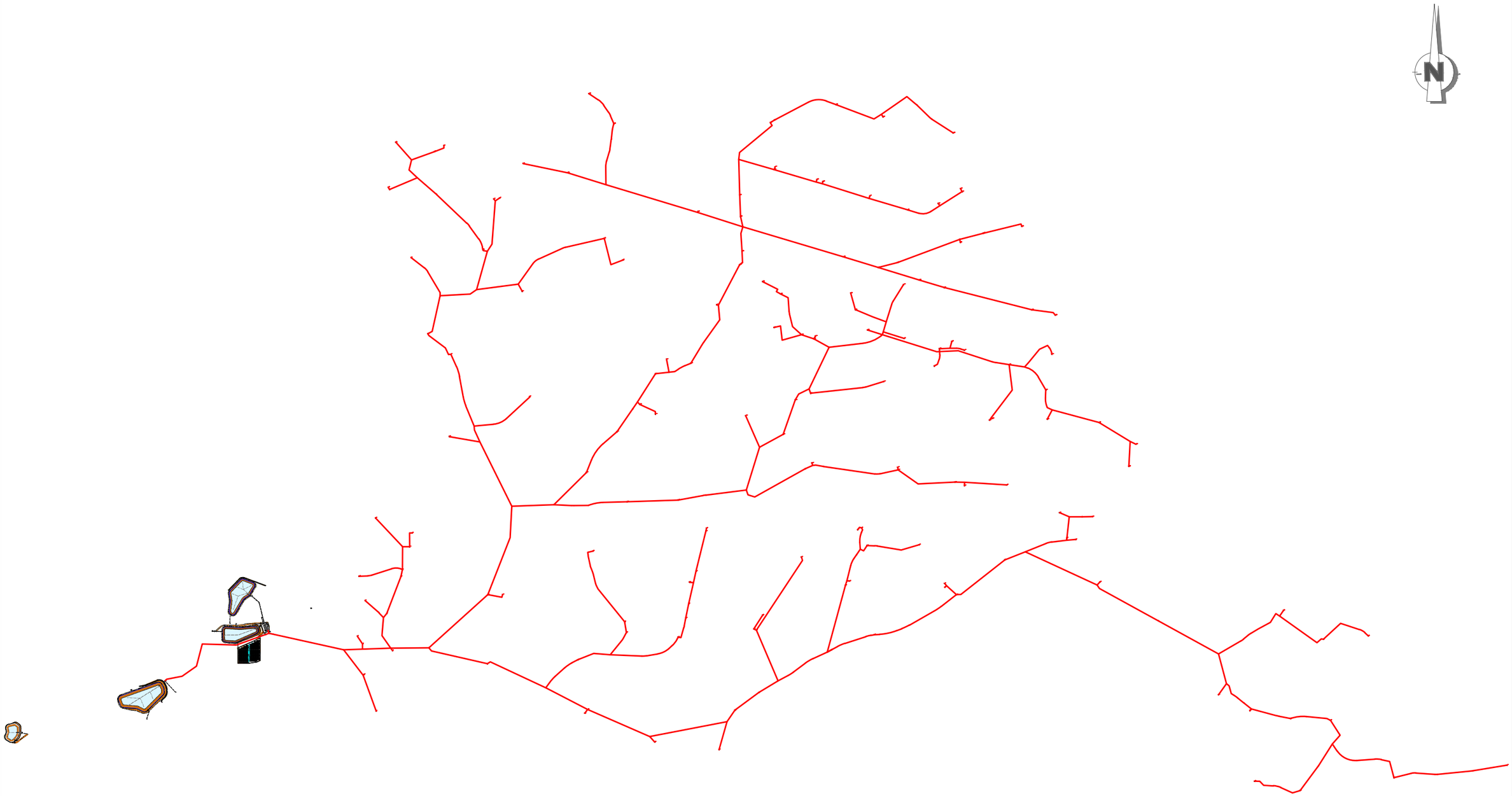
| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| R1-TR24 | 157 | 158 | 250 PVC-10 | 464,98 | 64,0 | 1,53 |
| R1-TR25 | 158 | NU46 | 200 PVC-10 | 343,24 | 40,0 | 1,49 |
| R1-TR26 | NU46 | 159 | 160 PVC-10 | 622,71 | 18,0 | 1,05 |

**Tabla 2.-** Resultados de la red del Piso 2

| TRAMO | N.Ini. | N.Fin. | TUBERÍA | LONGITUD (m) | CAUDAL DISEÑO (l/s) | VELOCIDAD (m/s) |
|---|---|---|---|---|---|---|
| DER_223 | NU17 | 223 | 125 PVC-10 | 35,305 | 15,0 | 1,43 |
| IMP2 | 0 | NU5 | 700 PRFV-10 | 1950,9 | 413,2 | 1,12 |
| R2-1-2 | NU16 | 226 | 160 PVC-10 | 70,341 | 18,0 | 1,05 |
| R2-1-TR01 | NU6 | NU17 | 315 PVC-10 | 148,54 | 103,0 | 1,55 |
| R2-1-TR02 | NU17 | NU16 | 315 PVC-10 | 227,24 | 103,0 | 1,55 |
| R2-1-TR03 | NU16 | 224 | 315 PVC-10 | 88,433 | 85,0 | 1,28 |
| R2-1-TR04 | 224 | 225 | 250 PVC-10 | 169,54 | 60,0 | 1,43 |
| R2-1-TR05 | 225 | 230 | 200 PVC-10 | 147,64 | 42,0 | 1,57 |
| R2-2 | NU8 | 227 | 200 PVC-10 | 173,96 | 21,0 | 0,78 |
| R2-3 | NU10 | 231 | 125 PVC-10 | 213,33 | 18,0 | 1,72 |
| R2-4 | NU7 | 228 | 140 PVC-10 | 258,28 | 18,0 | 1,37 |
| R2-TR01 | NU5 | 221 | 400 PVC-10 | 195,59 | 174,2 | 1,62 |
| R2-TR02 | 221 | 222 | 400 PVC-10 | 427,84 | 174,2 | 1,62 |
| R2-TR03 | 222 | NU6 | 400 PVC-10 | 501,31 | 144,6 | 1,35 |
| R2-TR04 | NU6 | NU8 | 400 PVC-10 | 252,73 | 86,0 | 0,80 |
| R2-TR05 | NU8 | NU7 | 250 PVC-10 | 141,98 | 65,0 | 1,55 |
| R2-TR06 | NU7 | NU10 | 200 PVC-10 | 227,1 | 47,0 | 1,76 |
| R2-TR07 | NU10 | 229 | 200 PVC-10 | 349 | 29,0 | 1,08 |
| R3-10 | NU12 | 212 | 250 PVC-10 | 91,739 | 29,0 | 0,69 |
| R3-2 | NU11 | 201 | 125 PVC-10 | 83,843 | 18,0 | 1,72 |
| R3-4 | NU9 | 205 | 125 PVC-10 | 49,21 | 15,0 | 1,43 |
| R3-6 | 207 | 208 | 200 PVC-10 | 145,06 | 41,0 | 1,53 |
| R3-8-2-1 | NU14 | 219 | 160 PVC-10 | 66,456 | 15,0 | 0,88 |
| R3-8-2-TR01 | NU13 | 215 | 315 PVC-10 | 82,473 | 113,8 | 1,71 |
| R3-8-2-TR02 | 215 | 217 | 315 PVC-10 | 115,29 | 75,0 | 1,13 |
| R3-8-2-TR03 | 217 | 218 | 250 PVC-10 | 29,973 | 60,0 | 1,43 |
| R3-8-2-TR04 | 218 | NU14 | 200 PVC-10 | 363,79 | 39,0 | 1,46 |
| R3-8-2-TR05 | NU14 | 220 | 140 PVC-10 | 73,58 | 24,0 | 1,83 |
| R3-8-TR01 | NU15 | NU13 | 400 PVC-10 | 310,32 | 167,5 | 1,56 |
| R3-8-TR02 | NU13 | 216 | 315 PVC-10 | 1243 | 66,0 | 0,99 |
| R3-TR01 | NU5 | NU11 | 500 PRFV-10 | 109,23 | 296,2 | 1,48 |
| R3-TR02 | NU11 | 202 | 500 PRFV-10 | 187,57 | 290,2 | 1,45 |
| R3-TR03 | 202 | 204 | 500 PRFV-10 | 250,25 | 285,0 | 1,42 |
| R3-TR04 | 204 | 203 | 500 PRFV-10 | 21,748 | 276,9 | 1,38 |
| R3-TR05 | 203 | NU9 | 500 PRFV-10 | 142,27 | 274,1 | 1,37 |
| R3-TR06 | NU9 | 206 | 500 PRFV-10 | 122,93 | 271,8 | 1,36 |
| R3-TR07 | 206 | 207 | 500 PRFV-10 | 248,57 | 270,2 | 1,35 |
| R3-TR08 | 207 | NU15 | 500 PRFV-10 | 676,64 | 243,8 | 1,22 |
| R3-TR09 | NU15 | 209 | 400 PVC-10 | 91,854 | 129,6 | 1,21 |
| R3-TR10 | 209 | 210 | 400 PVC-10 | 509,65 | 121,0 | 1,13 |
| R3-TR11 | 210 | 211 | 400 PVC-10 | 424,32 | 121,0 | 1,13 |
| R3-TR12 | 211 | NU12 | 400 PVC-10 | 410,3 | 103,0 | 0,96 |
| R3-TR13 | NU12 | 214 | 400 PVC-10 | 262,73 | 74,0 | 0,69 |
| R3-TR14 | 214 | 213 | 250 PVC-10 | 33,696 | 18,0 | 0,43 |

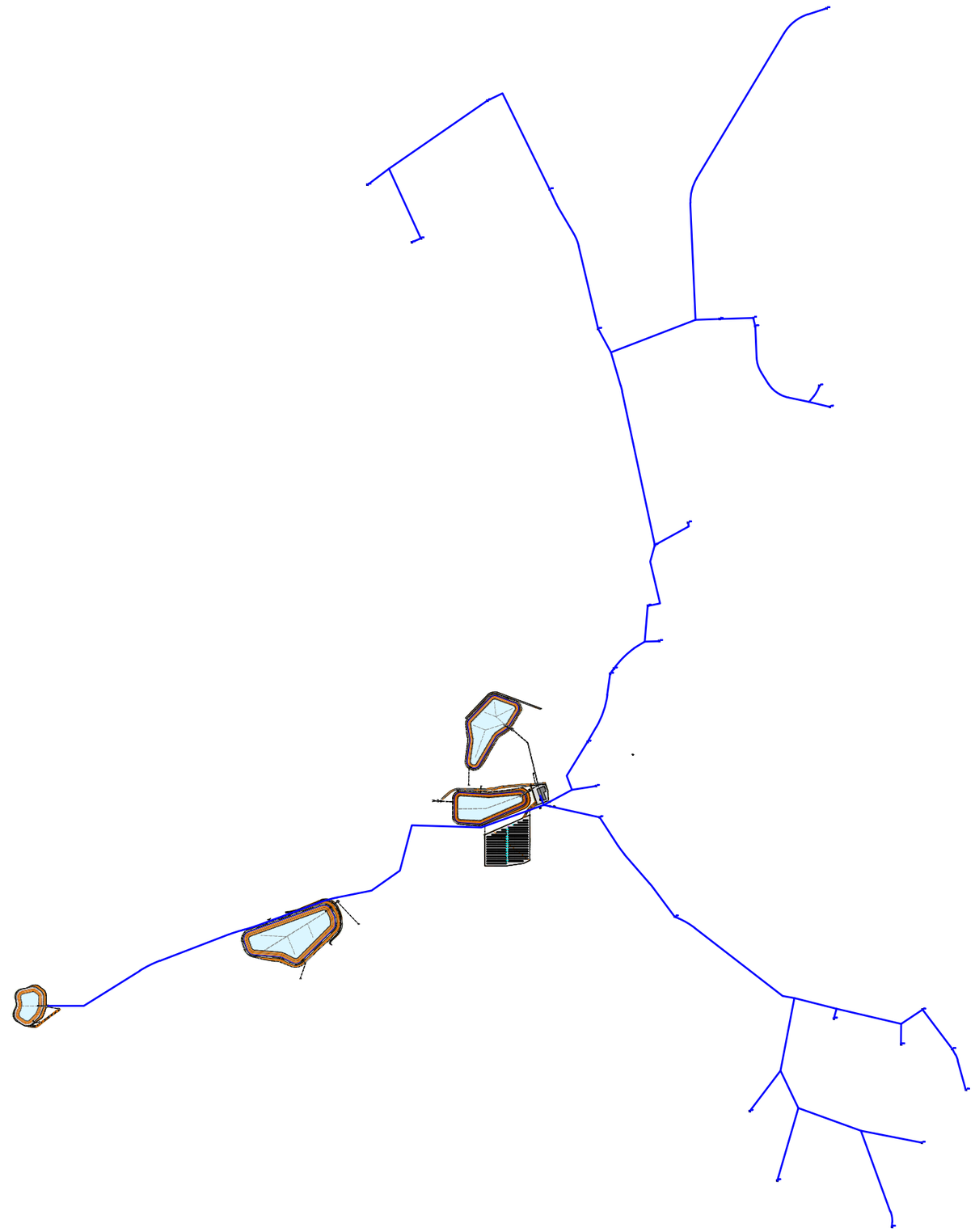
## 2 ESQUEMA DE LA RED DE RIEGO

Se incluye igualmente un esquema de la red de riego, en el que cada hidrante se representa con un punto azul. La definición completa de la red de riego (materiales, diámetros, acotaciones, cotas de rasante, etc.) puede verse en el documento nº2 Planos.



| LEYENDA | |
|---|---|
| | RED RIEGO |
| | HIDRANTE |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORA DE INGENIERÍA | SIN ESCALA<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | RED 1 | 00.00<br>Nº DE HOJA: 1 de 1 |



| LEYENDA | |
|---|---|
| | RED RIEGO |
| | HIDRANTE |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORA DE INGENIERÍA | SIN ESCALA<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | RED 2 | 00.00<br>Nº DE HOJA: 1 de 1 |

**APÉNDICE 2.- LISTADO DE PRESIONES**

**APÉNDICE 2.- LISTADO PRESIONES HIDRANTES ..... 1**

**1 INTRODUCCIÓN Y OBJETO ..... 1**

**2 PRESIÓN EN HIDRANTES ..... 1**

**3 PÉRDIDAS DE CARGA EN HIDRANTES COMPARTIDOS ..... 8**

# APÉNDICE 2.- LISTADO PRESIONES HIDRANTES

## 1 INTRODUCCIÓN Y OBJETO

En el presente documento se incluyen los cálculos individualizados de las pérdidas de carga en el conjunto hidrante.

Igualmente se presentan los cálculos de las pérdidas de carga en la distribución del agua en las tomas de hidrantes compartidos.

## 2 PRESIÓN EN HIDRANTES

A continuación, se presenta una tabla con las características de cada hidrante. Se indica para cada uno:

- Superficie (ha): Superficie considerada para el cálculo de la red de riego
- Dotación (l/s): dotación asignada en función de la superficie de riego
- Desnivel (m): existente desde el hidrante hasta el punto más alto de la finca
- P Disp Antes Hid (mca): Presión dinámica de cálculo a la llegada al hidrante
- DN Válv Hidráulica (mm): Diámetro de hidrante asignado
- Δh VH (mca): Pérdida de carga de la válvula hidráulica
- Δh colector (mca): Pérdida de carga en el colector (incluyendo codos)
- Δh Valvula seccionamiento (mca): Pérdida de carga de la válvula de seccionamiento
- Δh Filtro (mca): Pérdida de carga del filtro cazapiedras
- Δh total hid (mca): Pérdida de carga total en el conjunto hidrante (VH+colector+VS+Filtro)
- P min disp pto alto finca (mca): Presión mínima disponible en el punto más alto de la finca (descontadas las pérdidas del hidrante)

**Tabla 1.-** Presiones disponibles en los hidrantes de la red del Piso 1

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5,7467 | 15,0 | 379,0 | 383,0 | 4,0 | 43,64 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 37,50 |
| 2 | 3,3023 | 15,0 | 379,0 | 380,0 | 1,0 | 43,94 | 80 | 1,72 | 1,27 | 0,09 | 2,20 | 0,73 | 6,00 | 36,94 |
| 3 | 8,0991 | 18,0 | 379,0 | 381,6 | 2,6 | 43,60 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 37,92 |
| 4 | 1,3307 | 15,0 | 381,6 | 381,9 | 0,3 | 39,94 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 37,51 |
| 5 | 13,6925 | 24,0 | 376,4 | 378,0 | 1,6 | 46,08 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 43,46 |
| 6 | 4,2555 | 15,0 | 379,7 | 380,0 | 0,3 | 41,15 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 38,71 |
| 7 | 9,3035 | 18,0 | 376,0 | 376,4 | 0,4 | 46,33 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 43,32 |
| 8 | 3,6138 | 15,0 | 376,0 | 376,3 | 0,3 | 45,86 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 43,42 |
| 9 | 23,1691 | 40,0 | 374,0 | 378,1 | 4,1 | 47,60 | 150 | 1,02 | 0,60 | 0,05 | 0,83 | 0,32 | 2,82 | 40,68 |
| 10 | 2,0379 | 15,0 | 381,0 | 382,0 | 1,0 | 40,10 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 36,96 |
| 11 | 5,0861 | 15,0 | 371,0 | 378,3 | 7,3 | 48,57 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 39,13 |
| 12 | 20,5275 | 36,0 | 371,0 | 372,0 | 1,0 | 47,69 | 150 | 0,82 | 0,49 | 0,04 | 0,67 | 0,26 | 2,28 | 44,41 |
| 13 | 5,9214 | 15,0 | 378,0 | 378,4 | 0,4 | 41,03 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,00 | 1,81 | 38,81 |
| 14 | 39,1439 | 67,0 | 374,6 | 382,0 | 7,4 | 47,62 | 200 | 0,97 | 0,50 | 0,04 | 0,72 | 0,40 | 2,64 | 37,58 |
| 15 | 11,7745 | 21,0 | 368,7 | 373,9 | 5,2 | 52,89 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 43,52 |
| 16 | 9,3611 | 18,0 | 368,1 | 368,6 | 0,5 | 50,94 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 47,37 |
| 17 | 29,1650 | 50,0 | 375,0 | 362,0 | 0,0 | 45,99 | 200 | 0,54 | 0,28 | 0,02 | 0,40 | 0,23 | 1,47 | 44,52 |
| 18 | 18,6253 | 32,0 | 373,5 | 362,0 | 0,0 | 47,65 | 150 | 0,64 | 0,39 | 0,03 | 0,53 | 0,21 | 1,80 | 45,85 |
| 19 | 17,9321 | 31,0 | 371,0 | 371,0 | 0,0 | 49,64 | 150 | 0,60 | 0,36 | 0,03 | 0,50 | 0,19 | 1,69 | 47,95 |
| 20 | 7,0807 | 18,0 | 366,0 | 356,0 | 0,0 | 52,00 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 48,93 |
| 21 | 7,5717 | 18,0 | 367,2 | 374,3 | 7,1 | 50,34 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 40,16 |
| 22 | 21,2750 | 37,0 | 362,3 | 367,0 | 4,7 | 50,35 | 150 | 0,87 | 0,51 | 0,04 | 0,71 | 0,28 | 2,41 | 43,24 |
| 23 | 4,4553 | 15,0 | 359,9 | 362,0 | 2,1 | 57,14 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,00 | 1,81 | 53,22 |
| 24 | 13,6271 | 24,0 | 357,0 | 361,0 | 4,0 | 57,63 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 52,62 |
| 25 | 48,3535 | 83,0 | 369,2 | 372,0 | 2,8 | 50,42 | 200 | 1,49 | 0,76 | 0,07 | 1,10 | 0,62 | 4,05 | 43,58 |
| 26 | 6,9559 | 18,0 | 358,0 | 361,6 | 3,6 | 58,26 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 51,58 |
| 27 | 11,2809 | 20,0 | 357,8 | 360,0 | 2,2 | 58,03 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 52,04 |
| 28 | 9,4021 | 18,0 | 357,0 | 358,0 | 1,0 | 57,67 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 54,07 |
| 29 | 5,1647 | 15,0 | 356,2 | 361,7 | 5,5 | 55,48 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 47,84 |
| 30 | 15,6754 | 27,0 | 356,0 | 360,0 | 4,0 | 55,39 | 150 | 0,46 | 0,28 | 0,02 | 0,38 | 0,00 | 1,13 | 50,26 |
| 31 | 2,8475 | 15,0 | 364,0 | 364,2 | 0,2 | 54,85 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 52,51 |
| 32 | 9,7958 | 18,0 | 362,6 | 364,0 | 1,4 | 55,31 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 51,31 |
| 33 | 4,7292 | 15,0 | 360,0 | 363,0 | 3,0 | 53,49 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 48,35 |
| 34 | 9,6253 | 18,0 | 360,0 | 360,0 | 0,0 | 53,88 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 51,27 |
| 35 | 7,2139 | 18,0 | 359,2 | 359,4 | 0,2 | 51,81 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 48,54 |
| 36 | 6,0994 | 18,0 | 355,0 | 355,9 | 0,9 | 45,73 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 41,76 |
| 37 | 10,5114 | 19,0 | 350,1 | 354,0 | 3,9 | 55,06 | 100 | 1,06 | 0,77 | 0,06 | 1,01 | 0,52 | 3,42 | 47,74 |

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 9,9390 | 18,0 | 360,0 | 360,0 | 0,0 | 55,73 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 52,66 |
| 39 | 9,9835 | 18,0 | 360,0 | 360,0 | 0,0 | 55,57 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 52,49 |
| 40 | 7,3151 | 18,0 | 356,0 | 357,0 | 1,0 | 54,86 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 50,79 |
| 41 | 10,0397 | 18,0 | 356,3 | 357,0 | 0,7 | 55,25 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 51,47 |
| 42 | 8,4362 | 18,0 | 354,5 | 355,0 | 0,5 | 53,83 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 50,26 |
| 43 | 5,1756 | 15,0 | 352,0 | 352,0 | 0,0 | 50,12 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 47,99 |
| 44 | 2,0653 | 15,0 | 349,0 | 351,8 | 2,8 | 57,02 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 52,08 |
| 45 | 10,0200 | 18,0 | 357,0 | 357,0 | 0,0 | 57,12 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 54,04 |
| 46 | 7,6421 | 18,0 | 353,0 | 355,0 | 2,0 | 56,57 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 51,50 |
| 47 | 17,1537 | 30,0 | 353,0 | 353,4 | 0,4 | 56,60 | 150 | 0,56 | 0,34 | 0,03 | 0,47 | 0,18 | 1,58 | 54,62 |
| 48 | 10,3861 | 19,0 | 353,1 | 353,3 | 0,2 | 58,08 | 100 | 1,06 | 0,77 | 0,06 | 1,01 | 0,00 | 2,90 | 54,98 |
| 49 | 9,9381 | 18,0 | 342,0 | 345,1 | 3,1 | 64,55 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 58,38 |
| 50 | 5,6461 | 15,0 | 340,9 | 343,0 | 2,1 | 62,06 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 57,82 |
| 51 | 5,0193 | 15,0 | 340,1 | 341,0 | 0,9 | 61,46 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 58,42 |
| 52 | 10,9901 | 20,0 | 349,3 | 354,0 | 4,7 | 60,35 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 51,86 |
| 53 | 2,5302 | 15,0 | 342,7 | 349,4 | 6,7 | 64,60 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 55,76 |
| 54 | 7,6300 | 18,0 | 341,0 | 345,2 | 4,2 | 64,38 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 57,57 |
| 60 | 557,3886 | 86,0 | 365,6 | 367,0 | 1,4 | 53,21 | 200 | 1,60 | 0,82 | 0,07 | 1,18 | 0,67 | 4,34 | 47,47 |
| 61 | 11,6554 | 2,1 | 345,0 | 347,0 | 2,0 | 52,77 | 80 | 0,03 | 0,03 | 0,00 | 0,04 | 0,01 | 0,12 | 50,65 |
| 62 | 13,7903 | 25,0 | 340,8 | 342,2 | 1,4 | 56,80 | 150 | 0,39 | 0,24 | 0,02 | 0,32 | 0,13 | 1,10 | 54,30 |
| 63 | 10,4736 | 19,0 | 329,0 | 331,2 | 2,2 | 64,98 | 100 | 1,06 | 0,77 | 0,06 | 1,01 | 0,52 | 3,42 | 59,36 |
| 64 | 9,6409 | 18,0 | 328,0 | 335,1 | 7,1 | 65,94 | 80 | 2,50 | 1,80 | 0,12 | 3,18 | 0,00 | 7,60 | 51,24 |
| 65 | 10,7084 | 19,0 | 327,0 | 329,0 | 2,0 | 59,49 | 100 | 1,06 | 0,77 | 0,06 | 1,01 | 0,00 | 2,90 | 54,58 |
| 66 | 11,7005 | 21,0 | 339,4 | 344,6 | 5,2 | 57,25 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 47,88 |
| 67 | 26,2999 | 45,0 | 337,9 | 341,8 | 3,9 | 57,62 | 150 | 1,29 | 0,76 | 0,06 | 1,05 | 0,41 | 3,57 | 50,15 |
| 68 | 34,2357 | 59,0 | 343,8 | 346,2 | 2,4 | 49,77 | 200 | 0,75 | 0,39 | 0,03 | 0,56 | 0,31 | 2,05 | 45,32 |
| 69 | 6,0643 | 18,0 | 343,2 | 346,1 | 2,9 | 49,62 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 43,64 |
| 70 | 20,4362 | 35,0 | 339,0 | 339,0 | 0,0 | 52,17 | 150 | 0,77 | 0,46 | 0,04 | 0,64 | 0,25 | 2,16 | 50,01 |
| 71 | 13,3456 | 24,0 | 336,0 | 356,0 | 20,0 | 46,34 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 25,33 |
| 80 | 37,9780 | 65,0 | 378,0 | 378,0 | 0,0 | 41,04 | 200 | 0,92 | 0,47 | 0,04 | 0,68 | 0,38 | 2,49 | 38,56 |
| 81 | 29,7640 | 51,0 | 377,8 | 377,0 | 0,0 | 40,70 | 200 | 0,56 | 0,29 | 0,03 | 0,42 | 0,00 | 1,30 | 39,40 |
| 82 | 25,8153 | 45,0 | 369,9 | 375,7 | 5,8 | 48,21 | 150 | 1,29 | 0,76 | 0,06 | 1,05 | 0,00 | 3,16 | 39,25 |
| 83 | 13,4150 | 24,0 | 374,9 | 377,0 | 2,1 | 42,56 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 39,44 |
| 84 | 24,8690 | 43,0 | 367,9 | 373,0 | 5,1 | 45,62 | 150 | 1,18 | 0,69 | 0,06 | 0,96 | 0,37 | 3,26 | 37,26 |
| 85 | 37,2570 | 64,0 | 365,1 | 375,0 | 9,9 | 50,54 | 200 | 0,89 | 0,46 | 0,04 | 0,66 | 0,00 | 2,04 | 38,60 |
| 86 | 25,0526 | 43,0 | 364,5 | 375,2 | 10,7 | 51,11 | 150 | 1,18 | 0,69 | 0,06 | 0,96 | 0,37 | 3,26 | 37,15 |
| 87 | 9,5741 | 18,0 | 360,8 | 361,8 | 1,0 | 46,40 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 42,79 |
| 88 | 11,3054 | 20,0 | 354,6 | 364,4 | 9,8 | 55,08 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 41,49 |
| 89 | 13,3377 | 24,0 | 363,0 | 368,7 | 5,7 | 53,49 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 46,78 |
| 90 | 22,1144 | 38,0 | 365,0 | 369,0 | 4,0 | 50,77 | 150 | 0,91 | 0,54 | 0,04 | 0,75 | 0,29 | 2,54 | 44,23 |
| 91 | 9,0752 | 18,0 | 364,0 | 372,2 | 8,2 | 49,02 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 37,75 |

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92 | 3,4302 | 15,0 | 363,8 | 373,0 | 9,2 | 48,95 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 37,61 |
| 93 | 5,1325 | 15,0 | 362,0 | 367,0 | 5,0 | 46,88 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 39,74 |
| 94 | 4,6577 | 15,0 | 359,3 | 362,5 | 3,2 | 49,86 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 44,53 |
| 95 | 3,7206 | 15,0 | 363,0 | 366,0 | 3,0 | 44,52 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 39,38 |
| 100 | 18,5170 | 32,0 | 369,0 | 378,0 | 9,0 | 50,38 | 150 | 0,64 | 0,39 | 0,03 | 0,53 | 0,00 | 1,59 | 39,79 |
| 101 | 11,4340 | 21,0 | 372,0 | 377,0 | 5,0 | 46,46 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 37,28 |
| 102 | 21,4740 | 37,0 | 363,0 | 368,9 | 5,9 | 54,69 | 150 | 0,87 | 0,51 | 0,04 | 0,71 | 0,28 | 2,41 | 46,38 |
| 103 | 12,2518 | 22,0 | 367,0 | 377,0 | 10,0 | 50,37 | 150 | 0,30 | 0,19 | 0,02 | 0,25 | 0,10 | 0,85 | 39,52 |
| 104 | 12,9878 | 23,0 | 362,0 | 381,0 | 19,0 | 53,01 | 150 | 0,33 | 0,20 | 0,02 | 0,27 | 0,11 | 0,93 | 33,08 |
| 105 | 4,2768 | 15,0 | 384,3 | 385,0 | 0,7 | 31,24 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,00 | 1,81 | 28,73 |
| 106 | 10,8320 | 19,0 | 363,8 | 376,0 | 12,2 | 52,51 | 100 | 1,06 | 0,77 | 0,06 | 1,01 | 0,00 | 2,90 | 37,40 |
| 107 | 9,2981 | 22,0 | 361,7 | 364,1 | 2,4 | 52,59 | 150 | 0,30 | 0,19 | 0,02 | 0,25 | 0,10 | 0,85 | 49,34 |
| 108 | 8,9983 | 18,0 | 355,6 | 361,2 | 5,6 | 57,78 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 49,57 |
| 109 | 9,6854 | 18,0 | 354,8 | 358,0 | 3,2 | 58,22 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 51,95 |
| 110 | 6,7648 | 18,0 | 358,0 | 364,9 | 6,9 | 59,63 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 50,12 |
| 111 | 14,9080 | 27,0 | 354,0 | 356,2 | 2,2 | 62,17 | 150 | 0,46 | 0,28 | 0,02 | 0,38 | 0,15 | 1,28 | 58,69 |
| 112 | 7,5571 | 18,0 | 353,3 | 358,0 | 4,7 | 54,56 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 46,78 |
| 113 | 6,5084 | 18,0 | 350,0 | 353,0 | 3,0 | 62,33 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 56,26 |
| 114 | 9,8699 | 18,0 | 352,1 | 356,0 | 3,9 | 59,29 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 52,31 |
| 115 | 9,0456 | 18,0 | 355,0 | 363,0 | 8,0 | 54,76 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 44,15 |
| 116 | 3,1925 | 15,0 | 359,0 | 362,0 | 3,0 | 50,54 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 45,40 |
| 117 | 8,5843 | 18,0 | 361,5 | 362,8 | 1,3 | 47,37 | 80 | 2,50 | 1,80 | 0,12 | 3,18 | 1,05 | 8,65 | 37,42 |
| 118 | 3,0823 | 15,0 | 356,2 | 359,0 | 2,8 | 48,57 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 43,63 |
| 119 | 2,4976 | 15,0 | 356,0 | 356,8 | 0,8 | 46,16 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 43,22 |
| 120 | 11,4178 | 20,0 | 352,0 | 352,0 | 0,0 | 58,47 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 54,68 |
| 121 | 17,3976 | 30,0 | 344,0 | 347,1 | 3,1 | 57,83 | 150 | 0,56 | 0,34 | 0,03 | 0,47 | 0,18 | 1,58 | 53,15 |
| 122 | 8,7557 | 18,0 | 354,9 | 356,8 | 1,9 | 54,37 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 49,86 |
| 123 | 2,6836 | 15,0 | 355,5 | 357,0 | 1,5 | 50,55 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 46,91 |
| 124 | 7,7947 | 18,0 | 355,9 | 356,0 | 0,1 | 49,46 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 46,29 |
| 125 | 7,4889 | 18,0 | 353,6 | 355,1 | 1,5 | 49,18 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 44,61 |
| 126 | 6,1029 | 18,0 | 347,0 | 349,0 | 2,0 | 53,88 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 48,80 |
| 127 | 1,4620 | 15,0 | 354,0 | 355,0 | 1,0 | 51,26 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 48,12 |
| 128 | 2,3767 | 15,0 | 353,0 | 354,0 | 1,0 | 52,58 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 49,45 |
| 129 | 18,9047 | 33,0 | 347,8 | 355,0 | 7,2 | 55,79 | 150 | 0,69 | 0,41 | 0,03 | 0,56 | 0,22 | 1,92 | 46,67 |
| 130 | 6,6925 | 18,0 | 353,0 | 353,0 | 0,0 | 50,88 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 47,81 |
| 131 | 11,0194 | 20,0 | 352,9 | 353,0 | 0,1 | 49,37 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 45,48 |
| 132 | 25,5104 | 44,0 | 349,7 | 352,0 | 2,3 | 48,24 | 150 | 1,23 | 0,72 | 0,06 | 1,00 | 0,00 | 3,02 | 42,92 |
| 133 | 7,0911 | 18,0 | 352,0 | 352,0 | 0,0 | 49,21 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 46,60 |
| 134 | 8,6159 | 18,0 | 350,2 | 355,0 | 4,8 | 48,30 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 40,43 |
| 135 | 2,4285 | 15,0 | 340,0 | 348,7 | 8,7 | 57,77 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,00 | 1,81 | 47,26 |
| 136 | 11,7716 | 21,0 | 340,0 | 341,0 | 1,0 | 57,57 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 52,39 |

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 137 | 10,0773 | 18,0 | 348,0 | 348,7 | 0,7 | 47,36 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 43,58 |
| 138 | 10,9518 | 20,0 | 341,4 | 345,3 | 3,9 | 53,97 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 46,28 |
| 139 | 5,9359 | 15,0 | 334,0 | 335,3 | 1,3 | 56,41 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,00 | 1,81 | 53,30 |
| 140 | 10,8978 | 20,0 | 334,9 | 337,2 | 2,3 | 57,03 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 50,94 |
| 141 | 11,9446 | 21,0 | 351,0 | 353,9 | 2,9 | 60,15 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 53,07 |
| 142 | 8,7143 | 18,0 | 350,0 | 351,0 | 1,0 | 60,47 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 56,39 |
| 143 | 14,0415 | 25,0 | 345,5 | 352,0 | 6,5 | 62,56 | 150 | 0,39 | 0,24 | 0,02 | 0,32 | 0,13 | 1,10 | 54,96 |
| 144 | 14,0949 | 25,0 | 345,7 | 349,0 | 3,3 | 61,94 | 150 | 0,39 | 0,24 | 0,02 | 0,32 | 0,13 | 1,10 | 57,55 |
| 145 | 11,0763 | 20,0 | 341,0 | 345,0 | 4,0 | 64,01 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 56,22 |
| 146 | 3,6979 | 15,0 | 341,0 | 348,0 | 7,0 | 63,08 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 53,94 |
| 147 | 15,2609 | 27,0 | 338,0 | 342,0 | 4,0 | 62,28 | 150 | 0,46 | 0,28 | 0,02 | 0,38 | 0,15 | 1,28 | 57,00 |
| 150 | 17,9247 | 31,0 | 348,6 | 352,0 | 3,4 | 62,63 | 150 | 0,60 | 0,36 | 0,03 | 0,50 | 0,19 | 1,69 | 57,54 |
| 151 | 9,7691 | 18,0 | 350,0 | 355,0 | 5,0 | 60,48 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 52,87 |
| 152 | 26,2503 | 45,0 | 366,2 | 388,0 | 21,8 | 39,70 | 150 | 1,29 | 0,76 | 0,06 | 1,05 | 0,41 | 3,57 | 14,33 |
| 153 | 10,0509 | 18,0 | 364,8 | 364,0 | 0,0 | 40,32 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 37,25 |
| 154 | 4,7786 | 15,0 | 354,1 | 355,0 | 0,9 | 50,65 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 47,61 |
| 155 | 11,9097 | 21,0 | 355,0 | 361,0 | 6,0 | 47,00 | 80 | 3,44 | 2,43 | 0,17 | 4,32 | 1,43 | 11,79 | 29,21 |
| 156 | 3,3904 | 15,0 | 346,0 | 347,1 | 1,1 | 59,75 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 56,51 |
| 157 | 6,1967 | 18,0 | 345,6 | 345,8 | 0,2 | 57,74 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 54,47 |
| 158 | 13,7013 | 24,0 | 344,0 | 344,0 | 0,0 | 57,79 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 56,78 |
| 159 | 6,0812 | 18,0 | 341,0 | 342,7 | 1,7 | 53,40 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 48,63 |
| 160 | 12,4067 | 22,0 | 343,0 | 343,3 | 0,3 | 55,11 | 150 | 0,30 | 0,19 | 0,02 | 0,25 | 0,00 | 0,75 | 54,06 |
| 161 | 9,4315 | 18,0 | 347,0 | 348,0 | 1,0 | 60,50 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 56,42 |
| 162 | 11,5912 | 21,0 | 345,1 | 347,0 | 1,9 | 60,78 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,00 | 3,54 | 55,34 |
| 163 | 9,5215 | 18,0 | 345,0 | 362,0 | 17,0 | 59,92 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 39,85 |
| 164 | 19,6958 | 34,0 | 344,0 | 345,0 | 1,0 | 57,34 | 150 | 0,73 | 0,44 | 0,04 | 0,60 | 0,00 | 1,80 | 54,54 |
| 165 | 9,4579 | 18,0 | 347,0 | 347,0 | 0,0 | 60,94 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 57,87 |
| 166 | 9,4861 | 18,0 | 344,6 | 345,0 | 0,4 | 54,71 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 51,24 |
| 167 | 5,9777 | 15,0 | 344,0 | 344,0 | 0,0 | 51,38 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 49,24 |
| 169 | 9,7698 | 18,0 | 343,0 | 343,9 | 0,9 | 51,24 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 47,26 |
| 170 | 6,5279 | 18,0 | 343,5 | 344,0 | 0,5 | 50,58 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 47,01 |
| 171 | 7,9637 | 18,0 | 350,2 | 351,2 | 1,0 | 61,83 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 58,22 |
| 172 | 11,2569 | 20,0 | 345,6 | 348,1 | 2,5 | 62,65 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 56,36 |
| 173 | 7,6499 | 18,0 | 345,0 | 345,7 | 0,7 | 61,97 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 58,19 |
| 174 | 5,2981 | 15,0 | 345,0 | 346,0 | 1,0 | 60,69 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 57,55 |
| 175 | 3,8930 | 15,0 | 342,5 | 343,0 | 0,5 | 58,94 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 56,30 |
| 176 | 6,1156 | 18,0 | 341,8 | 342,0 | 0,2 | 58,31 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 55,50 |
| 177 | 11,4225 | 20,0 | 343,0 | 352,0 | 9,0 | 57,87 | 100 | 1,18 | 0,85 | 0,06 | 1,12 | 0,58 | 3,79 | 45,08 |
| 178 | 7,5678 | 18,0 | 339,5 | 342,0 | 2,5 | 54,37 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 48,79 |
| 179 | 5,0314 | 15,0 | 346,0 | 346,8 | 0,8 | 58,67 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 55,73 |
| 180 | 10,2861 | 19,0 | 345,4 | 352,0 | 6,6 | 56,80 | 100 | 1,06 | 0,77 | 0,06 | 1,01 | 0,52 | 3,42 | 46,77 |

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 181 | 5,6940 | 15,0 | 343,0 | 350,0 | 7,0 | 48,70 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 39,56 |
| 182 | 1,9848 | 15,0 | 341,6 | 342,0 | 0,4 | 47,40 | 80 | 1,72 | 1,27 | 0,09 | 2,20 | 0,73 | 6,00 | 41,00 |

**Tabla 2.-** Presiones disponibles en los hidrantes de la red del Piso 2

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 6,336 | 18,0 | 382,2 | 384,0 | 1,8 | 55,36 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 50,49 |
| 202 | 5,5832 | 15,0 | 382,8 | 387,0 | 4,2 | 56,07 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 49,74 |
| 203 | 2,9144 | 15,0 | 387,8 | 393,2 | 5,4 | 50,36 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 42,82 |
| 204 | 8,6905 | 18,0 | 386,8 | 391,7 | 4,9 | 51,41 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 43,91 |
| 205 | 2,4463 | 15,0 | 386,3 | 388,6 | 2,3 | 50,74 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 46,30 |
| 206 | 1,5806 | 15,0 | 384,0 | 390,0 | 6,0 | 53,51 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 45,37 |
| 207 | 1,8563 | 15,0 | 389,0 | 393,0 | 4,0 | 47,91 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 41,78 |
| 208 | 23,685 | 41,0 | 392,7 | 394,0 | 1,3 | 42,76 | 150 | 1,07 | 0,63 | 0,05 | 0,87 | 0,00 | 2,62 | 38,84 |
| 209 | 11,7365 | 21,0 | 385,2 | 389,0 | 3,8 | 50,11 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 42,14 |
| 210 | 7,2307 | 18,0 | 379,8 | 382,0 | 2,2 | 54,21 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 48,97 |
| 211 | 7,4112 | 18,0 | 375,9 | 382,0 | 6,1 | 57,08 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 47,91 |
| 212 | 16,761 | 29,0 | 382,1 | 390,0 | 7,9 | 49,95 | 150 | 0,53 | 0,32 | 0,03 | 0,44 | 0,17 | 1,48 | 40,57 |
| 213 | 7,8902 | 18,0 | 389,2 | 390,0 | 0,8 | 42,72 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 38,85 |
| 214 | 32,401 | 56,0 | 386,0 | 390,0 | 4,0 | 45,95 | 200 | 0,68 | 0,35 | 0,03 | 0,50 | 0,00 | 1,56 | 40,38 |
| 215 | 33,8796 | 58,0 | 377,5 | 385,0 | 7,5 | 56,07 | 200 | 0,73 | 0,38 | 0,03 | 0,54 | 0,00 | 1,68 | 46,89 |
| 216 | 38,1955 | 66,0 | 368,1 | 390,0 | 21,9 | 62,79 | 200 | 0,94 | 0,49 | 0,04 | 0,70 | 0,00 | 2,17 | 38,72 |
| 217 | 5,2239 | 15,0 | 376,8 | 377,9 | 1,1 | 56,39 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 53,15 |
| 218 | 11,6127 | 21,0 | 376,2 | 384,0 | 7,8 | 56,78 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,00 | 3,54 | 45,44 |
| 219 | 4,4747 | 15,0 | 383,5 | 388,0 | 4,5 | 45,85 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 39,21 |
| 220 | 13,3642 | 24,0 | 377,8 | 384,7 | 6,9 | 50,29 | 150 | 0,36 | 0,22 | 0,02 | 0,30 | 0,12 | 1,01 | 42,38 |
| 221 | 3,9831 | 15,0 | 383,0 | 392,0 | 9,0 | 55,74 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 44,60 |
| 222 | 24,1372 | 42,0 | 382,0 | 387,7 | 5,7 | 54,65 | 150 | 1,12 | 0,66 | 0,05 | 0,91 | 0,36 | 3,11 | 45,84 |
| 223 | 5,7233 | 15,0 | 386,0 | 386,6 | 0,6 | 47,48 | 100 | 0,66 | 0,49 | 0,04 | 0,63 | 0,32 | 2,14 | 44,74 |
| 224 | 14,2432 | 25,0 | 381,9 | 384,0 | 2,1 | 50,40 | 150 | 0,39 | 0,24 | 0,02 | 0,32 | 0,13 | 1,10 | 47,21 |
| 225 | 6,9973 | 18,0 | 383,4 | 384,0 | 0,6 | 47,75 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 44,08 |
| 226 | 6,6922 | 18,0 | 380,0 | 391,0 | 11,0 | 46,71 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 32,64 |
| 226 | 6,976 | 18,0 | 380,0 | 391,0 | 5,5 | 46,71 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,47 | 3,07 | 38,14 |
| 227 | 11,768 | 21,0 | 391,0 | 394,0 | 3,0 | 43,06 | 100 | 1,30 | 0,94 | 0,07 | 1,24 | 0,64 | 4,18 | 35,89 |
| 228 | 9,8415 | 18,0 | 386,0 | 390,1 | 4,1 | 44,21 | 100 | 0,95 | 0,70 | 0,05 | 0,91 | 0,00 | 2,61 | 37,50 |

| Hidrante | Superficie (ha) | Dotacion (l/s) | Cota Hid (m) | Cota Max. (m) | Desnivel (m) | P Disp Antes Hid (mca) | DN Válv Hidráulica (mm) | Δh VH (mca) | Δh colector (mca) | Δh Valvula seccionamiento (mca) | Δh Filtro (mca) | Δh contador (mca) | Δh total hid (mca) | P min disp pto. Alto finca (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 229 | 16,446 | 29,0 | 381,0 | 388,0 | 7,0 | 47,68 | 150 | 0,53 | 0,32 | 0,03 | 0,44 | 0,17 | 1,48 | 39,20 |
| 230 | 24,48895 | 42,0 | 381,8 | 383,0 | 1,2 | 47,81 | 150 | 1,12 | 0,66 | 0,05 | 0,91 | 0,36 | 3,11 | 43,50 |

# 3 PÉRDIDAS DE CARGA EN HIDRANTES COMPARTIDOS

A continuación, se presenta una tabla con las características de cada toma. Se indica para cada una:

- Superficie (ha): Superficie considerada en la toma
- Caudal hid (l/s): dotación asignada en función de la superficie de riego
- DN Válv Hidráulica (mm): Diámetro de hidrante asignado
- Cota hid: cota del hidrante general
- P Disp Antes Hid (mca): Presión dinámica de cálculo a la llegada al hidrante
- Cota máxima de la finca (para cada toma)
- Desnivel (m): existente desde el hidrante hasta el punto más alto de la finca
- Long terciaria: longitud de la tubería terciaria hasta la toma de parcela
- Caudal Toma (l/s): caudal de la toma según superficie
- DN Toma (mm): Diámetro de toma asignado
- DN Terciaria (mm): Diámetro de tubería terciaria asignada
- PC terciaria (mca): pérdida de carga originada por la tubería terciaria
- PC (mca): Pérdida de carga total (terciaria + toma)
- P min disp pto alto finca (mca): Presión mínima disponible en el punto más alto de la finca (descontadas las pérdidas del hidrante, las de la toma y las de la terciaria)

**Tabla 3.-** Presiones disponibles en tomas de hidrantes compartidos de la red del Piso 1

| Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Cota hid | P disp tras hid | Cota max finca | Desnivel | Long terciaria | Caudal toma (l/s) | DN toma (mm) | DN Terciaria (mm) | PC terciaria (mca) | PC TOTAL | P disp min parcela (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 7535 | 15 | 100 | 379,0 | 41,50 | 383,0 | 4,0 | 270 | 15 | 80 | 125 | 5,15 | 5,75 | 31,75 |
| 1 | 2 | 4003 | 15 | 100 | 379,0 | 41,50 | 383,0 | 4,0 | 370 | 10 | 80 | 110 | 6,27 | 6,55 | 30,95 |
| 1 | 3 | 33361 | 15 | 100 | 379,0 | 41,50 | 383,0 | 4,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 36,43 |
| 1 | 4 | 9560 | 15 | 100 | 379,0 | 41,50 | 383,0 | 4,0 | 40 | 15 | 80 | 90 | 3,81 | 4,41 | 33,09 |
| 1 | 5 | 3008 | 15 | 100 | 379,0 | 41,50 | 383,0 | 4,0 | 85 | 10 | 80 | 90 | 3,83 | 4,11 | 33,39 |
| 2 | 1 | 8.510 | 15 | 80 | 379,0 | 37,9 | 380,0 | 1,0 | 140 | 15 | 80 | 110 | 5,02 | 5,62 | 31,32 |
| 2 | 2 | 17.485 | 15 | 80 | 379,0 | 37,9 | 380,0 | 1,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 35,86 |
| 2 | 3 | 5.624 | 15 | 80 | 379,0 | 37,9 | 380,0 | 1,0 | 25 | 15 | 80 | 90 | 2,38 | 2,98 | 33,96 |
| 2 | 4 | 1.404 | 15 | 80 | 379,0 | 37,9 | 380,0 | 1,0 | 30 | 5 | 50 | 75 | 0,91 | 1,56 | 35,38 |
| 5 | 1 | 26.607 | 24 | 150 | 376,4 | 45,1 | 378,0 | 1,6 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 42,39 |
| 5 | 2 | 110.318 | 24 | 150 | 376,4 | 45,1 | 378,0 | 1,6 | 110 | 18 | 100 | 110 | 5,53 | 5,87 | 37,59 |
| 6 | 1 | 2108 | 15 | 100 | 379,7 | 39,01 | 380,0 | 0,3 | 140 | 5 | 50 | 75 | 4,25 | 4,89 | 33,81 |
| 6 | 2 | 852 | 15 | 100 | 379,7 | 39,01 | 380,0 | 0,3 | 120 | 5 | 50 | 75 | 3,64 | 4,29 | 34,42 |
| 6 | 3 | 1344 | 15 | 100 | 379,7 | 39,01 | 380,0 | 0,3 | 30 | 5 | 50 | 75 | 0,91 | 1,56 | 37,15 |
| 6 | 4 | 23704 | 15 | 100 | 379,7 | 39,01 | 380,0 | 0,3 | 10 | 15 | 80 | 90 | 0,95 | 1,55 | 37,16 |
| 6 | 5 | 1075 | 15 | 100 | 379,7 | 39,01 | 380,0 | 0,3 | 125 | 5 | 50 | 75 | 3,79 | 4,44 | 34,27 |
| 6 | 6 | 13472 | 15 | 100 | 379,7 | 39,01 | 380,0 | 0,3 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 37,63 |
| 10 | 1 | 8515 | 15 | 100 | 381,0 | 37,96 | 382,0 | 1,0 | 275 | 15 | 80 | 125 | 5,24 | 5,84 | 31,12 |
| 10 | 2 | 6920 | 15 | 100 | 381,0 | 37,96 | 382,0 | 1,0 | 140 | 15 | 80 | 110 | 5,02 | 5,62 | 31,34 |
| 10 | 3 | 1840 | 15 | 100 | 381,0 | 37,96 | 382,0 | 1,0 | 30 | 5 | 50 | 75 | 0,91 | 1,56 | 35,41 |
| 10 | 4 | 1481 | 15 | 100 | 381,0 | 37,96 | 382,0 | 1,0 | 25 | 5 | 50 | 75 | 0,76 | 1,41 | 35,56 |
| 10 | 5 | 644 | 15 | 100 | 381,0 | 37,96 | 382,0 | 1,0 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 36,16 |
| 10 | 6 | 979 | 15 | 100 | 381,0 | 37,96 | 382,0 | 1,0 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 36,16 |
| 11 | 1 | 30918 | 15 | 100 | 371,0 | 46,43 | 378,3 | 7,3 | 115 | 15 | 80 | 110 | 4,12 | 4,72 | 34,41 |
| 11 | 2 | 19943 | 15 | 100 | 371,0 | 46,43 | 378,3 | 7,3 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 38,06 |
| 18 | 1 | 90.691 | 32 | 150 | 373,5 | 45,8 | 362,0 | 0,0 | 195 | 18 | 100 | 110 | 9,80 | 10,14 | 35,71 |
| 18 | 2 | 95.562 | 32 | 150 | 373,5 | 45,8 | 362,0 | 0,0 | 5 | 18 | 100 | 110 | 0,25 | 0,60 | 45,25 |
| 20 | 1 | 43623 | 18 | 100 | 366,0 | 48,93 | 356,0 | 0,0 | 5 | 18 | 100 | 110 | 0,25 | 0,60 | 48,33 |
| 20 | 2 | 27184 | 18 | 100 | 366,0 | 48,93 | 356,0 | 0,0 | 285 | 15 | 80 | 110 | 10,22 | 10,82 | 38,11 |
| 21 | 1 | 35180 | 18 | 100 | 367,2 | 47,26 | 374,3 | 7,1 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 39,09 |
| 21 | 2 | 36778 | 18 | 100 | 367,2 | 47,26 | 374,3 | 7,1 | 375 | 15 | 80 | 125 | 7,15 | 7,75 | 32,41 |
| 21 | 3 | 3759 | 18 | 100 | 367,2 | 47,26 | 374,3 | 7,1 | 490 | 10 | 80 | 110 | 8,30 | 8,58 | 31,58 |
| 29 | 1 | 19216 | 15 | 100 | 356,2 | 53,34 | 361,7 | 5,5 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 46,77 |
| 29 | 2 | 32431 | 15 | 100 | 356,2 | 53,34 | 361,7 | 5,5 | 315 | 15 | 80 | 110 | 11,29 | 11,89 | 35,95 |
| 31 | 1 | 11501 | 15 | 100 | 364,0 | 52,71 | 364,2 | 0,2 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 51,44 |
| 31 | 2 | 16974 | 15 | 100 | 364,0 | 52,71 | 364,2 | 0,2 | 625 | 15 | 80 | 125 | 11,92 | 12,52 | 39,99 |
| 33 | 1 | 9194 | 15 | 100 | 360,0 | 51,35 | 363,0 | 3,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 47,28 |
| 33 | 2 | 38098 | 15 | 100 | 360,0 | 51,35 | 363,0 | 3,0 | 280 | 15 | 80 | 110 | 10,04 | 10,64 | 37,71 |
| 36 | 1 | 41201 | 18 | 100 | 355,0 | 42,66 | 355,9 | 0,9 | 15 | 18 | 100 | 110 | 0,75 | 1,10 | 40,66 |

| Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Cota hid | P disp tras hid | Cota max finca | Desnivel | Long terciaria | Caudal toma (l/s) | DN toma (mm) | DN Terciaria (mm) | PC terciaria (mca) | PC TOTAL | P disp min parcela (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 2 | 19793 | 18 | 100 | 355,0 | 42,66 | 355,9 | 0,9 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 40,68 |
| 40 | 1 | 54903 | 18 | 100 | 356,0 | 51,79 | 357,0 | 1,0 | 5 | 18 | 100 | 110 | 0,25 | 0,60 | 50,19 |
| 40 | 2 | 18248 | 18 | 100 | 356,0 | 51,79 | 357,0 | 1,0 | 60 | 15 | 80 | 90 | 5,72 | 6,32 | 44,47 |
| 44 | 1 | 11916 | 15 | 100 | 349,0 | 54,88 | 351,8 | 2,8 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 51,00 |
| 44 | 2 | 8737 | 15 | 100 | 349,0 | 54,88 | 351,8 | 2,8 | 245 | 15 | 80 | 110 | 8,78 | 9,38 | 42,69 |
| 46 | 1 | 14720 | 18 | 100 | 353,0 | 53,50 | 355,0 | 2,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 50,42 |
| 46 | 2 | 61701 | 18 | 100 | 353,0 | 53,50 | 355,0 | 2,0 | 300 | 18 | 100 | 110 | 15,07 | 15,42 | 36,08 |
| 92 | 1 | 6046 | 15 | 100 | 363,8 | 46,81 | 373,0 | 9,2 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 36,54 |
| 92 | 2 | 18972 | 15 | 100 | 363,8 | 46,81 | 373,0 | 9,2 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 36,54 |
| 92 | 3 | 9284 | 15 | 100 | 363,8 | 46,81 | 373,0 | 9,2 | 190 | 15 | 80 | 110 | 6,81 | 7,41 | 30,20 |
| 93 | 1 | 22203 | 15 | 100 | 362,0 | 44,74 | 367,0 | 5,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 38,67 |
| 93 | 2 | 29122 | 15 | 100 | 362,0 | 44,74 | 367,0 | 5,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 38,67 |
| 94 | 1 | 17034 | 15 | 100 | 359,3 | 47,73 | 362,5 | 3,2 | 25 | 15 | 80 | 90 | 2,38 | 2,98 | 41,54 |
| 94 | 2 | 7573 | 15 | 100 | 359,3 | 47,73 | 362,5 | 3,2 | 30 | 15 | 80 | 90 | 2,86 | 3,46 | 41,07 |
| 94 | 3 | 4325 | 15 | 100 | 359,3 | 47,73 | 362,5 | 3,2 | 5 | 10 | 80 | 90 | 0,23 | 0,51 | 44,01 |
| 94 | 4 | 5395 | 15 | 100 | 359,3 | 47,73 | 362,5 | 3,2 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 43,45 |
| 94 | 5 | 12250 | 15 | 100 | 359,3 | 47,73 | 362,5 | 3,2 | 35 | 15 | 80 | 90 | 3,33 | 3,93 | 40,59 |
| 95 | 1 | 6117 | 15 | 100 | 363,0 | 42,38 | 366,0 | 3,0 | 95 | 15 | 80 | 110 | 3,41 | 4,00 | 35,38 |
| 95 | 2 | 9004 | 15 | 100 | 363,0 | 42,38 | 366,0 | 3,0 | 90 | 15 | 80 | 90 | 8,57 | 9,17 | 30,21 |
| 95 | 3 | 14561 | 15 | 100 | 363,0 | 42,38 | 366,0 | 3,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 38,31 |
| 95 | 4 | 7524 | 15 | 100 | 363,0 | 42,38 | 366,0 | 3,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 38,31 |
| 107 | 1 | 88.634 | 22 | 150 | 361,7 | 51,7 | 364,1 | 2,4 | 5 | 18 | 100 | 110 | 0,25 | 0,60 | 48,74 |
| 107 | 2 | 4.347 | 22 | 150 | 361,7 | 51,7 | 364,1 | 2,4 | 140 | 10 | 80 | 90 | 6,30 | 6,59 | 42,75 |
| 112 | 1 | 62712 | 18 | 100 | 353,3 | 51,48 | 358,0 | 4,7 | 5 | 18 | 100 | 110 | 0,25 | 0,60 | 46,19 |
| 112 | 2 | 12859 | 18 | 100 | 353,3 | 51,48 | 358,0 | 4,7 | 400 | 15 | 80 | 110 | 14,34 | 14,94 | 31,84 |
| 118 | 1 | 2160 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 85 | 5 | 50 | 75 | 2,58 | 3,23 | 40,41 |
| 118 | 2 | 2265 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 42,83 |
| 118 | 3 | 15760 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 70 | 15 | 80 | 90 | 6,67 | 7,27 | 36,36 |
| 118 | 4 | 2145 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 95 | 5 | 50 | 75 | 2,88 | 3,53 | 40,10 |
| 118 | 5 | 2745 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 35 | 5 | 50 | 75 | 1,06 | 1,71 | 41,92 |
| 118 | 6 | 2143 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 45 | 5 | 50 | 75 | 1,37 | 2,01 | 41,62 |
| 118 | 7 | 1670 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 50 | 5 | 50 | 75 | 1,52 | 2,16 | 41,47 |
| 118 | 8 | 1935 | 15 | 100 | 356,2 | 46,43 | 359,0 | 2,8 | 100 | 5 | 50 | 75 | 3,03 | 3,68 | 39,95 |
| 119 | 1 | 4248 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 55 | 10 | 80 | 90 | 2,48 | 2,76 | 40,46 |
| 119 | 2 | 2307 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 45 | 5 | 50 | 75 | 1,37 | 2,01 | 41,21 |
| 119 | 3 | 2158 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 42,42 |
| 119 | 4 | 4064 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 5 | 10 | 80 | 90 | 0,23 | 0,51 | 42,71 |
| 119 | 5 | 4084 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 45 | 10 | 80 | 90 | 2,03 | 2,31 | 40,91 |
| 119 | 6 | 5601 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 130 | 15 | 80 | 90 | 12,39 | 12,98 | 30,24 |
| 119 | 7 | 2514 | 15 | 100 | 356,0 | 44,02 | 356,8 | 0,8 | 175 | 5 | 50 | 75 | 5,31 | 5,96 | 37,27 |
| 123 | 1 | 3376 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 130 | 10 | 80 | 90 | 5,85 | 6,14 | 40,77 |

| Hidrante | Toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Cota hid | P disp tras hid | Cota max finca | Desnivel | Long terciaria | Caudal toma (l/s) | DN toma (mm) | DN Terciaria (mm) | PC terciaria (mca) | PC TOTAL | P disp min parcela (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 123 | 2 | 6941 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 110 | 15 | 80 | 90 | 10,48 | 11,08 | 35,83 |
| 123 | 3 | 5344 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 275 | 15 | 80 | 110 | 9,86 | 10,46 | 36,45 |
| 123 | 4 | 2044 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 135 | 5 | 50 | 75 | 4,10 | 4,74 | 42,17 |
| 123 | 5 | 2091 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 115 | 5 | 50 | 75 | 3,49 | 4,14 | 42,77 |
| 123 | 6 | 1952 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 85 | 5 | 50 | 75 | 2,58 | 3,23 | 43,68 |
| 123 | 7 | 2324 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 55 | 5 | 50 | 75 | 1,67 | 2,32 | 44,59 |
| 123 | 8 | 2764 | 15 | 100 | 355,5 | 48,41 | 357,0 | 1,5 | 10 | 10 | 80 | 90 | 0,45 | 0,74 | 46,17 |
| 125 | 1 | 24896 | 18 | 100 | 353,6 | 46,11 | 355,1 | 1,5 | 20 | 15 | 80 | 90 | 1,91 | 2,50 | 42,10 |
| 125 | 2 | 49993 | 18 | 100 | 353,6 | 46,11 | 355,1 | 1,5 | 5 | 18 | 100 | 110 | 0,25 | 0,60 | 44,01 |
| 126 | 1 | 31618 | 18 | 100 | 347,0 | 50,80 | 349,0 | 2,0 | 130 | 18 | 100 | 110 | 6,53 | 6,88 | 41,93 |
| 126 | 2 | 23012 | 18 | 100 | 347,0 | 50,80 | 349,0 | 2,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 47,73 |
| 126 | 3 | 6399 | 18 | 100 | 347,0 | 50,80 | 349,0 | 2,0 | 20 | 15 | 80 | 90 | 1,91 | 2,50 | 46,30 |
| 127 | 1 | 1341 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 115 | 5 | 50 | 75 | 3,49 | 4,14 | 43,98 |
| 127 | 2 | 2356 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 80 | 5 | 50 | 75 | 2,43 | 3,07 | 45,04 |
| 127 | 3 | 1889 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 55 | 5 | 50 | 75 | 1,67 | 2,32 | 45,80 |
| 127 | 4 | 1509 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 30 | 5 | 50 | 75 | 0,91 | 1,56 | 46,56 |
| 127 | 5 | 1965 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 47,32 |
| 127 | 6 | 2018 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 47,32 |
| 127 | 7 | 1862 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 40 | 5 | 50 | 75 | 1,21 | 1,86 | 46,26 |
| 127 | 8 | 1680 | 15 | 100 | 354,0 | 49,12 | 355,0 | 1,0 | 70 | 5 | 50 | 75 | 2,12 | 2,77 | 45,35 |
| 128 | 1 | 2400 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 30 | 5 | 50 | 75 | 0,91 | 1,56 | 47,89 |
| 128 | 2 | 2556 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 48,65 |
| 128 | 3 | 4202 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 40 | 10 | 80 | 90 | 1,80 | 2,09 | 47,36 |
| 128 | 4 | 1500 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 60 | 5 | 50 | 75 | 1,82 | 2,47 | 46,98 |
| 128 | 5 | 2600 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 80 | 5 | 50 | 75 | 2,43 | 3,07 | 46,37 |
| 128 | 6 | 1330 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 110 | 5 | 50 | 75 | 3,34 | 3,98 | 45,46 |
| 128 | 7 | 2225 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 145 | 5 | 50 | 75 | 4,40 | 5,05 | 44,40 |
| 128 | 8 | 2153 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 175 | 5 | 50 | 75 | 5,31 | 5,96 | 43,49 |
| 128 | 9 | 4801 | 15 | 100 | 353,0 | 50,45 | 354,0 | 1,0 | 45 | 10 | 80 | 90 | 2,03 | 2,31 | 47,13 |
| 146 | 1 | 36979 | 15 | 100 | 341,0 | 60,94 | 348,0 | 7,0 | 5 | 15 | 80 | 90 | 0,00 | 0,60 | 53,35 |
| 159 | 1 | 21303 | 18 | 100 | 341,0 | 50,33 | 342,7 | 1,7 | 410 | 15 | 80 | 110 | 14,70 | 15,30 | 33,33 |
| 159 | 2 | 14228 | 18 | 100 | 341,0 | 50,33 | 342,7 | 1,7 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 47,55 |
| 159 | 3 | 25281 | 18 | 100 | 341,0 | 50,33 | 342,7 | 1,7 | 15 | 15 | 80 | 90 | 1,43 | 2,03 | 46,60 |
| 179 | 1 | 32813 | 15 | 100 | 346,0 | 56,53 | 346,8 | 0,8 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 54,66 |
| 179 | 2 | 17501 | 15 | 100 | 346,0 | 56,53 | 346,8 | 0,8 | 90 | 15 | 80 | 90 | 8,57 | 9,17 | 46,56 |

**Tabla 4.-** Presiones disponibles en tomas de hidrantes compartidos de la red del Piso 2

| HIDRANTE | Nº toma | Sup. Toma (m2) | Caudal hid (l/s) | DN VH (mm) | Cota hid | P disp antes hid | Cota max finca | Desnivel | long terciaria | Caudal toma (l/s) | DN Toma(mm) | DN Terciaria (mm) | PC Terciaria (mca) | PC TOTAL (mca) | P disp min parcela (mca) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 1 | 45644 | 18 | 100 | 382,2 | 55,36 | 384,0 | 1,8 | 30 | 15 | 80 | 90 | 2,86 | 3,46 | 47,03 |
| 201 | 2 | 17716 | 18 | 100 | 382,2 | 55,36 | 384,0 | 1,8 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 49,41 |
| 203 | 1 | 1258 | 15 | 100 | 387,8 | 50,36 | 393,2 | 5,4 | 130 | 5 | 50 | 75 | 3,94 | 4,59 | 38,23 |
| 203 | 2 | 11700 | 15 | 100 | 387,8 | 50,36 | 383,0 | 0,0 | 180 | 15 | 80 | 90 | 17,15 | 17,75 | 30,47 |
| 203 | 3 | 14669 | 15 | 100 | 387,8 | 50,36 | 381,0 | 0,0 | 180 | 15 | 80 | 90 | 17,15 | 17,75 | 30,47 |
| 203 | 4 | 1517 | 15 | 100 | 387,8 | 50,36 | 393,2 | 5,4 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 42,02 |
| 205 | 1 | 21306 | 15 | 100 | 386,3 | 50,74 | 383,0 | 0,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 47,53 |
| 205 | 2 | 1464 | 15 | 100 | 386,3 | 50,74 | 388,6 | 2,3 | 10 | 5 | 50 | 75 | 0,30 | 0,95 | 45,35 |
| 205 | 3 | 1693 | 15 | 100 | 386,3 | 50,74 | 383,0 | 0,0 | 10 | 5 | 50 | 75 | 0,30 | 0,95 | 47,65 |
| 206 | 1 | 8978 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 125 | 15 | 80 | 90 | 11,91 | 12,51 | 32,86 |
| 206 | 2 | 1300 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 5 | 5 | 50 | 75 | 0,15 | 0,80 | 44,57 |
| 206 | 3 | 1000 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 50 | 5 | 50 | 75 | 1,52 | 2,16 | 43,21 |
| 206 | 4 | 758 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 70 | 5 | 50 | 75 | 2,12 | 2,77 | 42,60 |
| 206 | 5 | 500 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 80 | 5 | 50 | 75 | 2,43 | 3,07 | 42,30 |
| 206 | 6 | 700 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 60 | 5 | 50 | 75 | 1,82 | 2,47 | 42,90 |
| 206 | 7 | 1220 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 20 | 5 | 50 | 75 | 0,61 | 1,25 | 44,12 |
| 206 | 8 | 1350 | 15 | 100 | 384,0 | 53,51 | 390,0 | 6,0 | 20 | 5 | 50 | 75 | 0,61 | 1,25 | 44,12 |
| 207 | 1 | 3819 | 15 | 100 | 389,0 | 47,91 | 383,0 | 0,0 | 190 | 10 | 80 | 90 | 8,55 | 8,84 | 36,94 |
| 207 | 2 | 14744 | 15 | 100 | 389,0 | 47,91 | 393,0 | 4,0 | 115 | 15 | 80 | 90 | 10,96 | 11,56 | 30,22 |
| 219 | 1 | 14302 | 15 | 100 | 383,5 | 45,85 | 388,0 | 4,5 | 260 | 15 | 80 | 110 | 9,32 | 9,92 | 29,29 |
| 219 | 2 | 30445 | 15 | 100 | 383,5 | 45,85 | 388,0 | 4,5 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 38,13 |
| 227 | 1 | 90756 | 21 | 100 | 391,0 | 43,06 | 394,0 | 3,0 | 135 | 18 | 100 | 125 | 3,61 | 3,95 | 31,93 |
| 227 | 2 | 20162 | 21 | 100 | 391,0 | 43,06 | 383,0 | 0,0 | 5 | 15 | 80 | 90 | 0,48 | 1,07 | 37,81 |

# APÉNDICE 3.- CÁLCULOS MECÁNICOS

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC140_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 140 mm
Espesor: e=6.7 mm
Diámetro interior: di= 126.6 mm
Radio medio: Rm= 66.65 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.08 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=16,07414 kN/m2
Debida a sobrecargas concentradas: Pvc=31,9105 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=47,98464 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=9,52226 kN/m2

### 2.3. Deformación Relativa: dv=1,33868 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,05054 kN m/m
En Riñones: M (Riñones)=-0,04327 kN m/m
En Base: M (Base)=0,05949kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=61,27571 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,17442 kN/mm2
En Riñones: 3,19111 kN/mm2
En Base: 17,36367 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,0913 --ADMISIBLE: cumple >2.5
En Riñones: 15,66853 --ADMISIBLE: cumple >2.5
En Base: 2,87958 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 26,70908 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1372,01519 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,19906 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC125_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 125 mm
Espesor: e=6.0 mm
Diámetro interior: di= 113 mm
Radio medio: Rm= 59.5 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.69 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=14,22145 kN/m2
Debida a sobrecargas concentradas: Pvc=31,93049 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=46,15194 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=8,08512 kN/m2

### 2.3. Deformación Relativa: dv=1,39337 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,04007 kN m/m
En Riñones: M (Riñones)=-0,03434 kN m/m
En Base: M (Base)=0,04691kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=54,78963 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,07999 kN/mm2
En Riñones: 3,24003 kN/mm2
En Base: 17,21244 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,10945 --ADMISIBLE: cumple >2.5
En Riñones: 15,43195 --ADMISIBLE: cumple >2.5
En Base: 2,90488 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 26,01323 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1480,27032 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 25,56398 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC125_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 125 mm
Espesor: e=6.0 mm
Diámetro interior: di= 113 mm
Radio medio: Rm= 59.5 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.69 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=25,74851 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01453 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=33,76304 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=14,55306 kN/m2

### 2.3. Deformación Relativa: dv=0,89575 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,02136 kN m/m
En Riñones: M (Riñones)=-0,01479 kN m/m
En Base: M (Base)=0,02645kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=54,43549 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,78513 kN/mm2
En Riñones: 6,51099 kN/mm2
En Base: 13,62837 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,91079 --ADMISIBLE: cumple >2.5
En Riñones: 7,67932 --ADMISIBLE: cumple >2.5
En Base: 3,66882 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 35,55844 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1480,27032 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 34,7243 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC140_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 140 mm
Espesor: e=6.7 mm
Diámetro interior: di= 126.6 mm
Radio medio: Rm= 66.65 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.7 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=14,36275 kN/m2
Debida a sobrecargas concentradas: Pvc=31,9105 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=46,27325 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=8,33163 kN/m2

### 2.3. Deformación Relativa: dv=1,38549 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,05029 kN m/m
En Riñones: M (Riñones)=-0,04312 kN m/m
En Base: M (Base)=0,05893kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=61,37962 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,15247 kN/mm2
En Riñones: 3,22794 kN/mm2
En Base: 17,30152 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,0955 --ADMISIBLE: cumple >2.5
En Riñones: 15,48977 --ADMISIBLE: cumple >2.5
En Base: 2,88992 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 26,18101 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1324,79111 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 25,67364 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC140_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 140 mm
Espesor: e=6.7 mm
Diámetro interior: di= 126.6 mm
Radio medio: Rm= 66.65 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.7 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=26,0719 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01391 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=34,08581 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=15,03054 kN/m2

### 2.3. Deformación Relativa: dv=0,89752 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,02684 kN m/m
En Riñones: M (Riñones)=-0,0186 kN m/m
En Base: M (Base)=0,03331kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=60,97128 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,83946 kN/mm2
En Riñones: 6,51711 kN/mm2
En Base: 13,7022 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,89425 --ADMISIBLE: cumple >2.5
En Riñones: 7,67211 --ADMISIBLE: cumple >2.5
En Base: 3,64905 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 35,54207 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1324,79111 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 34,61344 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC160_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 160 mm
Espesor: e=7.7 mm
Diámetro interior: di= 144.6 mm
Radio medio: Rm= 76.15 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=14,66431 kN/m2
Debida a sobrecargas concentradas: Pvc=31,88047 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=46,54478 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=8,60935 kN/m2

### 2.3. Deformación Relativa: dv=1,36015 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,06597 kN m/m
En Riñones: M (Riñones)=-0,05649 kN m/m
En Base: M (Base)=0,07739kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=70,10138 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,0495 kN/mm2
En Riñones: 3,21714 kN/mm2
En Base: 17,20024 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,11536 --ADMISIBLE: cumple >2.5
En Riñones: 15,54175 --ADMISIBLE: cumple >2.5
En Base: 2,90694 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 26,67891 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1185,06683 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,09152 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC160_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 160 mm
Espesor: e=7.7 mm
Diámetro interior: di= 144.6 mm
Radio medio: Rm= 76.15 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=26,79384 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01307 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=34,80692 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=15,6324 kN/m2

### 2.3. Deformación Relativa: dv=0,89637 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,03565 kN m/m
En Riñones: M (Riñones)=-0,02474 kN m/m
En Base: M (Base)=0,04435kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=69,61448 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,80246 kN/mm2
En Riñones: 6,4387 kN/mm2
En Base: 13,6807 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,9055 --ADMISIBLE: cumple >2.5
En Riñones: 7,76554 --ADMISIBLE: cumple >2.5
En Base: 3,65478 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 35,67578 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1185,06683 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 34,63317 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC160_16_1m
Fecha:
A la atención de D./Dña. :
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Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 20bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 160 mm
Espesor: e=11.8 mm
Diámetro interior: di= 136.4 mm
Radio medio: Rm= 74.1 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 16 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=20,20762 kN/m2
Debida a sobrecargas concentradas: Pvc=31,88047 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=52,0881 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=5,53625 kN/m2

### 2.3. Deformación Relativa: dv=0,63223 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,088 kN m/m
En Riñones: M (Riñones)=-0,0526 kN m/m
En Base: M (Base)=0,1001kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=106,3388 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,03737 kN/mm2
En Riñones: 6,58846 kN/mm2
En Base: 13,55392 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,83513 --ADMISIBLE: cumple >2.5
En Riñones: 7,58903 --ADMISIBLE: cumple >2.5
En Base: 3,68897 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 47,11564 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :4245,46393 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 46,59849 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC160_16_3m
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A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 20bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 160 mm
Espesor: e=11.8 mm
Diámetro interior: di= 136.4 mm
Radio medio: Rm= 74.1 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 16 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=38,89082 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01307 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=46,9039 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=10,75206 kN/m2

### 2.3. Deformación Relativa: dv=0,53279 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,07155 kN m/m
En Riñones: M (Riñones)=-0,03523 kN m/m
En Base: M (Base)=0,0825kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=105,94892 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,25433 kN/mm2
En Riñones: 7,32967 kN/mm2
En Base: 12,72266 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 4,08019 --ADMISIBLE: cumple >2.5
En Riñones: 6,82159 --ADMISIBLE: cumple >2.5
En Base: 3,93 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 52,32324 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :4245,46393 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 51,68623 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC200_10_1m
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A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 200 mm
Espesor: e=9.6 mm
Diámetro interior: di= 180.8 mm
Radio medio: Rm= 95.2 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=15,15358 kN/m2
Debida a sobrecargas concentradas: Pvc=31,8089 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=46,96248 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=9,35831 kN/m2

### 2.3. Deformación Relativa: dv=1,3281 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,10338 kN m/m
En Riñones: M (Riñones)=-0,08856 kN m/m
En Base: M (Base)=0,12163kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=87,63295 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,12892 kN/mm2
En Riñones: 3,19084 kN/mm2
En Base: 17,31333 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,10002 --ADMISIBLE: cumple >2.5
En Riñones: 15,66985 --ADMISIBLE: cumple >2.5
En Base: 2,88795 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,36244 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :965,46799 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,60833 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC200_10_3m
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Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
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Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 200 mm
Espesor: e=9.6 mm
Diámetro interior: di= 180.8 mm
Radio medio: Rm= 95.2 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=27,73428 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01125 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=35,74553 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=17,03289 kN/m2

### 2.3. Deformación Relativa: dv=0,89611 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,05625 kN m/m
En Riñones: M (Riñones)=-0,03904 kN m/m
En Base: M (Base)=0,07044kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=86,98717 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,87853 kN/mm2
En Riñones: 6,41727 kN/mm2
En Base: 13,8011 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,88243 --ADMISIBLE: cumple >2.5
En Riñones: 7,79147 --ADMISIBLE: cumple >2.5
En Base: 3,6229 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 35,94878 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :965,46799 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 34,65829 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC200_16_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
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Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 20bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 200 mm
Espesor: e=14.7 mm
Diámetro interior: di= 170.6 mm
Radio medio: Rm= 92.65 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 16 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=19,55587 kN/m2
Debida a sobrecargas concentradas: Pvc=31,8089 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=51,36477 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=5,69351 kN/m2

### 2.3. Deformación Relativa: dv=0,61766 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,13588 kN m/m
En Riñones: M (Riñones)=-0,08096 kN m/m
En Base: M (Base)=0,15479kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=133,01736 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,05246 kN/mm2
En Riñones: 6,6452 kN/mm2
En Base: 13,57409 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,8307 --ADMISIBLE: cumple >2.5
En Riñones: 7,52423 --ADMISIBLE: cumple >2.5
En Base: 3,68349 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 49,37386 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :3421,08921 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 48,67142 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC200_16_3m
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RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 20bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 200 mm
Espesor: e=14.7 mm
Diámetro interior: di= 170.6 mm
Radio medio: Rm= 92.65 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 16 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.72 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=37,68549 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01125 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=45,69675 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=11,08375 kN/m2

### 2.3. Deformación Relativa: dv=0,5129 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,10876 kN m/m
En Riñones: M (Riñones)=-0,05234 kN m/m
En Base: M (Base)=0,12573kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=132,5233 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,22221 kN/mm2
En Riñones: 7,43337 kN/mm2
En Base: 12,69074 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 4,09091 --ADMISIBLE: cumple >2.5
En Riñones: 6,72643 --ADMISIBLE: cumple >2.5
En Base: 3,93988 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 55,49797 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :3421,08921 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 54,61204 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC250_10_1m
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RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 250 mm
Espesor: e=11.9 mm
Diámetro interior: di= 226.2 mm
Radio medio: Rm= 119.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.75 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=15,7816 kN/m2
Debida a sobrecargas concentradas: Pvc=31,69811 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=47,4797 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=10,28118 kN/m2

### 2.3. Deformación Relativa: dv=1,31028 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,16193 kN m/m
En Riñones: M (Riñones)=-0,13899 kN m/m
En Base: M (Base)=0,19124kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=109,60608 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,3435 kN/mm2
En Riñones: 3,14648 kN/mm2
En Base: 17,58349 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05932 --ADMISIBLE: cumple >2.5
En Riñones: 15,89078 --ADMISIBLE: cumple >2.5
En Base: 2,84358 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,70338 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :775,23547 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,74755 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC250_10_3m
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A la atención de D./Dña. :
Empresa/entidad :
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Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 250 mm
Espesor: e=11.9 mm
Diámetro interior: di= 226.2 mm
Radio medio: Rm= 119.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.75 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=29,26076 kN/m2
Debida a sobrecargas concentradas: Pvc=8,00861 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=37,26937 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=18,97512 kN/m2

### 2.3. Deformación Relativa: dv=0,91628 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,08922 kN m/m
En Riñones: M (Riñones)=-0,06223 kN m/m
En Base: M (Base)=0,11275kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=108,71198 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,07431 kN/mm2
En Riñones: 6,39246 kN/mm2
En Base: 14,07171 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,82429 --ADMISIBLE: cumple >2.5
En Riñones: 7,82171 --ADMISIBLE: cumple >2.5
En Base: 3,55323 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 35,29301 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :775,23547 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 33,75624 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC250_16_1m
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RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 20bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 250 mm
Espesor: e=18.4 mm
Diámetro interior: di= 213.2 mm
Radio medio: Rm= 115.8 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 16 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.75 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=18,9515 kN/m2
Debida a sobrecargas concentradas: Pvc=31,69811 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=50,6496 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=5,76132 kN/m2

### 2.3. Deformación Relativa: dv=0,59573 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,2104 kN m/m
En Riñones: M (Riñones)=-0,12442 kN m/m
En Base: M (Base)=0,24006kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=166,26124 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,99218 kN/mm2
En Riñones: 6,67622 kN/mm2
En Base: 13,51567 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,84847 --ADMISIBLE: cumple >2.5
En Riñones: 7,48927 --ADMISIBLE: cumple >2.5
En Base: 3,69941 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 52,04779 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :2787,86818 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 51,0939 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

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RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 20bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 250 mm
Espesor: e=18.4 mm
Diámetro interior: di= 213.2 mm
Radio medio: Rm= 115.8 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 16 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.75 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=36,80092 kN/m2
Debida a sobrecargas concentradas: Pvc=8,00861 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=44,80953 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=11,30934 kN/m2

### 2.3. Deformación Relativa: dv=0,48998 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,16677 kN m/m
En Riñones: M (Riñones)=-0,07839 kN m/m
En Base: M (Base)=0,1933kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=165,62553 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 12,1395 kN/mm2
En Riñones: 7,48558 kN/mm2
En Base: 12,60844 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 4,11878 --ADMISIBLE: cumple >2.5
En Riñones: 6,67951 --ADMISIBLE: cumple >2.5
En Base: 3,9656 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 58,83123 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :2787,86818 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 57,6154 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC315_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 315 mm
Espesor: e=15.0 mm
Diámetro interior: di= 285 mm
Radio medio: Rm= 150 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=0.85 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=16,53671 kN/m2
Debida a sobrecargas concentradas: Pvc=31,51959 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,0563 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=11,04705 kN/m2

### 2.3. Deformación Relativa: dv=1,29132 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,25888 kN m/m
En Riñones: M (Riñones)=-0,22233 kN m/m
En Base: M (Base)=0,30693kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=138,07326 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,3809 kN/mm2
En Riñones: 3,09825 kN/mm2
En Base: 17,66261 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05234 --ADMISIBLE: cumple >2.5
En Riñones: 16,13812 --ADMISIBLE: cumple >2.5
En Base: 2,83084 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,04184 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :624,46788 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,83673 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC315_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
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Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 315 mm
Espesor: e=15.0 mm
Diámetro interior: di= 285 mm
Radio medio: Rm= 150 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=0.85 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=31,66015 kN/m2
Debida a sobrecargas concentradas: Pvc=8,00448 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=39,66463 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=21,06302 kN/m2

### 2.3. Deformación Relativa: dv=0,95169 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,14767 kN m/m
En Riñones: M (Riñones)=-0,10409 kN m/m
En Base: M (Base)=0,18817kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=136,77483 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,22101 kN/mm2
En Riñones: 6,23009 kN/mm2
En Base: 14,3035 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,78186 --ADMISIBLE: cumple >2.5
En Riñones: 8,02557 --ADMISIBLE: cumple >2.5
En Base: 3,49565 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 33,97453 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :624,46788 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 32,2215 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC400_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 400 mm
Espesor: e=19.1 mm
Diámetro interior: di= 361.8 mm
Radio medio: Rm= 190.45 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=17,3096 kN/m2
Debida a sobrecargas concentradas: Pvc=31,23003 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,53964 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=11,74347 kN/m2

### 2.3. Deformación Relativa: dv=1,27193 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,4207 kN m/m
En Riñones: M (Riñones)=-0,36145 kN m/m
En Base: M (Base)=0,50095kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=175,2769 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,36773 kN/mm2
En Riñones: 3,05159 kN/mm2
En Base: 17,69136 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05479 --ADMISIBLE: cumple >2.5
En Riñones: 16,38489 --ADMISIBLE: cumple >2.5
En Base: 2,82624 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,39366 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :500,07227 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,86811 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC400_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 400 mm
Espesor: e=19.1 mm
Diámetro interior: di= 361.8 mm
Radio medio: Rm= 190.45 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=34,47141 kN/m2
Debida a sobrecargas concentradas: Pvc=7,9978 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=42,46922 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=23,29843 kN/m2

### 2.3. Deformación Relativa: dv=0,99518 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,25095 kN m/m
En Riñones: M (Riñones)=-0,17929 kN m/m
En Base: M (Base)=0,3224kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=173,36353 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,37595 kN/mm2
En Riñones: 6,00805 kN/mm2
En Base: 14,55629 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,73805 --ADMISIBLE: cumple >2.5
En Riñones: 8,32217 --ADMISIBLE: cumple >2.5
En Base: 3,43494 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 32,45216 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :500,07227 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 30,47452 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC500_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 500 mm
Espesor: e=23.9 mm
Diámetro interior: di= 452.2 mm
Radio medio: Rm= 238.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.14 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=17,90956 kN/m2
Debida a sobrecargas concentradas: Pvc=30,81396 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,72353 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=12,40829 kN/m2

### 2.3. Deformación Relativa: dv=1,24132 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,6596 kN m/m
En Riñones: M (Riñones)=-0,56702 kN m/m
En Base: M (Base)=0,78925kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=219,10589 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,36583 kN/mm2
En Riñones: 3,02898 kN/mm2
En Base: 17,73532 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05515 --ADMISIBLE: cumple >2.5
En Riñones: 16,50718 --ADMISIBLE: cumple >2.5
En Base: 2,81923 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,99922 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :406,43125 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 27,0679 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA B PVC500_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 500 mm
Espesor: e=23.9 mm
Diámetro interior: di= 452.2 mm
Radio medio: Rm= 238.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.14 m
Ángulo de inclinacion de la zanja: Beta=78.7º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.6 N/mm2 E2= 4 N/mm2
Módulos de compresión del terreno: E3=10 N/mm2 E4= 10 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=36,78549 kN/m2
Debida a sobrecargas concentradas: Pvc=7,98807 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=44,77356 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=25,40443 kN/m2

### 2.3. Deformación Relativa: dv=1,02216 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,40833 kN m/m
En Riñones: M (Riñones)=-0,29474 kN m/m
En Base: M (Base)=0,52902kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=216,41889 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,52154 kN/mm2
En Riñones: 5,8326 kN/mm2
En Base: 14,798 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,6978 --ADMISIBLE: cumple >2.5
En Riñones: 8,57251 --ADMISIBLE: cumple >2.5
En Base: 3,37883 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 31,55756 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :406,43125 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 29,28381 --ADMISIBLE: cumple >2.5

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN500_PN10_1m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN500_PN10_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Including predeformation (2.0 / 1.6) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | No | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | γ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,34 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

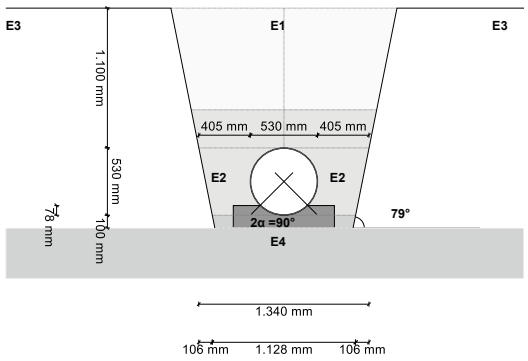
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN500 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 500 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 530,1 | mm |
| Espesor de pared total: | s | 7,8 | mm |
| Gravedad específica: | $\gamma_R$ | 23,46 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,34 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,43 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 506,1 | kN/m² |
| Carga vertical total: | $q_v$ | 46,60 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,86 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,00 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN500_PN10_3m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN500_PN10_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Including predeformation (2.0 / 1.6) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | No | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,34 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

### 1.1.5 Tubo con rigidez nominal

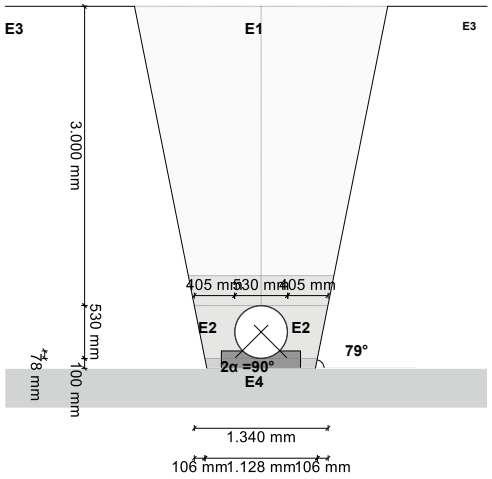
| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN500 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 500 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 530,1 | mm |
| Espesor de pared total: | s | 7,8 | mm |
| Gravedad específica: | $\gamma_R$ | 23,46 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |

| | |
|---|---|
| Ultimate strain tensile strength according to standard: | Si |

**Carga de tráfico: SLW 30**






## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |
| (Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos) | | | | | |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | | | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | | | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,58 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |
| (Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos) | | | | | |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | | | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | | | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,77 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 474,1 | kN/m² |
| Carga vertical total: | $q_v$ | 57,76 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 8,21 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,00 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.



# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN600_PN10_1m

Nombre: ZONA B_PRFV_DN600_PN10_1m

Notas: ninguno

Conclusión: ninguno

Añadir boceto para imprimir: Si

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,48 | m |

| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

### 1.1.5 Tubo con rigidez nominal

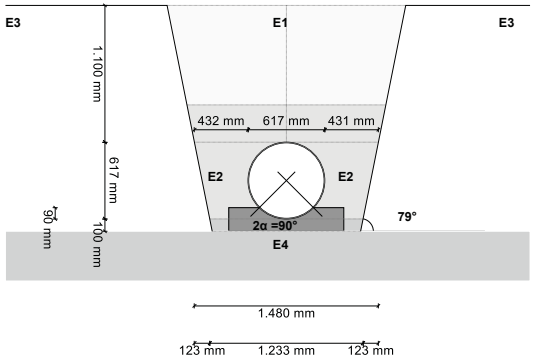
| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN600 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 600 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 617,0 | mm |
| Espesor de pared total: | s | 8,9 | mm |
| Gravedad específica: | $\gamma_R$ | 23,18 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |

Ultimate strain tensile strength according to standard: Si

**Carga de tráfico: SLW 30**






## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,33 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,43 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 508,0 | kN/m² |
| Carga vertical total: | $q_v$ | 46,91 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,83 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.



# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN600_PN10_3m

Nombre: ZONA B_PRFV_DN600_PN10_3m

Notas: ninguno

Conclusión: ninguno

Añadir boceto para imprimir: Si

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,48 | m |

| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

**1.1.5 Tubo con rigidez nominal**

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN600 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 600 [mm] |

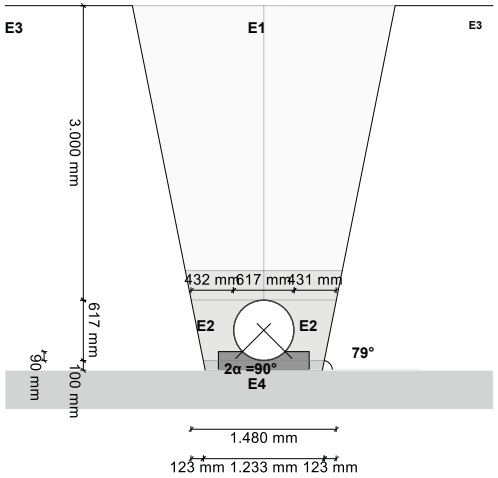
**1.1.6 Valores de la base de datos**

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 617,0 | mm |
| Espesor de pared total: | s | 8,9 | mm |
| Gravedad específica: | $\gamma_R$ | 23,18 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |

Ultimate strain tensile strength according to standard: Si



**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,64 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,84 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 475,8 | kN/m² |
| Carga vertical total: | $q_v$ | 59,33 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 8,02 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN700_PN10_1m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN700_PN10_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | γ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,62 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

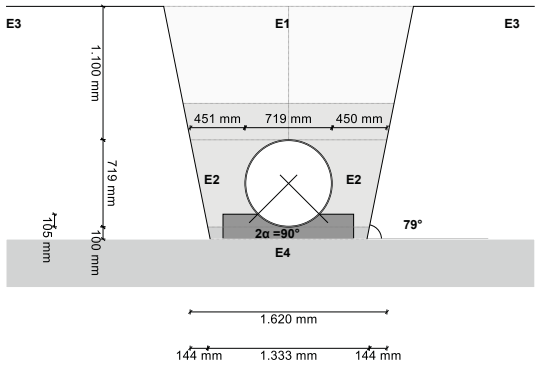
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN700 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 700 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 719,0 | mm |
| Espesor de pared total: | s | 10,3 | mm |
| Gravedad específica: | $\gamma_R$ | 22,95 | kN/m³ |
| Coeficiente de poisson: | ν | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,34 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,43 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 511,9 | kN/m² |
| Carga vertical total: | $q_v$ | 47,52 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,77 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN700_PN10_3m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN700_PN10_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,62 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

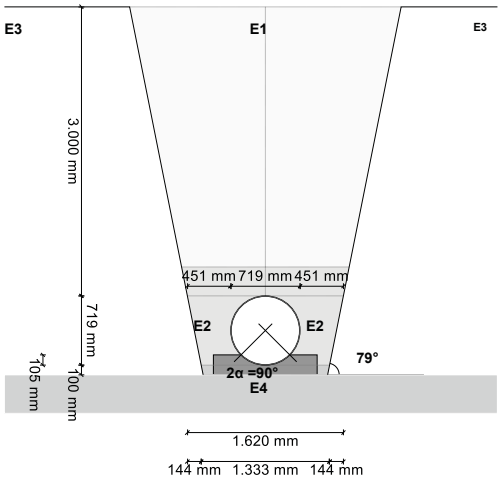
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN700 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 700 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 719,0 | mm |
| Espesor de pared total: | s | 10,3 | mm |
| Gravedad específica: | $\gamma_R$ | 22,95 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**






## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |
| (Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos) | | | | | |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | | | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | | | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,74 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |
| (Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos) | | | | | |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | | | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | | | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,96 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 479,4 | kN/m² |
| Carga vertical total: | $q_v$ | 61,75 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 7,76 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.



# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN800_PN10_1m

Nombre: ZONA B_PRFV_DN800_PN10_1m

Notas: ninguno

Conclusión: ninguno

Añadir boceto para imprimir: Si

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,76 | m |

| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

### 1.1.5 Tubo con rigidez nominal

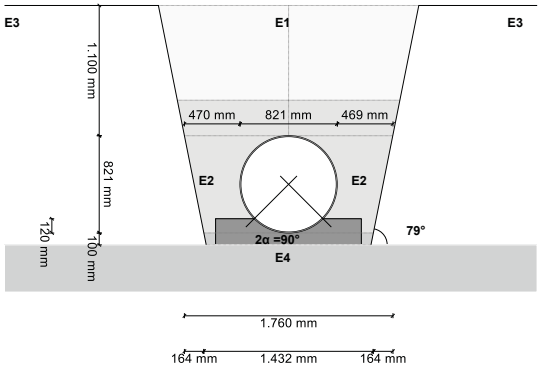
| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN800 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 800 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 821,0 | mm |
| Espesor de pared total: | s | 11,6 | mm |
| Gravedad específica: | $\gamma_R$ | 22,78 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |

Ultimate strain tensile strength according to standard: Si

**Carga de tráfico: SLW 30**






## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |
| (Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos) | | | | | |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | | | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | | | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,32 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |
| (Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos) | | | | | |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | | | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | | | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,42 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 516,4 | kN/m² |
| Carga vertical total: | $q_v$ | 47,90 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,78 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.



# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN800_PN10_3m

Nombre: ZONA B_PRFV_DN800_PN10_3m

Notas: ninguno

Conclusión: ninguno

Añadir boceto para imprimir: Si

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,76 | m |

| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

**1.1.5 Tubo con rigidez nominal**

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN800 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 800 [mm] |

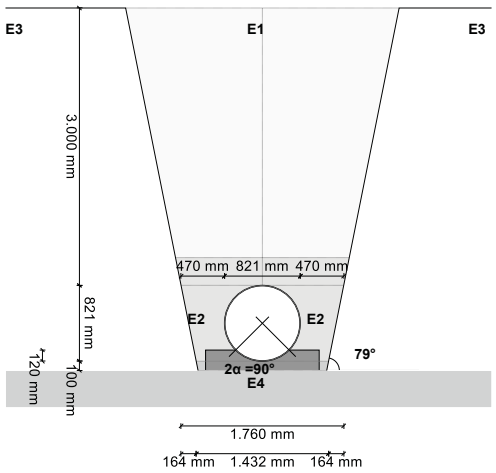
**1.1.6 Valores de la base de datos**

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 821,0 | mm |
| Espesor de pared total: | s | 11,6 | mm |
| Gravedad específica: | $\gamma_R$ | 22,78 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |

Ultimate strain tensile strength according to standard: Si



**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,81 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 4,03 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 484,0 | kN/m² |
| Carga vertical total: | $q_v$ | 63,61 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 7,61 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN900_PN10_1m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN900_PN10_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,90 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

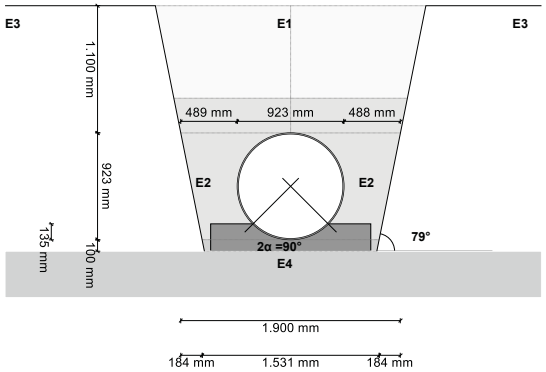
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN900 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 900 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 923,0 | mm |
| Espesor de pared total: | s | 13,2 | mm |
| Gravedad específica: | $\gamma_R$ | 22,64 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,30 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,39 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 520,7 | kN/m² |
| Carga vertical total: | $q_v$ | 48,09 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,83 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN900_PN10_3m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN900_PN10_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 1,90 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

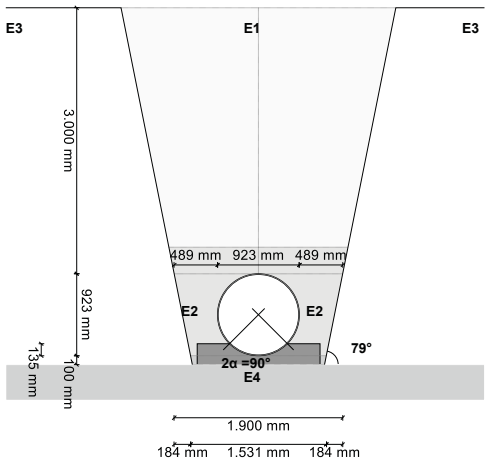
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN900 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 900 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 923,0 | mm |
| Espesor de pared total: | s | 13,2 | mm |
| Gravedad específica: | $\gamma_R$ | 22,64 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,84 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 4,07 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 487,8 | kN/m² |
| Carga vertical total: | $q_v$ | 64,96 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 7,51 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN1000_PN10_1m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN1000_PN10_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | γ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 2,04 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

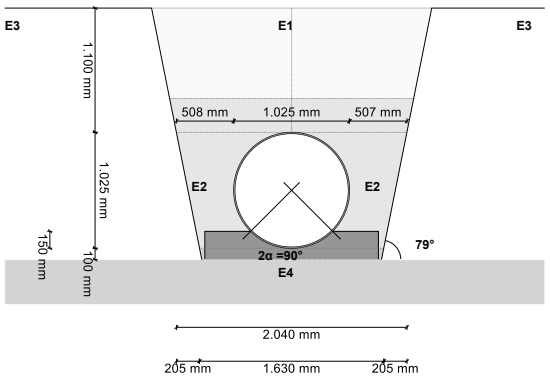
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN1000 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 1000 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 1.025,0 | mm |
| Espesor de pared total: | s | 14,5 | mm |
| Gravedad específica: | $\gamma_R$ | 22,54 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,27 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,36 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 525,2 | kN/m² |
| Carga vertical total: | $q_v$ | 48,17 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,90 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN1000_PN10_3m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN1000_PN10_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 2,04 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

### 1.1.5 Tubo con rigidez nominal

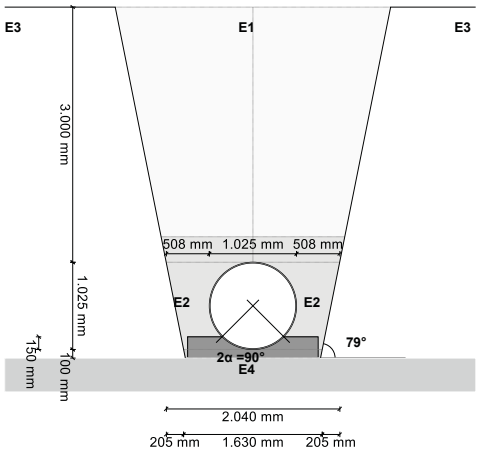
| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN1000 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 1000 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 1.025,0 | mm |
| Espesor de pared total: | s | 14,5 | mm |
| Gravedad específica: | $\gamma_R$ | 22,54 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |

Ultimate strain tensile strength according to standard: Si

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,86 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 4,09 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 492,0 | kN/m² |
| Carga vertical total: | $q_v$ | 65,98 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 7,46 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN1400_PN10_1m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN1400_PN10_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 2,60 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

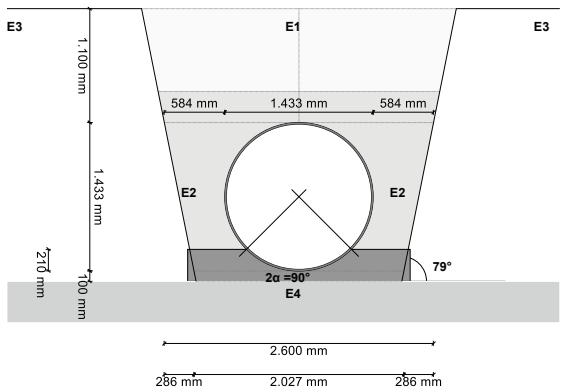
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN1400 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 1400 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 1.433,0 | mm |
| Espesor de pared total: | s | 20,0 | mm |
| Gravedad específica: | $\gamma_R$ | 22,26 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,13 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,22 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 541,4 | kN/m² |
| Carga vertical total: | $q_v$ | 47,98 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 11,28 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA B_PRFV_DN1400_PN10_3m

| | |
|---|---|
| Nombre: | ZONA B_PRFV_DN1400_PN10_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G4 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G4 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 10,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 10,00 | bar |
| Sección llena (por ejemplo canal): | No | | |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |
| Ancho de zanja: | b | 2,60 | m |



| | | | |
|---|---|---|---|
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 79 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

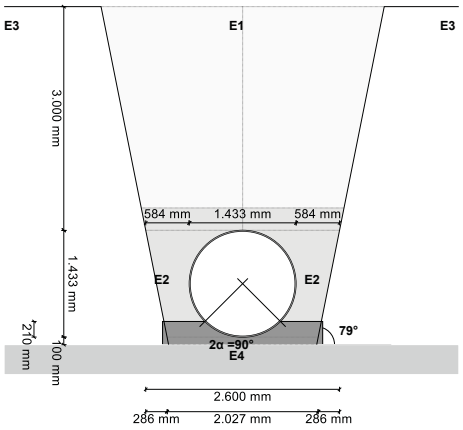
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN10 SN5000 DN1400 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 10 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 1400 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 1.433,0 | mm |
| Espesor de pared total: | s | 20,0 | mm |
| Gravedad específica: | $\gamma_R$ | 22,26 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 3,83 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 4,07 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 507,8 | kN/m² |
| Carga vertical total: | $q_v$ | 68,36 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 7,43 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC140_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 140 mm
Espesor: e=6.7 mm
Diámetro interior: di= 126.6 mm
Radio medio: Rm= 66.65 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.08 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=37,25662 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01391 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=45,27053 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=21,85109 kN/m2

### 2.3. Deformación Relativa: dv=1,07825 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,03088 kN m/m
En Riñones: M (Riñones)=-0,02207 kN m/m
En Base: M (Base)=0,03935kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=60,4243 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,32831 kN/mm2
En Riñones: 5,95696 kN/mm2
En Base: 14,4538 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,75141 --ADMISIBLE: cumple >2.5
En Riñones: 8,39354 --ADMISIBLE: cumple >2.5
En Base: 3,4593 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,31037 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1372,01519 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 27,73802 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC160_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 160 mm
Espesor: e=7.7 mm
Diámetro interior: di= 144.6 mm
Radio medio: Rm= 76.15 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.12 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=16,34169 kN/m2
Debida a sobrecargas concentradas: Pvc=31,88047 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,22216 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=9,75468 kN/m2

### 2.3. Deformación Relativa: dv=1,31964 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,06632 kN m/m
En Riñones: M (Riñones)=-0,05671 kN m/m
En Base: M (Base)=0,07813kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=69,98571 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,07263 kN/mm2
En Riñones: 3,1793 kN/mm2
En Base: 17,26232 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,11088 --ADMISIBLE: cumple >2.5
En Riñones: 15,72671 --ADMISIBLE: cumple >2.5
En Base: 2,89648 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,106 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1223,38477 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,51844 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC160_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 160 mm
Espesor: e=7.7 mm
Diámetro interior: di= 144.6 mm
Radio medio: Rm= 76.15 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.12 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=37,93707 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01307 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=45,95014 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=22,40849 kN/m2

### 2.3. Deformación Relativa: dv=1,07643 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,04096 kN m/m
En Riñones: M (Riñones)=-0,0293 kN m/m
En Base: M (Base)=0,05225kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=68,99405 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,2886 kN/mm2
En Riñones: 5,88181 kN/mm2
En Base: 14,42554 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,76262 --ADMISIBLE: cumple >2.5
En Riñones: 8,50079 --ADMISIBLE: cumple >2.5
En Base: 3,46607 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,44626 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :1223,38477 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 27,79986 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC200_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 200 mm
Espesor: e=9.6 mm
Diámetro interior: di= 180.8 mm
Radio medio: Rm= 95.2 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.12 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=16,6512 kN/m2
Debida a sobrecargas concentradas: Pvc=31,8089 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,4601 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=10,31298 kN/m2

### 2.3. Deformación Relativa: dv=1,29378 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,10379 kN m/m
En Riñones: M (Riñones)=-0,08881 kN m/m
En Base: M (Base)=0,12259kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=87,49992 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,14455 kN/mm2
En Riñones: 3,16032 kN/mm2
En Base: 17,36392 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,09702 --ADMISIBLE: cumple >2.5
En Riñones: 15,8212 --ADMISIBLE: cumple >2.5
En Base: 2,87953 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,64577 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :990,1852 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,89487 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC200_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 200 mm
Espesor: e=9.6 mm
Diámetro interior: di= 180.8 mm
Radio medio: Rm= 95.2 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.12 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=38,54447 kN/m2
Debida a sobrecargas concentradas: Pvc=8,01125 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=46,55572 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=23,59964 kN/m2

### 2.3. Deformación Relativa: dv=1,06805 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,06408 kN m/m
En Riñones: M (Riñones)=-0,04575 kN m/m
En Base: M (Base)=0,08218kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=86,22545 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,33724 kN/mm2
En Riñones: 5,88792 kN/mm2
En Base: 14,51215 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,7489 --ADMISIBLE: cumple >2.5
En Riñones: 8,49197 --ADMISIBLE: cumple >2.5
En Base: 3,44539 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,77662 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :990,1852 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 27,96394 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC250_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 250 mm
Espesor: e=11.9 mm
Diámetro interior: di= 226.2 mm
Radio medio: Rm= 119.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.3 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=17,01212 kN/m2
Debida a sobrecargas concentradas: Pvc=31,69811 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,71022 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=10,79092 kN/m2

### 2.3. Deformación Relativa: dv=1,30116 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,16259 kN m/m
En Riñones: M (Riñones)=-0,13954 kN m/m
En Base: M (Base)=0,1926kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=109,46898 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,36234 kN/mm2
En Riñones: 3,1114 kN/mm2
En Base: 17,63157 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,0558 --ADMISIBLE: cumple >2.5
En Riñones: 16,06993 --ADMISIBLE: cumple >2.5
En Base: 2,83582 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,43847 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :782,61619 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,50906 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC250_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 250 mm
Espesor: e=11.9 mm
Diámetro interior: di= 226.2 mm
Radio medio: Rm= 119.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.3 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=39,71378 kN/m2
Debida a sobrecargas concentradas: Pvc=8,00861 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=47,72239 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=24,85843 kN/m2

### 2.3. Deformación Relativa: dv=1,09593 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,1013 kN m/m
En Riñones: M (Riñones)=-0,0728 kN m/m
En Base: M (Base)=0,13076kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=107,79112 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,53709 kN/mm2
En Riñones: 5,85481 kN/mm2
En Base: 14,78285 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,69356 --ADMISIBLE: cumple >2.5
En Riñones: 8,53999 --ADMISIBLE: cumple >2.5
En Base: 3,3823 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,00643 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :782,61619 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 27,03883 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC315_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 315 mm
Espesor: e=15.0 mm
Diámetro interior: di= 285 mm
Radio medio: Rm= 150 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.43 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=17,47247 kN/m2
Debida a sobrecargas concentradas: Pvc=31,51959 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,99205 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=11,36631 kN/m2

### 2.3. Deformación Relativa: dv=1,27841 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,25934 kN m/m
En Riñones: M (Riñones)=-0,2227 kN m/m
En Base: M (Base)=0,30823kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=137,93119 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,38499 kN/mm2
En Riñones: 3,07942 kN/mm2
En Base: 17,68892 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05157 --ADMISIBLE: cumple >2.5
En Riñones: 16,23682 --ADMISIBLE: cumple >2.5
En Base: 2,82663 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,89393 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :629,60561 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,71055 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC315_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 315 mm
Espesor: e=15.0 mm
Diámetro interior: di= 285 mm
Radio medio: Rm= 150 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.43 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=40,99467 kN/m2
Debida a sobrecargas concentradas: Pvc=8,00448 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=48,99915 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=26,29238 kN/m2

### 2.3. Deformación Relativa: dv=1,10333 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,16408 kN m/m
En Riñones: M (Riñones)=-0,11837 kN m/m
En Base: M (Base)=0,21298kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=135,71875 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,6125 kN/mm2
En Riñones: 5,76872 kN/mm2
En Base: 14,91659 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,6731 --ADMISIBLE: cumple >2.5
En Riñones: 8,66743 --ADMISIBLE: cumple >2.5
En Base: 3,35197 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,8899 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :629,60561 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,70685 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC400_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 400 mm
Espesor: e=19.1 mm
Diámetro interior: di= 361.8 mm
Radio medio: Rm= 190.45 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=1.8 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=17,98545 kN/m2
Debida a sobrecargas concentradas: Pvc=31,23003 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=49,21548 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=11,73356 kN/m2

### 2.3. Deformación Relativa: dv=1,27612 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,42152 kN m/m
En Riñones: M (Riñones)=-0,36241 kN m/m
En Base: M (Base)=0,50275kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=175,14596 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,37554 kN/mm2
En Riñones: 3,02971 kN/mm2
En Base: 17,71512 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05334 --ADMISIBLE: cumple >2.5
En Riñones: 16,50325 --ADMISIBLE: cumple >2.5
En Base: 2,82245 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,92901 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :499,29301 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,4495 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC400_10_3m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 400 mm
Espesor: e=19.1 mm
Diámetro interior: di= 361.8 mm
Radio medio: Rm= 190.45 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=1.8 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=42,80171 kN/m2
Debida a sobrecargas concentradas: Pvc=7,9978 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=50,79951 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=27,48949 kN/m2

### 2.3. Deformación Relativa: dv=1,13872 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,27559 kN m/m
En Riñones: M (Riñones)=-0,20134 kN m/m
En Base: M (Base)=0,35913kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=172,17559 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,74144 kN/mm2
En Riñones: 5,57443 kN/mm2
En Base: 15,11841 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,63863 --ADMISIBLE: cumple >2.5
En Riñones: 8,96953 --ADMISIBLE: cumple >2.5
En Base: 3,30723 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 27,05813 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :499,29301 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 25,66715 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC500_10_1m
Fecha:
A la atención de D./Dña. :
Empresa/entidad :
Dirección :
Ciudad :
Teléfono/Fax :
Correo electrónico:
Referencia de la obra :

RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 500 mm
Espesor: e=23.9 mm
Diámetro interior: di= 452.2 mm
Radio medio: Rm= 238.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=1.1 m
Anchura de la zanja: B1=2.1 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=18,4333 kN/m2
Debida a sobrecargas concentradas: Pvc=30,81396 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=49,24727 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=12,20254 kN/m2

### 2.3. Deformación Relativa: dv=1,25807 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,66131 kN m/m
En Riñones: M (Riñones)=-0,56919 kN m/m
En Base: M (Base)=0,79214kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=218,98416 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 16,37985 kN/mm2
En Riñones: 3,00171 kN/mm2
En Base: 17,76167 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,05253 --ADMISIBLE: cumple >2.5
En Riñones: 16,65718 --ADMISIBLE: cumple >2.5
En Base: 2,81505 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 28,29492 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :403,17935 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 26,43942 --ADMISIBLE: cumple >2.5

# Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## Datos sobre el informe

Informe número: ZONA A PVC500_10_3m
Fecha:
A la atención de D./Dña. :
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RESULTADO DEL CÁLCULO MECÁNICO: INSTALACIÓN VÁLIDA
(Si se aplican en la instalación los parámetros especificados en el cálculo)
Coeficiente de seguridad empleado en el cálculo: A (> 2.5)

## 1. Características del tubo y la instalación.

TIPO DE CONDUCCIÓN: AGUA A PRESIÓN (Tubos según norma UNE-EN 1.452-2)
Instalacion en: ZANJA

Material del tubo: PVC-U
Presión nominal: 12.5 *bar (entre paréntesis, PN no habitual)
Diámetro nominal: Dn = 500 mm
Espesor: e=23.9 mm
Diámetro interior: di= 452.2 mm
Radio medio: Rm= 238.05 mm
Módulo de elasticidad: Et(lp)=1750 N/mm2 , Et(cp)=3600 N/mm2
Peso específico: P.esp.=14 kN/m3
Esfuerzo tang. máximo: Sigma-t(lp)= 50 N/mm2 , Sigma-t(cp)=90 N/mm2
Nota: Las propiedades del material se han obtenido del informe UNE 53.331 IN

Presión agua interior: Pi = 10 bar
Presión agua exterior: Pe= 0 bar

Altura de la zanja: H1=3 m
Anchura de la zanja: B1=2.1 m
Ángulo de inclinacion de la zanja: Beta=45º

Apoyo sobre material granular compactado (Tipo A)
Ángulo de apoyo: 2alfa=90º
Tipo de relleno: Medianamente cohesivo
Tipo de suelo: Cohesivo

Relleno de la zanja compactado por capas en toda la altura
Peso especifico de la tierra de relleno: Y1=20 kN/m3
Módulos de compresión del relleno: E1=0.8 N/mm2 E2= 5 N/mm2
Módulos de compresión del terreno: E3=14 N/mm2 E4= 14 N/mm2
Sobrecargas concentradas debidas a tráfico: MEDIO (<39t)
Número de ejes de los vehículos: 2
Distancia entre ruedas: a=2 m
Distancia entre ejes: b=3 m
Sobrecarga concentrada: Pc=65 kN
Sobrecarga repartida: Pd= kN
Zona no pavimentada



Programa ASETUB PVC

Versión 2.1

Informe de resultados de cálculo mecánico

## 2. Determinación de las acciones sobre el tubo

### 2.1. Presión vertical de las tierras.

Debida a las tierras: qv=44,24882 kN/m2
Debida a sobrecargas concentradas: Pvc=7,98807 kN/m2
Debida a sobrecargas repartidas: Pvr=0 kN/m2
Presión vertical total sobre el tubo: qvt=52,23689 kN/m2

### 2.2. Presión lateral de las tierras

Reacción máxima lateral del suelo
a la altura del centro del tubo: qht=28,81559 kN/m2

### 2.3. Deformación Relativa: dv=1,15746 % --ADMISIBLE: cumple <= 5%

### 2.4. Momento flector total (M)

En Clave: M (Clave)=0,44407 kN m/m
En Riñones: M (Riñones)=-0,32737 kN m/m
En Base: M (Base)=0,58168kN m/m

### 2.5. Fuerza axil total (N)

En Clave: N (Clave)=215,09738 kN m/m
En Riñones: N (Riñones)= kN m/m
En Base: N (Base)=kN m/m

### 2.6. Esfuerzos tangenciales máximos.

En Clave: 13,86206 kN/mm2
En Riñones: 5,42697 kN/mm2
En Base: 15,3143 kN/mm2

### 2.7. Verificación del esfuerzo tangencial( coef. de seguridad a rotura)

En Clave: 3,60697 --ADMISIBLE: cumple >2.5
En Riñones: 9,21325 --ADMISIBLE: cumple >2.5
En Base: 3,26492 --ADMISIBLE: cumple >2.5

### 2.8. Estabilidad (Coeficientes de seguridad al aplastamiento).

Debido al terreno: 26,67554 --ADMISIBLE: cumple >2.5
Debido a la presión ext. de agua :403,17935 --ADMISIBLE: cumple >2.5
Debido al terreno y al agua: 25,02014 --ADMISIBLE: cumple >2.5

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA A_PRFV_DN500_PN6_1m

| | |
|---|---|
| Nombre: | ZONA A_PRFV_DN500_PN6_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G3 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G3 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 6,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 6,00 | bar |
| Sección llena (por ejemplo canal): | Si | | |
| Densidad del medio: | $\gamma_F$ | 10,0 | kN/m³ |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |



| | | | |
|---|---|---|---|
| Ancho de zanja: | b | 2,10 | m |
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 45 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

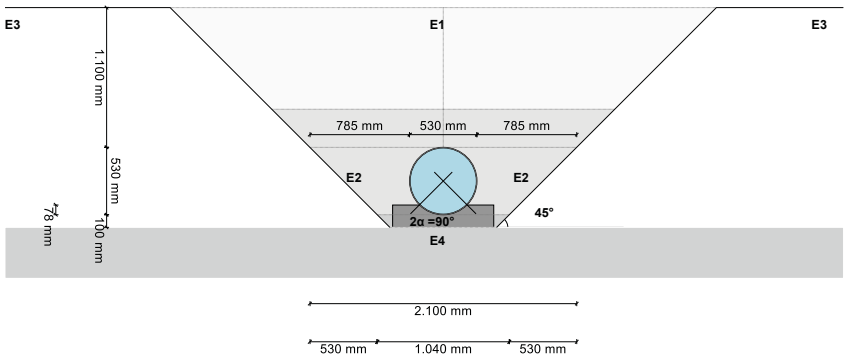
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN6 SN5000 DN500 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 6 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 500 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 530,1 | mm |
| Espesor de pared total: | s | 8,4 | mm |
| Gravedad específica: | $\gamma_R$ | 23,57 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,86 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,94 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 557,7 | kN/m² |
| Carga vertical total: | $q_v$ | 43,12 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 12,93 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA A_PRFV_DN500_PN6_3m

| | |
|---|---|
| Nombre: | ZONA A_PRFV_DN500_PN6_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G3 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G3 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 6,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 6,00 | bar |
| Sección llena (por ejemplo canal): | Si | | |
| Densidad del medio: | $\gamma_F$ | 10,0 | kN/m³ |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |



| | | | |
|---|---|---|---|
| Ancho de zanja: | b | 2,10 | m |
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 45 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

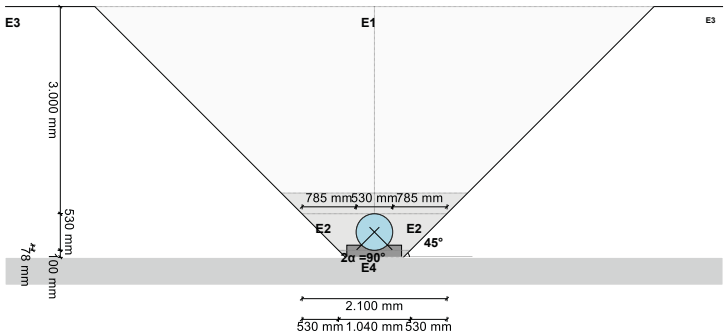
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN6 SN5000 DN500 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 6 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 500 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 530,1 | mm |
| Espesor de pared total: | s | 8,4 | mm |
| Gravedad específica: | $\gamma_R$ | 23,57 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,46 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,54 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 518,9 | kN/m² |
| Carga vertical total: | $q_v$ | 41,30 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 12,56 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA A_PRFV_DN1400_PN6_1m

| | |
|---|---|
| Nombre: | ZONA A_PRFV_DN1400_PN6_1m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G3 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G3 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 1,10 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 6,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 6,00 | bar |
| Sección llena (por ejemplo canal): | Si | | |
| Densidad del medio: | $\gamma_F$ | 10,0 | kN/m³ |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |



| | | | |
|---|---|---|---|
| Ancho de zanja: | b | 5,00 | m |
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 45 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

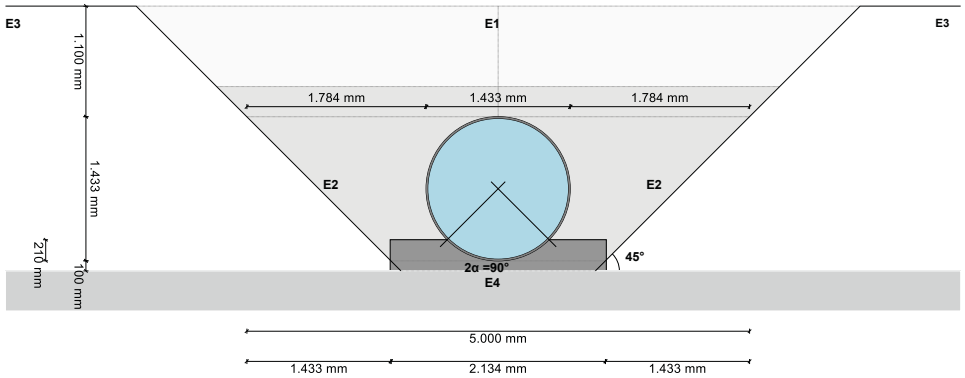
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN6 SN5000 DN1400 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 6 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 1400 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 1.433,0 | mm |
| Espesor de pared total: | s | 21,4 | mm |
| Gravedad específica: | $\gamma_R$ | 22,43 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,88 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,97 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 560,6 | kN/m² |
| Carga vertical total: | $q_v$ | 45,28 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 12,38 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

# 1 Cálculo estático de acuerdo a la ATV-DVWK-A 127: ZONA A_PRFV_DN1400_PN6_1m

| | |
|---|---|
| Nombre: | ZONA A_PRFV_DN1400_PN6_3m |
| Notas: | ninguno |
| Conclusión: | ninguno |
| Añadir boceto para imprimir: | Si |

## 1.1 Entrada de datos

### 1.1.1 Factores de seguridad

| | | | |
|---|---|---|---|
| Clase de seguridad: | A (caso normal) | | |
| Safety stability according to table 13: | Without predeformation (2.5 / 2.0) | | |
| Deflexión admisible: | 6% (estándar) | | |
| Tratamiento de la presión interna: | En concordancia con la nota de pié de página 39 en ATV A 127 | | |
| Consideration of dyn pvh*: | According to standard | | |
| Consideration of Type A 'predeformation' in the deformation proof: | Si | | |

### 1.1.2 Suelo

| | | | |
|---|---|---|---|
| E1: Relleno: | G3 | | |
| Cálculos E1: | Densidad Proctor | | |
| Densidad Proctor E1: | $D_{Pr,E1}$ | 85,0 | % |
| E20: Zona del tubo: | G3 | | |
| Cálculos E20: | Densidad Proctor | | |
| Densidad Proctor E20: | $D_{Pr,E20}$ | 95,0 | % |
| E3: Suelo natural: | G3 | | |
| Cálculos E3: | Densidad Proctor | | |
| Densidad Proctor E3: | $D_{Pr,E3}$ | 100,0 | % |
| E4 = 10 · E1: | Si | | |
| Application of silo theory: | Automático | | |

### 1.1.3 Carga

| | | | |
|---|---|---|---|
| Profundidad de instalación: | h | 3,00 | m |
| Nivel freático mínimo sobre el lecho del tubo: | $h_{W,min}$ | 0,00 | m |
| Nivel freático máximo sobre el lecho del tubo: | $h_{W,max}$ | 0,00 | m |
| Densidad del suelo: | $\gamma$ | 20,0 | kN/m³ |
| Carga superficial adicional: | $p_0$ | 0,0 | kN/m² |
| Presión interna, corto plazo: | $P_{I,K}$ | 6,00 | bar |
| Presión interna, largo plazo: | $P_{I,L}$ | 6,00 | bar |
| Sección llena (por ejemplo canal): | Si | | |
| Densidad del medio: | $\gamma_F$ | 10,0 | kN/m³ |
| Carga de tráfico: | SLW 30 | | |

### 1.1.4 Instalación

| | | | |
|---|---|---|---|
| Instalación: | Zanja | | |



| | | | |
|---|---|---|---|
| Ancho de zanja: | b | 5,00 | m |
| Check minimum trench width: | Si | | |
| Automatic consideration of bedding layer: | Si | | |
| Ángulo de la pendiente: | ß | 45 | ° |
| Condiciones de cobertura: | A1 | | |
| Condiciones de instalación: | B2 | | |
| El alineamiento debajo el tubo es tomado en cuenta según reporte ATV Grupo de Trabajo 1.5.5.: | No | | |
| Tipo de lecho: | Suelto | | |
| Ángulo del lecho: | 90º | | |
| Calculate bedding automatically: | Si | | |
| Set lower height base: | Si | | |
| Lower height base: | $h_{s,u}$ | 0,100 | m |

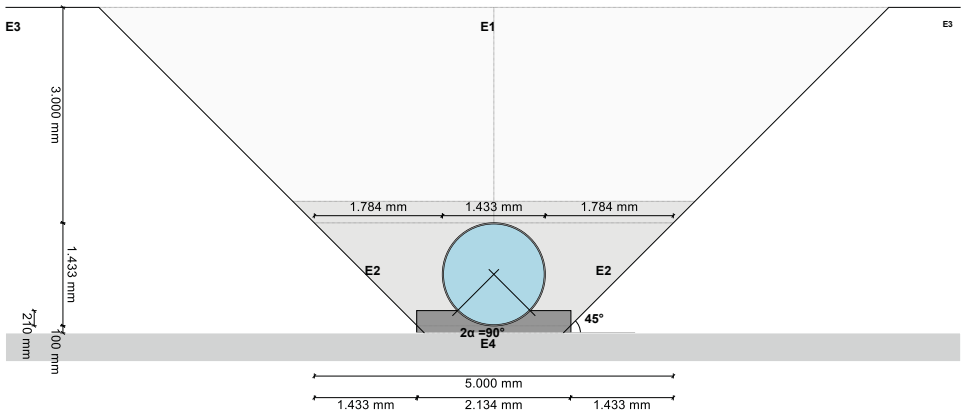
### 1.1.5 Tubo con rigidez nominal

| | |
|---|---|
| Selección de tuberías: | PN6 SN5000 DN1400 |
| Tipo de tubo de PRFV: | Pressure Series (FP 2.1) |
| Tubería de presión: | Si |
| Presión nominal: | PN 6 [bar] |
| Rigidez nominal: | SN 5000 [N/m²] |
| Diámetro nominal: | DN 1400 [mm] |

### 1.1.6 Valores de la base de datos

| | | | |
|---|---|---|---|
| Diámetro exterior: | $d_a$ | 1.433,0 | mm |
| Espesor de pared total: | s | 21,4 | mm |
| Gravedad específica: | $\gamma_R$ | 22,43 | kN/m³ |
| Coeficiente de poisson: | v | 0,28 | [-] |
| Amplitud del tubo: | $2\sigma_a$ | 0,00 | N/mm² |
| Local predeformation: | $\delta_{v,lokal}$ | 0,0 | % |
| Ultimate strain tensile strength according to standard: | Si | | |

**Carga de tráfico: SLW 30**



## 1.2 Resultados

### 1.2.1 # new res #

The minimum trench width according to DIN EN 1610 / DWA-A 139 is not checked.

### 1.2.2 Section forces

### 1.2.3 Caso de carga a corto plazo

1.2.3.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 4,000 | 4,000 | 4,000 | [-] |
| Coeficiente de seguridad interior | γ | 4,000 | 4,000 | 4,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.3.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,77 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.

### 1.2.4 Caso de carga a largo plazo

1.2.4.1 prueba de alargamiento unitario

| | | clave | generatriz sobre el diámetro horizontal del tubo | base | |
|---|---|---|---|---|---|
| Coeficiente de seguridad exterior | γ | 2,000 | 2,000 | 2,000 | [-] |
| Coeficiente de seguridad interior | γ | 2,000 | 2,000 | 2,000 | [-] |

(Los coeficientes de seguridad por la tensión de compresión por flexión están marcados con un signo menos)

| | | | |
|---|---|---|---|
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a tracción: | erf $\gamma_{RBZ}$ | 2,00 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad, tensión a compresión: | erf $\gamma_{RBD}$ | 2,00 | [-] |

Todos los coeficientes de seguridad calculados de la prueba de estiramiento unitario son suficientes.

1.2.4.2 Prueba de deformación

| | | | |
|---|---|---|---|
| Total vertical deformation (Type A + Type B): | $\delta_{v,Ges}$ | 2,95 | % |
| Deflexión admisible: | zul $\delta_v$ | 6,00 | % |

La deflexión determinada es menor que la deflexión permitida.



1.2.4.3 Nachweis Stabilität radial, linear

**Earth and traffic loads**

| | | | |
|---|---|---|---|
| Kritische vertikale Gesamtlast: | krit $q_v$ | 523,3 | kN/m² |
| Carga vertical total: | $q_v$ | 50,47 | kN/m² |
| Sicherheit Stabilität, radial: | $\gamma_{Stab,rad}$ | 10,37 | [-] |
| Coeficiente global de seguridad requerido, fallo por inestabilidad: | erf $\gamma_{stab}$ | 2,50 | [-] |

Der Stabilitätsnachweis ist erbracht.

1.2.4.4 Prueba de estabiliad no lineal

La prueba de estabilidad no linealno es aplicable porque el VRB > 1 (tubo rígido).

Todas las pruebas necesarias son correctas.

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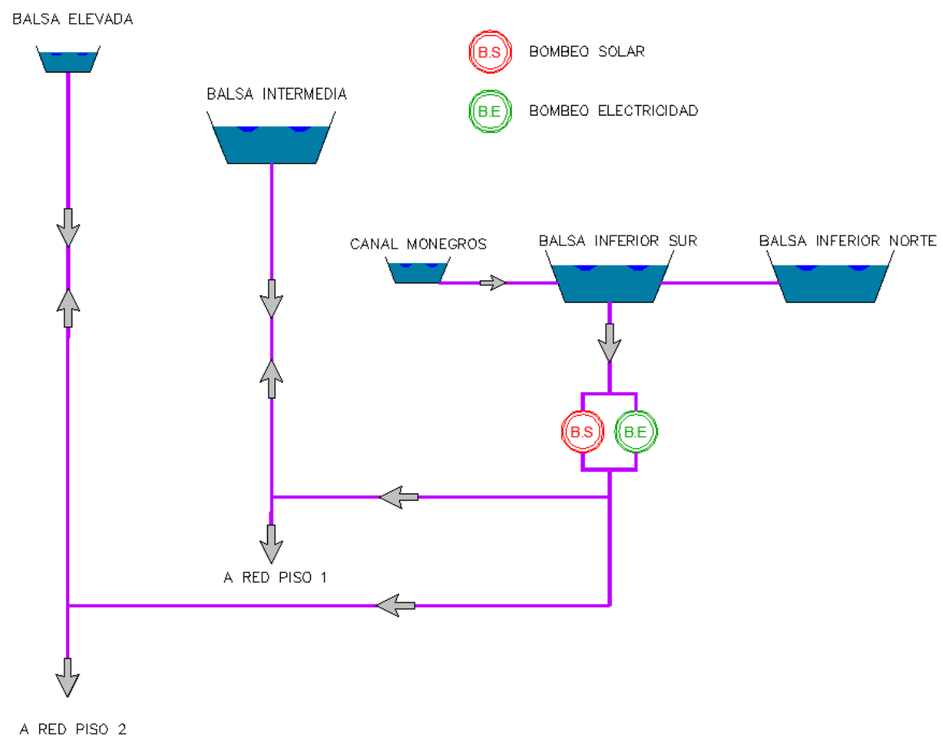
# ANEJO 9.- CÁLCULOS HIDRÁULICOS DEL BOMBEO

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

En las parcelas objeto del proyecto se pretende la modernización del riego mediante la implantación de un sistema de tuberías a presión enterradas, alimentadas desde el canal de Monegros.

En la solución que se desarrolla, se prevé la necesidad de bombear agua desde las balsas inferiores hasta dos balsas elevadas. Las tuberías de impulsión alimentarán desde la estación de bombeo las denominadas balsa intermedia y balsa elevada, para desde cada una de ellas, distribuir el agua por gravedad a sendas redes de riego.

**Figura 1.** Esquema general del funcionamiento de las instalaciones proyectadas




Para minimizar el uso de energía eléctrica convencional se va a instalar un sistema de placas fotovoltaicas para aprovechar la energía solar.

## 2 IMPULSION A BALSA INTERMEDIA

### 2.1 CARACTERÍSTICAS DE LA IMPULSIÓN

Tal y como se ha mencionado anteriormente la tubería de Impulsión servirá a su vez como parte de la infraestructura de distribución de la Red de Riego.

El trazado previsto para la impulsión a la Balsa Intermedia, estará compuesto por una tubería con las siguientes características:

- Diámetro: 1400 mm
- Material: PRFV PN10
- Longitud: 898 m.

### 2.2 DETERMINACIÓN DE LA CURVA DEL SISTEMA

#### 2.2.1 CONSIDERACIONES EN EL DIMENSIONAMIENTO

Las bombas proyectadas trabajarán dentro de un rango de funcionamiento variable, en función del número de bombas que estén en marcha y de los niveles de agua existentes en las balsas inferiores y la balsa intermedia. Estas situaciones darán lugar a alturas manométricas diferentes y por tanto puntos diferentes de trabajo en la curva característica de la bomba.

Para la determinación del punto de funcionamiento de los equipos de bombeo, se ha utilizado la situación más probable relativa al estado de llenado de la balsa intermedia, encontrándose a 1/2 de capacidad, y las balsas inferiores al 1/2 de su altura máxima y la pérdida de carga del bombeo, considerando el funcionamiento de todos los equipos simultáneamente.

Paralelamente se ha comprobado el funcionamiento de los equipos para las condiciones extremas definidas por:

- Máxima resistencia: Obtenida a partir de la curva resistente de la impulsión con la balsa inferior vacía, la balsa intermedia en su nivel máximo de explotación y con todos los equipos bombeando a la vez.

- Mínima resistencia SIN riego: Obtenido a partir de la curva resistente de la impulsión con la balsa inferior llena, la balsa intermedia en su nivel mínimo de explotación y un solo equipo funcionando.

### 2.2.2 ALTURA MANOMÉTRICA PARA LOS EQUIPOS DE BOMBEO

Para el dimensionamiento de los equipos de bombeo a instalar en la Estación de Bombeo se han considerado los siguientes parámetros:

| | |
|---|---|
| Cota N.A.M.O Balsas Inferiores | 388,30 m.s.n.m. |
| Cota de Fondo Balsas Inferiores | 384,30 m.s.n.m. |
| Cota N.A.M.O Balsa Intermedia | 428,00 m.s.n.m. |
| Cota de Fondo Balsa Intermedia | 422,00 m.s.n.m. |

Tal y como se desprende de los parámetros indicados anteriormente, los equipos de bombeo deben estar previstos para un funcionamiento adecuado dentro del rango de alturas manométricas derivadas de los diferentes niveles posibles de almacenamiento, tanto de la balsa de regulación inferior, como de la balsa intermedia.

### 2.2.3 CAUDAL DE DISEÑO DE LA TUBERÍA DE IMPULSIÓN

El caudal considerado para el dimensionamiento de esta infraestructura ha sido el obtenido de la siguiente forma:

- Superficie de riego desde la balsa Intermedia: 2.339,96 ha
- Caudal ficticio: 0,67 l/s
- Horas de bombeo semanales: 123 h

Q impulsión (l/s) = 2.339,96 ha * 0.67 l/s ha * (168/123) = 2.141,35 l/s.

Se considera un 1,5% de margen para estar del lado de la seguridad, por lo que finalmente se dimensionan los equipos de bombeo para 2.172 l/s

### 2.2.4 PÉRDIDAS DE CARGA CONTINUAS

Las características de la tubería de impulsión, que conducirá el agua desde las Balsas Inferiores hasta la Balsa Intermedia, serán las siguientes:

- Diámetro: 1400 mm
- Material: PRFV PN10
- Longitud: 898 m.

**Formulación.**

Para verificar la funcionalidad de este elemento, se determinó la pérdida de carga de esta conducción en el caso de que funcionara "en carga", mediante la fórmula de Darcy-Weisbach:

$$H_f = f * \frac{L}{D} * \frac{V^2}{2 * g}$$

Donde:
Hf = Pérdida de carga en m.c.a..
f = Factor de fricción (adimensional).
L = Longitud del tramo en m.
D = Diámetro interior de la tubería en m.
V = Velocidad de la tubería en m/seg.
g = Aceleración de la gravedad 9,8 m/seg$^2$.

El factor de fricción se ha calculado por la fórmula de White Colebrook, de expresión:

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{2{,}51}{\mathrm{Re}\sqrt{f}} + \frac{Ka}{3{,}71D}\right)$$

Donde:
Re = Núm. de Reynolds.
Ka = Coeficiente de rugosidad absoluta.
(Ka = 0,007 mm para las tuberías de PRFV)

Obteniéndose los siguientes resultados:

| Caudal (l/s) | Velocidad (m/s) | Hf (mca) |
|---|---|---|
| 2.172 | 1,41 | 0,73 |

De esta forma, el valor total considerado en la pérdida de carga para la impulsión será de 0,73 m.c.a, además de considerar por otro lado, los 4,00 m.c.a para las pérdidas singulares.

### 2.2.5 PÉRDIDAS DE CARGA SINGULARES

Para la determinación de la curva resistente del sistema se han considerado una seria de pérdidas de carga sobre los elementos singulares del bombeo (valvulería, codos, calderería, bombas, etc…) y del propio trazado de la tubería (valvulería y piezas de calderería como pueden ser codos y Tes), así como las pérdidas en trazado.

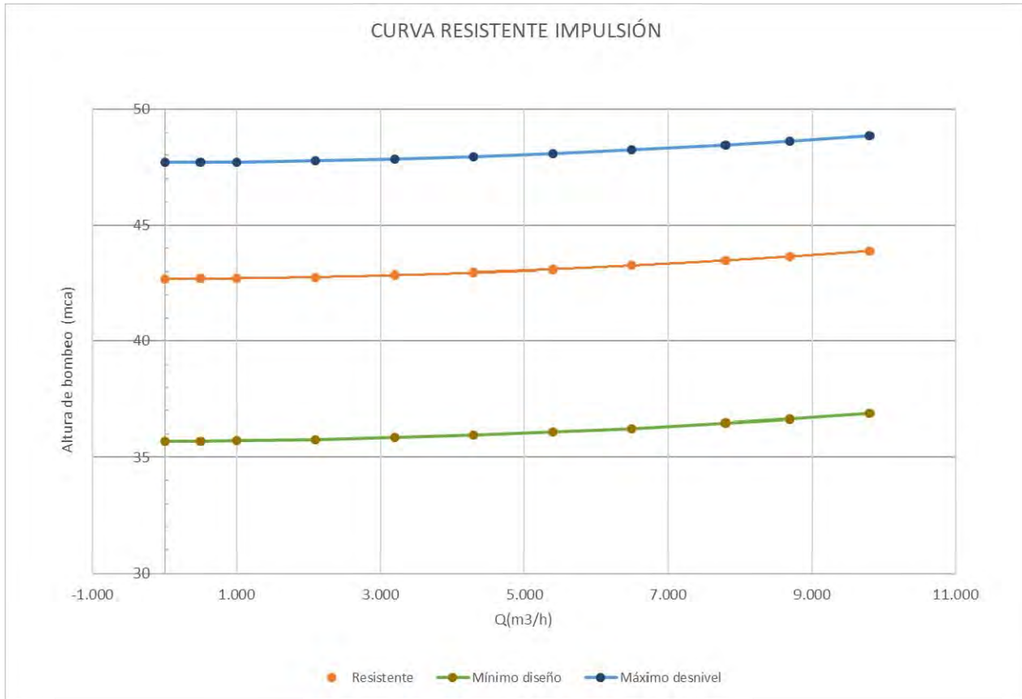
Así pues, los valores considerados en cada uno de estos aspectos variarán según la hipótesis de cálculo estudiada:

| Pérdidas de Carga | DISEÑO | Mínima Resistencia | Máxima Resistencia |
|---|---|---|---|
| Estación de bombeo: | 4 mca | 2 mca | 4 mca |
| Tubería Impulsión: | +10% s/PC en tramo para la tubería | | |

### 2.2.6 CURVA RESISTENTE

Tomando en consideración lo expuesto anteriormente la situación previa establecida en la determinación de la curva resistente en cada una de las tres situaciones estudiada será:

| Pérdidas de Carga | DISEÑO | Mínima Resistencia | Máxima Resistencia |
|---|---|---|---|
| Cota Balsa Intermedia: | 425 | 422 | 428 |
| Cota Balsas Inferiores: | 386,3 | 388,3 | 384,3 |
| Diferencia de cota: | 38,7 | 33,7 | 43,7 |
| PC Bombeo: | 4 | 2 | 4 |
| PC Filtrado: | | 0 | |
| TOTAL P.C. Fija: | 42,7 | 35,7 | 47,7 |
| TOTAL P.C. Variable: | Pérdidas de Carga lineales + 10% adicional por Pérdidas de Carga singulares | | |




## 2.3 CÁLCULO DE LOS EQUIPOS DE BOMBEO A BALSA INTERMEDIA

Para la estimación de los equipos de bombeo a instalar en la impulsión a la balsa intermedia se cuenta con el valor del caudal obtenido en el apartado anterior, así como la altura manométrica que se calculara a continuación.

Se ha estudiado la situación media en cuanto a la altura del bombeo. Esta situación se producirá cuando ambas balsas (inferiores e intermedia) se encuentren a nivel medio. Se estudia el funcionamiento con el caudal de diseño (2.172 l/s)

## 2.4 FRACCIONAMIENTO DEL BOMBEO

Se plantea el fraccionamiento del bombeo para una mejor optimización del mismo, adaptándose mejor a la energía fotovoltaica disponible, maximizar el rendimiento hidráulico de los equipos y a su vez, permitiendo adaptarse a las necesidades de la demanda a lo largo de la campaña, y a no condenar toda la instalación ante eventuales averías o mantenimiento.

Para mejorar las condiciones de funcionamiento del conjunto ante las previsibles variaciones en la disponibilidad energética y de la demanda de la red se prevé un fraccionamiento del bombeo, planteándose la instalación de un total de CINCO bombas (1 Tipo 1+1 tipo 2 + 3 tipo 3):

- 1 bomba pequeña de cámara partida (tipo 1) de 110 kW potencia motor funcionando a 181 l/s (652 $m^3$/h) a 44 m.c.a, accionada mediante variador de frecuencia para maximizar el aprovechamiento de la energía fotovoltaica disponible en las primeras y últimas horas del día.

- 1 bomba intermedia de cámara partida (tipo 2) de 200 kW potencia motor funcionando a 362 l/s (1.305 $m^3$/h) a 44 m.c.a, accionada mediante variador de frecuencia para maximizar el aprovechamiento de la energía fotovoltaica disponible en las primeras y últimas horas del día.

- 3 bombas grandes de cámara partida (tipo 3) de 315 kW potencia motor funcionando a 543 l/s (1.995 $m^3$/h) a 44 m.c.a cada una. Todos los equipos estarán regulados mediante variador.

Al estar accionados por variadores de frecuencia serán capaces de trabajar correctamente en todos los rangos de funcionamiento posible, es decir entre los 43 mca de la situación más favorable y los 48 mca de la situación más desfavorable, y de garantizar estos puntos de funcionamiento para el caudal mínimo de cada equipo, garantizando así el solape entre ellos.

Estos variadores de frecuencia son híbridos y permiten la alimentación por la red eléctrica convencional y por energía fotovoltaica indistintamente, ya sea mediante corriente continua conectada al bus de continua del variador o través del puente de potencia en corriente alterna.

Se plantean dos situaciones de trabajo en función del sistema de alimentación de los equipos, ya sea mediante energía fotovoltaica o mediante la red eléctrica. Para cada situación el bombeo funcionará de una determinada forma. En los siguientes párrafos se describe cada situación de manera detallada.

### 2.4.1 FUNCIONAMIENTO CON ENERGÍA SOLAR

En esta situación que se dará durante el día, aproximadamente entre las 8:00 am hasta las 18:00 pm en julio, los equipos se alimentarán a través de la energía generada por el campo fotovoltaico.

Con este planteamiento la bomba tipo 1 trabajará en los momentos que el campo genere poca energía fotovoltaica y el resto de las bombas irán trabajando en función de que haya más energía disponible. Recalcar que los variadores de frecuencia serán los mismos que para la situación de alimentación a través de la red eléctrica.

### 2.4.2 FUNCIONAMIENTO CON ENERGÍA ELECTRICA

El funcionamiento con energía eléctrica, se dará cuando no sea suficiente el suministro de energía solar para satisfacer todas las necesidades de la zona regable. Este se dará principalmente en los meses de junio, julio, agosto y septiembre, tal y como se puede comprobar en el Anejo 14.- Instalación Fotovoltaica.

En todos estos meses, se dará un consumo en las horas denominadas P6, que equivalen al periodo más económico. Por lo tanto, se dispondrá de 88 horas a la semana para bombear agua.

### 2.4.3 EQUIPO DE BOMBEO TIPO 1

Este equipo de bombeo es el más pequeño a instalar y trabajará exclusivamente con energía fotovoltaica. Esta bomba la denominaremos tipo 1 y será la que se accionará en primera instancia, para permitir un inicio del bombeo más progresivo. Además, con esta bomba de pequeñas dimensiones, conseguimos un mayor aprovechamiento de la energía fotovoltaica disponible, pudiéndose accionar en otros momentos para complementar a los otros equipos, tal y como puede verse en la secuencia de arranque del apartado 2.6.

A continuación, se refleja el punto de funcionamiento para el caudal máximo y mínimo de bombeo en la situación de diseño.

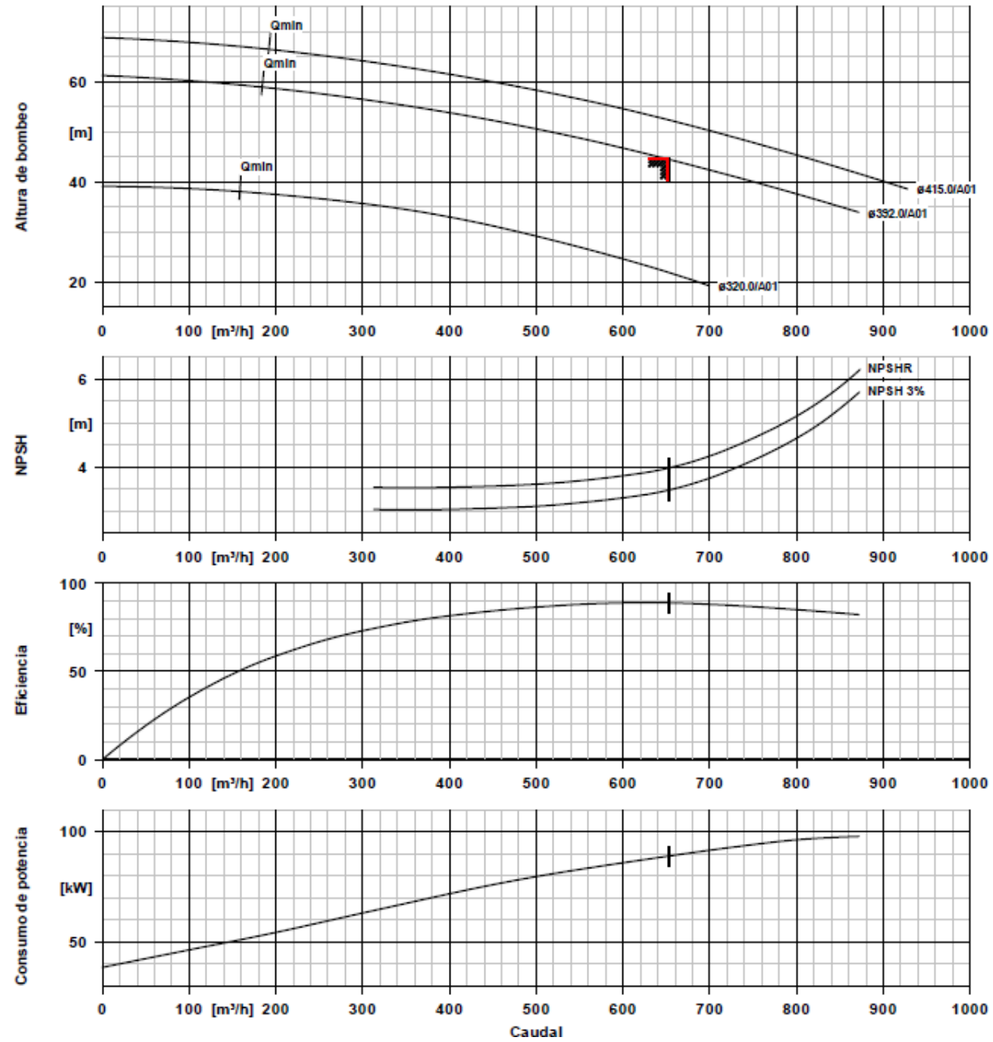
Para Caudal Diseño:

- Rendimiento de la Bomba ..... 88,9 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 1490 rpm
- Caudal de la Bomba ..... 181,1 l/s
- Altura de Bombeo (Hm): ..... 44,5 mca
- Potencia hidráulica a eje motor..... 88,9 kW
- Potencia absorbida: ..... 93,6 kW

Para Caudal Mínimo:

- Rendimiento de la Bomba ..... 58,22 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 1300 rpm
- Caudal de la Bomba ..... 47,2 l/s
- Altura de Bombeo (Hm): ..... 44,5 mca
- Potencia hidráulica a eje motor..... 35,4 kW
- Potencia absorbida: ..... 37,3 kW

***Figura 1: Curva de las bombas TIPO 1 en situación media***




Se dimensiona un equipo de bombeo cámara partida capaz de proporcionar 181,1 l/s a una altura de 44,5 m.c.a., accionados mediante motor eléctrico de 110 kW, 50 Hz 400 V a 1.490 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar. Además deberá ser capaz de cubrir el rango entre los 47,2 l/s y los 181,1 l/s previstos con rendimientos de cuerdo a la curva anterior.

Del mismo modo se comprueban las situaciones extremas para los equipos, comprobando el correcto funcionamiento de la bomba elegida a dichas situaciones.

### 2.4.4 EQUIPO DE BOMBEO TIPO 2

Una vez que la bomba tipo 1 llegue a su caudal máximo, entrará a funcionar la bomba tipo 2, dejando de hacerlo la bomba tipo 1. Este punto de conexión es el punto de mínimo caudal del equipo.

A continuación, se refleja el punto de funcionamiento para el caudal máximo y mínimo de bombeo en la situación de diseño.

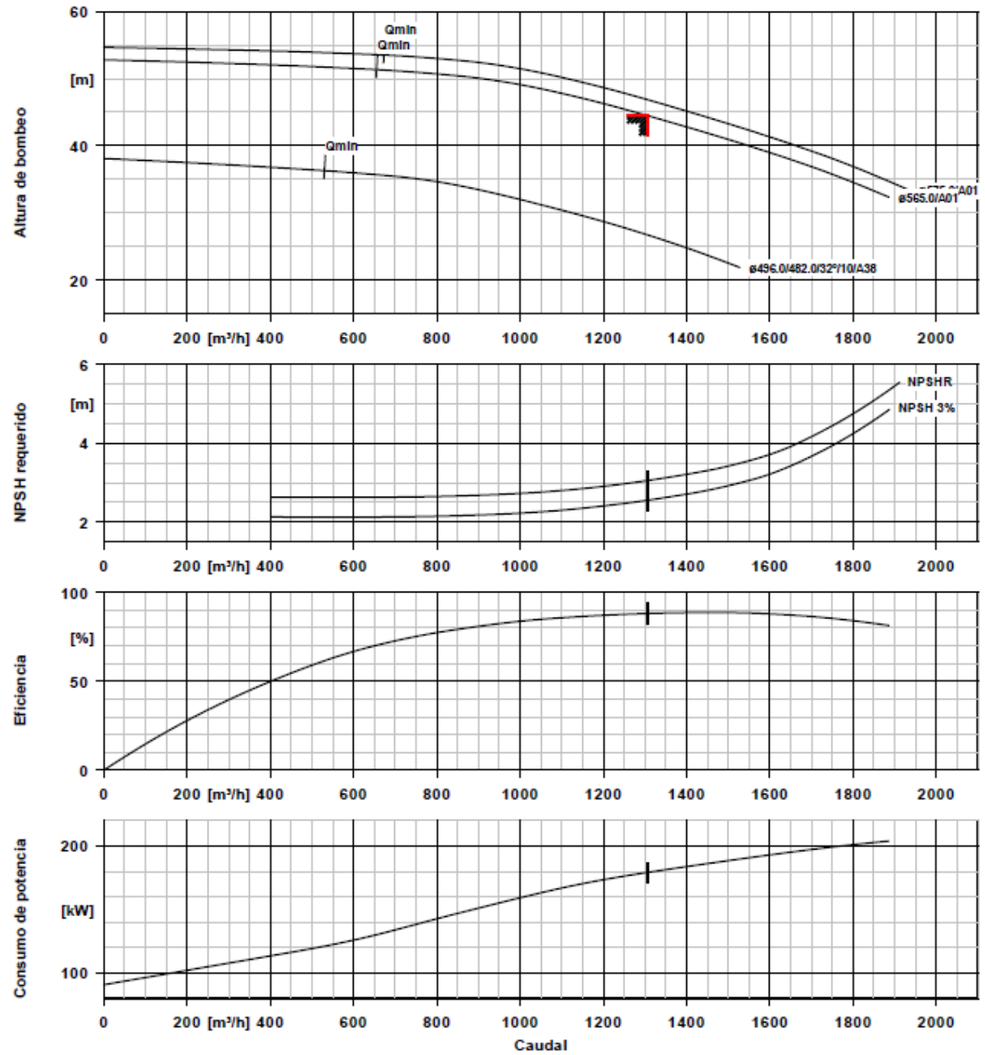
Para Caudal Diseño:

- Rendimiento de la Bomba ..... 88,1 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 993 rpm
- Caudal de la Bomba ..... 363 l/s
- Altura de Bombeo (Hm): ..... 44,5 mca
- Potencia hidráulica a eje motor..... 179,6 kW
- Potencia absorbida: ..... 189 kW

Para Caudal Mínimo:

- Rendimiento de la Bomba ..... 72,37 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 938 rpm
- Caudal de la Bomba ..... 181 l/s
- Altura de Bombeo (Hm): ..... 44,5 mca
- Potencia hidráulica a eje motor..... 109,3 kW
- Potencia absorbida: ..... 115 kW

***Figura 2: Curva de las bombas TIPO 2 en situación media***




Se dimensiona un equipo de bombeo cámara partida capaz de proporcionar 363 l/s a una altura de 44,5 m.c.a., accionados mediante motor eléctrico de 200 kW, 50 Hz 400 V a 993 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar. Además deberá ser capaz de cubrir el rango entre los 181,1 l/s y los 363 l/s previstos con rendimientos de cuerdo a la curva anterior.

Del mismo modo se comprueban las situaciones extremas para los equipos, comprobando el correcto funcionamiento de la bomba elegida a dichas situaciones.

### 2.4.5 EQUIPO DE BOMBEO TIPO 3

Se van a instalar 3 unidades de este equipo. Una vez que la bomba tipo 2 llegue a su caudal máximo, entrará a funcionar la primera bomba tipo 3. Este punto de conexión es el punto de mínimo caudal del equipo.

El primer equipo tipo 3 continuará funcionando hasta llegar al punto de caudal máximo, a partir de este caudal entrará de nuevo la bomba tipo 1 y el variador de frecuencia hará que la bomba tipo 1 vaya aumentando el caudal. Este proceso puede verse en la tabla de secuencia de funcionamiento del apartado 2.6.

Repetir la importancia de la correcta programación del variador de frecuencia y automatización lo que permitirá que los equipos trabajen de manera correcta en los puntos que se describen a continuación.

A continuación, se reflejan los puntos de funcionamiento por equipo de bombeo en la situación de diseño, balsas en nivel medio, para mínimo y máximo caudal.

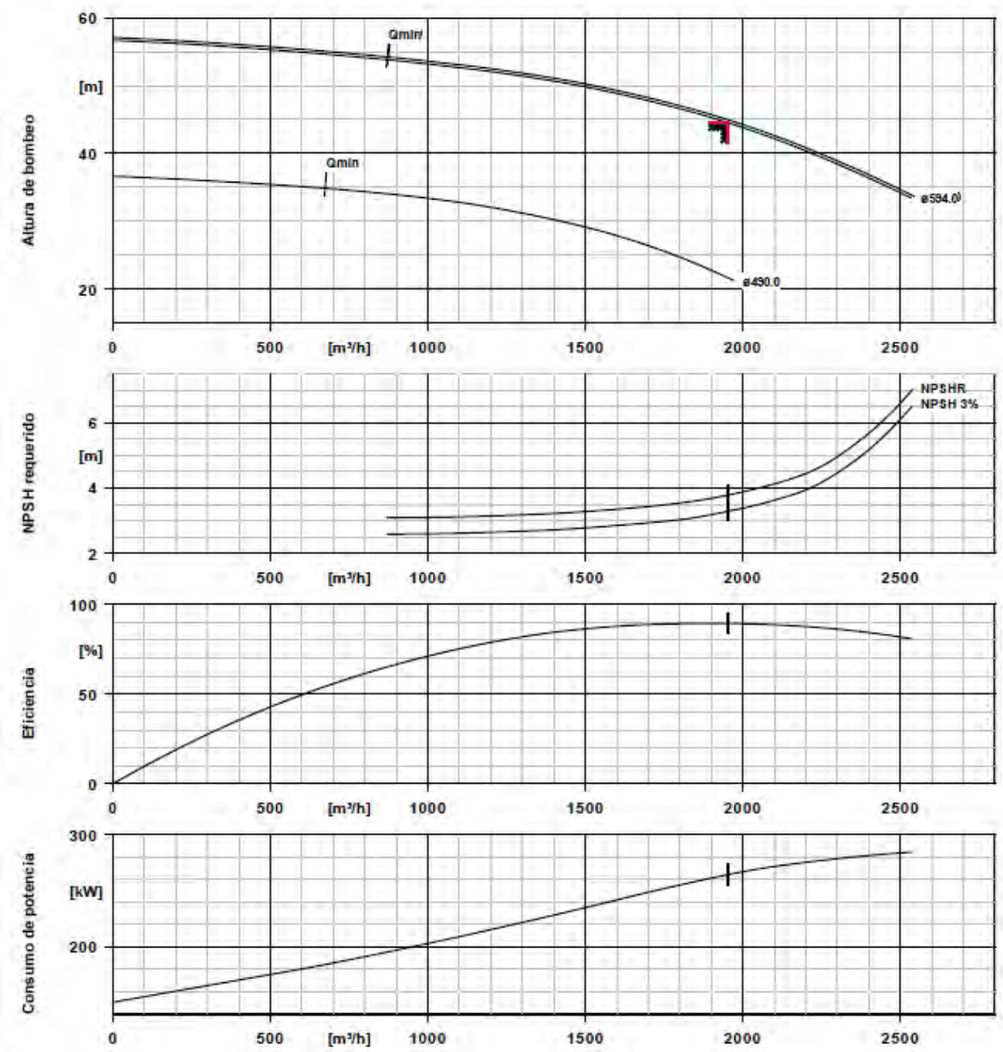
Para Caudal Diseño:

- Rendimiento de la Bomba ..... 89,5 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 994 rpm
- Caudal de la Bomba ..... 543 l/s
- Altura de Bombeo (Hm): ..... 44,5 mca
- Potencia hidráulica a eje motor..... 264,9 kW
- Potencia absorbida: ..... 278,8 kw

Para Caudal Mínimo:

- Rendimiento de la Bomba ..... 84,11 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 941 rpm
- Caudal de la Bomba ..... 363 l/s
- Altura de Bombeo (Hm): ..... 44,5 mca
- Potencia hidráulica a eje motor..... 188,2 kW
- Potencia absorbida: ..... 198,1 kw

***Figura 3: Curva de las bombas TIPO 3 en situación media***

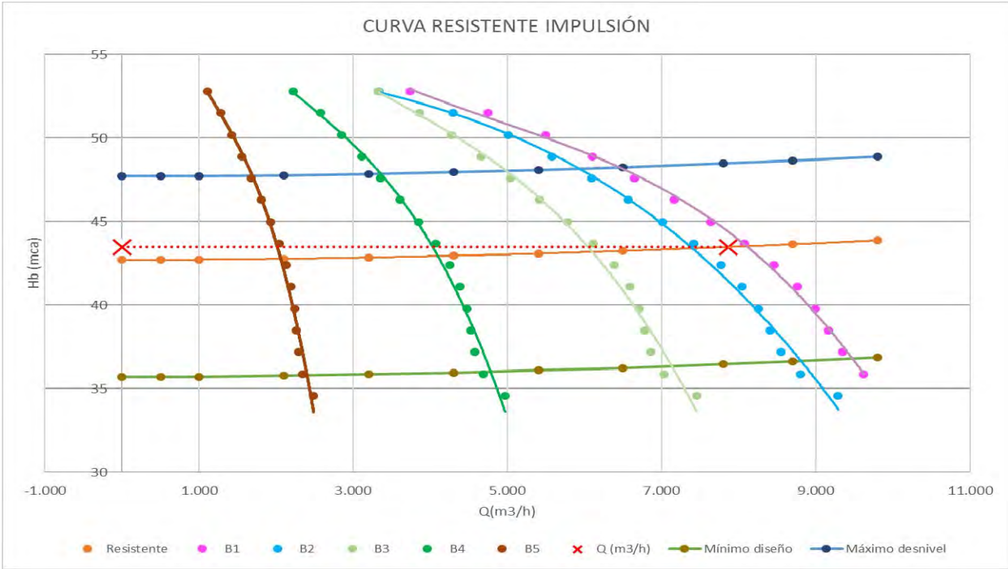



Se dimensiona un equipo de bombeo cámara partida capaz de proporcionar 543 l/s a una altura de 44,5 m.c.a., accionados mediante motor eléctrico de 315 kW, 50 Hz 400 V a 994 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar. Además deberá ser capaz de cubrir el rango entre los 363 l/s y los 543 l/s previstos con rendimientos de cuerdo a la curva anterior.

Del mismo modo se comprueban las situaciones extremas para los equipos, comprobando el correcto funcionamiento de la bomba elegida a dichas situaciones.

## 2.5 CURVA RESISTENTE DEL SISTEMA CON EQUIPOS DE BOMBEO

En la siguiente gráfica se muestra la curva resistente para cada uno de los casos estudiados y la curva de los cinco equipos de bombeo instalados trabajando en paralelo a velocidad nominal. En el gráfico se aprecia que la gráfica corta en todos los puntos. En este sentido hay que recalcar que los equipos cuentan con variador de frecuencia les permitirá adaptarse a otras curvas del sistema sin ningún problema.




A continuación, se analizan las situaciones extremas para los equipos en el supuesto que trabajaran a velocidad nominal (50Hz), sin ningún tipo de limitaciones, comprobando el funcionamiento de la bomba elegida en dichas situaciones.

**Bomba Tipo 3:**

| Punto de funcionamiento | Q unitario | Hman | NPSHr | Rendimiento | P absorbida | P motor seleccionada |
|---|---|---|---|---|---|---|
| | (m3/h) | m.c.a. | | % | (kW) | (kW) |
| **Punto diseño** | 1.955 | 44,5 | 3,7 | 89,5 | 278,8 | 315 kW (3uds) |
| **Punto mínima resistencia** | 2.400 | 35,7 | 5,5 | 85,0 | 289,2 | |
| **Punto máxima resistencia** | 1.700 | 48,0 | 3,0 | 89,0 | 263,1 | |

**Bomba Tipo 2:**

| Punto de funcionamiento | Q unitario | Hman | NPSHr | Rendimiento | P absorbida | P motor seleccionada |
|---|---|---|---|---|---|---|
| | (m3/h) | m.c.a. | | % | (kW) | (kW) |
| **Punto diseño** | 1.305 | 44,5 | 3,05 | 88,1 | 189 | 200 kW (1uds) |
| **Punto mínima resistencia** | 1.700 | 35,7 | 4,25 | 86,0 | 202,5 | |
| **Punto máxima resistencia** | 1.050 | 48,0 | 2,80 | 85,0 | 170,1 | |

**Bomba Tipo 1:**

| Punto de funcionamiento | Q unitario | Hman | NPSHr | Rendimiento | P absorbida | P motor seleccionada |
|---|---|---|---|---|---|---|
| | (m3/h) | m.c.a. | | % | (kW) | (kW) |
| **Punto diseño** | 652 | 44,5 | 3,98 | 88,9 | 93,6 | 110 kW (1uds) |
| **Punto mínima resistencia** | 820 | 35,7 | 5,4 | 85,0 | 98,8 | |
| **Punto máxima resistencia** | 560 | 48,0 | 3,5 | 88,0 | 87,6 | |

Al respecto de lo anterior resulta importante destacar que en este caso, en el que todos los equipos estarán accionados por variadores de frecuencia, los equipos podrán trabajar a velocidad nominal o por encima si hay potencia disponible, o por debajo cuando se requiera.
Con esta premisa, y teniendo en cuenta que se debe salvaguardar la demanda de potencia de los motores, se plantea que mediante el autómata del bombeo, el cual gobernará todos los equipos, se limite la demanda de potencia de los motores tanto en la situación favorable como en la desfavorable a una potencia similar a la de diseño. Regulado con el variador por debajo de 50Hz en la situación favorable, y que en la situación desfavorable el equipo pueda subir por encima de los 50Hz.
Deberá prestarse especial atención a este funcionamiento en todos los casos, especialmente en el equipo Tipo 2.

## 2.6 RESUMEN Y CONCLUSIONES.

Así pues, como conclusión a todo lo expuesto anteriormente se prevé la instalación de:

- Bomba Tipo 1. Se dimensiona **un equipo de bombeo** de cámara partida capaz de proporcionar 181,1 l/s a una altura de 44,5 m.c.a., accionados mediante motor eléctrico de 110 kW, 50 Hz 400 V a 1490 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar.

- Bomba Tipo 2. Este equipo de **bombeo consta de una bomba** de cámara partida horizontal capaz de proporcionar 362,5 l/s a una altura de 44,5 m.c.a. y un caudal mínimo de 181,1 l/s, accionados mediante motor eléctrico de 200 kW, 50 Hz 400 V a 993 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar.

  Se accionará una vez que la bomba pequeña llegue al 100 % y haya disponibilidad de energía adicional para accionar más bombas. En este momento la bomba tipo 1 saldrá des sistema temporalmente.

- Bomba Tipo 3. Este equipo de **bombeo consta de tres bombas**. Se accionará una vez que la bomba Tipo 2 llegue al 100 % y haya disponibilidad de energía adicional para accionar más bombas. En este momento la bomba tipo 3 saldrá del sistema temporalmente.

  Se dimensiona un equipo de bombeo de cámara partida horizontal capaz de proporcionar 543 l/s a una altura de 44,5 m.c.a., accionados mediante motor eléctrico de 315 kW, 50 Hz 400 V a 994 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar. Además deberá ser capaz de cubrir el rango entre los 362,5 l/s y los 543 l/s previstos con rendimientos de cuerdo a la curva anterior.

Las bombas irán alternando su funcionamiento según la tabla de secuencias de arranque, comandados por el autómata del bombeo en base a la energía disponible.

La potencia total instalada en esta elevación será de 3x315 + 1x200 + 1x110 kW. La potencia total absorbida será la suma de las potencias absorbidas por cada equipo, 1.140,9 kW. Para el suministro eléctrico convencional, tanto de este bombeo como la impulsión a la balsa elevada, se plantea un trafo de 2.000 kVA, y para el suministro fotovoltaico para no incurrir en el periodo tarifario P2 se prevé un total del 1.359,56 kWp (funcionarán hasta los 5 equipos al 100%, dependiendo de la potencia disponible) para una potencia demandada de 1.140,9 kW.

A continuación, se representa la secuencia de funcionamiento del bombeo a balsa Intermedia

| | **Caudal TOTAL (l/s)** | Bomba 1 **110 kW** (Tipo 1) | Bomba 2 **200 kW** (Tipo 2) | Bomba 3 **315 kW** (Tipo 3) | Bomba 4 **315 kW** (Tipo 3) | Bomba 5 **315 kW** (Tipo 3) |
|---|---|---|---|---|---|---|
| Paso 1 | 47-181 | Conexión 57,2%-88,9% 1300-1490rpm | Desconectada | Desconectada | Desconectada | Desconectada |
| Paso 2 | 181-363 | Desconexión | Conexión 75,1%-88,1% 938-993rpm | Desconectada | Desconectada | Desconectada |
| Paso 3 | 363-554 | Desconectada | Desconexión | Conexión 85,2%-89,5% 940-994rpm | Desconectada | Desconectada |
| Paso 4 | 554-735 | Conexión 57,2%-88,9% 1300-1490rpm | Desconectada | Conectada 89,5% 994rpm | Desconectada | Desconectada |
| Paso 5 | 735-917 | Desconexión | Conexión 75,1%-88,1% 938-993rpm | Conectada 89,5% 994rpm | Desconectada | Desconectada |
| Paso 6 | 917-1098 | Conexión 57,2%-88,9% 1300-1490rpm | Conectada 88,1% 993rpm | Conectada 89,5% 994rpm | Desconectada | Desconectada |
| Paso 7 | 1098-1278 | Conectada 57,2%-88,9% 1300-1490rpm | Desconexión | Conectada 89,5% 994rpm | Conexión 89,5% 994rpm | Desconectada |
| Paso 8 | 1278-1460 | Desconexión | Conexión 75,1%-88,1% 938-993rpm | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm | Desconectada |
| Paso 9 | 1460-1641 | Conexión 57,2%-88,9% 1300-1490rpm | Conectada 88,1% 993rpm | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm | Desconectada |
| Paso 10 | 1641-1821 | Conectada 57,2%-88,9% 1300-1500 | Desconexión | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm | Conexión 89,5% 994rpm |
| Paso 11 | 1821-2003 | Desconexión | Conexión 88,1% 993rpm | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm |
| Paso 12 | 2003-2184 | Conexión 88,9% 1490rpm | Conectada 88,1% 993rpm | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm | Conectada 89,5% 994rpm |

Como se puede observar, las bombas se irán conectando de forma progresiva conforme vaya aumentado la disponibilidad energética y por lo tanto se pueda suministrar más caudal.

# 3 IMPULSION A BALSA ELEVADA

## 3.1 CARACTERÍSTICAS DE LA IMPULSIÓN

Tal y como se ha mencionado anteriormente la tubería de Impulsión servirá a su vez como parte de la infraestructura de distribución de la Red de Riego.

El trazado previsto para la impulsión a la Balsa Elevada, estará compuesto por una tubería con las siguientes características:

- Diámetro: 700 mm
- Material: PRFV PN10
- Longitud: 1.969 m.

## 3.2 DETERMINACIÓN DE LA CURVA DEL SISTEMA

### 3.2.1 CONSIDERACIONES EN EL DIMENSIONAMIENTO

Las bombas proyectadas trabajarán dentro de un rango de funcionamiento variable, en función del número de bombas que estén en marcha y de los niveles de agua existentes en las balsas inferiores y la balsa elevada Estas situaciones darán lugar a alturas manométricas diferentes y por tanto puntos diferentes de trabajo en la curva característica de la bomba.

Para la determinación del punto de funcionamiento de los equipos de bombeo, se ha utilizado la situación más probable relativa al estado de llenado de la balsa elevada, encontrándose a 1/2 de capacidad, y las balsas inferiores al 1/2 de su altura máxima y la pérdida de carga del bombeo, considerando el funcionamiento de todos los equipos simultáneamente.

Paralelamente se ha comprobado el funcionamiento de los equipos para las condiciones extremas.

### 3.2.2 ALTURA MANOMÉTRICA PARA LOS EQUIPOS DE BOMBEO

Para el dimensionamiento de los equipos de bombeo a instalar en la Estación de Bombeo se han considerado los siguientes parámetros:

| | |
|---|---|
| Cota N.A.M.O Balsas Inferiores | 388,30 m.s.n.m. |
| Cota de Fondo Balsas Inferiores | 384,30 m.s.n.m. |
| Cota N.A.M.O Balsa Elevada | 444,25 m.s.n.m. |
| Cota de Fondo Balsa Elevada | 440,00 m.s.n.m. |

Tal y como se desprende de los parámetros indicados anteriormente, los equipos de bombeo deben estar previstos para un funcionamiento adecuado dentro del rango de alturas manométricas derivadas de los diferentes niveles posibles de almacenamiento, tanto de la balsa de regulación inferior, como de la balsa elevada.

### 3.2.3 CAUDAL DE DISEÑO DE LA TUBERÍA DE IMPULSIÓN

El caudal considerado para el dimensionamiento de esta infraestructura ha sido el obtenido de la siguiente forma:

- Superficie de riego desde la balsa Elevada: 374,57 ha
- Caudal ficticio: 0,67 l/s
- Horas de bombeo semanales: 123 h

Q impulsión (l/s) = 374,57 ha * 0 ,67 l/s ha * (168/123) = 342,78 l/s.

En este caso, se considera un 2% de margen para estar del lado de la seguridad, por lo que finalmente se dimensionan los equipos de bombeo para 350 l/s

### 3.2.4 PÉRDIDAS DE CARGA CONTINUAS

Las características de la tubería de impulsión, que conducirá el agua desde las Balsas Inferiores hasta la Balsa Elevada, serán las siguientes:

- Diámetro: 700 mm
- Material: PRFV PN10
- Longitud: 1.969 m.

**Formulación.**

Para verificar la funcionalidad de este elemento, se determinó la pérdida de carga de esta conducción en el caso de que funcionara "en carga", mediante la fórmula de Darcy-Weisbach:

$$H_f = f * \frac{L}{D} * \frac{V^2}{2 * g}$$

Donde:
Hf = Pérdida de carga en m.c.a..
f = Factor de fricción (adimensional).
L = Longitud del tramo en m.
D = Diámetro interior de la tubería en m.
V = Velocidad de la tubería en m/seg.
g = Aceleración de la gravedad 9,8 m/seg$^2$.

El factor de fricción se ha calculado por la fórmula de White Colebrook, de expresión:

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{2{,}51}{\mathrm{Re}\sqrt{f}} + \frac{Ka}{3{,}71D}\right)$$

Donde:
Re = Núm. de Reynolds.
Ka = Coeficiente de rugosidad absoluta.
(Ka = 0,007 mm para las tuberías de PRFV)

Obteniéndose los siguientes resultados:

| Caudal (l/s) | Velocidad (m/s) | Hf (mca) |
|---|---|---|
| 350 | 0,91 | 1,53 |

De esta forma, el valor total considerado en la pérdida de carga para la impulsión será de 1,53 m.c.a, además de considerar por otro lado, los 4,00 m.c.a para las pérdidas singulares.

### 3.2.5 PÉRDIDAS DE CARGA SINGULARES

Para la determinación de la curva resistente del sistema se han considerado una seria de pérdidas de carga sobre los elementos singulares del bombeo (valvulería, codos, calderería, bombas, etc…) y del propio trazado de la tubería (valvulería y piezas de calderería como pueden ser codos y Tes), así como las pérdidas en trazado.

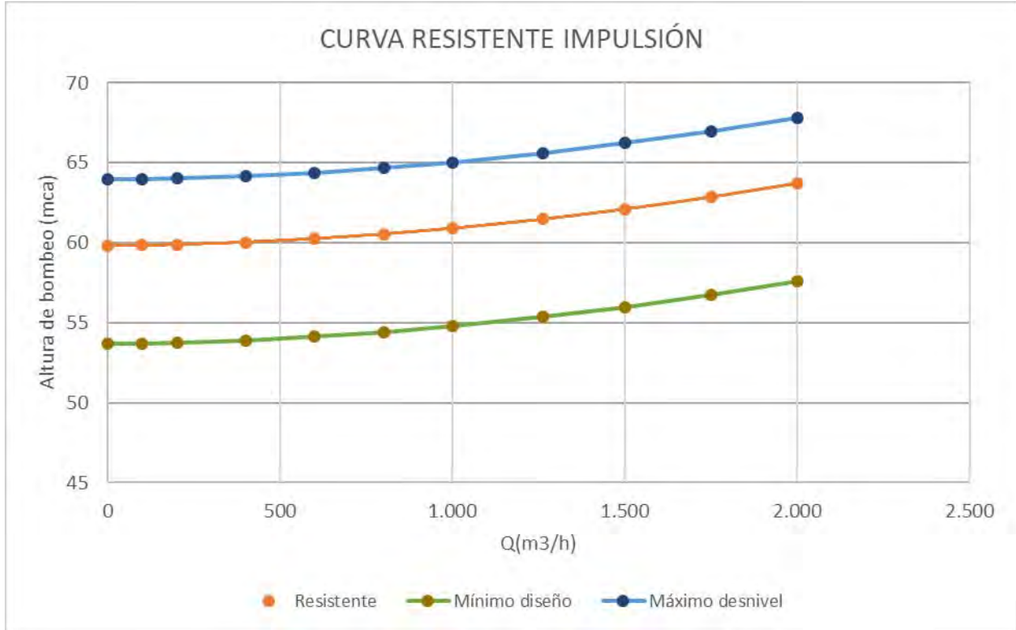
Así pues, los valores considerados en cada uno de estos aspectos variarán según la hipótesis de cálculo estudiada:

| Pérdidas de Carga | DISEÑO | Mínima Resistencia | Máxima Resistencia |
|---|---|---|---|
| Estación de bombeo: | 4 mca | 2 mca | 4 mca |
| Tubería Impulsión: | +10% s/PC en tramo para la tubería | | |

### 3.2.6 CURVA RESISTENTE

Tomando en consideración lo expuesto anteriormente la situación previa establecida en la determinación de la curva resistente en cada una de las tres situaciones estudiada será:

| Pérdidas de Carga | DISEÑO | Mínima Resistencia | Máxima Resistencia |
|---|---|---|---|
| Cota Balsa Elevada: | 442,13 | 440 | 444,25 |
| Cota Balsas Inferiores: | 386,3 | 388,3 | 384,3 |
| Diferencia de cota: | 55,83 | 51,70 | 59,95 |
| PC Bombeo: | 4 | 2 | 4 |
| PC Filtrado: | | 0 | |
| TOTAL P.C. Fija: | 59,83 | 53,70 | 63,95 |
| TOTAL P.C. Variable: | Pérdidas de Carga lineales + 10% adicional por Pérdidas de Carga singulares | | |




### 3.3 CÁLCULO DE LOS EQUIPOS DE BOMBEO A BALSA ELEVADA

Para la estimación de los equipos de bombeo a instalar en la impulsión a la balsa elevada se cuenta con el valor del caudal obtenido en el apartado anterior, así como la altura manométrica que se calculara a continuación.

Se ha estudiado la situación media en cuanto a la altura del bombeo. Esta situación se producirá cuando ambas balsas (inferiores y elevada) se encuentren a nivel medio. Se estudia el funcionamiento con el caudal de diseño (351 l/s)

### 3.4 FRACCIONAMIENTO DEL BOMBEO

Se plantea el fraccionamiento del bombeo para una mejor optimización del mismo, adaptándose mejor a la energía fotovoltaica disponible, maximizar el rendimiento hidráulico de los equipos y a su vez, permitiendo adaptarse a las necesidades de la demanda a lo largo de la campaña, y a no condenar toda la instalación ante eventuales averías o mantenimiento.

Para mejorar las condiciones de funcionamiento del conjunto ante las previsibles variaciones en la disponibilidad energética y de la demanda de la red se prevé un fraccionamiento del bombeo, planteándose la instalación de un total de TRES bombas de iguales características:

- 3 bombas de 110 kW potencia motor funcionando a 117 l/s (652 $m^3/h$) a 62 m.c.a, accionada mediante variador de frecuencia para maximizar el aprovechamiento de la energía fotovoltaica disponible en las primeras y últimas horas del día.

Al estar accionados por variadores de frecuencia serán capaces de trabajar correctamente en todos los rangos de funcionamiento posible, es decir entre los 54 mca de la situación más favorable y los 64 mca de la situación más desfavorable, y de garantizar estos puntos de funcionamiento para el caudal mínimo de cada equipo, garantizando así el solape entre ellos.

Estos variadores de frecuencia son híbridos y permiten la alimentación por la red eléctrica convencional y por energía fotovoltaica indistintamente, ya sea mediante corriente continua conectada al bus de continua del variador o través del puente de potencia en corriente alterna.

Se plantean dos situaciones de trabajo en función del sistema de alimentación de los equipos, ya sea mediante energía fotovoltaica o mediante la red eléctrica. Para cada situación el bombeo funcionará de una determinada forma. En los siguientes párrafos se describe cada situación de manera detallada.

### 3.4.1 FUNCIONAMIENTO CON ENERGÍA SOLAR

En esta situación que se dará durante el día, aproximadamente entre las 8:00 am hasta las 18:00 pm en julio, los equipos se alimentarán a través de la energía generada por el campo fotovoltaico.

Con este planteamiento la primera bomba trabajará en los momentos que el campo genere poca energía fotovoltaica y el resto de las bombas irán trabajando en función de que haya más energía disponible. Recalcar que los variadores de frecuencia serán los mismos que para la situación de alimentación a través de la red eléctrica.

### 3.4.2 FUNCIONAMIENTO CON ENERGÍA ELECTRICA

El funcionamiento con energía eléctrica, se dará cuando no sea suficiente el suministro de energía solar para satisfacer todas las necesidades de la zona regable. Este se dará principalmente en los meses de junio, julio, agosto y septiembre, tal y como se puede comprobar en el Anejo 14.- Instalación Fotovoltaica.

En todos estos meses, se dará un consumo en las horas denominadas P6, que equivalen al periodo más económico. Por lo tanto, se dispondrá de 88 horas a la semana para bombear agua.

### 3.4.3 EQUIPO DE BOMBEO

A continuación, se refleja el punto de funcionamiento para el caudal máximo y mínimo de bombeo en la situación de diseño.

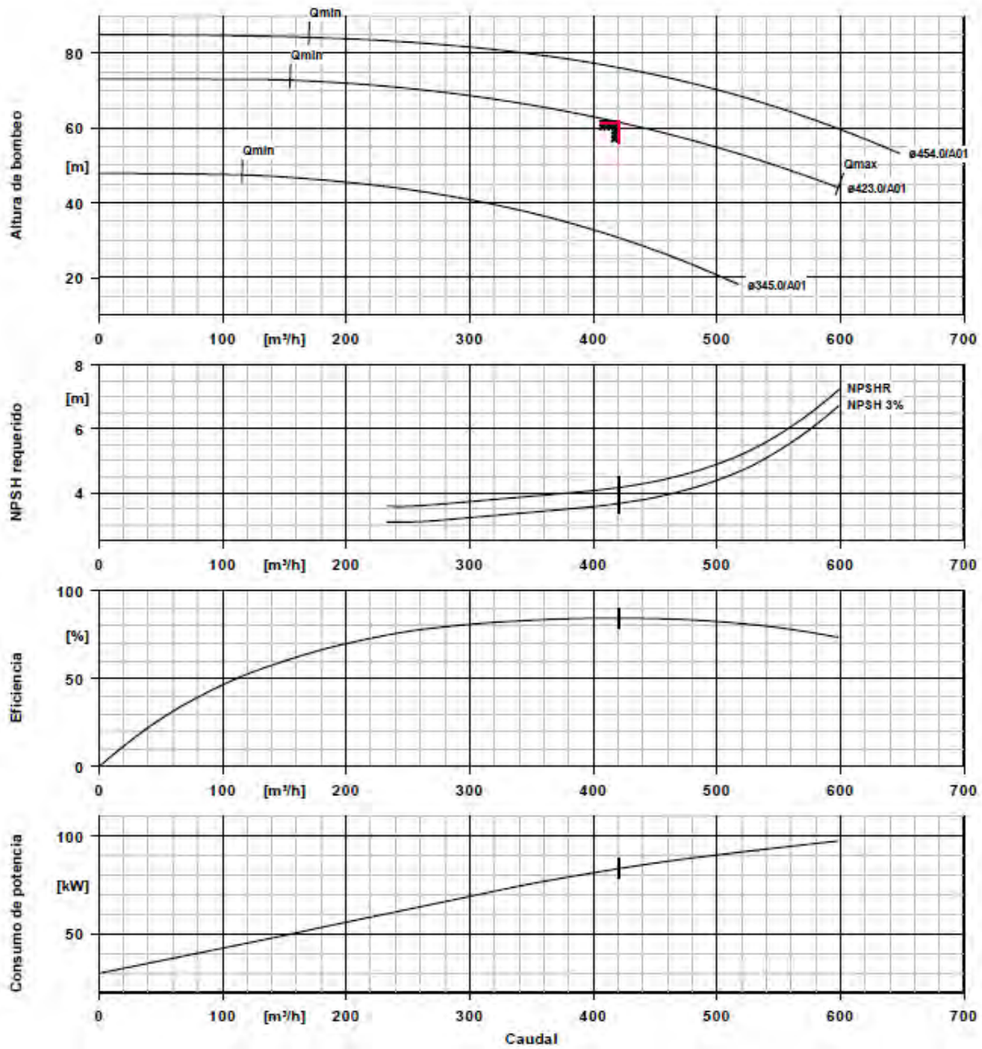
Para Caudal Diseño:

- Rendimiento de la Bomba ..... 84,5 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 1490 rpm
- Caudal de la Bomba ..... 116,94 l/s
- Altura de Bombeo (Hm): ..... 62 mca
- Potencia hidráulica a eje motor..... 84,2 kW
- Potencia absorbida: ..... 88,6 kW

Para Caudal Mínimo:

- Rendimiento de la Bomba ..... 62 %
- Rendimiento del Motor..... 95 %
- Revoluciones de giro..... 1391 rpm
- Caudal de la Bomba ..... 41,67 l/s
- Altura de Bombeo (Hm): ..... 62 mca
- Potencia hidráulica a eje motor..... 40,89 kw
- Potencia absorbida: ..... 43,04 kw

***Figura 4: Curva de las bombas en situación media***

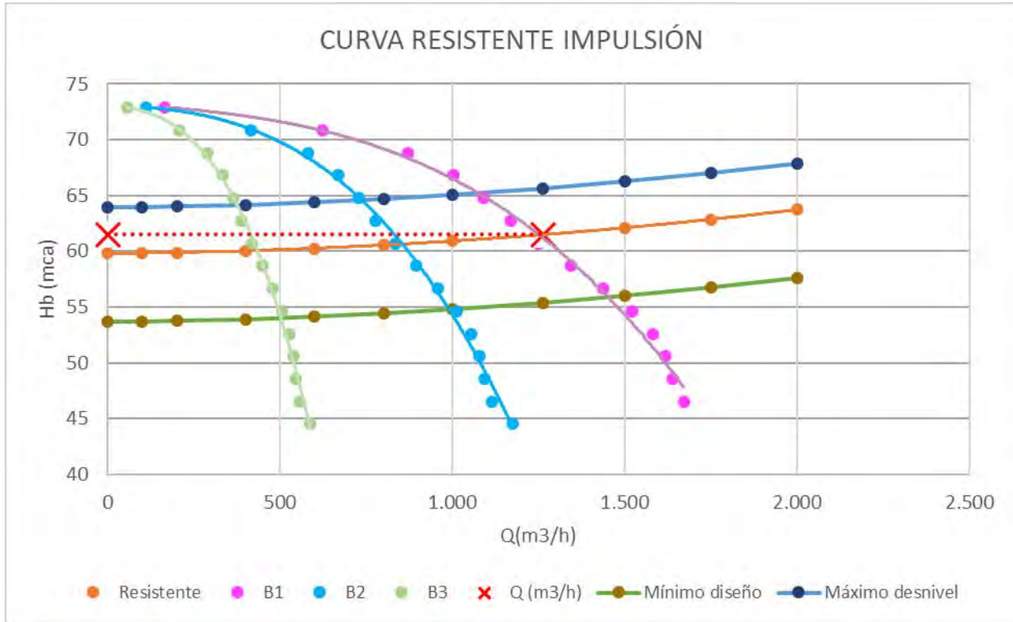



Se dimensiona un equipo de bombeo cámara partida capaz de proporcionar 116,94 l/s a una altura de 62,0 m.c.a., accionados mediante motor eléctrico de 110 kW, 50 Hz 400 V a 1.490 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar. Además deberá ser capaz de cubrir el rango entre los 41,67 l/s y los 116,94 l/s previstos con rendimientos de cuerdo a la curva anterior.

Del mismo modo se comprueban las situaciones extremas para los equipos, comprobando el correcto funcionamiento de la bomba elegida a dichas situaciones.

## 3.5 CURVA RESISTENTE DEL SISTEMA CON EQUIPOS DE BOMBEO

En la siguiente gráfica se muestra la curva resistente para cada uno de los casos estudiados y la curva de los tres equipos de bombeo instalados trabajando en paralelo a velocidad nominal. En el gráfico se aprecia que la gráfica corta en todos los puntos. En este sentido hay que recalcar que los equipos cuentan con variador de frecuencia les permitirá adaptarse a otras curvas del sistema sin ningún problema.




A continuación, se analizan las situaciones extremas para los equipos, comprobando el correcto funcionamiento de la bomba elegida a dichas situaciones.

| Punto de funcionamiento | Q unitario | Hman | NPSHr | Rendimiento | P absorbida | P motor seleccionada |
|---|---|---|---|---|---|---|
| | (m3/h) | m.c.a. | | % | (kW) | (kW) |
| **Punto diseño** | 421,0 | 62,0 | 4,2 | 84,5 | 88,6 | 110 kW (3uds) |
| **Punto mínima resistencia** | 510 | 54,8 | 5,0 | 80,0 | 100,24 | |
| **Punto máxima resistencia** | 365 | 65,2 | 4,0 | 84,0 | 81,29 | |

Al respecto de lo anterior resulta importante destacar que, en este caso, en el que todos los equipos estarán accionados por variadores de frecuencia, los equipos podrán trabajar a velocidad nominal o por encima si hay potencia disponible, o por debajo cuando se requiera. Con esta premisa, y teniendo en cuenta que se debe salvaguardar la demanda de potencia de los motores, se plantea que mediante el autómata del bombeo, el cual gobernará todos los equipos, se limite la demanda de potencia de los motores tanto en la situación favorable como en la desfavorable a una potencia similar a la de diseño. Regulado con el variador por debajo de 50Hz en la situación favorable, y que en la situación desfavorable el equipo pueda subir por encima de los 50Hz.

### 3.6 RESUMEN Y CONCLUSIONES.

Así pues, como conclusión a todo lo expuesto anteriormente se prevé la instalación de:

- Se dimensiona un equipo de bombeo **cámara partida** capaz de proporcionar 116,94 l/s a una altura de 62,0 m.c.a., accionados mediante motor eléctrico de 110 kW, 50 Hz 400 V a 1.490 rpm, accionado por variador de frecuencia híbrido específico para funcionamiento solar. Además deberá ser capaz de cubrir el rango entre los 41,67 l/s y los 116,94 l/s previstos con rendimientos de cuerdo a la curva anterior.

  Este equipo de bombeo **consta de tres bombas.** Se accionará una bomba a continuación de la otra, una vez que la anterior llegue al 100 % y haya disponibilidad de energía adicional para accionar más bombas. Cuando la primera llegue al 100% y haya energía disponible, esta reducirá el régimen hasta el 50% para dar entrada a la segunda bomba. Para la entrada de la tercera, las dos bombas activas reducirán su régimen y se igualarán para dar entrada a la tercera bomba, de modo que las tres trabajen en el mismo punto de funcionamiento, hasta el 100% de funcionamiento de los equipos. Para la salida de las bombas el funcionamiento será similar.

La potencia total instalada en esta elevación será de 3x110 kW. La potencia total absorbida será la suma de las potencias absorbidas por cada equipo, 265,8 kW. Para el suministro eléctrico convencional, tano de este bombeo como la impulsión a la balsa intermedia, se plantea un trafo de 2.000 kVA, y para el suministro fotovoltaico para no incurrir en el periodo tarifario P2 se prevé un total del 335 kWp (funcionarán hasta los 3 equipos al 100%, dependiendo de la potencia disponible) para una potencia demandada de 265,8 kW.

A continuación, se representa la secuencia de funcionamiento del bombeo a balsa Elevada:

| | **Caudal TOTAL (m3/h)** | Bomba 1 **110 kW** (Tipo 1) | Bomba 2 **110 kW** (Tipo 1) | Bomba 3 **110 kW** (Tipo 1) |
|---|---|---|---|---|
| Paso 1 | 150-421 | Conexión 62%-84,5% 1390-1490rpm | Desconectada | Desconectada |
| Paso 2 | 421-842 | Conectada 75,7%-84,5% 1407-1490rpm | Conexión 75,7%-84,5% 1407-1490 | Desconectada |
| Paso 3 | 842-1.263 | Conectada 82,5%-84,5% 1419-1490rpm | Conectada 82,5%-84,5% 1419-1490rpm | Conexión 82,5%-84,5% 1419-1490rpm |

Como se puede observar, las bombas se irán conectando de forma progresiva conforme vaya aumentado la disponibilidad energética y por lo tanto se pueda suministrar más caudal.

# 4 COSTES ENERGÉTICOS.

Para la realización de este estudio se ha partido de precios existentes en otras Comunidades de Regantes de tarifas para la modalidad de 6 periodos horarios.

La tarifa eléctrica de aplicación es la 6.1 TD. Esta tarifa cuenta una discriminación horaria variable a lo largo de los diferentes meses del año, en 6 periodos horarios.

Así pues, esta tarifa tiene diferentes precios de la energía según sea la hora a la que se consume, es decir, cuenta con contadores de electricidad para cada uno de los periodos, con lo que en la factura de luz vendrá reflejada la energía en cada uno de los periodos con su precio por periodo correspondiente, siendo el periodo P1 el periodo más caro y el periodo P6 el más barato.

La distribución de periodos se refleja en la siguiente figura:

**Figura 1.** Distribución horaria de la Tarifa 6.1 TD

| HORA/MES | ENERO | FEBRERO | MARZO | ABRIL | MAYO | JUNIO | JULIO | AGOSTO | SEPTIEMBRE | OCTUBRE | NOVIEMBRE | DICIEMBRE | FESTIVO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 a 01h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 01 a 02h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 02 a 03h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 03 a 04h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 04 a 05h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 05 a 06h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 06 a 07h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 07 a 08h | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 | P6 |
| 08 a 09h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |
| 09 a 10h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 10 a 11h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 11 a 12h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 12 a 13h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 13 a 14h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 14 a 15h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |
| 15 a 16h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |
| 16 a 17h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |
| 17 a 18h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |
| 18 a 19h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 19 a 20h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 20 a 21h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 21 a 22h | P1 | P1 | P2 | P4 | P4 | P3 | P1 | P3 | P3 | P4 | P2 | P1 | P6 |
| 22 a 23h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |
| 23 a 24h | P2 | P2 | P3 | P5 | P5 | P4 | P2 | P4 | P4 | P5 | P3 | P2 | P6 |

*Nuevos periodos tarifarios para zona península. Fuente: MyEnergyMap*

El coste del término de potencia depende de las potencias contratadas en cada período tarifario y el término de energía de las potencias realmente demandadas en el mismo durante el período de facturación, según la siguiente tabla de precios:

**Tabla 1.** Precios considerados para el cálculo de los costes energéticos.

| | ***Periodos horarios eléctricos*** | | | | | |
|---|---|---|---|---|---|---|
| | ***P1*** | ***P2*** | ***P3*** | ***P4*** | ***P5*** | ***P6*** |
| **Término de POTENCIA (€/kWh · año)** | 39,139427 | 19,586654 | 14,334178 | 14,334178 | 14,334178 | 6,540177 |
| **Término de ENERGÍA (€/kWh)** | 0,137322 | 0,114125 | 0,101906 | 0,088886 | 0,081456 | 0,064648 |

## 4.1 COSTE USO 100% ENERGÍA RED ELÉCTRICA

En la tabla se resume el cálculo de los costes energéticos en el caso de que todos los bombeos se alimentaran exclusivamente con energía eléctrica.

**Tabla 2.** Estimación coste energético en el caso de utilización energía eléctrica P6+P2

| BOMBEO | Coste T. POTENCIA | Coste T. ENERGÍA | COSTE TOTAL Con impuesto e IVA | Energía Eléctrica Consumida (MWh/año) |
|---|---|---|---|---|
| EB 1 | 88.892,41 € | 162.522,32 € | 306.544,84 € | 2.371,55 |
| EB 2 | 22.812,69 € | 38.240,29 € | 74.440,54 € | 558,96 |
| **TOTAL** | **111.705,10 €** | **200.762,61** | **380.985,38 €** | **2.930,51** |

Así pues, el coste energético anual en el caso de que se empleara exclusivamente energía eléctrica ascendería a 380.985,38 €, si consideramos el coste energético durante el plazo de vida útil de la instalación, que en este caso se han considerado 25 años, ascenderá a un total de 9.524.634,50 € impuestos eléctricos e I.V.A. incluidos.

## 4.2 COSTE USO ENERGÍA RED + ENERGÍA ALTERNATIVA

En la tabla se resume el cálculo de los costes energéticos en el caso de que todos los bombeos se alimentaran exclusivamente con energía eléctrica en periodo P6 y fotovoltaica.

**Tabla 3.** Estimación coste energético en el caso de utilización energía eléctrica exclusivamente en P6

| BOMBEO | Coste T. POTENCIA | Coste T. ENERGÍA | COSTE TOTAL Con impuesto e IVA | Energía Eléctrica Consumida (MWh/año) |
|---|---|---|---|---|
| EB 1 | 8.409,92 € | 51.846,28 € | 73.469,15 € | 801,98 |
| EB 2 | 2.158,26 € | 10.257,21 € | 15.137,93 € | 158,66 |
| **TOTAL** | **10.568,18 €** | **62.103,49 €** | **88.607,08 €** | **960,64** |

Así pues, el coste energético anual en el caso de que se empleara exclusivamente energía eléctrica ascendería a 88.607,08 €, si consideramos el coste energético durante el plazo de vida útil de la instalación, que en este caso se han considerado 25 años, ascenderá a un total de 2.215.177 € impuestos eléctricos e I.V.A. incluidos.

### 4.3 RESUMEN DEL COSTE ENERGÉTICO DE EXPLOTACIÓN

El resumen de los datos obtenidos de la estimación de los costes energéticos de las diferentes situaciones estudiadas, quedan recogidos en la tabla dispuesta a continuación.

| RESUMEN COSTES | Coste T. POTENCIA | Coste T. ENERGÍA | COSTE TOTAL Con impuesto e IVA | Energía Eléctrica Consumida (MWh/año) |
|---|---|---|---|---|
| ***P6 + SOLAR*** | **10.568,18 €** | **62.103,49 €** | **88.607,08 €** | **960,64** |
| ***P6 + P2*** | **111.705,10 €** | **200.762,61** | **380.985,38 €** | **2.930,51** |

En primer lugar, hay que indicar que, si no existieran los bombeos solares se tendría que consumir en los periodos tarifarios P6 y P2 de la tarifa eléctrica 6.1 (más económico y segundo más caro respectivamente). El coste anual previsto se situaría en los 380.985,38 €/año.

En segundo lugar, indicar que la instalación del bombeo solar permite eliminar la necesidad de incurrir en el periodo tarifario P2 y disminuir las necesidades de P6, lo cual reduce el coste energético hasta los 88.607,08 €/año. Es decir, el planteamiento mediante bombeo fotovoltaico permite reducir un 76,74 % el coste energético de la instalación.

Por otro lado, si atendemos a las necesidades hídricas del proyecto podemos decir que el volumen total anual a impulsar en el conjunto de la zona regable es de 19.240.624,82 $m^3$/año, por lo que el coste unitario del metro cúbico de agua impulsada después de impuestos e IVA se sitúa en los 0,004605 €/$m^3$.

En el Apéndice 1 se detalla el cálculo de los costes energético.

En el Anejo 14 Instalación fotovoltaica se detallan las características del parque solar proyectado y su aporte al bombeo general.

# APÉNDICE 1.- CÁLCULO DE COSTES ENERGÉTICOS

# BOMBEO EB1_sin FV

## NECESIDAES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35,60 | 111,26 | 172,54 | 396,70 | 865,65 | 1276,87 | 1795,58 | 1414,46 | 860,09 | 124,97 | 2,18 | 32,13 | 7088,03 |

## HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 147,57 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 147,57 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 4,93 | 0,00 | 33,53 | 0,00 | 0,00 | 0,00 | 0,00 | 38,46 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 10,65 | 33,29 | 51,63 | 118,70 | 259,03 | 377,14 | 389,71 | 389,71 | 257,36 | 37,39 | 0,65 | 9,61 | 1934,90 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

## POTENCIA CONSUMIDA KW

| ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1285,88 | 1118,16 | 1118,16 |

## DATOS

| | |
|---|---|
| Superficies [ha] | 2340 |
| Caudal [l/s] | 2172 |
| Altura bombeo m.c.a | 44,5 |
| Potencias [kW] | |
| Consumida | 1118 |
| Contratada | 1286 |

## TERMINO DE ENERGIA

| | CONSUMO [kWh] | | | | | | | | | | | | COSTE | | | TERMINO DE POTENCIA | | | COSTES TOTALES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | Tarifa €/Kw | Coste | POTEN Contrat | COSTES Tarifa €/kw | Coste | |
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 165010,2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 165010,2 | 0,114125 | 18.831,79 € | 1286 | 19,586654 | 25.186,18 € | 44.017,97 € |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € | 1286 | 14,334178 | 18.432,10 € | 18.432,10 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 5514,7 | 0,0 | 37493,3 | 0,0 | 0,0 | 0,0 | 0,0 | 43008,0 | 0,088886 | 3.822,81 € | 1286 | 14,334178 | 18.432,10 € | 22.254,91 € |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € | 1286 | 14,334178 | 18.432,10 € | 18.432,10 € |
| P6 | 11911,2 | 37225,9 | 57729,2 | 132729,7 | 289633,2 | 421706,4 | 435763,2 | 435763,2 | 287772,9 | 41813,0 | 729,4 | 10750,2 | 2163527,6 | 0,064648 | 139.867,73 € | 1286 | 6,540177 | 8.409,92 € | 148.277,65 € |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| Coste Anual Antes de Impuestos eléctricos sin IVA | | | | | | | | | | | | | | | 162.522,32 € | | | 88.892,41 € | 251.414,73 € |
| Impuesto Eléctrico | | | | | | | | | | | | | | | | | | | 1.928,11 € |
| | | | | | | | | | | | | | | | | | | | 253.342,84 € |
| IVA 21 % | | | | | | | | | | | | | | | | | | | 53.202,00 € |
| COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[€ ] | | | | | | | | | | | | | | | | | | | 306.544,84 € |

# BOMBEO EB2_Sin FV

## NECESIDAES HÍDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35,60 | 111,26 | 172,54 | 396,70 | 865,65 | 1276,87 | 1795,58 | 1414,46 | 860,09 | 124,97 | 2,18 | 32,13 | 7088,03 |

## HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 144,07 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 144,07 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 2,44 | 0,00 | 30,77 | 0,00 | 0,00 | 0,00 | 0,00 | 33,22 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 10,58 | 33,08 | 51,29 | 117,93 | 257,34 | 377,14 | 389,71 | 389,71 | 255,69 | 37,15 | 0,65 | 9,55 | 1929,83 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

## POTENCIA CONSUMIDA KW

| ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 265,27 | 265,27 | 265,27 | 265,27 | 265,27 | 265,27 | 265,27 | 265,27 | 265,27 | 330,00 | 265,27 | 265,27 |

## DATOS

| | |
|---|---|
| Superficies [ha] | 375 |
| Caudal [l/s] | 350 |
| Altura bombeo m.c.a. | 62 |
| Potencias [kW] | |
| Consumida | 265 |
| Contratada | 330 |

## TÉRMINO DE ENERGÍA

| | CONSUMO [kWh] | | | | | | | | | | | | COSTE | | | TÉRMINO DE POTENCIA | | | COSTES TOTALES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | Tarifa €/Kw | Coste | POTEN Contrat | COSTES Tarifa €/kw | Coste | |
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 38218,5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 38218,5 | 0,114125 | 4.361,68 € | 330 | 19,586654 | 6.463,60 € | 10.825,28 € |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € | 330 | 14,334178 | 4.730,28 € | 4.730,28 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 647,9 | 0,0 | 8163,3 | 0,0 | 0,0 | 0,0 | 0,0 | 8811,2 | 0,088886 | 783,19 € | 330 | 14,334178 | 4.730,28 € | 5.513,47 € |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € | 330 | 14,334178 | 4.730,28 € | 4.730,28 € |
| P6 | 2807,4 | 8774,0 | 13606,5 | 31283,8 | 68265,2 | 100046,2 | 103381,0 | 103381,0 | 67826,7 | 9855,1 | 171,9 | 2533,8 | 511932,6 | 0,064648 | 33.095,42 € | 330 | 6,540177 | 2.158,26 € | 35.253,68 € |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| Coste Anual Antes de Impuestos eléctricos sin IVA | | | | | | | | | | | | | | | 38.240,29 € | | | 22.812,69 € | 61.052,98 € |
| Impuesto Eléctrico | | | | | | | | | | | | | | | | | | | 468,22 € |
| | | | | | | | | | | | | | | | | | | | 61.521,20 € |
| IVA 21 % | | | | | | | | | | | | | | | | | | | 12.919,45 € |
| COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ] | | | | | | | | | | | | | | | | | | | 74.440,65 € |

# BOMBEO EB1_P6+FV

## NECESIDAES HIDRICAS [m^3/ha]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0,00 | 0,00 | 0,00 | 0,00 | 112,40 | 499,20 | 948,71 | 628,64 | 207,98 | 0,00 | 0,00 | 0,00 | 2396,94 |

## HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 33,63 | 149,37 | 283,88 | 188,11 | 62,23 | 0,00 | 0,00 | 0,00 | 717,23 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

## POTENCIA CONSUMIDA KW

| ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1118,16 | 1285,88 | 1118,16 | 1118,16 |

## DATOS

| | |
|---|---|
| Superficies [ha] | 2340 |
| Caudal [l/s] | 2172 |
| Altura bombeo m.c.a | 44,5 |
| Potencias [kW] | |
| Consumida | 1118 |
| Contratada | 1286 |

## TERMINO DE ENERGIA

| | CONSUMO [kWh] | | | | | | | | | | | | COSTE | | | TERMINO DE POTENCIA | | | COSTES TOTALES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | Tarifa €/Kw | Coste | POTEN Contrat | COSTES Tarifa €/kw | Coste | |
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,114125 | 0,00 € | 0 | 19,586654 | 0,00 € | 0,00 € |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € | 0 | 14,334178 | 0,00 € | 0,00 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,088886 | 0,00 € | 0 | 14,334178 | 0,00 € | 0,00 € |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € | 0 | 14,334178 | 0,00 € | 0,00 € |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 37606,6 | 167025,0 | 317424,8 | 210333,2 | 69588,5 | 0,0 | 0,0 | 0,0 | 801978,1 | 0,064648 | 51.846,28 € | 1286 | 6,540177 | 8.409,92 € | 60.256,20 € |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| Coste Anual Antes de Impuestos eléctricos sin IVA | | | | | | | | | | | | | | | 51.846,28 € | | | 8.409,92 € | 60.256,20 € |
| Impuesto Eléctrico | | | | | | | | | | | | | | | | | | | 462,11 € |
| | | | | | | | | | | | | | | | | | | | 60.718,30 € |
| IVA 21 % | | | | | | | | | | | | | | | | | | | 12.750,84 € |
| COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[€ ] | | | | | | | | | | | | | | | | | | | 73.469,15 € |

# BOMBEO EB2_P6+FV

## NECESIDAES HIDRICAS [m^3/ha]

| ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0,00 | 0,00 | 0,00 | 0,00 | 45,96 | 412,64 | 857,19 | 558,91 | 137,25 | 0,00 | 0,00 | 0,00 | 2011,95 |

## HORAS DE RIEGO [horas/año]

| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P2 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P3 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P4 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P5 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| P6 | 0,00 | 0,00 | 0,00 | 0,00 | 13,63 | 122,38 | 254,22 | 165,76 | 40,70 | 0,00 | 0,00 | 0,00 | 596,69 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |
| | | | | | | | | | | | | | 0,00 |

## POTENCIA CONSUMIDA KW

| ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 265,91 | 265,91 | 265,91 | 265,91 | 265,91 | 265,91 | 265,91 | 265,91 | 265,91 | 330,00 | 265,91 | 265,91 |

## DATOS

| | |
|---|---|
| Superficies [ha] | 375 |
| Caudal [l/s] | 351 |
| Altura bombeo m.c.a. | 62 |
| Potencias [kW] | |
| Consumida | 266 |
| Contratada | 330 |

## TÉRMINO DE ENERGÍA

| | CONSUMO [kWh] | | | | | | | | | | | | COSTE | | | TÉRMINO DE POTENCIA | | | COSTES TOTALES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ENE | FEB | MAR | ABR | MAY | JUN 1ª | JUL | AGO | SEP | OCT | NOV | DIC | TOTAL | Tarifa €/Kw | Coste | POTEN Contrat | COSTES Tarifa €/kw | Coste | |
| P1 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,137322 | 0,00 € | 0 | 39,139427 | 0,00 € | 0,00 € |
| P2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,114125 | 0,00 € | 0 | 19,586654 | 0,00 € | 0,00 € |
| P3 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,101906 | 0,00 € | 0 | 14,334178 | 0,00 € | 0,00 € |
| P4 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,088886 | 0,00 € | 0 | 14,334178 | 0,00 € | 0,00 € |
| P5 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,081456 | 0,00 € | 0 | 14,334178 | 0,00 € | 0,00 € |
| P6 | 0,0 | 0,0 | 0,0 | 0,0 | 3624,2 | 32541,1 | 67598,4 | 44075,6 | 10823,2 | 0,0 | 0,0 | 0,0 | 158662,5 | 0,064648 | 10.257,21 € | 330 | 6,540177 | 2.158,26 € | 12.415,47 € |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |
| | | | | | | | | | | | | | 0,0 | | | | | | |

| | | | | |
|---|---|---|---|---|
| Coste Anual Antes de Impuestos eléctricos sin IVA | 10.257,21 € | | 2.158,26 € | 12.415,47 € |
| Impuesto Eléctrico | | | | 95,21 € |
| | | | | 12.510,69 € |
| IVA 21 % | | | | 2.627,24 € |
| COSTE ENERGÉTICO TOTAL ANUAL CON IMPUESTOS ELÉCTRICO E IVA[ € ] | | | | 15.137,93 € |

# APÉNDICE 2.- CÁLCULO DE TRANSITORIOS

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# APÉNDICE 2.- CÁLCULO DE TRANSITORIOS

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

El estudio hidráulico detallado de los fenómenos transitorios en redes a presión es importante por tres motivos:

- Garantiza la seguridad de las instalaciones ante los efectos potencialmente destructivos de los mismos.
- Define y optimiza los sistemas de protección, si son necesarios, en el sentido de realizar su proyecto eficaz y del lado de la seguridad, sin incurrir en sobredimensionados.
- Ahorra costes en la construcción de la red, cuando es posible, ajustando los diámetros y timbrajes respecto a los dados por los criterios iniciales durante el dimensionado.

En cualquier caso, se consigue una mayor fiabilidad en el diseño, y ello se traduce en menores problemas y riesgos en explotación, que también tiene una clara traducción económica.

En las siguientes páginas se va a proceder a realizar una explicación de los fenómenos transitorios, teniendo en cuenta la teoría aplicar, los métodos de protección frente a los fenómenos transitarios, la metodología de cálculo de los mismos para la distintas hipótesis para las tuberías de impulsión, así como la descripción de las protecciones propuestas.

## 2 DESCRIPCIÓN DEL FENÓMENO Y METODOLOGÍA DE CÁLCULO

### 2.1 DESCRIPCIÓN DEL GOLPE DE ARIETE

El fenómeno del golpe de ariete, también denominado transitorio, consiste en la alternancia de depresiones y sobrepresiones debido al movimiento oscilatorio de ondas de presión generadas por variaciones de caudal repentinas en un tramo o en la instalación.

Este fenómeno, el cual se puede dar en instalaciones de transporte de fluido tanto en impulsiones directas como en abastecimientos por presión natural, puede generar por un lado situaciones de sobrepresión y/o depresión que puede afectar al comportamiento mecánico de los materiales de la tubería y por tanto a la instalación, y por otro, situaciones de cavitación que si llega a ser severa pueda derivar en daños por cavitación a la instalación.

El valor de la sobrepresión y de la depresión debe tenerse en cuenta a la hora de dimensionar la capacidad mecánica de las tuberías y por tanto del timbraje de las mismas, no obstante, y de forma genérica, el peligro de rotura debido a la depresión no es importante si los diámetros son muy pequeños. Otro aspecto fundamental en el diseño de las instalaciones es el estudio de equipos de protección que garanticen la viabilidad y durabilidad de la instalación.

Otro aspecto a tener en cuenta en el diseño es la posibilidad de que se produzca el fenómeno de la cavitación. Este se producirá si en algún caso el valor de la depresión iguala a la presión de vapor del líquido. En ese momento se producirán cavidades de vapor en el fluido, las cuales colapsarán con el incremento de presión producido en la fase de sobrepresión del transitorio, el colapso de estas cavidades de vapor de agua producirá un chorro de agua. Si este colapso se produce en las proximidades de algún elemento puede ocasionar erosiones en los materiales de la instalación y por tanto en su deterioro.

Por lo tanto, el correcto estudio del golpe de ariete es fundamental en el dimensionamiento de las tuberías, ya que un dimensionado erróneo puede conducir a:

1. Un sobredimensionamiento de las conducciones, con lo que la instalación se encarece de forma innecesaria.
2. Tubería calculada por defecto, con el consiguiente riesgo de que se produzca una rotura.

#### 2.1.1 GOLPE DE ARIETE. DESCRIPCIÓN POR FASES

En el caso de impulsiones, se inicia una depresión aguas abajo de la bomba, que se traslada hacia el final para transformarse en compresión que retrocede a la bomba.

Cuando se produce la parada del grupo de bombeo, el fluido, inicialmente circulando con velocidad (v), continuará en movimiento a lo largo de la tubería hasta que la depresión a la salida del grupo ocasionada por la ausencia de líquido (el que avanza no es repuesto, no es "empujado"), provoque su parada. En estas condiciones, viaja una onda depresiva, que además va deteniendo el fluido, de tal manera que al cabo de un cierto tiempo toda la tubería está bajo los efectos de una depresión y con el líquido en reposo. Ha concluido la primera etapa del golpe de ariete.

Como la presión al final del sistema es siempre superior a la de la tubería, que se encuentra bajo los efectos de la depresión, se inicia un retroceso del fluido hacia la válvula de retención con velocidad (-v). Con el agua en sentido contrario, nuevamente se tiene la presión de partida en la tubería, de manera que al cabo de un cierto tiempo toda ella estará sometida a la presión inicial y con el fluido circulando a velocidad (-v).

El inicio de la tercera fase es una consecuencia del choque del líquido contra la válvula de retención. El resultado es un brusco aumento de presión y una detención progresiva del fluido, de modo que al cabo de un cierto tiempo todo el líquido de la tubería está en reposo y la conducción sometida a una sobrepresión de la misma magnitud que la depresión inicial.

En la cuarta fase comienza la descompresión, iniciándose de nuevo el movimiento, por lo que al cabo de un tiempo la situación es idéntica a la que teníamos al principio. Comienza un nuevo ciclo.

#### 2.1.2 SOLUCIONES A ADOPTAR PARA MINIMIZAR SU EFECTO

Para reducir el efecto del golpe de ariete se pueden instalar alguno o una combinación de los equipos que se enumeran a continuación.

- Ventosas
- Ventosas amortiguadoras del golpe de ariete
- Válvulas de retención
- Válvula de alivio rápido
- Válvulas anticipadoras de onda
- Tanques unidireccionales
- Volante de inercia
- Chimenea de equilibrio
- Calderín

### 2.2 METODOLOGÍA DE CÁLCULO UTILIZADA

Para el cálculo del golpe de ariete se utiliza el software informático HAMMER desarrollado por Bentley. Este software permite:

- Desarrollar rentables estrategias de control
- Evitar costosos daños de infraestructura
- Modelar cualquier dispositivo de protección
- Minimizar el desgaste de las tuberías
- Simular cualquier condición transitoria
- Asegurar la longevidad del sistema de abastecimiento de agua
- Preparar suministros eléctricos y reducir al mínimo las interrupciones de servicio

HAMMER utiliza el Método de las Características cómo norma de referencia y, sin duda, el más riguroso y robusto algoritmo de análisis de flujos transitorios hidráulicos.

Algoritmos como el Método Wave Plan (a.k.a. the Wave Characteristic Method) aseguran la exactitud de sus soluciones sólo computando resultados y cruces. El Método de las Características calcula los resultados a lo largo de la tubería, y captura con precisión cambios críticos que podrían haberse perdido.

La versión del software utilizada es Bentley Hammer v8i.

Una de las ecuaciones más importantes es la que permite el cálculo de la celeridad, que rige la velocidad de propagación de la onda del transitorio a lo largo del sistema:

$$a = \frac{9900}{\sqrt{48.3 + K \cdot \frac{D}{e}}}$$

Donde:
e= espesor de la tubería
D= diámetro exterior de la tubería
K= módulo elástico del material

Para el caso que nos ocupa la celeridad calculada para las tuberías de PRFV DN1400 y DN700 PN10 es de 266 m/s y 389 m/s respectivamente.

# 3 CARACTERÍSTICAS Y MODELIZACIÓN DEL SISTEMA

Para el estudio se han parametrizado las tuberías, la geometría de las rasantes y la ubicación de los elementos, así como la definición de los equipos de bombeo.

En este sentido el programa permite cargar los parámetros generales, la geometría de la impulsión, los datos de nodos y elementos, las especificaciones del análisis y realizar la consulta de resultados, numérica o gráfica. Los detalles de la configuración de la red, tales como equipos de bombeo y elementos de protección (ventosas, válvulas, ...) se introducen cumplimentando todos los formularios y etapas necesarios para su definición.

Los tramos de tuberías de impulsión se han creado eligiendo, como nodos extremos de los tramos, los vértices significativos, donde es posible instalar elementos de protección (tales como las ventosas, tanques unidireccionales, chimenea de equilibrio, ...), los nodos con cotas desfavorables (puntos más elevados y con cotas relativas más bajas de cada tramo) así como los puntos de potencial cambio de timbraje y ubicación de estaciones de bombeo.

## 3.1 CARACTERÍSTICAS DE LA IMPULSIONES

### 3.1.1 IMPULSIÓN 1 (A BALSA INTERMEDIA)

El trazado previsto para la impulsión a la Balsa Intermedia, estará compuesto por una tubería con las siguientes características:

- Diámetro: 1400 mm
- Material: PRFV PN10
- Longitud: 898 m.
- Rugosidad (k): 0,007 mm

En cuanto a los equipos de bombeo, tenemos:

- 1 bomba de 110 kW con un caudal máximo de 181 l/s
- 1 bomba de 200 kW con un caudal máximo de 362 l/s
- 3 bombas de 315 kW con un caudal máximo de 543 l/s
- Altura de bombeo: 44 mca
- Caudal máximo bombeado: 2.172 l/s

Cotas:

- Cota del agua en la Balsa Inferior (Nivel Medio): 386,3 m
- Cota del agua en la Balsa Intermedia (Nivel Medio): 425 m

### 3.1.2 IMPULSIÓN 2 (A BALSA ELEVADA)

El trazado previsto para la impulsión a la Balsa Intermedia, estará compuesto por una tubería con las siguientes características:

- Diámetro: 700 mm
- Material: PRFV PN10
- Longitud: 1.969 m.
- Rugosidad (k): 0,007 mm

En cuanto a los equipos de bombeo, tenemos:

- 3 bombas de 315 kW con un caudal máximo de 117 l/s
- Altura de bombeo: 62 mca
- Caudal máximo bombeado: 350 l/s

Cotas:

- Cota del agua en la Balsa Inferior (Nivel Medio): 386,3 m
- Cota del agua en la Balsa Intermedia (Nivel Medio): 442,13 m

### 3.2 ELEMENTOS DE PROTECCIÓN

A lo largo de ambas tuberías de impulsión se instalarán una serie de elementos de protección como son ventosas, válvulas de retención y válvulas anticipadoras de onda (éstas últimas en el interior de la estación de bombeo).

## 4 ESCENARIOS E HIPÓTESIS DEL PRESENTE ESTUDIO

En el presente estudio se consideran diferentes hipótesis, las cuales determinarán las necesidades de protección y su influencia en el funcionamiento, o de manejo de la red para que no se produzcan sobrepresiones ni depresiones importantes.

Se estudia el comportamiento de las Impulsiones frente a los transitorios que se puedan dar durante su explotación. Se pueden dar estos fenómenos por varios motivos, como pueden ser las operaciones normales del bombeo como pueden ser el arranque y el paro de bombas, cierre de válvulas de seccionamiento o válvulas antirretorno, colapso de tuberías o el paro brusco de un equipo de bombeo por el corte eléctrico.

Esta situación de parada de bomba por desconexión instantánea de la alimentación eléctrica, es sin lugar a duda, la situación crítica. Por lo que se puede concluir que, si la tubería está protegida frente al golpe de ariete por corte eléctrico, estará protegida frente al resto de fenómenos.

Para ello se estudia el periodo de tiempo necesario para que se sucedan todos los acontecimientos de sobrepresiones y depresiones hasta su regulación. En este caso se estudian al menos 240 segundos desde la parada de bombas.

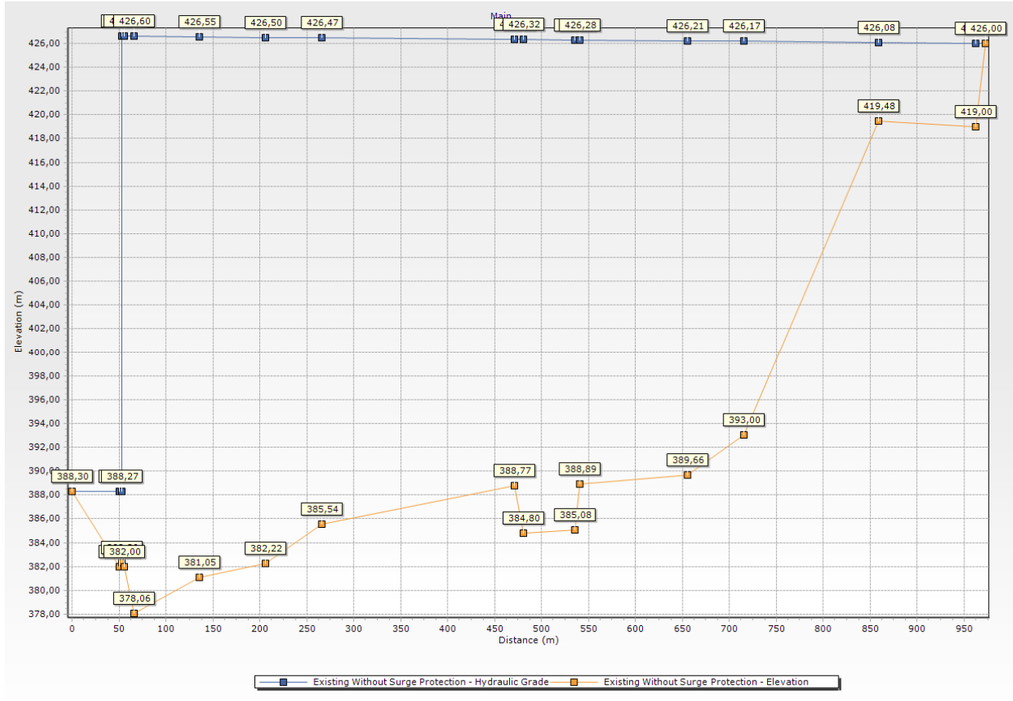
Se estudian 2 hipótesis:

- **Hipótesis 0**. Comportamiento de la red ante la parada de las bombas sin ningún tipo de protección.
- **Hipótesis 1**, en la que se dispondrá de ventosas trifuncionales a lo largo de la impulsión a modo de protección, así como protecciones al inicio de la impulsión, en la Estación de bombeo, como son una válvula de alivio de sobrepresión y by-pass conectado con la tubería de aspiración.

## 5 CÁLCULO DE LA IMPULSIÓN 1

### 5.1 PERFIL DE LA IMPULSIÓN 1

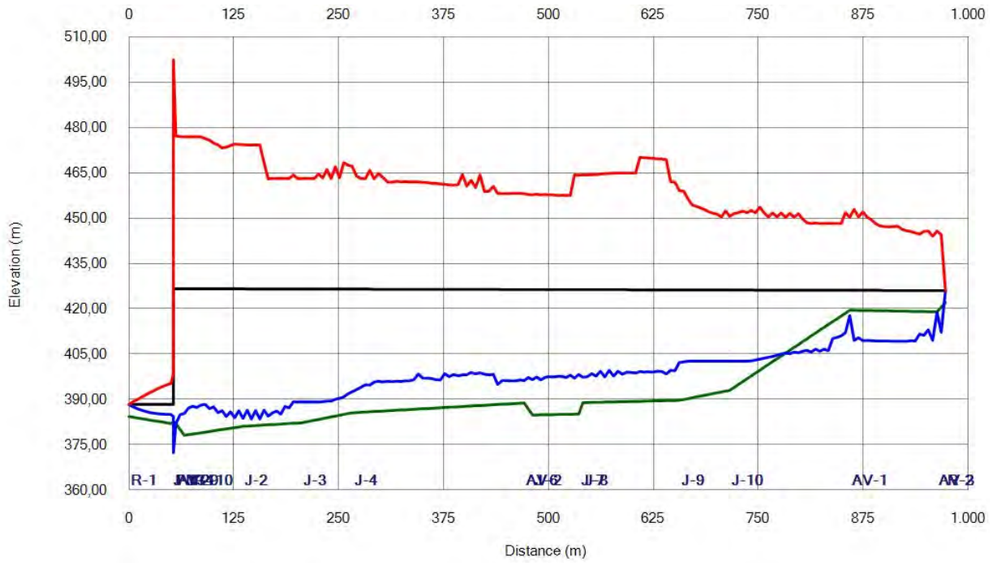
En la siguiente gráfica se representa el perfil de la impulsión desde la EB hasta la Balsa Intermedia.




En la gráfica se aprecia en azul la línea piezométrica y en naranja la geométrica del perfil a la cota de rasante de la tubería.

## 5.2 HIPÓTESIS 0

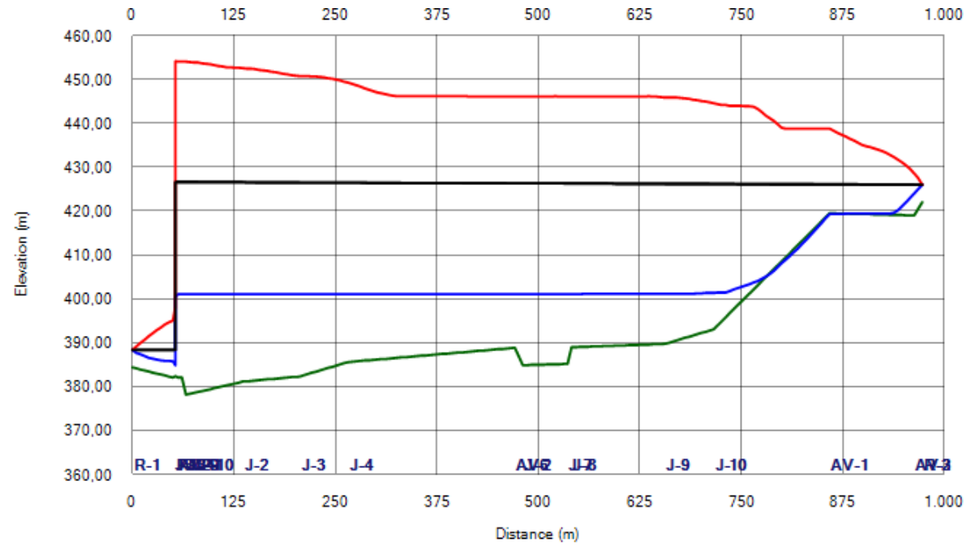
En el siguiente gráfico se muestra los resultados del transitorio, para la hipótesis 0, es decir sin elementos de protección.




La línea roja, marca la onda de sobrepresiones, como se puede observar, hay puntos que se alcanza una sobrepresión de 117,5 mca respecto a la cota del terreno. En cuanto a las depresiones, observamos que se alcanza el vacío en la última parte de la impulsión, donde se alcanza un valor de depresión de casi 9,8 mca. Por lo que es más que probable, que se alcance la presión de vaporización del agua y se produzcan fenómenos de cavitación.

## 5.3 HIPÓTESIS 1

En el siguiente gráfico se muestra los resultados del transitorio, para la hipótesis 1, es decir con ventosas trifuncionales en los puntos singulares de la red, y protecciones en la EB como válvula de alivio y by-pass.




Con la introducción de la válvula de alivio DN200, el by-pass y las ventosas trifuncionales, se ha conseguido reducir el efecto de las sobrepresiones, quedando la máxima en 74,4 mca. En cuanto a las depresiones, prácticamente se han conseguido anular, siendo el valor máximo de depresión de 0,2 mca en el punto más desfavorable. Con estas depresiones en ningún momento se alcanzaría la presión de vapor del agua, evitando así la aparición de fenómenos de cavitación en la tubería.

## 5.4 CONCLUSIONES GENERALES DEL ESTUDIO

Como se ha demostrado en el presente estudio, la instalación está completamente protegida frente a los posibles transitorios que se pueden generar durante la vida útil de la instalación.

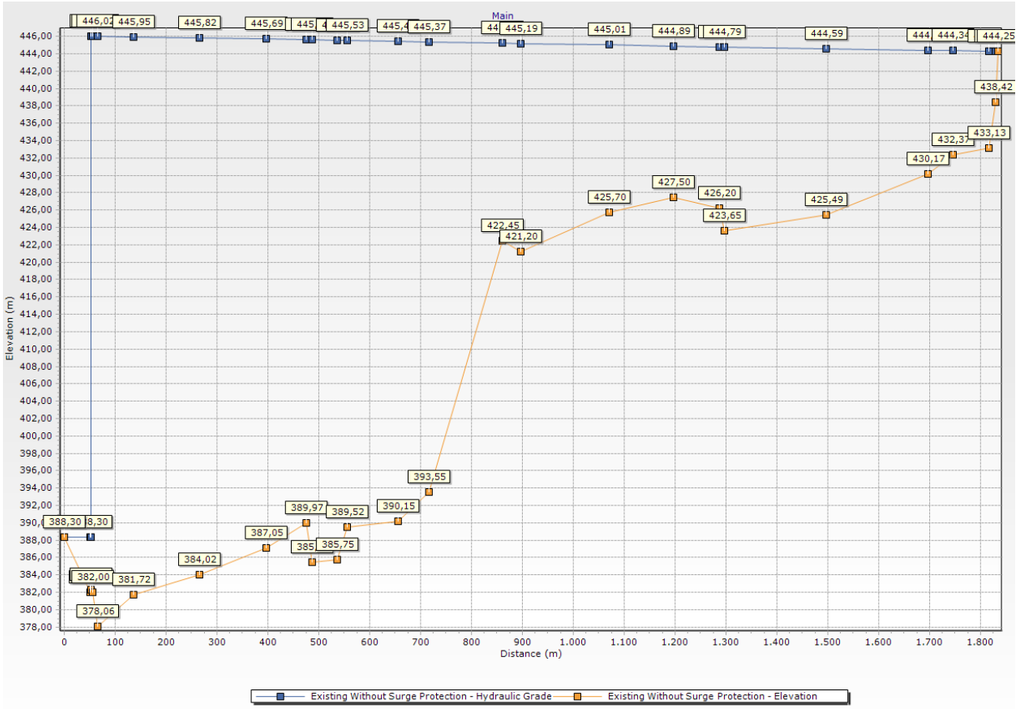
La tubería de Impulsión, está perfectamente protegida frente a los posibles transitorios que se puedan generar al contar con una válvula de alivio de DN200, un by-pass de DN400 y con la instalación de ventosas trifuncionales en los puntos singulares de la instalación.

En la tubería de impulsión, tubería de PRFV DN1400 SN5000 PN10, hay que destacar que se generarán de unas mínimas depresiones de en torno a 0,2 mca, y que no afectarán a la tubería instalada, ya que es perfectamente capaz de resistir depresiones mayores.

# 6 CÁLCULO DE LA IMPULSIÓN 2

## 6.1 PERFIL DE LA IMPULSIÓN 2

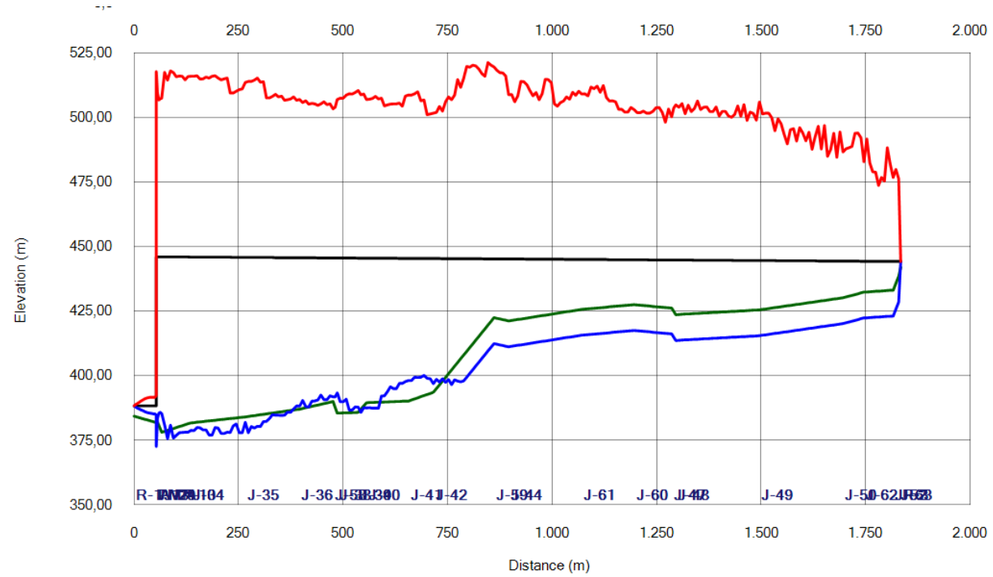
En la siguiente gráfica se representa el perfil de la impulsión desde la EB hasta la Balsa Elevada.




En la gráfica se aprecia en azul la línea piezométrica y en naranja la geométrica del perfil a la cota de rasante de la tubería.

## 6.2 HIPÓTESIS 0

En el siguiente gráfico se muestra los resultados del transitorio, para la hipótesis 0, es decir sin elementos de protección.

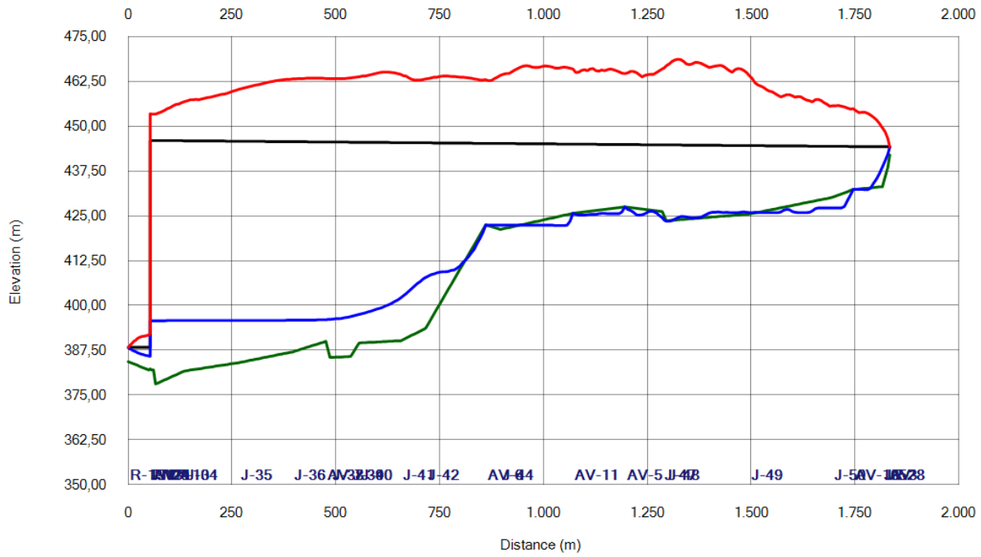



La línea roja, marca la onda de sobrepresiones, como se puede observar, hay puntos que se alcanza una sobrepresión de 132 mca respecto a la cota del terreno. En cuanto a las depresiones, observamos que se alcanza el vacío en la última parte de la impulsión, donde se alcanza un valor de depresión de casi 9,8 mca. Por lo que es más que probable, que se alcance la presión de vaporización del agua y se produzcan fenómenos de cavitación.

## 6.3 HIPÓTESIS 1

En el siguiente gráfico se muestra los resultados del transitorio, para la hipótesis 1, es decir con ventosas trifuncionales en los puntos singulares de la red, y protecciones en la EB como válvula de alivio y by-pass.

Con la introducción de la válvula de alivio DN200, el by-pass y las ventosas trifuncionales, se ha conseguido reducir el efecto de las sobrepresiones, quedando la máxima en 76 mca. En cuanto a las depresiones, se han reducido hasta los 2,9 mca en el punto más desfavorable. Con estas depresiones en ningún momento se alcanzaría la presión de vapor del agua, evitando así la aparición de fenómenos de cavitación en la tubería. Por otra parte, los valores máximos de depresión que se pueden llegar a alcanzar son claramente inferiores a la depresión máxima que es capaz de absorber la tubería.




## 6.4 CONCLUSIONES GENERALES DEL ESTUDIO

Como se ha demostrado en el presente estudio, la instalación está completamente protegida frente a los posibles transitorios que se pueden generar durante la vida útil de la instalación.

Cada una de las tuberías de Impulsión, está perfectamente protegida frente a los posibles transitorios que se puedan generar al contar cada una de ellas con una válvula de alivio de DN200, un by-pass de DN400 y con la instalación de ventosas trifuncionales en los puntos singulares de la instalación.

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# ANEJO 10.- BALSAS DE REGULACIÓN

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

En este anejo, una vez conocida la zona regable y el sistema de riego, se pretende dimensionar y justificar los elementos que se deberán ejecutar en la construcción de las balsas de regulación previstas en el Proyecto.

Para cada una de ellas se presenta en primer lugar, los cálculos hidráulicos de los elementos que definen la balsa, como son la tubería de llenado, la toma de fondo, el desagüe de fondo, el aliviadero, así como los drenajes. En el segundo lugar se presentan los cálculos de los geotextiles de la Balsa. En el último apartado se hace referencia a la estabilidad de taludes de la Balsa.

## 2 BALSAS INFERIORES

Las balsas Inferiores se encuentran situadas en el polígono 2 del término municipal de Torralba del Aragón, como puede verse en los planos 05.02 y 06.02. Tal y como se ha explicado en el Apéndice 3 del Anejo 4 Estudio de Alternativas, el diseño de una única balsa inferior ha resultado imposible por motivos geotécnicos. De esta forma, se proyectan 2 balsas más pequeñas y comunicadas entre sí, que funcionen conjuntamente como una única balsa.

Las Balsas Inferiores recogen las aportaciones del Canal de Monegros y abastecen a la balsa intermedia y la balsa elevada mediante bombeo.

### 2.1 CRITERIOS DE DIMENSIONAMIENTO

Para la estimación del volumen de almacenamiento de agua de riego se han considerado los siguientes parámetros:

Superficie Total: ..... 2.714,53 ha
Demanda en el mes de máximas necesidades: ..... 1.795,6 $m^3$/ha
Caudal Ficticio continuo en el mes de máximas necesidades: .....0,67 l/s y ha
Horas de llenado desde Canal: ..... 168 h/semana
Horas de bombeo a Balsa Intermedia / Elevada: ..... 123 h/semana
Caudal de entrada (desde Canal): ..... 1.846 l/s
Caudal de salida (lunes-viernes): ..... 1.576 l/s
Caudal de salida (sábado-domingo): ..... 2.521 l/s

Con los datos anteriores, se ha calculado las necesidades de regulación de la Balsa Inferior, siendo preciso un volumen de 116.705 $m^3$ aproximadamente.

Finalmente se proyectan dos balsas con una capacidad total de 147.938,83 $m^3$, lo que asegura una reserva de 1 día en caso de corte en la entrada de agua desde la acequia.

### 2.2 TOMA EN CANAL

Para el llenado de la Balsa Inferior se tiene previsto realizar una nueva toma de captación de aguas en el Canal de Monegros. El punto previsto se sitúa junto a la Balsa Inferior Sur, tal y como se observa en el plano 04. El caudal solicitado será el correspondiente al CFC para la superficie de riego, es decir, 1.818,73 l/s. Sin embargo, las obras proyectadas de diseñan para un caudal máximo igual al de bombeo (2.521 l/s), con objeto de dotar a la instalación de mayor capacidad de maniobra.

La nueva toma estará compuesta por los siguientes elementos:

- Se proyecta una apertura en el lateral del Canal en la que se dispondrá una compuerta tipo mural con cierre estanco a 4 caras. La compuerta tendrá unas dimensiones de 2,0 x 2,0 $m^2$. La compuerta estará motorizada y automatizada para asignar la consigna de caudal a entregar.

- Arqueta de desbaste para la instalación de un limpiarrejas compuesto por máquina y sistema de expulsión, para reja con dimensiones 3,0 m de ancho por 4,0 m de alto, con 50mm de paso entre barrotes verticales. La arqueta de desbaste tendrá unas dimensiones interiores de 5,00 x 3,00 $m^2$ y una altura de 3,70 m.

- Tubería de PRFV DN1600 PN6 que partirá del muro del canal y conectará con la Balsa Inferior Sur. El primer tramo de esta tubería (bajo el camino de servicio del canal) irá protegida mediante una viga de hormigón armado.
- Sobre la tubería de llenado, se proyecta un caudalímetro de ultrasonidos no invasivo en arqueta accesible. El caudalímetro controlará que el caudal de entrada a la balsa sea el preciso. Las coordenadas (UTM ETRS89, H30) del caudalímetro son:

  X: 705.564

  Y: 4.645.153
- Para que el caudalímetro funcione correctamente, la conducción debe trabajar a sección llena, por lo que en la salida de la tubería a la balsa se proyecta un aliviadero invertido de forma que, aunque la balsa esté por debajo del Nivel Máximo (que coincide con la cota de solera del Canal de Monegros), la tubería permanezca llena.
- Para facilitar el vaciado de la tubería en caso de limpieza, se prevé una pequeña compuerta manual en el aliviadero invertido.
- Por último, se dispondrán elementos de control de nivel aguas arriba (en el canal) y aguas abajo (en la balsa)

## 2.3 TUBERÍA DE LLENADO

La determinación del caudal de llenado de las Balsas Inferiores se ha realizado a partir de las necesidades calculadas en el Anejo 3 "Estudio Agronómico". Dado que las balsas se llenan por gravedad desde el Canal de Monegros, se dispone de 24 h al día.

Como se ha indicado anteriormente, el caudal medio de llenado utilizado para el dimensionamiento de esta conducción sería el resultado del producto entre el caudal ficticio continúo adoptado (0,67 l/s y ha) y la superficie total de riego (2.714,53 ha), lo que supondría un caudal de 1.818 l/s. Sin embargo, en este caso, se proyecta una tubería capaz de transportar el caudal máximo de bombeo (2.521 l/s), con objeto de dotar a la instalación de mayor capacidad de maniobra.

Se ha proyectado una conducción que, partiendo de la nueva toma permitirá el transporte del caudal máximo de diseño de dicha toma, hasta la balsa inferior Sur.

La tubería de llenado se proyecta en PRFV con las siguientes características:

Material: ..... PRFV
Diámetro nominal: .....100 mm
Presión nominal: ..... 6 kg/cm$^2$
Rigidez SN: .....5 KN/m$^2$
Longitud: .....110 m

**Formulación.**

Para verificar la funcionalidad de este elemento, se determinó la pérdida de carga de esta conducción en el caso de que funcionara "en carga", mediante la fórmula de Darcy-Weisbach de expresión:

$$H_f = f * \frac{L}{D} * \frac{V^2}{2 * g}$$

donde:

Hf = Pérdida de carga en mca.
f = Factor de fricción (adimensional).
L = Longitud del tramo en m.
D = Diámetro interior de la tubería en m.
V = Velocidad de la tubería en m/s.
g = Aceleración de la gravedad 9,8 m/s$^2$.
El factor de fricción se ha calculado por la fórmula de White Colebrook, de expresión:

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{2{,}51}{\mathrm{Re}\sqrt{f}} + \frac{Ka}{3{,}71D}\right)$$

donde:

Re = Nº de Reynolds.
Ka = Coeficiente de rugosidad absoluta. Se ha considerado Ka = 0.05 mm para las tuberías de PRFV

Obteniéndose los siguientes resultados:

| Caudal (l/s) | Velocidad (m/s) | Hf (mca) |
|---|---|---|
| 2.521 | 1,25 | 0,06 |

La conducción de entrada a su paso bajo el dique de la balsa, se protegerá con una viga de fondo en HA-35. Toda la información relativa a la tubería de llenado y la obra de toma en el Canal de Monegros se amplía en los planos 04.

# 3 BALSA INFERIOR SUR

## 3.1 OBRA DE ENTRADA

Tal y como se ha indicado con anterioridad en el punto de vertido en balsa se prevé una obra de entrada tipo aliviadero invertido, garantizando un vertido laminar sobre la lámina impermeabilizante de la balsa y minimizando la energía de entrada, y por tanto los posibles daños.

El caudal de diseño para esta infraestructura será de 2.521 l/s (caudal máximo de entrada), siendo el caudal habitual mucho menor, 1.818 l/s.

Los cálculos de este aliviadero invertido se recogen a continuación, mediante la siguiente expresión:

$$Q_i = 1{,}82 \cdot L \cdot (h)^{\frac{3}{2}}$$

donde h es la elevación de la lámina de agua sobre el labio vertiente del aliviadero y L la longitud de dicho labio vertiente.

A continuación, se recoge las características y el resultado de los cálculos realizados, para distintas longitudes de labio de vertido:

| | Q ($m^3/s$) | L (m) | h (m) |
|---|---|---|---|
| Aliviadero | 2,52 | 11,00 | 0,25 |
| | 2,52 | 12,00 | 0,24 |
| | 2,52 | 13,00 | 0,22 |

La longitud del labio del aliviadero será de 12,00 m para una altura de lámina de agua de 0,24 m, en la situación de caudal máximo. Es decir, cota máxima de agua será de 388,89 msnm, garantizando un resguardo de 2,87 m respecto a la cota de coronación del cajero del canal (391,76 msnm).

Para facilitar el vaciado de la tubería en caso de limpieza, se prevé una pequeña compuerta manual en el aliviadero invertido.

## 3.2 ALIVIADERO

Para el diseño y dimensionamiento de esta infraestructura se considerará como hipótesis de trabajo aquella en la que la balsa se encuentre a su máxima capacidad, es decir, la lámina de agua se encuentre en el Nivel de Almacenamiento Máximo Ordinario (en adelante NAMO), se esté derivando a la misma el caudal de llenado anteriormente indicado y, además, se esté produciendo en ese instante un episodio de lluvia torrencial.

Conocido el caudal de diseño, únicamente nos queda por determinar el caudal debido a la lluvia. Así, según el Manual Técnico Núm. 2 "Diseño y construcción de Pequeños Embalses" editado en 1.986 por el Instituto Nacional de Reforma y Desarrollo Agrario (Ministerio de Agricultura, Pesca y Alimentación) se puede tomar como valor de la máxima precipitación horaria probable el 40 % de la máxima precipitación diaria correspondiente al mismo periodo de retorno.

Para calcular la máxima lluvia diaria para un periodo de retorno considerado de 50 años se ha utilizado la serie monográfica "Máximas lluvias diarias en la España peninsular" del Ministerio de Fomento.

Así pues, se obtiene una lluvia máxima en una hora de 37,19 mm.

Superficie interior .....20.970 $m^2$
Lluvia considerada .....37,19 mm/h
Caudal a desalojar ..... 216,6 l/s

Teniendo en cuenta esto, el caudal considerado en este caso para el dimensionamiento del aliviadero será de 2.737,6 l/s, obtenido de la suma del caudal de llenado (2.521 l/s) y del caudal resultante de la lluvia considerada (216,6 l/s).

Los cálculos de este aliviadero se recogen a continuación, mediante la siguiente expresión:

$$Q_i = 1{,}82 \cdot L \cdot (h)^{\frac{3}{2}}$$

donde h es la elevación de la lámina de agua sobre el labio vertiente del aliviadero y L la longitud de dicho labio vertiente.

A continuación, se recoge las características y el resultado de los cálculos realizados, para distintas longitudes de labio de vertido:

| | Q ($m^3$/s) | L (m) | h (m) |
|---|---|---|---|
| Aliviadero | 2,755 | 11,00 | 0,27 |
| | 2,755 | 12,00 | 0,25 |
| | 2,755 | 13,00 | 0,24 |

Se adopta el criterio de considerar un labio de 12 m. de longitud, con lo que el Nivel de Almacenamiento Máximo Extraordinario (NAME) queda fijado con una altura de vertido de 0,25 m., es decir, a la cota 388,65 msnm.

La tubería que evacuará el agua de alivio será de Acero Helicosoldado DN 813 de 7,9 mm de espesor (en el primer tramo bajo el dique) y tras este tramo se inicia un tramo con tubería de PRFV DN 800 mm.

El vertido de esta tubería se realiza en el Barranco de Valverada, a través de una obra de salida ejecutada en hormigón armado (HA-35), tal y como se indica en el plano 6.10. En la obra de salida se instalará una reja que evite la entrada de animales a la balsa a través del aliviadero.

## 3.3 RESGUARDO

### 3.3.1 DETERMINACIÓN DEL NAMO

Denominaremos como NAMO al Nivel de Almacenamiento Máximo Ordinario, cuyo volumen de almacenamiento será el comprendido entre la cota de fondo de la balsa y el labio de vertido del aliviadero.

En este caso la altura de almacenamiento es de 4,1 m, con lo que la cota de Nivel de Almacenamiento Máximo Ordinario será 388,4 m.s.n.m.

### 3.3.2 DETERMINACIÓN DEL NAME

Denominaremos como NAME al Nivel de Almacenamiento Máximo Extraordinario, cuyo volumen de almacenamiento será el comprendido entre la cota de fondo de la balsa y la altura máxima de vertido sobre el labio de vertido del aliviadero.

El máximo caudal a aliviar tal y como se ha calculado anteriormente será de 2.755 l/s.

Para un labio de vertido de 12 m de longitud y un caudal máximo a evacuar de 2.755 l/s, obtendremos una altura máxima de vertido por encima del labio del aliviadero de 0,25 m aproximadamente. Por lo tanto, el NAME quedará definido en la cota 388,65 m.

### 3.3.3 DETERMINACIÓN DEL RESGUARDO Y COTA DE CORONACIÓN

La altura de coronación de la balsa quedará determinada por la cota del NAME más el resguardo que asegure que las olas, en el momento en que se produce el mencionado NAME, no salten por encima del dique.

Para la estimación del resguardo necesario se recomienda la utilización de la siguiente expresión empírica, en m:

h = 1,5 x h1

h1 = 0,6 x $\sqrt[4]{L}$; siendo L el fetch en Km.

Considerando un valor del fetch de 250 m, siendo éste el valor de la mayor longitud de recorrido del viento en la lámina de agua, obtenemos un resguardo mínimo de 0,64 m.

Así pues, considerando la altura de vertido de agua sobre el labio de vertido del aliviadero, establecida en la cota 388,65 m obtenemos un resguardo efectivo respecto a esta situación de NAME de 0,65 m, superior al resguardo recomendado por la fórmula empírica mencionada anteriormente (0,64 m).

Por último, la cota de coronación quedará determinada en la cota 389,3 estando 0,90 metros por encima del NAMO.

## 3.4 TOMA DE FONDO

La toma de fondo está constituida por el tramo de conducción entre la balsa y la Estación de Bombeo. Esta conducción realizará las funciones de toma de fondo y desagüe de fondo.

Para el dimensionado de esta conducción, se considerará el caudal máximo de salida (2.521 l/s). Es recomendable que la velocidad de circulación del agua en el interior de la tubería de toma se encuentre comprendida entre 0,5 y 2 m/s.

La Toma de fondo estará formado por una tubería de Acero Helicosoldado (S 235 JR), con un diámetro de 1620 mm, espesor de pared de 12,7 mm que unirá la balsa con el colector de aspiración de la EB.

**Formulación.**

Para verificar la funcionalidad de este elemento, se determinó la pérdida de carga de esta conducción con un funcionamiento "en carga", mediante la fórmula de Darcy-Weisbach de expresión:

$$H_f = f * \frac{L}{D} * \frac{V^2}{2 * g}$$

donde:

Hf = Pérdida de carga en mca.

f = Factor de fricción (adimensional).

L = Longitud del tramo en m.

D = Diámetro interior de la tubería en m.

V = Velocidad de la tubería en m/s.

g = Aceleración de la gravedad 9,8 m/s$^2$.

El factor de fricción se ha calculado por la fórmula de White Colebrook, de expresión:

$$\frac{1}{\sqrt{f}} = -2\log\left(\frac{2,51}{\mathrm{Re}\sqrt{f}} + \frac{Ka}{3,71D}\right)$$

donde:

Re = Nº de Reynolds.

Ka = Coeficiente de rugosidad absoluta. Se ha considerado Ka = 0,05 mm para las tuberías de acero.

**Preparación de datos.**

Los datos de la toma de fondo son:

| | |
|---|---|
| Material | AH S235 JR |
| Diámetro | 1626 |
| Espesor | 12,7 mm |
| Longitud | 40 m |
| Caudal máximo | 2.521 l/s |
| Velocidad | 1,22 m/s |
| Pérdida de Carga | 0,02 m |

De esta forma, la pérdida de carga total de la conducción es de 0,02 m.

## 3.5 JAULA DE DESBASTE

Se diseña una jaula de desbaste de 1600 mm de diámetro y 1500 mm de altura, dejando un zócalo de 30 cm de zona no filtrante para retener posibles lodos.

**JAULA TOMA FONDO.**

**Condiciones de diseño:**

| | | |
|---|---|---|
| Caudal riego Gravedad: | 0,00 | l/s |
| Caudal Bombeo: | 2523,00 | l/s |
| **Velocidad de paso referencia:** | **1** | **m/s** |

**Superficie mínima requerida:**

| | | |
|---|---|---|
| Gravedad: | 0,000 | $m^2$ |
| Bombeo Directo: | 2,523 | $m^2$ |
| | 2,523 | $m^2$ |
| Ratio obturación: | 70% | |
| **Total superficie requerida:** | **4,2891** | **$m^2$** |

**Diseño filtro:**

| | | |
|---|---|---|
| **Diámetro:** | **1,6** | **m** |
| Altura Sup. filtrante: | 1,2 | m |
| Zócalo (zona no filtrante): | 0,3 | m |
| **Altura TOTAL filtro:** | **1,5** | **m** |

**Superficie total Bruta:**

| | | |
|---|---|---|
| Área superior: | 2,011 | $m^2$ |
| Área lateral: | 6,032 | $m^2$ |
| Total Superficie Bruta: | 8,042 | $m^2$ |
| **Sup. BRUTA Diseño:** | **6,032** | **$m^2$** |

**Superficie ocupada:**

| | | |
|---|---|---|
| Separación pletinas verticales: | 0,02 | m |
| nº pletinas verticales: | 252 | uds |
| Espesor pletinas: | 0,005 | m |
| Separación barras horizontales: | 0,3 | m |
| nº barras horizontales: | 4 | uds |
| nº de barras por tramo: | 2 | uds |
| Espesor barras: | 0,006 | m |
| Sup. Ocupada por pletinas: | 1,512 | $m^2$ |
| Sup. Ocupada por barras: | 0,241 | $m^2$ |
| **Total superficie ocupada:** | **1,512** | **$m^2$** |

| | | | |
|---|---|---|---|
| **TOTAL SUPERFICIE NETA:** | **4,520** | **$m^2$** | **CUMPLE** |
| % Sup. Lateral libre: | 74,93% | | |
| **Velocidad diseño:** | Qmax | | |
| Filtro limpio: | 0,56 | m/s | |
| Con % de obturación: | 0,95 | m/s | (0,7) |

## 3.6 DESAGÜE DE FONDO

A la salida de la tubería de toma, en la arqueta de válvulas, se proyecta una derivación en DN400 hacia el Barranco de Valverada, que sirva como desagüe de fondo en caso necesario

## 3.7 RED DE DRENAJE

Para el dimensionamiento de las tuberías de drenaje, ante la imposibilidad de conocer los caudales a drenar, se han realizado varios tanteos con las pendientes disponibles y los diámetros, eligiendo los considerados suficientes. De manera general, se supone que si el caudal de drenaje de la balsa, es superior al 5% del caudal de llenado, la balsa se considera que no es funcional.

En este caso, el caudal máximo de entrada es de 2.521 l/s, por lo que los drenajes deberían dimensionarse para una capacidad 126 l/s.

La red de drenaje consta de cuatro drenajes principales, 2 perimetrales y 2 centrales, de PVC ranurado DN 250 que permiten una sectorización de la balsa. Los drenajes vierten de forma individual a la arqueta correspondiente que, al ser registrable, permite ubicar las posibles fugas.

Estos drenajes confluyen en un único punto junto a la toma de fondo, en la parte interior de la balsa, para cruzar el dique de la balsa en cuatro tuberías, una por cada uno de los drenajes. Una vez cruzan la balsa, estas descargarán en la arqueta de desagüe de fondo. Para la evacuación al barranco de Valverada, se proyecta una tubería de PVC de DN250 PN10.

Formulación.

Para el cálculo de las pérdidas de carga se ha recurrido a la fórmula de Manning, por considerarse como la más apropiada para estas condiciones de funcionamiento.

**Tabla 1.-** Capacidad de evacuación de los drenajes de la Balsa Inferior Sur

| **Material** | **PVC-Ranurado** |
|---|---|
| Diámetro (mm) | 250 |
| Pendiente mínima | 0,5% |
| V (m/s) | 1,13 |
| Caudal (l/s) | 49 |

En la anterior tabla vemos el caudal desalojado en función de la pendiente de los drenajes. En el caso de la balsa inferior Sur, tendremos drenajes con una pendiente de 0,5%. por lo que el caudal total que serán capaces de desalojar los 4 drenajes será de al menos 196 l/s (superior a los 126 l/s establecidos como máximo admisible)

## 3.8 CORONACIÓN

Para la determinación de la anchura de coronación se emplea la siguiente expresión:

$$W = Z/5 + 3;$$

Siendo Z = altura del dique (m.); Z = 5 m
W = anchura de coronación (m.); W = 4 metros

Se proyecta finalmente la anchura de coronación de 4,00 m, considerándose ésta como la anchura requerida para poder transitar por la misma.

En la coronación se aplicará una capa de 0,20 m de zahorra natural compactada al 98% PM, con pendiente al exterior del 2% a fin de que haga la función de camino de servicio a lo largo de todo el perímetro.

## 3.9 CAPACIDAD

Para determinar la capacidad de la balsa, se realiza la semisuma del producto resultante de la sección que posee la balsa interiormente por la diferencia de cota que existe entre dichas secciones.

En la siguiente tabla, se muestra el resultado de dicha cubicación:

| **PERFIL** | **COTA (m)** | **SUPERFICIE (m2)** | **SEMISUMA (m2)** | **DISTANCIA (m)** | **VOLUMEN (m3)** | **VOL. Acumulado (m3)** |
|---|---|---|---|---|---|---|
| 1 | 384,30 | 13.605,69 | | | | 0,00 |
| 2 | 385,30 | 15.000,13 | 14.302,91 | 1,00 | 14.302,91 | 14.302,91 |
| 3 | 386,30 | 16.433,84 | 15.716,99 | 1,00 | 15.716,99 | 30.019,90 |
| 4 | 387,30 | 17.906,82 | 17.170,33 | 1,00 | 17.170,33 | 47.190,23 |
| 5 | 388,40 | 19.572,45 | 18.739,64 | 1,10 | 20.613,60 | 67.803,83 |
| | | | **TOTAL NAMO** | | | **67.803,83** |

## 3.10 CÁLCULO DE LOS ANCLAJES DE LA LÁMINA DE PEAD

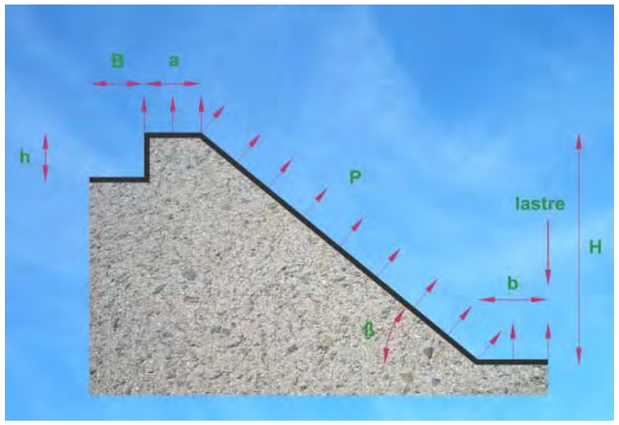
Para la definición de los lastres a colocar en la balsa se ha utilizado un software libre que facilita esta labor, adecuando los datos de entrada a las dimensiones de la balsa a estudiar.

Parámetros que definen la situación de la lámina:

- Talud del dique: 2,5H : 1V
- Altura del dique: h = 5 m
- Calado de agua: c = 4,1 m
- Longitud del talud: l = 13,46 m

En proyecto se prevén sujeción en la cabeza del talud mediante zanja con material compactado y lastres de hormigón en laterales y fondo de balsa. En este momento se planteará simplificar los lastres dejando los previstos en cabecera y en el fondo.

**Imagen 1.** Esquema del talud, parámetros y esfuerzos que intervienen.

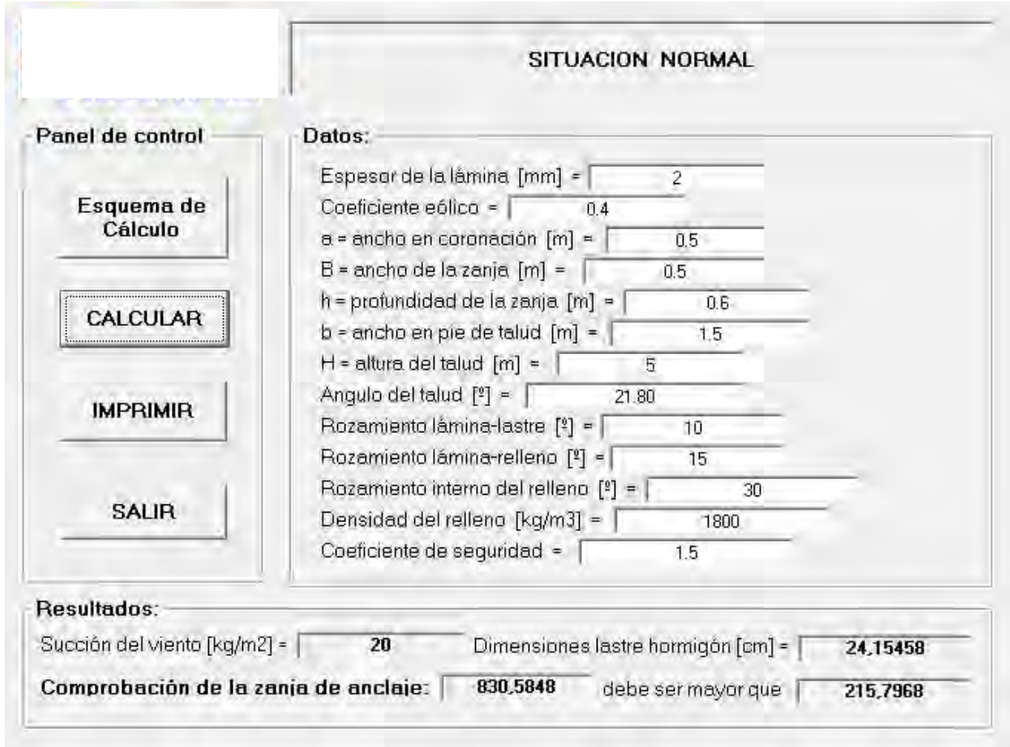



En el cálculo se estudian dos posibles hipótesis.

- Situación Normal (balsa llena)
- Situación Expuesta (balsa vacía)

### 3.10.1 SITUACIÓN NORMAL

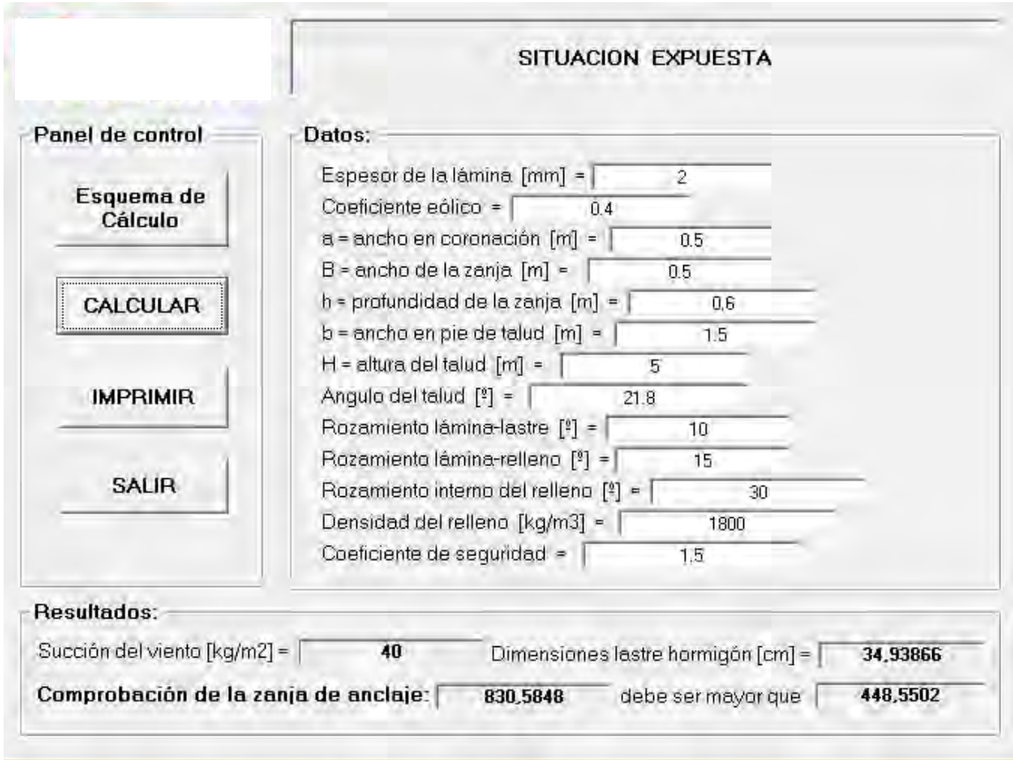
La situación normal corresponde a la balsa llena, situación predominante en este tipo de balsas. Los datos resultantes son:




Se requiere un dado de hormigón de 0,25 cm x 0,25 cm, que equivale a 150,00 Kg/ml. Teniendo en cuenta el peso de un bordillo tipo T2 (85 kg/ud), se propone la instalación de 2 ud de bordillo T2.

### 3.10.2 SITUACIÓN EXPUESTA

La situación expuesta corresponde a la balsa vacía, situación que tan solo se dará en la fase de montaje ya que en cualquier otra fase siempre habrá algo de agua en el vaso. Los datos resultantes son:




Para la situación expuesta con un coeficiente de seguridad de 1,5 y un coeficiente de viento alto se requiere un dado de hormigón de 0,35 cm x 0,35 cm, que equivale a 294,00 Kg/ml. Teniendo en cuenta el peso de un bordillo tipo T3 (117 kg/ud), se propone la instalación de 3 ud de bordillo T3.

#### 3.10.3 PROPUESTA LASTRES.

En coronación sujeción mediante zanja con materiales compactos, con dimensiones acorde a lo definido en planos.

A pie de talud, instalación de 3 bordillos tipo T3, con un lastre total de 351 kg/m, para un máximo de cálculo de 294 kg/m correspondiente a la situación más expuesta o lastres con peso similar.

### 3.11 ESTABILIDAD DE TALUDES

En el Anejo nº 7 "Estudio geotécnico" se detalla la metodología y el procedimiento de cálculo seguido para la determinación de la estabilidad de los taludes de la balsa.

En este trabajo se analiza el diseño de la balsa en cuanto a la inclinación de los taludes y a la estabilidad global del conjunto terraplén-cimiento. El análisis de estabilidad se realiza utilizando los métodos tradicionales de Bishop, Janbu, etc., mediante la aplicación del programa de cálculo SLOPE / W y considerando círculos de rotura pasando por el cimiento.

Se analiza tanto en condiciones "secas" como en el caso de rotura de la lámina y desembalse rápido. No se consideran acciones sísmicas pues la zona actuación se localiza dentro de áreas con aceleración sísmica básica inferior a 0,04 g (NCSE-02).

Tal y como se indica en el mismo documento, los taludes planteados en proyecto para la balsa son estables y no es necesario saneo o tratamiento alguno bajo la cimentación del dique de cierre de la balsa.

### 3.12 RESUMEN DE LAS CARACTERÍSTICAS DE LA BALSA INFERIOR SUR

Tabla resumen de las características técnicas de la balsa:

| | |
|---|---|
| Cota de coronación (m) | 389,30 |
| Anchura de coronación (m) | 4,00 |
| Cota de fondo (m) | 384,30 |
| Cota de agua (N.A.M.O.) (m) | 388,40 |
| Altura de agua (N.A.M.O.) (m) | 4,10 |
| Cota de agua (N.A.M.E.) (m) | 388,65 |
| Volumen de agua (N.A.M.O.) ($m^3$) | 67.803,83 |
| Resguardo sobre N.A.M.O. (m) | 0,90 |
| Superficie de fondo de balsa ($m^2$) | 13.605,69 |
| Perímetro fondo de balsa (m) | 550,00 |
| Superficie lámina de agua (N.A.M.O.) ($m^2$) | 19.572,45 |
| Superficie de coronación ($m^2$) | 20.970,58 |
| Perímetro arista de coronación (m) | 628,4 |
| Talud aguas arriba (interior) | 2,5/1 |
| Talud aguas abajo desmonte (exterior) | 1/1 |
| Talud aguas abajo terraplén (exterior) | 2/1 |
| Volumen de desmonte ($m^3$) | 56.416,68 |
| Volumen de terraplén ($m^3$) | 12.568,22 |

## 4 BALSA INFERIOR NORTE

### 4.1 ALIVIADERO

Tal y como se estableció en la anterior balsa, la lluvia máxima en una hora es de 37,19 mm.

Superficie interior ..... 20.258 m2
Lluvia considerada .....37,19 mm/h
Caudal a desalojar ..... 209,3 l/s

Teniendo en cuenta esto, el caudal considerado en este caso para el dimensionamiento del aliviadero será de 1.469,8 l/s, obtenido de la suma del caudal de llenado (1.260,5 l/s) y del caudal resultante de la lluvia considerada (209,3 l/s). En el caso de la balsa inferior Norte se considera un caudal de llenado menor que en el caso de la Balsa Inferior Sur, dado que el caudal se reparte entre las dos balsas.

Los cálculos de este aliviadero se recogen a continuación, mediante la siguiente expresión:

$$Q_i = 1{,}82 \cdot L \cdot (h)^{\frac{3}{2}}$$

donde h es la elevación de la lámina de agua sobre el labio vertiente del aliviadero y L la longitud de dicho labio vertiente.

A continuación, se recoge las características y el resultado de los cálculos realizados, para distintas longitudes de labio de vertido:

| | Q ($m^3$/s) | L (m) | h (m) |
|---|---|---|---|
| Aliviadero | 1,470 | 8,00 | 0,22 |
| | 1,470 | 9,00 | 0,20 |
| | 1,470 | 7,00 | 0,24 |

Se adopta el criterio de considerar un labio de 9,0 m. de longitud, con lo que el Nivel de Almacenamiento Máximo Extraordinario (NAME) queda fijado con una altura de vertido de 0,20 m., es decir, a la cota 388,6 msnm.

La tubería que evacuará el agua de alivio será de Acero Helicosoldado DN 610 de 6,4 mm de espesor (en el primer tramo bajo el dique) y tras este tramo se inicia un tramo que se realiza con tubería de PRFV DN 600 mm.

El vertido de esta tubería se realiza en el Barranco de Valverada a través de una obra de salida ejecutada en hormigón armado (HA-35), tal y como se indica en el plano 5.09. En la obra de salida se instalará una reja que evite la entrada de animales a la balsa a través del aliviadero.

Desde esta arqueta partirá una tubería de vertido de 60 m de longitud hasta el Barranco de Valverada. En la obra de salida se instalará una reja que evite la entrada de animales a la balsa a través del aliviadero.

## 4.2 RESGUARDO

### 4.2.1 DETERMINACIÓN DEL NAMO

Como en la balsa anterior, la altura de almacenamiento es de 4,1 m, con lo que la cota de Nivel de Almacenamiento Máximo Ordinario será 388,4 m.s.n.m.

### 4.2.2 DETERMINACIÓN DEL NAME

El máximo caudal a aliviar tal y como se ha calculado anteriormente será de 1.470 l/s.

Para un labio de vertido de 9 m de longitud y un caudal máximo a evacuar de 1.470 l/s, obtendremos una altura máxima de vertido por encima del labio del aliviadero de 0,20 m aproximadamente. Por lo tanto, el NAME quedará definido en la cota 388,60 m.

### 4.2.3 DETERMINACIÓN DEL RESGUARDO Y COTA DE CORONACIÓN

Para la estimación del resguardo necesario se recomienda la utilización de la siguiente expresión empírica, en m:

$$h = 1{,}5 \times h1$$

$$h1 = 0{,}6 \times \sqrt[4]{L}\,; \qquad \text{siendo L el fetch en Km.}$$

Considerando un valor del fetch de 272 m, siendo éste el valor de la mayor longitud de recorrido del viento en la lámina de agua, obtenemos un resguardo mínimo de 0,65 m.

Así pues, considerando la altura de vertido de agua sobre el labio de vertido del aliviadero, establecida en la cota 388,6 m obtenemos un resguardo efectivo respecto a esta situación de NAME de 0,7 m, superior al resguardo recomendado por la fórmula empírica mencionada anteriormente (0,65 m).

Por último, la cota de coronación quedará determinada en la cota 389,4 estando 0,90 metros por encima del NAMO.

## 4.3 TOMA DE FONDO

La toma de fondo está constituida por el tramo de conducción entre la balsa Inferior Norte y la Estación de Bombeo. Al mismo tiempo, esta conducción realizará las funciones de tubería de llenado, al estar comunicada directamente con la toma de fondo de la Balsa Inferior Sur,

Para el dimensionado de esta conducción, se considera que el caudal máximo de entrada desde el canal se reparte entre ambas balsas, por lo que el caudal de diseño queda en 1.260,5 l/s. Es recomendable que la velocidad de circulación del agua en el interior de la tubería de toma se encuentre comprendida entre 0,5 y 2 m/s.

La Toma de fondo estará formado por una tubería de Acero Helicosoldado (S 235 JR G2), con un diámetro de 1016 mm, espesor de pared de 10 mm y una longitud de 250 metros y unirá la balsa con el colector de aspiración de la EB.

**Principales características de la toma de fondo-tubería de llenado.**

Los datos de la toma de fondo son:

Material .....AH S235 JR G2
Diámetro .....1016
Espesor .....10 mm
Longitud .....250 m
Caudal máximo ..... 1.260 l/s
Velocidad .....1,55 m/s
Pérdida de Carga .....0,37 m

De esta forma, la pérdida de carga total de la conducción es de 0,37 m.

## 4.4 JAULA DE DESBASTE

Se diseña una jaula de desbaste de 1000 mm de diámetro y 1300 mm de altura, dejando un zócalo de 30 cm de zona no filtrante para retener posibles lodos.

**Condiciones de diseño:**

| | | |
|---|---|---|
| Caudal riego Gravedad: | 0,00 | l/s |
| Caudal Bombeo: | 1261,50 | l/s |
| **Velocidad de paso referencia:** | **1** | **m/s** |
| **Superficie mínima requerida:** | | |
| Gravedad: | 0,000 | $m^2$ |
| Bombeo Directo: | 1,262 | $m^2$ |
| | 1,262 | $m^2$ |
| Ratio obturación: | 70% | |
| **Total superficie requerida:** | **2,14455** | **$m^2$** |

**Diseño filtro:**

| | | |
|---|---|---|
| **Diámetro:** | **1** | **m** |
| Altura Sup. filtrante: | 1 | m |
| Zócalo (zona no filtrante): | 0,3 | m |
| **Altura TOTAL filtro:** | **1,3** | **m** |
| **Superficie total Bruta:** | | |
| Área superior: | 0,785 | $m^2$ |
| Área lateral: | 3,142 | $m^2$ |
| Total Superficie Bruta: | 3,927 | $m^2$ |
| **Sup. BRUTA Diseño:** | **3,142** | **$m^2$** |
| **Superficie ocupada:** | | |
| Separación pletinas verticales: | 0,02 | m |
| nº pletinas verticales: | 158 | uds |
| Espesor pletinas: | 0,005 | m |
| Separación barras horizontales: | 0,3 | m |
| nº barras horizontales: | 4 | uds |
| nº de barras por tramo: | 2 | uds |
| Espesor barras: | 0,006 | m |
| Sup. Ocupada por pletinas: | 0,79 | $m^2$ |
| Sup. Ocupada por barras: | 0,151 | $m^2$ |
| **Total superficie ocupada:** | **0,790** | **$m^2$** |

| | | | |
|---|---|---|---|
| **TOTAL SUPERFICIE NETA:** | **2,352** | **$m^2$** | **CUMPLE** |
| % Sup. Lateral libre: | 74,85% | | |
| **Velocidad diseño:** | Qmax | | |
| Filtro limpio: | 0,54 | m/s | |
| Con % de obturación: | 0,91 | m/s | (0,7) |

## 4.5 DESAGÜE DE FONDO

En la tubería de unión entre balsas inferiores, antes del cruce del barranco, se proyecta una derivación en DN400 hacia el Barranco de Valverada, que sirva como desagüe de fondo en caso necesario.

## 4.6 RED DE DRENAJE

Para el dimensionamiento de las tuberías de drenaje, ante la imposibilidad de conocer los caudales a drenar, se han realizado varios tanteos con las pendientes disponibles y los diámetros, eligiendo los considerados suficientes. De manera general, se supone que si el caudal de drenaje de la balsa, es superior al 5% del caudal de llenado, la balsa se considera que no es funcional.

En este caso, el caudal máximo de entrada es de 1260 l/s, (considerando que el caudal máximo de entrada desde el Canal de Monegros se reparte entre las 2 balsas inferiores) por lo que los drenajes deberían dimensionarse para una capacidad 63 l/s.

La red de drenaje consta de cuatro drenajes principales, 2 perimetrales y 2 centrales, de PVC ranurado DN 160 que permiten una sectorización de la balsa. Los drenajes vierten de forma individual a la arqueta correspondiente que, al ser registrable, permite ubicar las posibles fugas.

Estos drenajes confluyen en un único punto junto a la toma de fondo, en la parte interior de la balsa, para cruzar el dique de la balsa en cuatro tuberías, una por cada uno de los drenajes. Una vez cruzan la balsa, estas descargarán en la arqueta dentro de la arqueta de la válvula de seccionamiento. Para la evacuación al barranco de Valverada, se proyecta una tubería de PVC DN315 que discurra paralela a la tubería de llenado hasta su vertido.

Formulación.

Para el cálculo de las pérdidas de carga se ha recurrido a la fórmula de Manning, por considerarse como la más apropiada para estas condiciones de funcionamiento.

**Tabla 2.-** Capacidad de evacuación de los drenajes de la Balsa Inferior Norte

| **Material** | **PVC-Ranurado** |
|---|---|
| Diámetro (mm) | 160 |
| Pendiente mínima | 0,5% |
| V (m/s) | 0,89 |
| Caudal (l/s) | 15,9 |

En la anterior tabla vemos el caudal desalojado en función de la pendiente de los drenajes. En el caso de la balsa inferior norte, tendremos drenajes con una pendiente de 0,5%. por lo que el caudal total que serán capaces de desalojar los 4 drenajes será de al menos 63,6 l/s (superior a los 63 l/s establecidos como máximo admisible)

## 4.7 CORONACIÓN

Para la determinación de la anchura de coronación se emplea la siguiente expresión:

$$W = Z/5 + 3;$$

Siendo Z = altura del dique (m.); Z = 5 m
W = anchura de coronación (m.); W = 4 metros

Se proyecta finalmente la anchura de coronación de 4,00 m, considerándose ésta como la anchura requerida para poder transitar por la misma.

En la coronación se aplicará una capa de 0,20 m de zahorra natural compactada al 98% PM, con pendiente al exterior del 2% a fin de que haga la función de camino de servicio a lo largo de todo el perímetro.

## 4.8 CAPACIDAD

Para determinan la capacidad de la balsa se realiza la semisuma del producto resultante de la sección que posee la balsa interiormente por la diferencia de cota que existe entre dichas secciones.

En la siguiente tabla, se muestra el resultado de dicha cubicación:

| PERFIL | COTA (m) | SUPERFICIE (m2) | SEMISUMA (m2) | DISTANCIA (m) | VOLUMEN (m3) | VOL. Acumulado (m3) |
|---|---|---|---|---|---|---|
| 1 | 384,30 | 16.382,79 | | | | 0,00 |
| 2 | 385,30 | 17.889,67 | 17.136,23 | 1,00 | 17.136,23 | 17.136,23 |
| 3 | 386,30 | 19.435,82 | 18.662,75 | 1,00 | 18.662,75 | 35.798,98 |
| 4 | 387,30 | 21.021,24 | 20.228,53 | 1,00 | 20.228,53 | 56.027,51 |
| 5 | 388,40 | 22.810,56 | 21.915,90 | 1,10 | 24.107,49 | 80.135,00 |
| | | | **TOTAL NAMO** | | | **80.135,00** |

## 4.9 CÁLCULO DE LOS ANCLAJES DE LA LÁMINA DE PEAD

En este caso, los parámetros que definen la situación de la lámina son los mismos que en el caso de la Balsa Inferior Norte:

- Talud del dique: 2,5H : 1V
- Altura del dique: h = 5 m
- Calado de agua: c = 4,1 m
- Longitud del talud: l = 13,46 m

Por tanto, la propuesta de lastres es la misma:

- En coronación sujeción mediante zanja con materiales compactos, con dimensiones acorde a lo definido en planos.
- A pie de talud, instalación de 3 bordillos tipo T3, con un lastre total de 351 kg/m, para un máximo de cálculo de 294 kg/m correspondiente a la situación más expuesta o lastres con peso similar.

## 4.10 RESUMEN DE LAS CARACTERÍSTICAS DE LA BALSA INFERIOR NORTE

Tabla resumen de las características técnicas de la balsa:

| | |
|---|---|
| Cota de coronación (m) | 389,30 |
| Anchura de coronación (m) | 4,00 |
| Cota de fondo (m) | 384,30 |
| Cota de agua (N.A.M.O.) (m) | 388,40 |
| Altura de agua (N.A.M.O.) (m) | 4,10 |
| Cota de agua (N.A.M.E.) (m) | 388,60 |
| Volumen de agua (N.A.M.O.) ($m^3$) | 80.135,00 |
| Resguardo sobre N.A.M.O. (m) | 0,90 |
| Superficie de fondo de balsa ($m^2$) | 16.383,00 |
| Perímetro fondo de balsa (m) | 595,00 |
| Superficie lámina de agua (N.A.M.O.) ($m^2$) | 22.810,5 |
| Superficie de coronación ($m^2$) | 24.309,89 |
| Perímetro arista de coronación (m) | 673,45 |
| Talud aguas arriba (interior) | 2,5/1 |
| Talud aguas abajo desmonte (exterior) | 1/1 |
| Talud aguas abajo terraplén (exterior) | 2/1 |
| Volumen de desmonte ($m^3$) | 65.789,18 |
| Volumen de terraplén ($m^3$) | 6.764,56 |

# 5 BALSA INTERMEDIA

## 5.1 ALIVIADERO

En este caso, tenemos los siguientes datos:

Superficie interior ..... 37.868 m2
Lluvia considerada ..... 37,19 mm/h
Caudal a desalojar ..... 391,2 l/s

Teniendo en cuenta esto, el caudal considerado en este caso para el dimensionamiento del aliviadero será de 2.5364,2 l/s, obtenido de la suma del caudal de llenado (2.172 l/s) y del caudal resultante de la lluvia considerada (391,2 l/s).

Los cálculos de este aliviadero se recogen a continuación, mediante la siguiente expresión:

$$Q_i = 1{,}82 \cdot L \cdot (h)^{\frac{3}{2}}$$

donde h es la elevación de la lámina de agua sobre el labio vertiente del aliviadero y L la longitud de dicho labio vertiente.

A continuación, se recoge las características y el resultado de los cálculos realizados, para distintas longitudes de labio de vertido:

| | Q ($m^3/s$) | L (m) | h (m) |
|---|---|---|---|
| Aliviadero | 2,564 | 11 | 0,25 |
| | 2,564 | 12 | 0,24 |
| | 2,564 | 13 | 0,23 |

Se adopta el criterio de considerar un labio de 12 m. de longitud, con lo que el Nivel de Almacenamiento Máximo Extraordinario (NAME) queda fijado con una altura de vertido de 0,24 m., es decir, a la cota 428,24 msnm.

La tubería que evacuará el agua de alivio será de Acero Helicosoldado DN 813 de 7,9 mm de espesor (en el primer tramo bajo el dique) con una longitud de 15 m, tras este tramo se inicia un tramo de 32 m de longitud que se realiza con tubería de PRFV DN 800 mm.

El vertido de esta tubería se realiza en una zona en la que la pendiente del terreno resulta favorable para el desagüe en caso necesario tal y como se indica en el plano 09.09. En la obra de salida se instalará una reja que evite la entrada de animales a la balsa a través del aliviadero.

## 5.2 RESGUARDO

### 5.2.1 DETERMINACIÓN DEL NAMO

En el caso de la Balsa Intermedia la altura de almacenamiento es de 6 m, con lo que la cota de Nivel de Almacenamiento Máximo Ordinario será 428 m.s.n.m.

### 5.2.2 DETERMINACIÓN DEL NAME

El máximo caudal a aliviar tal y como se ha calculado anteriormente será de 2.5364,2 l/s.

Para un labio de vertido de 12 m de longitud y un caudal máximo a evacuar de 2.5364,2 l/s, obtendremos una altura máxima de vertido por encima del labio del aliviadero de 0,24 m aproximadamente. Por lo tanto, el NAME quedará definido en la cota 428,24 m.

### 5.2.3 DETERMINACIÓN DEL RESGUARDO Y COTA DE CORONACIÓN

Considerando un valor del fetch de 311 m, siendo éste el valor de la mayor longitud de recorrido del viento en la lámina de agua, obtenemos un resguardo mínimo de 0,67 m.

Así pues, considerando la altura de vertido de agua sobre el labio de vertido del aliviadero, establecida en la cota 428,24 m obtenemos un resguardo efectivo respecto a esta situación de NAME de 0,76 m, superior al resguardo recomendado por la fórmula empírica mencionada anteriormente (0,67 m).

Por último, la cota de coronación quedará determinada en la cota 429 estando 1,00 metros por encima del NAMO.

## 5.3 TOMA DE FONDO

La infraestructura de toma de fondo propiamente dicha de la balsa corresponderá con el punto de suministro a la red de riego.

Para el dimensionado de la Toma de Fondo, se ha tenido en cuenta el caudal de abastecimiento a la red de riego en la situación de diseño. En este caso el caudal de cabecera para el funcionamiento de la red es 2.632 l/s.

La Toma de Fondo estará formada por una tubería de acero helicosoldado con diámetro de 1422 mm y espesor de 10,3 mm, con un régimen de funcionamiento en carga, que unirá el fondo de la Balsa con la red de riego.

La cota de captación de la Toma de Fondo será de 422 msnm.

### Pérdidas de carga

Los datos a considerar en el cálculo y dimensionamiento de las condiciones de servicio de esta Toma de Fondo son los siguientes:

Tubería .....AH 1422 mm
Espesor ..... e=10,3 mm
Longitud ..... 35 (viga de fondo)
Caudal .....2.632 l/s
Velocidad .....1,69 m/s
Pérdida de Carga ..... 0,03 mca

## 5.4 JAULA DE DESBASTE

Se diseña una jaula de desbaste de 1400 mm de diámetro y 1700 mm de altura, dejando un zócalo de 30 cm de zona no filtrante para retener posibles lodos.

**Condiciones de diseño:**

| | | |
|---|---|---|
| Caudal riego Gravedad: | 2632,00 | l/s |
| Caudal Bombeo: | 2172,00 | l/s |
| **Velocidad de paso referencia:** | **1** | **m/s** |
| **Superficie mínima requerida:** | | |
| Gravedad: | 2,632 | $m^2$ |
| Bombeo Directo: | 2,172 | $m^2$ |
| | 2,632 | $m^2$ |
| Ratio obturación: | 70% | |
| **Total superficie requerida:** | **4,4744** | **$m^2$** |

**Diseño filtro:**

| | | |
|---|---|---|
| **Diámetro:** | **1,4** | **m** |
| Altura Sup. filtrante: | 1,4 | m |
| Zócalo (zona no filtrante): | 0,3 | m |
| **Altura TOTAL filtro:** | **1,7** | **m** |
| **Superficie total Bruta:** | | |
| Área superior: | 1,539 | $m^2$ |
| Área lateral: | 6,158 | $m^2$ |
| Total Superficie Bruta: | 7,697 | $m^2$ |
| **Sup. BRUTA Diseño:** | **6,158** | **$m^2$** |
| **Superficie ocupada:** | | |
| Separación pletinas verticales: | 0,02 | m |
| nº pletinas verticales: | 220 | uds |
| Espesor pletinas: | 0,005 | m |
| Separación barras horizontales: | 0,3 | m |
| nº barras horizontales: | 5 | uds |
| nº de barras por tramo: | 2 | uds |
| Espesor barras: | 0,006 | m |
| Sup. Ocupada por pletinas: | 1,54 | $m^2$ |
| Sup. Ocupada por barras: | 0,264 | $m^2$ |
| **Total superficie ocupada:** | **1,540** | **$m^2$** |

| | | | | | |
|---|---|---|---|---|---|
| **TOTAL SUPERFICIE NETA:** | **4,618** | **$m^2$** | **CUMPLE** | | |
| % Sup. Lateral libre: | 74,99% | | | | |
| **Velocidad diseño:** | Qmax | | | Qmin: | |
| Filtro limpio: | 0,57 | m/s | | 0,47 | m/s |
| Con % de obturación: | 0,97 | m/s | (0,7) | 0,80 | m/s |

## 5.5 DESAGÜE DE FONDO

Para el vaciado de la balsa en caso de ser necesario se empleará la propia tubería de llenado, por lo que no es necesario proyectar una tubería de desagüe independiente.

## 5.6 RED DE DRENAJE

En este caso, el caudal máximo de entrada es de 2.172 l/s, por lo que los drenajes deberían dimensionarse para una capacidad máxima de un 5%, es decir 108,6 l/s.

La red de drenaje de la balsa se plantea en 4 sectores independientes, 2 en el fondo y 2 más en los taludes (parte inferior). Los drenajes constarán de tubos ranurados envueltos de gravas y de geotextil y confluirán en un único punto junto a la toma de fondo, en la parte interior de la balsa, para cruzar el dique de la balsa en seis tuberías, una por cada uno de los drenajes. La salida de los drenajes (de manera independiente) se conducirán hasta una arqueta de control donde confluirán los 4 finales de tuberías que, a simple vista, permitirá saber si existe algún problema de fuga y en qué zona de la balsa presenta el problema.

La evacuación final del agua de los drenajes se realizará mediante tubería de DN250 hasta una zona en la que la pendiente del terreno resulta favorable para el posible vertido.

**Formulación.**

Para el cálculo de las pérdidas de carga se ha recurrido a la fórmula de Manning, por considerarse como la más apropiada para estas condiciones de funcionamiento.

Los datos y resultados se expresan en las tablas siguientes:

**Tabla 3.-** Capacidad de evacuación de los drenajes de la Balsa Intermedia

| **Material** | **PVC-Ranurado** |
|---|---|
| Diámetro (mm) | 200 |
| Pendiente mínima | 0,5% |
| V (m/s) | 1,01 |
| Caudal (l/s) | 27,9 |

En la siguiente tabla vemos el caudal desalojado en función de la pendiente de los drenajes. En el caso de la balsa intermedia, tendremos drenajes con una pendiente de 0,5%. por lo que el caudal total que serán capaces de desalojar los 4 drenajes será de al menos 112 l/s (superior a los 107 l/s establecidos como máximo admisible)

## 5.7 CORONACIÓN

Para la determinación de la anchura de coronación se emplea la siguiente expresión:

$$W = Z/5 + 3;$$

Siendo Z = altura del dique (m.); Z = 7 m
W = anchura de coronación (m.); W = 4 metros

Se proyecta finalmente la anchura de coronación de 5,00 m, considerándose ésta como la anchura requerida para poder transitar por la misma.

En la coronación se aplicará una capa de 0,20 m de zahorra natural compactada al 98% PM, con pendiente al exterior del 2% a fin de que haga la función de camino de servicio a lo largo de todo el perímetro.

## 5.8 CAPACIDAD

Para determinar la capacidad de la balsa, se realiza la semisuma del producto resultante de la sección que posee la balsa interiormente por la diferencia de cota que existe entre dichas secciones.

En la siguiente tabla, se muestra el resultado de dicha cubicación:

**Tabla 4.-** Capacidad de la Balsa Intermedia

| PERFIL | COTA (m) | SUPERFICIE ($m^2$) | SEMISUMA ($m^2$) | DISTANCIA (m) | VOLUMEN ACUM. ($m^3$) |
|---|---|---|---|---|---|
| 1 | 422,00 | 24.633,88 | | | |
| 2 | 423,00 | 26.406,63 | 25.520,26 | 1 | 25.520,26 |
| 3 | 424,00 | 28.218,66 | 27.312,65 | 1 | 52.832,90 |
| 4 | 425,00 | 30.069,96 | 29.144,31 | 1 | 81.977,21 |
| 5 | 426,00 | 31.960,52 | 31.015,24 | 1 | 112.992,45 |
| 6 | 427,00 | 33.890,36 | 32.925,44 | 1 | 145.917,90 |
| 7 | 428,00 | 35.859,47 | 34.874,91 | 1 | 180.792,81 |
| | | | | **TOTAL NAMO** | **180.792,81** |

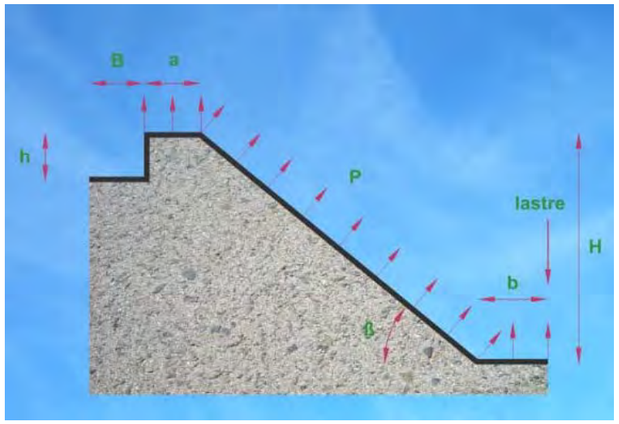
## 5.9 CÁLCULO DE LOS ANCLAJES DE LA LÁMINA DE PEAD

La Balsa Intermedia tiene una geometría que hace que la propuesta de lastres sea diferente a las balsas Inferiores. En este caso, los parámetros que definen la situación de la lámina:

- Talud del dique: 2,5H : 1V
- Altura del dique: h = 7 m
- Calado de agua: c = 6 m
- Longitud del talud: l = 18,85 m

En proyecto se prevén sujeción en la cabeza del talud mediante zanja con material compactado y lastres de hormigón en laterales y fondo de balsa. En este momento se planteará simplificar los lastres dejando los previstos en cabecera y en el fondo.

**Imagen 2.** Esquema del talud, parámetros y esfuerzos que intervienen.

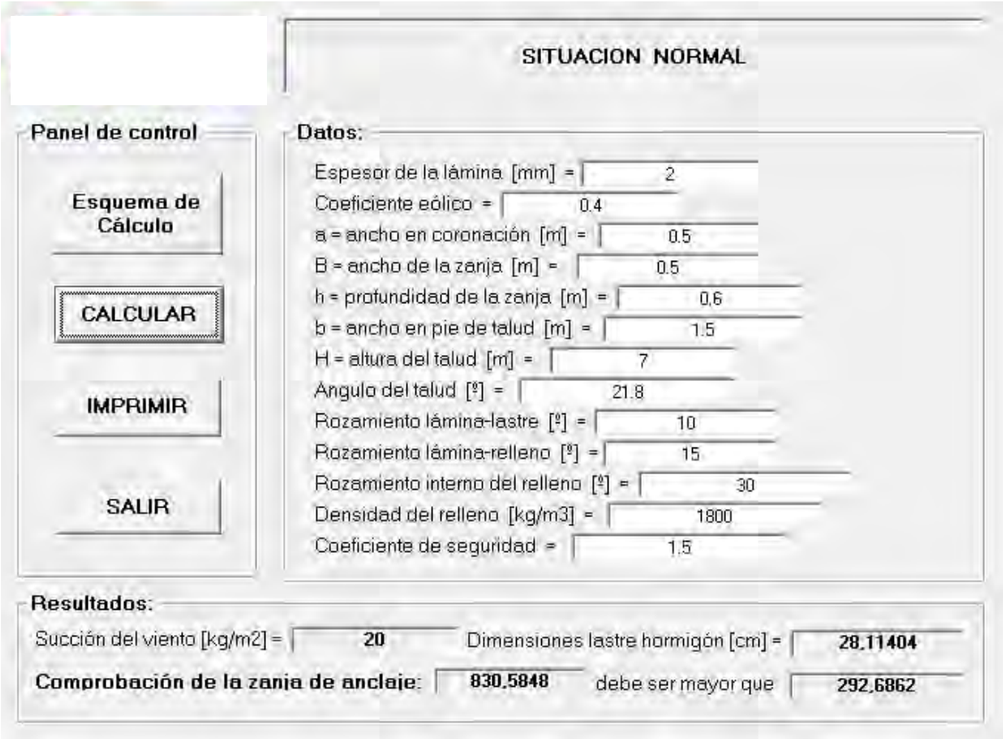



En el cálculo se estudian dos posibles hipótesis.

- Situación Normal (balsa llena)
- Situación Expuesta (balsa vacía)

### 5.9.1 SITUACIÓN NORMAL

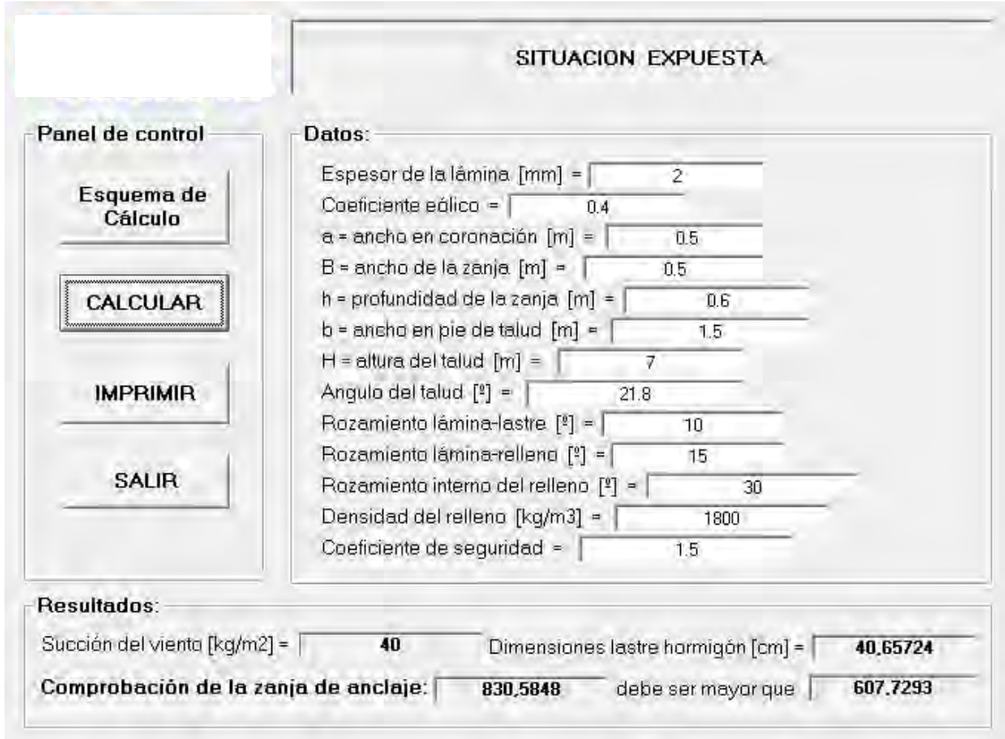
La situación normal corresponde a la balsa llena, situación predominante en este tipo de balsas. Los datos resultantes son:




Se requiere un dado de hormigón de 0,28 cm x 0,28 cm, que equivale a 188,00 Kg/ml. Teniendo en cuenta el peso de un bordillo tipo T2 (85 kg/ud) y el peso de un bordillo T3 (117 kg/ud), se propone la instalación de 1 ud de bordillo T2 y 1 ud de bordillo T3.

### 5.9.2 SITUACIÓN EXPUESTA

La situación expuesta corresponde a la balsa vacía, situación que tan solo se dará en la fase de montaje ya que en cualquier otra fase siempre habrá algo de agua en el vaso. Los datos resultantes son:




Para la situación expuesta con un coeficiente de seguridad de 1,5 y un coeficiente de viento alto se requiere un dado de hormigón de 0,40 cm x 0,40 cm, que equivale a 384,00 Kg/ml. Teniendo en cuenta el peso de un bordillo tipo T2 (85 kg/ud) y el peso de un bordillo T3 (117 kg/ud), se propone la instalación de 2 ud de bordillo T3 y 2 ud de bordillo T2.

### 5.9.3 PROPUESTA LASTRES.

En coronación sujeción mediante zanja con materiales compactos, con dimensiones acorde a lo definido en planos.

A pie de talud, instalación de 2 bordillos tipo T3 y 2 bordillo T2 con un lastre total de 404 kg/m, para un máximo de cálculo de 384 kg/m correspondiente a la situación más expuesta o lastres con peso similar.

### 5.10 RESUMEN DE LAS CARACTERÍSTICAS DE LA BALSA INTERMEDIA

Tabla resumen de las características técnicas de la balsa:

| | |
|---|---|
| Cota de coronación (m) | 429,00 |
| Anchura de coronación (m) | 5,00 |
| Cota de fondo (m) | 422,00 |
| Cota de agua (N.A.M.O.) (m) | 428,00 |
| Altura de agua (N.A.M.O.) (m) | 6,00 |
| Cota de agua (N.A.M.E.) (m) | 428,24 |
| Volumen de agua (N.A.M.O.) ($m^3$) | 180.792,81 |
| Resguardo sobre N.A.M.O. (m) | 1,00 |
| Superficie de fondo de balsa ($m^2$) | 24.633,82 |
| Perímetro fondo de balsa (m) | 701,25 |
| Superficie lámina de agua (N.A.M.O.) ($m^2$) | 35.859,46 |
| Superficie de coronación ($m^2$) | 37.867,84 |
| Perímetro arista de coronación (m) | 811,20 |
| Talud aguas arriba (interior) | 2,5/1 |
| Talud aguas abajo desmonte (exterior) | 1/1 |
| Talud aguas abajo terraplén (exterior) | 2/1 |
| Volumen de desmonte ($m^3$) | 142.663,18 |
| Volumen de terraplén ($m^3$) | 28.969,54 |

## 6 BALSA ELEVADA

### 6.1 ALIVIADERO

En este caso, tenemos los siguientes datos:

Superficie interior .....8.427 $m^2$
Lluvia considerada .....37,19 mm/h
Caudal a desalojar .....87,1 l/s

Teniendo en cuenta esto, el caudal considerado en este caso para el dimensionamiento del aliviadero será de 438,1 l/s, obtenido de la suma del caudal de llenado (350 l/s) y del caudal resultante de la lluvia considerada (87.1 l/s).

Los cálculos de este aliviadero se recogen a continuación, mediante la siguiente expresión:

$$Q_i = 1{,}82 \cdot L \cdot (h)^{\frac{3}{2}}$$

donde h es la elevación de la lámina de agua sobre el labio vertiente del aliviadero y L la longitud de dicho labio vertiente.

A continuación, se recoge las características y el resultado de los cálculos realizados, para distintas longitudes de labio de vertido:

| | Q ($m^3$/s) | L (m) | h (m) |
|---|---|---|---|
| Aliviadero | 0,438 | 3 | 0,19 |
| | 0,438 | 3,5 | 0,17 |
| | 0,438 | 4 | 0,15 |

Se adopta el criterio de considerar un labio de 3,5 m. de longitud, con lo que el Nivel de Almacenamiento Máximo Extraordinario (NAME) queda fijado con una altura de vertido de 0,17 m., es decir, a la cota 444,42 msnm.

La tubería que evacuará el agua de alivio será de Acero Helicosoldado DN 406 de 6,4 mm de espesor (en el primer tramo bajo el dique), tras este tramo se inicia un tramo que se realiza con tubería de PVC PN10 DN400 mm.

El vertido de esta tubería se realiza en una zona en la que la pendiente del terreno resulta favorable para el desagüe en caso necesario tal y como se indica en el plano 11.09. En la obra de salida se instalará una reja que evite la entrada de animales a la balsa a través del aliviadero.

## 6.2 RESGUARDO

### 6.2.1 DETERMINACIÓN DEL NAMO

En el caso de la Balsa Elevada la altura de almacenamiento es de 4,25 m, con lo que la cota de Nivel de Almacenamiento Máximo Ordinario será 444,25 m.s.n.m.

### 6.2.2 DETERMINACIÓN DEL NAME

El máximo caudal a aliviar tal y como se ha calculado anteriormente será de 438,1 l/s.

Para un labio de vertido de 3,5 m de longitud y un caudal máximo a evacuar de 438,1 l/s, obtendremos una altura máxima de vertido por encima del labio del aliviadero de 0,17 m aproximadamente. Por lo tanto, el NAME quedará definido en la cota 444,42 m.

### 6.2.3 DETERMINACIÓN DEL RESGUARDO Y COTA DE CORONACIÓN

Considerando un valor del fetch de 124 m, siendo éste el valor de la mayor longitud de recorrido del viento en la lámina de agua, obtenemos un resguardo mínimo de 0,53 m.

Así pues, considerando la altura de vertido de agua sobre el labio de vertido del aliviadero, establecida en la cota 444,42 m obtenemos un resguardo efectivo respecto a esta situación de NAME de 0,58 m, superior al resguardo recomendado por la fórmula empírica mencionada anteriormente (0,53 m).

Por último, la cota de coronación quedará determinada en la cota 445 estando 0,75 metros por encima del NAMO.

## 6.3 TOMA DE FONDO

Para el dimensionado de la Toma de Fondo, se ha tenido en cuenta el caudal de abastecimiento a la red de riego en la situación de diseño. En este caso el caudal de cabecera para el funcionamiento de la red es 420,40 l/s.

La Toma de Fondo estará formada por una tubería de acero helicosoldado con diámetro de 711 mm y espesor de 7,9 mm, con un régimen de funcionamiento en carga, que unirá el fondo de la Balsa con la red de riego.

La cota de captación de la Toma de Fondo será de 440 msnm.

**Pérdidas de carga**

Los datos a considerar en el cálculo y dimensionamiento de las condiciones de servicio de esta Toma de Fondo son los siguientes:

Tubería ..... AH 711 mm
Espesor ..... e=7,9 mm
Longitud ..... 30 (viga de fondo)
Caudal ..... 420,40 l/s
Velocidad ..... 1,09 m/s
Pérdida de Carga ..... 0,03 mca

## 6.4 JAULA DE DESBASTE

Se diseña una jaula de desbaste de 700 mm de diámetro y 800 mm de altura, dejando un zócalo de 30 cm de zona no filtrante para retener posibles lodos.

**Condiciones de diseño:**

| | | |
|---|---|---|
| Caudal riego Gravedad: | 420,40 | l/s |
| Caudal Bombeo: | 351,00 | l/s |
| **Velocidad de paso referencia:** | **1** | **m/s** |

**Superficie mínima requerida:**

| | | |
|---|---|---|
| Gravedad: | 0,420 | $m^2$ |
| Bombeo Directo: | 0,351 | $m^2$ |
| | 0,420 | $m^2$ |
| Ratio obturación: | 70% | |
| **Total superficie requerida:** | **0,71468** | **$m^2$** |

**Diseño filtro:**

| | | |
|---|---|---|
| **Diámetro:** | **0,7** | **m** |
| Altura Sup. filtrante: | 0,5 | m |
| Zócalo (zona no filtrante): | 0,3 | m |
| **Altura TOTAL filtro:** | **0,8** | **m** |

**Superficie total Bruta:**

| | | |
|---|---|---|
| Área superior: | 0,385 | $m^2$ |
| Área lateral: | 1,100 | $m^2$ |
| Total Superficie Bruta: | 1,484 | $m^2$ |
| **Sup. BRUTA Diseño:** | **1,100** | **$m^2$** |

**Superficie ocupada:**

| | | |
|---|---|---|
| Separación pletinas verticales: | 0,02 | m |
| nº pletinas verticales: | 110 | uds |
| Espesor pletinas: | 0,005 | m |
| Separación barras horizontales: | 0,3 | m |
| nº barras horizontales: | 2 | uds |
| nº de barras por tramo: | 2 | uds |
| Espesor barras: | 0,006 | m |
| Sup. Ocupada por pletinas: | 0,275 | $m^2$ |
| Sup. Ocupada por barras: | 0,053 | $m^2$ |
| **Total superficie ocupada:** | **0,275** | **$m^2$** |

| | | | | | |
|---|---|---|---|---|---|
| **TOTAL SUPERFICIE NETA:** | **0,825** | **$m^2$** | **CUMPLE** | | |
| % Sup. Lateral libre: | 74,99% | | | | |
| **Velocidad diseño:** | Qmax | | | Qmin: | |
| Filtro limpio: | 0,51 | m/s | | 0,43 | m/s |
| Con % de obturación: | 0,87 | m/s | (0,7) | 0,72 | m/s |

## 6.5 DESAGÜE DE FONDO

Para el vaciado de la balsa en caso de ser necesario se empleará la propia tubería de llenado por lo que no es necesario proyectar una tubería de desagüe independiente.

## 6.6 RED DE DRENAJE

En este caso, el caudal máximo de entrada es de 350 l/s, por lo que los drenajes deberían dimensionarse para una capacidad máxima de un 5%, es decir 17,55 l/s.

La red de drenaje de la balsa se plantea en 3 sectores independientes, 1 en el fondo y 2 más en los taludes (parte inferior). Los drenajes constarán de tubos ranurados envueltos de gravas y de geotextil y confluirán en un único punto junto a la toma de fondo, en la parte interior de la balsa, para cruzar el dique de la balsa en seis tuberías, una por cada uno de los drenajes. La salida de los drenajes (de manera independiente) se conducirán hasta una arqueta de control donde confluirán los 3 finales de tuberías que, a simple vista, permitirá saber si existe algún problema de fuga y en qué zona de la balsa presenta el problema.

La evacuación final del agua de los drenajes se realizará mediante tubería de DN200 hasta una zona en la que la pendiente del terreno resulta favorable para el posible vertido.

**Formulación.**

Para el cálculo de las pérdidas de carga se ha recurrido a la fórmula de Manning, por considerarse como la más apropiada para estas condiciones de funcionamiento. Los datos y resultados se expresan en las tablas siguientes:

**Tabla 5.-** Capacidad de evacuación de los drenajes de la Balsa Elevada

| **Material** | **PVC-Ranurado** |
|---|---|
| Diámetro (mm) | 140 |
| Pendiente mínima | 0,5% |
| V (m/s) | 0,82 |
| Caudal (l/s) | 11,1 |

En la siguiente tabla vemos el caudal desalojado en función de la pendiente de los drenajes. En el caso de la balsa elevada, tendremos drenajes con una pendiente de 0,5%. por lo que el caudal total que serán capaces de desalojar los 3 drenajes será de al menos 33 l/s (superior a los 17,55 l/s establecidos como máximo admisible)

## 6.7 CORONACIÓN

Para la determinación de la anchura de coronación se emplea la siguiente expresión:

$$W = Z/5 + 3;$$

Siendo Z = altura del dique (m.); Z = 5 m

W = anchura de coronación (m.); W = 4 metros

Se proyecta finalmente la anchura de coronación de 4,00 m, considerándose ésta como la anchura requerida para poder transitar por la misma.

En la coronación se aplicará una capa de 0,20 m de zahorra natural compactada al 98% PM, con pendiente al exterior del 2% a fin de que haga la función de camino de servicio a lo largo de todo el perímetro.

## 6.8 CAPACIDAD

Para determinar la capacidad de la balsa, se realiza la semisuma del producto resultante de la sección que posee la balsa interiormente por la diferencia de cota que existe entre dichas secciones.

En la siguiente tabla, se muestra el resultado de dicha cubicación:

**Tabla 6.-** Capacidad de la Balsa Elevada

| **PERFIL** | **COTA (m)** | **SUPERFICIE (m2)** | **SEMISUMA (m2)** | **DISTANCIA (m)** | **VOLUMEN (m3)** | **VOL. Acumulado (m3)** |
|---|---|---|---|---|---|---|
| 1 | 440,00 | 5.115,43 | | | | 0,00 |
| 2 | 441,00 | 5.830,87 | 5.473,15 | 1,00 | 5.473,15 | 5.473,15 |
| 3 | 442,00 | 6.585,58 | 6.208,23 | 1,00 | 6.208,23 | 11.681,38 |
| 4 | 443,00 | 7.379,56 | 6.982,57 | 1,00 | 6.982,57 | 18.663,95 |
| 5 | 444,00 | 8.212,82 | 7.796,19 | 1,00 | 7.796,19 | 26.460,14 |
| | 444,25 | 8.427,26 | 8.320,04 | 0,25 | 2.080,01 | 28.540,15 |
| | | | **TOTAL NAMO** | | | **28.540,15** |

## 6.9 CÁLCULO DE LOS ANCLAJES DE LA LÁMINA DE PEAD

En el caso de la Balsa Elevada, los parámetros que definen la situación de la lámina son los mismos que en el caso de las Balsas Inferiores:

- Talud del dique: 2,5H : 1V
- Altura del dique: h = 5 m
- Calado de agua: c = 4,25 m
- Longitud del talud: l = 13,46 m

Por tanto, la propuesta de lastres es la misma:

- En coronación sujeción mediante zanja con materiales compactos, con dimensiones acorde a lo definido en planos.
- A pie de talud, instalación de 3 bordillos tipo T3, con un lastre total de 351 kg/m, para un máximo de cálculo de 294 kg/m correspondiente a la situación más expuesta o lastres con peso similar.

## 6.10 RESUMEN DE LAS CARACTERÍSTICAS DE LA BALSA ELEVADA

Tabla resumen de las características técnicas de la balsa:

| | |
|---|---|
| Cota de coronación (m) | 445,00 |
| Anchura de coronación (m) | 4,00 |
| Cota de fondo (m) | 440,00 |
| Cota de agua (N.A.M.O.) (m) | 444,25 |
| Altura de agua (N.A.M.O.) (m) | 4,25 |
| Cota de agua (N.A.M.E.) (m) | 444,42 |
| Volumen de agua (N.A.M.O.) ($m^3$) | 28.540,15 |
| Resguardo sobre N.A.M.O. (m) | 0,75 |
| Superficie de fondo de balsa ($m^2$) | 5.115,43 |
| Perímetro fondo de balsa (m) | 278,32 |
| Superficie lámina de agua (N.A.M.O.) ($m^2$) | 8.427,26 |
| Superficie de coronación ($m^2$) | 9.085,34 |
| Perímetro arista de coronación (m) | 356,86 |
| Talud aguas arriba (interior) | 2,5/1 |
| Talud aguas abajo desmonte (exterior) | 1/1 |
| Talud aguas abajo terraplén (exterior) | 2/1 |
| Volumen de desmonte ($m^3$) | 21.416 |
| Volumen de terraplén ($m^3$) | 8.048 |

# ANEJO Nº 11.- ANÁLISIS DEL RIESGO Y PROPUESTA DE CLASIFICACIÓN DE LAS BALSAS

Cingral
CONSULTORA DE INGENIERÍA

**N/REF:**

**20/013**

**TITULO:**

# PROPUESTA DE CLASIFICACIÓN EN FUNCIÓN DEL RIESGO POTENCIAL ANTE LA ROTURA DE LA "BALSA INTERMEDIA DE LA COMUNIDAD DE REGANTES DE SANTA ANA" (HUESCA)


EL INGENIERO AUTOR DEL PROYECTO:

**JAVIER MUR SATUÉ**
INGENIERO CIVIL


**DICIEMBRE 2022**


GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACIÓN
SOCIEDAD MERCANTIL ESTATAL DE INFRAESTRUCTURAS AGRARIAS
seiasa

# ANÁLISIS DEL RIESGO Y PROPUESTA DE CLASIFICACIÓN

**PROPUESTA DE CLASIFICACIÓN EN FUNCIÓN DEL RIESGO POTENCIAL ANTE LA ROTURA DE LA "BALSA INTERMEDIA DE LA COMUNIDAD DE REGANTES DE SANTA ANA" (HUESCA) ..... 1**

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# PROPUESTA DE CLASIFICACIÓN EN FUNCIÓN DEL RIESGO POTENCIAL ANTE LA ROTURA DE LA "BALSA INTERMEDIA DE LA COMUNIDAD DE REGANTES DE SANTA ANA" (HUESCA)

TITULAR: SEIASA

DIRECCIÓN: C/JOSE ABASCAL,4-6ª PLANTA, 28003 MADRID

D. VÍCTOR MORALES GODOY, DOMICILIADO EN C/JOSE ABASCAL,4-6ª PLANTA, 28003 MADRID, CON DNI Nº12.375.665-D, ACTUANDO EN NOMBRE DE SEIASA COMO DIRECTOR TÉCNICO:

EXPONE

En cumplimiento del articulo 3.5.1.3 de la Directriz básica de Planificación de la Protección Civil ante el Riesgo de Inundaciones, aprobada por el acuerdo de Consejo de Ministros el día 9 de diciembre de 1994 y publicada en el Boletín Oficial del Estado de fecha 14 de febrero de 1995, se propone que LA "BALSA INTERMEDIA DE LA COMUNIDAD DE REGANTES DE SANTA ANA" (HUESCA) sea clasificada como **Categoría C**

En madrid a diciembre de 2022

Fdo.: Victor Morales Godoy
Director Técnico

# 1 OBJETO

El presente anejo tiene como objeto cumplir con los requerimientos de clasificación en función del riesgo potencial derivado de la balsa intermedia al supererar los límites establecidos de un dique exterior mayor de 5 metros y una capacidad de más de 100.000 $m^3$.

# 2 NORMATIVA EMPLEADA

A continuación, se hace una breve exposición de la normativa empleada para la redacción de la presente propuesta de clasificación:

- La Directriz Básica de Planificación de Protección Civil ante el Riesgo de Inundaciones (en adelante Directriz), aprobada por Acuerdo del Consejo de Ministros del día 9 de diciembre de 1994, establece en su Art. 3.5.1.3 la obligatoriedad de que las presas se clasifiquen en categorías en función del riesgo potencial que pueda derivarse de su rotura o funcionamiento incorrecto. Asimismo, se definen en ella los criterios fundamentales de clasificación, el procedimiento a seguir y determinadas obligaciones que, para los titulares de presas, se derivan de la categoría asignada.
- Por otra parte, la Orden Ministerial de 12 de marzo de 1996, por la que se aprobó el Reglamento Técnico sobre Seguridad de Presas y Embalses (en adelante RTSPE), establecía en su disposición previa quinta que los titulares o concesionarios de todas las presas en servicio, independientemente de su titularidad dentro del ámbito de competencias del Estado, debían presentar a la Dirección General de Obras Hidráulicas (hoy Dirección General del Agua) la propuesta razonada de clasificación frente al riesgo en los términos previstos por la Directriz y el RTSPE, que en su Art. 3.2 definía las categorías de clasificación en función del riesgo potencial de forma idéntica que la Directriz.
- Los criterios de clasificación tenían un carácter descriptivo y general, por lo que se hacía necesario desarrollarlos de forma que las resoluciones de clasificación de presas se pudieran dictar con criterios objetivos, de fácil aplicación y homogéneos para todas las presas. Por esos motivos, la entonces Dirección General de Obras Hidráulicas y Calidad de las Aguas publicó en el año 1996 la Guía Técnica para la Clasificación de Presas en función del riesgo potencial, que tenía por objeto desarrollar los criterios de clasificación de presas establecidos en la Directriz y en el RTSPE y plantear con carácter orientativo una metodología general de aplicación y el contenido mínimo de la información que había de acompañar a las propuestas de clasificación, todo ello con la finalidad de que las Resoluciones de clasificación de presas se preparasen y se dictasen de manera homogénea y coordinada.
- Por otro lado, el Real Decreto 9/2008, de 11 de enero, por el que se modifica el Reglamento del Dominio Público Hidráulico (en adelante RDPH), añade un nuevo Título VII dedicado a la seguridad de presas, embalses y balsas, introduciendo importantes novedades en la materia como la creación de un Registro de Seguridad de Presas y Embalses, la implantación de las Normas Técnicas de Seguridad, o el establecimiento de una serie de obligaciones a los titulares, entre las que destaca la de solicitar la clasificación, en función de las dimensiones y del riesgo potencial, de todas aquellas presas y balsas de altura superior a 5 metros o de capacidad de embalse mayor de 100.000 m3 (Art. 367.1 del RDPH).
- Con la entrada en vigor del Real Decreto 264/2021, de 13 de abril, por el que se aprueban las Normas Técnicas de Seguridad para las presas y sus embalses, publicado en el Boletín Oficial del Estado el día 14 de abril de 2021, dichas normas han pasado a constituir la normativa de referencia en materia de seguridad y explotación de presas en nuestro país, sustituyendo a la Instrucción para el Proyecto, Construcción y Explotación de Grandes Presas y al mencionado RTSPE.
    - El Art. 4 del Real Decreto 264/2021 establece la obligatoriedad por parte de los titulares de las presas y embalses a los que se refiere el Art. 367.1 del RDPH, de solicitar su clasificación atendiendo al doble criterio de sus dimensiones y al riesgo potencial derivado de su rotura o funcionamiento incorrecto. La propuesta de clasificación deberá justificarse de acuerdo con los criterios establecidos en la Norma Técnica de Seguridad para la Clasificación de las Presas y para la Elaboración e Implantación de los Planes de Emergencia de Presas y Embalses (en adelante NTS1), recogida en el Anexo I del mencionado Real Decreto.
        - La NTS1 dedica su Capítulo II a la clasificación de presas, y en él se desarrollan los criterios básicos para proceder a la clasificación de las presas, atendiendo tanto a sus dimensiones como al riesgo potencial derivado de su rotura o funcionamiento incorrecto.
- En consonancia con el RD 264/2021 se redacta la "Guía Técnica para la Clasificación de Presas" publicada en noviembre de 2021 por la Dirección General del Agua pertenenciente al Ministerio para la Transición Ecológica y Reto Demográfico.

# 3 CARACTERÍSTICAS DE LA BALSA

## 3.1 CARACTERISTICAS PRINCIPALES DE LA BALSA

| | | |
|---|---|---|
| **A. IDENTIFICACIÓN DE LA PRESA Y DEL TITULAR** | | |
| Denominación | Balsa intermedia de la Comunidad de Regantes de Santa Ana | |
| Titular | S.E.I.A.S.A. | |
| Datos del titular | C/ José Abascal nº4, 6ª planta. 28003 Madrid<br>Teléfono: 917 81 36 87 | |
| **B. SITUACIÓN** | | |
| Cuenca hidrográfica | Ebro | |
| Cauce | Canal de monegros | |
| Provincia | Huesca | |
| Comunidad Autónoma | Aragón | |
| Situación | Coordenadas UTM30: (X = 705.076  Y = 4.644.683) | |
| Plano de situación | 323-II del Mapa Topográfico Nacional de España a escala 1:25.000. | |
| **C. CARACTERISTICAS** | | |
| Tipología de la presa | Balsa de materiales sueltos procedente de excavación compactados 98% del Próctor modificado. | |
| Tipología del aliviadero | Labio de vertido a 1 nivel | |
| Cota de coronación (m.s.n.m) | 429,0 | |
| Cota del aliviadero (m.s.n.m) | 428,0 | |
| Cota Pie de Talud (m.s.n.m) | 423,51 | |
| Cota de fondo Embalse (m.s.n.m) | 422,00 | |
| Altura de Presa (m) | 5,49 + 0,3 (cimiento) = 5,79 (P.K. 0+820) | |
| Longitud coronación (m) | 826,9 | |
| Cota de agua (N.A.M.O.) (m.s.n.m) | 428,0 | |
| Organos de desagüe | Aliviadero | 2,5364 $m^3/s$ |
| **D. CARACTERISTICAS DEL EMBALSE** | | |
| Volumen de agua (N.A.M.O.) ($m^3$) | 180.792,81 | |
| **E. CARACTERISTICAS HIDROLÓGICAS** | | |
| Hidrograma de entrada y laminado | No procede, no es una presa. | |

## 3.2 DESCRIPCIÓN DE LAS INFRAESTRUCTURAS

La balsa objeto de la presente clasificación será ejecutada a raíz de los trabajos relativos al "PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA)."

La balsa de regulación se proyecta con el fin de poder realizar un mejor aprovechamiento del bombeo, fundamentalmente desde el punto de vista económico, al aprovechar, de una forma más racional las horas con una tarifa eléctrica más barata.

La balsa se compone de un dique perimetral con materiales procedentes de la excavación adecuadamente compactados eliminado tanto el material vegetal como los rellenos antrópicos, impermeabilizándose mediante lámina de PEAD y geotextil.

Las características constructivas de la balsa de regulación se recogen en los siguientes subapartados.

### 3.2.1 ENTRADA Y TOMA DE AGUA

La infraestructura de toma de fondo propiamente dicha de la balsa corresponderá con el punto de suministro a la red de riego.

Para el dimensionado de la Toma de Fondo, se ha tenido en cuenta el caudal de abastecimiento a la red de riego en la situación de diseño. En este caso el caudal de cabecera para el funcionamiento de la red es 2.632 l/s.

La Toma de Fondo estará formada por una tubería de acero helicosoldado con diámetro de 1422 mm y espesor de 10,3 mm, con un régimen de funcionamiento en carga, que unirá el fondo de la Balsa con la red de riego.

La cota de captación de la Toma de Fondo será de 422 msnm.

### 3.2.2 ALIVIADERO

En este caso, tenemos los siguientes datos:

Superficie interior ..... 37.868 m2
Lluvia considerada ..... 37,19 mm/h

Caudal a desalojar .....391,2 l/s

Teniendo en cuenta esto, el caudal considerado en este caso para el dimensionamiento del aliviadero será de 2.5364,2 l/s, obtenido de la suma del caudal de llenado (2.172 l/s) y del caudal resultante de la lluvia considerada (391,2 l/s).

Los cálculos de este aliviadero se recogen a continuación, mediante la siguiente expresión:

$$Q_i = 1{,}82 \cdot L \cdot (h)^{\frac{3}{2}}$$

donde h es la elevación de la lámina de agua sobre el labio vertiente del aliviadero y L la longitud de dicho labio vertiente.

A continuación, se recoge las características y el resultado de los cálculos realizados, para distintas longitudes de labio de vertido:

| | Q ($m^3/s$) | L (m) | h (m) |
|---|---|---|---|
| Aliviadero | 2,564 | 11 | 0,25 |
| | 2,564 | 12 | 0,24 |
| | 2,564 | 13 | 0,23 |

Se adopta el criterio de considerar un labio de 12 m. de longitud, con lo que el Nivel de Almacenamiento Máximo Extraordinario (NAME) queda fijado con una altura de vertido de 0,24 m., es decir, a la cota 428,24 msnm.

La tubería que evacuará el agua de alivio será de Acero Helicosoldado DN 813 de 7,9 mm de espesor (en el primer tramo bajo el dique) con una longitud de 15 m, tras este tramo se inicia un tramo de 32 m de longitud que se realiza con tubería de PRFV DN 800 mm.

### 3.2.3 CORONACIÓN

En la coronación se aplicará una capa de 0,20 m de zahorra natural compactada al 98% PM, con pendiente al exterior del 2% a fin de que haga la función de camino de servicio a lo largo de todo el perímetro.

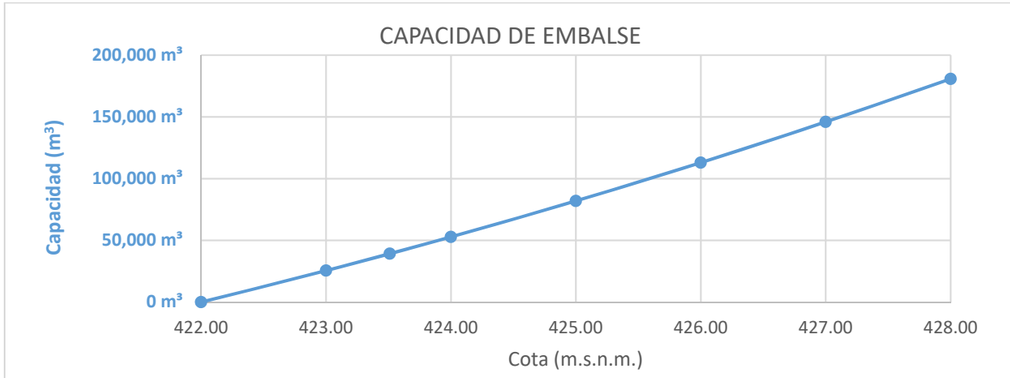
Se proyecta finalmente la anchura de coronación total de 5,00 m, resultando una plataforma transitable de 4 metros considerándose ésta como la anchura requerida para poder transitar por la misma.

### 3.2.4 GEOTEXTILES DE LA BALSA

El sistema de impermeabilización de la balsa (fondo y taludes), consta de una geomembrana de polietileno de alta densidad de 2,0 mm, siendo sus caras lisas y un geotextil de 285 gr/m2, cuya función es separar, drenar, filtrar y proteger a la geomembrana de una posible perforación, debido a la presencia de cantos en el terreno del vaso de la balsa.

### 3.2.5 CAPACIDAD DE EMBALSE

El volumen del embalse es de 180.792,81 m³ y la curva característica del embalse es la siguiente:




### 3.2.6 RED DE DRENAJE

En este caso, el caudal máximo de entrada es de 2.172 l/s, por lo que los drenajes deberían dimensionarse para una capacidad máxima de un 5%, es decir 108,6 l/s.

La red de drenaje de la balsa se plantea en 4 sectores independientes, 2 en el fondo y 2 más en los taludes (parte inferior). Los drenajes constarán de tubos ranurados envueltos de gravas y de geotextil y confluirán en un único punto junto a la toma de fondo, en la parte interior de la balsa, para cruzar el dique de la balsa en seis tuberías, una por cada uno de los drenajes. La salida de los drenajes (de manera independiente) se conducirán hasta una arqueta de control donde confluirán los 4 finales de tuberías que, a simple vista, permitirá saber si existe algún problema de fuga y en qué zona de la balsa presenta el problema.

La evacuación final del agua de los drenajes se realizará mediante tubería de DN250 hasta una zona en la que la pendiente del terreno resulta favorable para el posible vertido.

### 3.2.7 DESAGÜE DE FONDO

Para el vaciado de la balsa en caso de ser necesario se empleará la propia tubería de llenado, por lo que no es necesario proyectar una tubería de desagüe independiente.

## 3.3 PLANOS DE LA BALSA

Con el objeto de complementar la descripción de la balsa, en el "Apéndice 1. Caracteristicas constructivas de la Balsa" que se adjunta con el presente informe, se incluye una colección de planos extraidos del proyecto constructivo.

- Planta General
- Sección Tipo
- Obra de Entrada y Toma de Fondo
- Aliviadero
- Drenajes

# 4 METODOLOGÍA

La metodología de aplicación en el proceso de clasificación de presas y balsas se rige en base a la "Guía Técnica para la Clasificación de Presas" publicada en noviembre de 2021 por la Dirección General del Agua pertenenciente al Ministerio para la Transición Ecológica y Reto Demográfico. Esta guía técnica se basa a en lo estipulado en La NTS1, la cual, dedica su capitulo II a la clasificación de presas. En él se desarrollan los criterios básicos para proceder a la clasificación de las presas, atendiendo tanto a sus dimensiones como al riesgo potencial derivado de su rotura o funcionamiento incorrecto.

## 4.1 CRITERIOS PARA LA CLASIFICACIÓN

El Real Decreto 264/2021 por el que se aprueban las normas técnicas de seguridad para las presas y sus embalses en su ANEXO I Norma técnica de seguridad, se establece en el apartado 3.2 un primer nivel de clasificación en función de las dimensiones, de esta manera se dividen en dos grandes grupos:

a) Gran presa: aquella cuya altura es superior a 15 metros o la que, teniendo una altura comprendida entre 10 y 15 metros, tiene una capacidad de embalse superior a 1 hectómetro cúbico.

b) Pequeña presa: aquella que no cumpla las condiciones de gran presa.

Posteriormente, en el apartado 3.3 de define una nueva clasificación en función de los riesgos potenciales que pudieren derivarse de su hipotética rotura o funcionamiento incorrecto:

- Categoría A: Presas cuya rotura o cuyo funcionamiento incorrecto puede afectar gravemente a núcleos urbanos o a servicios esenciales, o producir daños materiales o medioambientales muy importantes.
- Categoría B: Presas cuya rotura o cuyo funcionamiento incorrecto puede ocasionar daños materiales o medioambientales importantes o afectar a un reducido número de viviendas.
- Categoría C: Presas cuya rotura o cuyo funcionamiento incorrecto puede producir daños materiales de moderada importancia y solo incidentalmente pérdida de vidas humanas.
    - En todo caso, a esta última categoría pertenecerán todas las presas no incluidas en las categorías A o B.

## 4.2 ESCENARIOS A ANALIZAR

Se considerarán distintos escenarios de posibles roturas de la presa, identificando en cada uno de ellos los riesgos potenciales, asignándose como clasificación aquélla que corresponda al escenario más desfavorable. Se considerarán, como mínimo, los siguientes escenarios:

a) Escenario sin avenida. Rotura con el embalse situado en su Nivel máximo normal (de acuerdo con el apartado 6 de la Norma Técnica de Seguridad para el proyecto, construcción y puesta en carga de presas y llenado de embalses).

b) Escenario límite. Embalse en su Nivel máximo normal y desagüe de un hidrograma que pueda llenarlo hasta la coronación de la presa, manteniendo ésta todos sus elementos de desagüe abiertos, produciéndose a continuación su rotura.

A efectos de la evaluación de los daños a considerar, se tendrán únicamente en cuenta los incrementales, entendidos éstos como el incremento entre los que se producirían por efecto de la onda de rotura y los que se habrían producido sin la existencia de la presa.

En ambos casos se tendrá en cuenta la posible rotura de presas situadas aguas abajo (efecto dominó).

## 4.3 USO DE MODELOS HIDRÁULICOS BIDIMENSIONALES

De acuerdo a la"Guía Técnica para la Clasificación de Presas" publicada en noviembre de 2021, el estudio de la propagación aguas abajo de la onda de avenida provocada por la rotura de la presa se llevará a cabo mediante el empleo de modelos hidráulicos de cálculo bidimensional en régimen variable, salvo en aquellos casos en los que la clasificación en la categoría A resulte obvia y pueda por tanto recurrirse al juicio ingenieril o a métodos más simplificados que sirvan para comprobar analíticamente la clasificación prevista y dotar de objetividad y consistencia a apreciaciones que pudieran ser subjetivas.

Por este motivo, para el cálculo de la onda de rotura y su propagación por el cauce aguas abajo, se empleará el programa informático HEC-RAS 5.0.5:

- The U.S. Army Corps of Engineers River Analysis System (HEC-RAS) es un software desarrollado en el Hydrologic Engineering Center (HEC), una división del Institute for Water Resources (IWR) del Cuerpo de ingenieros de Estados Unidos, que permite simular flujos hidráulicos en una o dos dimensiones.

- El programa, obtiene el hidrograma necesario para la modelización de la llanura de inundación gracias a la modelización de la brecha en cierto punto de la presa a lo largo del tiempo. Este hidrograma se hace circular aguas abajo gracias a las ecuaciones de Navier-Strokes aplicando como condicionantes diferentes factores como son la topografía y coeficientes de rugosidad de manning, entre otros.

#### 4.3.1 MÉTODO DE CÁLCULO DE ROTURA DE PRESA

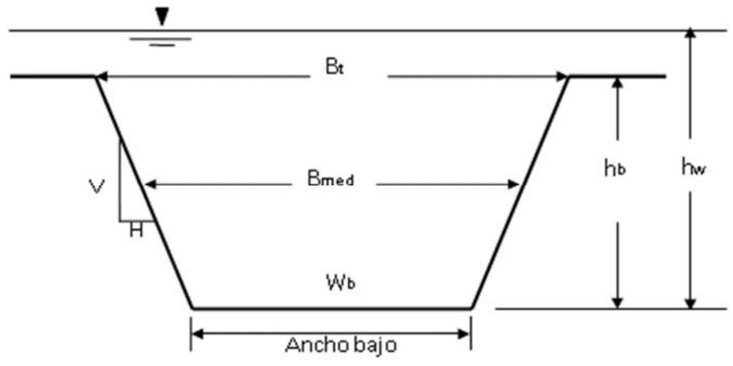
HEC-RAS puede utilizar para calcular un hidrograma de inundación generado por un vaso mediante modelos 2D de la presa.

El método consiste en que el programa es capaz de determinar la cota de superficie del agua del vaso de la presa en todo momento. Con esta información, la generación progresiva de la apertura de la brecha y el volumen asociado de la presa a cada cota, se determina un hidrograma de salida que a su vez disminuirá los niveles de agua mencionados y por tanto el volumen disponible dentro del vaso modelizado. El hidrograma de salida, se obtiene mediante las ecuaciones de Navier-Stokes que simulan el comportamiento de los fluidos en tres dimensiones. Estas ecuaciones aplican el gradiente generado entre el nivel de agua de la presa y la cota del terreno donde descarga, y, a su vez, la superficie libre generada por la apertura de la brecha para generar un hidrograma en términos de caudales y velocidades. Dichas fórmulas se desarrollan con un mayor grado de detalle en el apartado posterior relativo a la propagación de la inundación (Ecuaciones Hidráulicas).

La estimación de la ubicación de la brecha, el tamaño y el tiempo de desarrollo son cruciales para realizar una estimación precisa de los hidrogramas de salida y la inundación aguas abajo.

El software HEC-RAS requiere que el usuario ingrese la siguiente información para describir una rotura de presa:

- **Forma de la rotura:** El ancho de la brecha se describe como el ancho promedio de la brecha ($B_{medio}$) en las ecuaciones propuestas por la guía técnica, mientras que HEC-RAS requiere el ancho del fondo de la brecha (Wb) como dato de entrada. La altura de la brecha (hb) es la extensión vertical desde la coronación de la presa hasta la elevación de la cota de fondo o el terreno natural (la más defavorable). Otras publicaciones y ecuaciones también utilizan la altura del agua (hw), que es la extensión vertical desde la superficie máxima del agua hasta la elevación invertida de la brecha. Las pendientes laterales se expresan en unidades de distancia horizontal a cada unidad en la vertical. Las dimensiones de la abertura máxima de la brecha deben determinarse fuera del programa. Con este fin se utilizarán las formulas propuestas por la Guía Técnica.




- **Tiempo de desarrollo de incumplimiento crítico:** HEC-RAS requiere que el usuario ingrese lo que se denomina "tiempo de desarrollo de incumplimiento crítico" o el tiempo en el que se crea la apertura máxima de la brecha. Al igual que ocurre con la introducción de los anchos de la brecha el tiempo debe ser un criterio a introducir y para ello se utilizarán las formulas propuestas por la Guía Técnica.

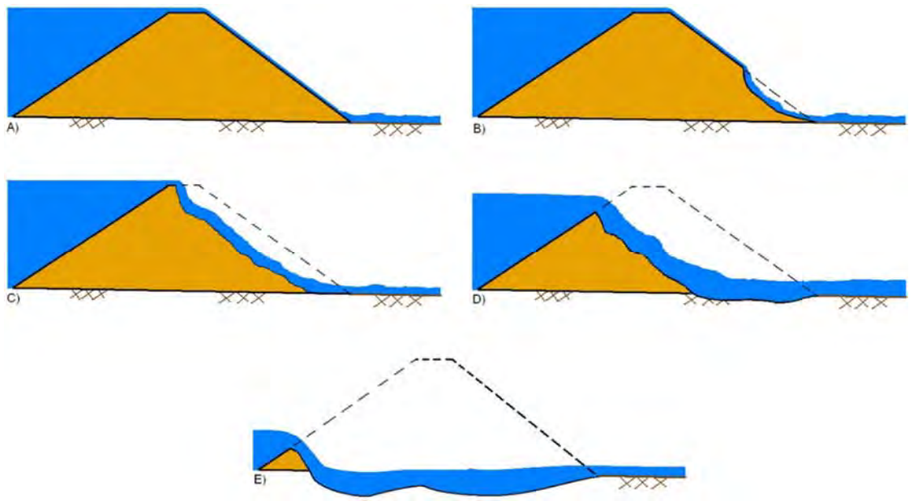
- **Tiempo de activación de la rotura:** Este tiempo se puede describir de la siguiente manera:
  - Mediante el alcance de una cota de la balsa.
  - Mediante el alcance de una cota de la presa + Un tiempo a partir de este hecho.
  - Tiempo fijo determinado.

- **Ubicación de la rotura:** La ubicación de la rotura se basa en muchos factores (tipo y forma de dique, tipo de rotura, modo y fuerza motriz de la rotura). En general, se deben considerar todos los factores relacionados con la presa, incluido cualquier conocimiento histórico de problemas de infiltración y cimientos, y colocar la ubicación de la brecha en la ubicación más probable para cada tipo de falla. El ingeniero deberá determinar cual es la ubicación de la rotura más probable.

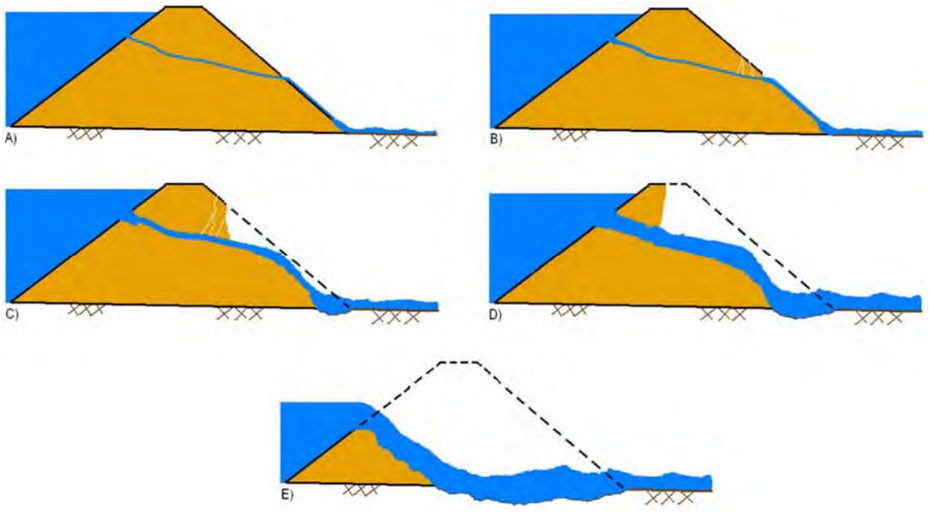
- **Tipo de Rotura:** Si bien los cálculos hidráulicos de HEC-RAS se limitan a los modos de rotura por tubificación (piping) o desbordamiento (overtopping), se puede simular cualquier otro tipo a partir de uno de estos dos métodos. El modo de rotura es el mecanismo para iniciar y aumentar la brecha. Las fallas de desbordamiento comienzan en la parte superior de la presa y crecen hasta la extensión máxima, mientras que un modo de falla de tubería puede comenzar en cualquier elevación / ubicación y crecer hasta la extensión máxima. El tamaño

final de la brecha y el tiempo de formación de la brecha son mucho más críticos en la estimación del hidrograma de salida que el modo de inicio de la rotura en sí mismo.

Evolución de la formación de la brecha por desbordamiento:




Evolución de la formación de la brecha por tubificación:




### 4.3.2 MÉTODO DE CÁLCULO DE PROPAGACIÓN DE LA AVENIDA

A continación se describe el método utilizado para la propagración de la avenida sobre la malla de cálculo.

El programa 2D HEC-RAS 5.0.5, utiliza las ecuaciones de Navier-Stokes las cuales describen el movimiento de los fluidos en tres dimensiones. Se supone un flujo incompresible, una densidad uniforme y una presión hidrostática, las ecuaciones se promedian en Reynolds, de modo que el movimiento turbulento se aproxima utilizando la viscosidad de Foucault. También se supone que la escala de longitud vertical es mucho más pequeña que la escala de longitud horizontal. Como consecuencia, la velocidad vertical es pequeña y la presión es hidrostática, lo que lleva a la forma diferencial de las ecuaciones hidráulicas de aguas someras derivadas en las secciones subsiguientes.

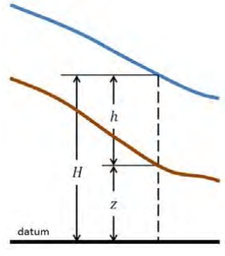
En algunos flujos poco profundos, el término de gradiente de presión barotrópica (gravedad) y los términos de fricción inferior (rozamiento del terreno) son los términos dominantes en las ecuaciones de impulso y los términos inestables, advección y viscosos pueden ser ignorados. La ecuación de impulso se convierte entonces en la forma bidimensional de la aproximación de onda de difusión. La combinación de esta ecuación con la conservación de la masa, produce un modelo de una ecuación, conocido como las ecuaciones de Aproximación de Onda Difusiva de las Aguas Poco Profundas (DSW).

Además, para mejorar el tiempo de cálculo, se puede utilizar un enfoque de batimetría de sub-red. La idea detrás de este enfoque es utilizar una cuadrícula computacional relativamente gruesa y una información de escala más fina sobre la topografía subyacente (Casulli, 2008). La ecuación de conservación de masa se discretiza utilizando una técnica de volumen finito. Los detalles de la cuadrícula fina se factorizan como parámetros que representan múltiples integrales sobre volúmenes y áreas de cara. Como resultado, el transporte de masa fluida explica la topografía a una escala más fina dentro de cada celda discreta. Como esta idea se relaciona solo con la ecuación de masa, se puede usar independientemente de la versión de la ecuación de momento. En las siguientes secciones, las ecuaciones de batimetría de sub-cuadrícula se derivan para dos situaciones: Ecuaciones completas en aguas poco profundas (SW) y ecuaciones de onda de difusión (DSW).

Se asumirá que el fondo de la elevación de la superficie inferior viene dada por z (x, y)

La profundidad del agua es h (x, y, t); y la elevación de la superficie del agua es:

- H (x,y,t) = z (x,y) + h (x,y,t)



#### 4.3.2.1 ECUACIONES HIDRÁULICAS

**A) <u>Convervación de la masa:</u>**

Suponiendo que el flujo es incompresible, la forma diferencial inestable de la ecuación de conservación de masa (continuidad) es:

$$\frac{\partial H}{\partial t}+\frac{\partial(hu)}{\partial x}+\frac{\partial(hv)}{\partial y}+q=0$$

(Ec.1)

donde t es el tiempo, u y v son los componentes de la velocidad en la dirección x e y respectivamente, y q, es un término de flujo fuente / sumidero.

En forma vectorial, la ecuación de continuidad toma la forma:

$$\frac{\partial H}{\partial t}+\nabla \bullet hV+q=0$$

(Ec.2)

donde V = (u, v) es el vector de velocidad y el operador diferencial del (∇) es el vector de los operadores de derivada parcial dado por ∇ = (∂ / ∂x, ∂ / ∂y).

Al integrarse sobre una región horizontal con el vector normal del límite n y usar el teorema de la divergencia de Gauss, se obtiene la forma integral de la ecuación:

$$\frac{\partial}{\partial t}\iiint_{\Omega} d\Omega+\iint_{S} V \bullet ndS+Q=0$$

(Ec.3)

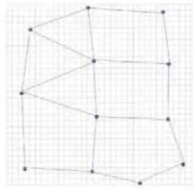
La región volumétrica Ω representa el espacio tridimensional ocupado por el fluido. Los límites laterales vienen dados por S. Q, representa cualquier flujo que atraviese la superficie inferior (infiltración) o la superficie superior del agua de Ω (evaporación o lluvia). El término de flujo fuente / sumidero Q también es conveniente para representar otras condiciones que transfieren masa hacia, dentro o fuera del sistema, como las bombas. Siguiendo las convenciones de signos estándar, los sumideros son positivos y las fuentes negativas.

Esta forma integral de la ecuación de continuidad será apropiada para seguir un enfoque de batimetría de sub-red en las secciones subsiguientes. En este contexto, el volumen representará una celda de volumen finito, y, las integrales, se computarán utilizando información sobre la topografía subyacente.

**Topografía y modelo digital utilizado.** Los avances modernos en el campo de la detección remota en el aire pueden proporcionar datos topográficos de muy alta resolución. En muchos casos, los datos son demasiado densos para ser utilizados directamente como una cuadrícula para el modelo numérico. Esto presenta un dilema en el cual se debe usar una cuadrícula computacional relativamente gruesa para producir una simulación fluida.

La solución a este problema es el enfoque de batimetría de sub-red (Casulli, 2008). Las celdas de la cuadrícula computacional contienen información adicional, como el radio hidráulico, el volumen y el área de la sección transversal, que se pueden calcular previamente a partir de la batimetría fina. Los detalles de alta resolución se pierden, pero hay suficiente información disponible para que el método numérico más grueso pueda explicar la batimetría fina a través de la conservación de masas. Para muchas aplicaciones, este método es apropiado porque la superficie del agua libre es más suave que la batimetría, por lo que se puede usar una cuadrícula más gruesa para calcular la variabilidad espacial en la elevación de la superficie libre.

En la figura que se presenta a continuación, la cuadrícula fina está representada por la cuadrícula cartesiana en gris y la cuadrícula computacional se muestra en azul.



La integral volumétrica triple de la ecuación anterior representa el volumen Ω de una región delimitada horizontalmente. Suponiendo que es una función de la elevación de la superficie del agua H, el primer término de la ecuación se discretiza como:

$$\frac{\partial}{\partial t}\iiint_{\Omega} d\Omega=\frac{\Omega\left(H^{n+1}\right)-\Omega\left(H^{n}\right)}{\Delta t}$$

(Ec.4)

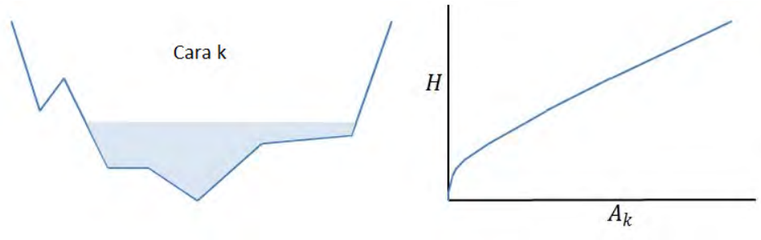
donde los superíndices se utilizan para indexar pasos de tiempo y la diferencia entre dos pasos de tiempo consecutivos es Δt.

Si se supone que las celdas tienen una forma poligonal, la integral doble del límite de la ecuación 3 se puede escribir como una suma sobre las caras verticales de la región volumétrica

$$\int\int V \bullet ndS=\sum V_k \bullet n_k A_k(H)$$

(Ec.5)

donde $V_k$ y $n_k$ son la velocidad promedio y el vector normal unitario en la cara k y $A_k$ (H) es el área de la cara k en función de la elevación del agua, en el espíritu de la técnica de batimetría de sub-rejilla. En la Figura siguiente, la imagen de la izquierda representa la forma de una cara como se ve en la rejilla fina y la función correspondiente para el área de la cara $A_k$ en términos de la elevación de la superficie del agua H.




Las ecuaciones 4 y 5 se pueden reemplazar de nuevo en la ecuación 3 para obtener la ecuación de conservación de la masa de batimetría de la cuadrícula:

$$\frac{\Omega(H^{n+1})-\Omega(H^{n})}{\Delta t}+\sum_{k} V_k \bullet n_k A_k(H)+Q=0 \qquad \text{(Ec.6)}$$

Algunas consideraciones especiales serán necesarias para las células secas. Se observa que en el caso de que el volumen de la celda zero sea cero, las celdas secas permanecen secas hasta que obtienen una ganancia de volumen al equilibrar un flujo de entrada de una de sus caras o del término fuente.

**B) <u>Convervación del momento:</u>**

Cuando las escalas de longitud horizontal son mucho más grandes que la escala de longitud vertical, la conservación del volumen implica que la velocidad vertical es pequeña. La ecuación de momento vertical de Navier-Stokes se puede utilizar para justificar que la presión es casi hidrostática.

En ausencia de gradientes de presión baroclínica (densidad variable), fuerte fuerza del viento y fuerzas no hidrostáticas, es adecuada una versión de la ecuación de momento promediada verticalmente. Los términos de velocidad vertical y derivada vertical se pueden ignorar de forma segura (en las ecuaciones de masa y de momento).

Se obtienen las ecuaciones de aguas poco profundas:

$$\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=-g\frac{\partial H}{\partial x}+v_t\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right)-c_f u+fv \qquad \text{(Ec.7)}$$

$$\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}=-g\frac{\partial H}{\partial y}+v_t\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}\right)-c_f v+fu \qquad \text{(Ec.8)}$$

Donde u y v son las velocidades en las direcciones cartesianas, g es la aceleración gravitacional, vt es el coeficiente de viscosidad de remolino horizontal, cf es el coeficiente de fricción del fondo, R es el radio hidráulico y f es el parámetro de Coriolis.

El lado izquierdo de la ecuación contiene los términos de aceleración. El lado derecho representa las fuerzas internas o externas que actúan sobre el fluido. Los términos del lado izquierdo y derecho suelen estar organizados de acuerdo con la segunda ley de Newton, de la cual se derivan finalmente las ecuaciones de impulso.

Las ecuaciones de impulso también se pueden representar como una forma vectorial diferencial única. La ventaja de esta presentación de la ecuación es que se vuelve más compacta y fácil de leer. La forma vectorial de la ecuación de momento es:

$$\frac{\partial V}{\partial t}+V\bullet\nabla V=-g\nabla H+v_t\nabla^2 V-c_f V+fk\times V \qquad \text{(Ec.9)}$$

donde el operador diferencial del (∇) es el vector de los operadores derivados parciales dado por ∇ = (∂ / ∂x, ∂ / ∂y) y k es el vector unitario en la dirección vertical.

De izquierda a derecha hay la aceleración inestable, la aceleración convectiva, el término de presión barotrópica, la difusión de Foucault, la fricción del fondo y el término de Coriolis.

Un análisis dimensional muestra que cuando la profundidad del agua es muy pequeña, el término de fricción inferior domina la ecuación. Como consecuencia, la ecuación 9 para células secas toma el límite de la forma V = 0. Las células secas se tratan computacionalmente como un caso especial, pero el resultado es continuo y físicamente consistente durante el proceso de humedecimiento o secado.

**Aceleración.** Los términos de aceleración de Euler a la izquierda se pueden condensar en un término de aceleración derivado de Lagrangiano tomado a lo largo del recorrido que se mueve con el término de velocidad:

$$\frac{DV}{Dt} = \frac{\partial V}{\partial t} + V \bullet \nabla V$$

(Ec.10)

El uso del derivado de Lagrangiano reduce las restricciones de número de Courant y proporciona un método de solución más robusto.

**Gravedad.** Si la superficie de flujo no es horizontal, el peso de las columnas de agua contiguas con diferentes alturas producirá un gradiente de presión al que se hace referencia en el caso de densidad uniforme como un gradiente de presión barotrópico. Esto se expresa mediante el primer término en el lado derecho de la ecuación 9.

La latitud afecta el valor de g en tanto como ± 0.3%, debido a la rotación de la Tierra y la protuberancia ecuatorial. Según la fórmula de Somigliana:

donde φ es latitud, $g_0$ = 9,7803267715 m/s$^2$ es la aceleración gravitacional en el ecuador, k = 0,0019318514 es la constante de gravedad normal y e = 0,0066943800 es el cuadrado de la excentricidad de la Tierra.

$$g = g_o\left(\frac{1 + k\sin^2\varphi}{\sqrt{1 - e^2\sin^2\varphi}}\right)$$

(Ec.11)

**Viscosidad Eddy.** La turbulencia es un fenómeno complejo de movimiento caótico (turbulento) fluido y remolinos que abarcan una amplia gama de escalas de longitud. Muchas de estas escalas son demasiado pequeñas para ser resueltas de manera factible mediante un modelo numérico discreto, por lo que la mezcla de flujo turbulento se modela como un proceso de difusión de gradiente. En este enfoque, la tasa de difusión se establece como el coeficiente de viscosidad de Foucault $v_t$.

Su parametrización es la siguiente:

$$v_t = Dhu_*$$

(Ec.12)

Donde D es una constante empírica no dimensional y u * es la velocidad de corte, que se puede calcular como:

$$u_* = \sqrt{gRS} = \frac{\sqrt{g}}{C}|V| = \frac{n\sqrt{g}}{R^{1/6}}|V|$$

(Ec.13)

R es el radio hidráulico y S denota la pendiente de energía, que se puede calcular con la fórmula de Chézy en la siguiente sección, y se puede simplificar aún más con la fórmula de Manning, que también se explica más adelante.

Se asume que la difusión es isotrópica. Se asume que los valores empíricos DL y DT son idénticos. El coeficiente de mezcla D es un valor empírico que varía con la geometría y la superficie del fondo / pared.

**Fricción inferior.** Usando la fórmula de Chézy, el coeficiente de fricción inferior está dado por:

$$c_f = \frac{g|V|}{C^2R}$$

(Ec.14)

Los resultados empíricos muestran que el coeficiente de Chézy se puede aproximar utilizando la fórmula de GaucklerManning-Strickler, o la fórmula de Manning para abreviar. Esta relación indica que el coeficiente de Chézy C está relacionado con el radio hidráulico R por la fórmula C=R$^{1/6}$/n, donde n es un coeficiente de rugosidad derivado empíricamente conocido como n de Manning. Como se esperaba, el coeficiente n no es independiente de las unidades y generalmente se mide en s/m$^{1/3}$ en el sistema SI. Para transformar al sistema habitual de los Estados Unidos, la constante de conversión es 1,48592 (ft/m)$^{1/3}$. Usando la fórmula de Manning, el coeficiente de fricción inferior ahora viene dado por:

$$c_f = \frac{n^2g|V|}{R^{4/3}}$$

(Ec.15)

**Efecto Coriolis.** El último término de la ecuación de momento se relaciona con el efecto Coriolis. Esto explica el hecho de que el marco de referencia de la ecuación está unido a la Tierra, que gira alrededor de su eje. El componente vertical del término Coriolis se ignora de acuerdo con los supuestos de aguas poco profundas. La fuerza horizontal aparente sentida por cualquier objeto en el marco giratorio es proporcional al parámetro de Coriolis dado por:

$$f = 2\omega\sin\varphi$$

(Ec.16)

donde ω = 0,00007292115855306587 / s es la velocidad angular sideral de la Tierra y φ es la latitud.

**C) <u>Aproximación de onda de difusión de las ecuaciones de aguas someras:</u>**

En la sección anterior, se utilizó la fórmula de Manning para estimar el coeficiente de Chézy. Si se asumen más restricciones en la física del flujo, se obtiene una relación entre el gradiente de presión barotrópica y la fricción del fondo a partir de la forma de onda de difusión de la ecuación de momento. Esta relación es extremadamente útil debido a su simplicidad. Sin embargo, se debe tener en cuenta que solo se puede aplicar en un alcance más estrecho que la ecuación de momento más general que se estudió anteriormente. Bajo las condiciones descritas en esta sección, la ecuación de onda de difusión se puede usar en lugar de la ecuación de momento. Se verá en secciones subsiguientes que el modelo correspondiente se convierte en un modelo de una ecuación conocido como la aproximación de onda de difusión de las ecuaciones de aguas someras (DSW).

Hasta este punto, hemos descrito la hidráulica para el momento. A partir de ahora, la discusión se orientará hacia la formulación y los valores numéricos de la solución. Será conveniente denotar el radio hidráulico y las áreas de la sección transversal de la cara en función de la elevación de la superficie del agua H, por lo que R = R (H), A = A (H).

**Forma de onda de difusión de la ecuación del momento.** Con poca fricción y flujo controlado por gravedad; Los términos de inestabilidad, advección, turbulencia y Coriolis de la ecuación de momento pueden ser ignorados para llegar a una versión simplificada. El movimiento del flujo es impulsado por un gradiente de presión barotrópico equilibrado por la fricción del fondo simplificando los resultados de la ecuación de momento en:

$$\frac{n^2|V|V}{(R(H))^{4/3}} = -\nabla H \qquad \text{(Ec.17)}$$

Dividiendo ambos lados de la ecuación por la raíz cuadrada de su norma, la ecuación se puede reorganizar en la forma más clásica.

$$V = \frac{-(R(H))^{2/3}}{n}\frac{\nabla H}{|\nabla H|^{1/2}} \qquad \text{(Ec.18)}$$

Donde V es el vector de velocidad, R es el radio hidráulico, ∇ H es el gradiente de elevación de la superficie y n es la n de Manning derivada empíricamente.

**Onda de difusión** para **la aproximación de las ecuaciones de aguas poco profundas.** Cuando la velocidad se determina por un balance entre el gradiente de presión barotrópica y la fricción del fondo, la forma de onda de difusión de la ecuación de momento (19) se puede usar en lugar de la ecuación de momento completo y el sistema de ecuaciones correspondiente se puede simplificar de hecho a una un modelo de ecuación La sustitución directa de la ecuación de la onda de difusión (19) en la ecuación de conservación de masa (2) produce la forma diferencial clásica de las ecuaciones de aproximación de la onda de difusión de las aguas poco profundas (DSW):

$$\frac{\partial H}{\partial t} - \nabla \bullet \beta \nabla H + q = 0 \qquad \text{(Ec.19)}$$

Donde: $\beta = \frac{(R(H))^{5/3}}{n|\nabla H|^{1/2}}$

Si la información de batimetría es de interés, la ecuación de la onda de difusión (18) también se puede sustituir en la forma de batimetría de la sub-rejilla de la ecuación de continuidad (6) para obtener la ecuación:

$$\frac{\Omega(H^{n+1}) - \Omega(H^n)}{\Delta t} - \sum_k \alpha \nabla H \bullet n + Q = 0 \qquad \text{(Ec.20)}$$

Donde:

$$\alpha = \alpha(H) = \frac{(R(H))^{2/3} A_k(H)}{n|\nabla H|^{1/2}} \qquad \text{(Ec.21)}$$

Como se ve en la ecuación (6), Ω (Hn) es la celda en el tiempo n y Ak (h) es el área de la cara k, como funciones de la elevación del agua.

Una vez resuelta la ecuación de DSW, las velocidades se pueden recuperar sustituyendo la elevación del agua en la ecuación (19) de la onda de difusión.

**D) <u>Condiciones de contorno:</u>**

En todos los intervalos de tiempo durante el cálculo, las condiciones de contorno deben darse en todos los bordes del dominio. Dentro de HEC-RAS pueden ser de tres tipos diferentes.

- Elevación de la superficie del agua: El valor de la elevación de la superficie del agua H = Hb se da en uno de los bordes delimitadores.
- Gradiente de la superficie del agua: se impone la pendiente de la superficie del agua Sb en la dirección normal al límite. Esta condición se expresa como:

$$\nabla H \bullet n = Sb \qquad \text{(Ec. 22)}$$

- Flujo: se proporciona el flujo Qb que cruza el límite. En la ecuación de continuidad (3), esta condición se implementa mediante la sustitución directa en la fórmula de flujo de las caras de borde correspondientes. La integral de superficie en la ecuación (3) está limitada por la condición:

$$\iint_b V \bullet n\, dS = Q_b \qquad \text{(Ec. 23)}$$

#### 4.3.2.2 MÉTODO NUMÉRICO

Se utiliza un esquema de discretización híbrido que combina diferencias finitas y volúmenes finitos para aprovechar la ortogonalidad en las cuadrículas. La solución discreta para las ecuaciones hidráulicas se calcula utilizando una técnica de solución similar a la de Newton que se explica más adelante.

**A) <u>Aproximaciones de diferencias finitas:</u>**

Un esquema de diferencias finitas expresa un derivado como la diferencia de dos cantidades. Esta técnica ya se ha utilizado tácitamente en la ecuación (6), para discretizar la derivada de volumen en el tiempo como la diferencia de los volúmenes en los momentos n y n + 1 y dividida por el paso de tiempo Δt,

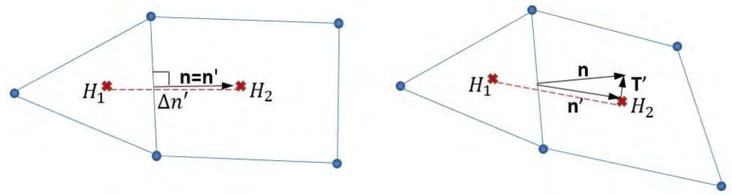
$$\frac{\partial \Omega}{\partial t} \approx \frac{\Omega\left(H^{n+1}\right) - \Omega\left(H^{n}\right)}{\Delta t} \qquad \text{(Ec. 24)}$$

Las diferencias finitas en el espacio funcionan de manera idéntica. Dadas dos celdas adyacentes j1 y j2 con elevación de la superficie del agua H1 y H2 respectivamente, la derivada direccional en la dirección n 'determinada por los centros de las celdas se aproxima por:

$$\nabla H \bullet n' = \frac{\partial H}{\partial n'} \approx \frac{H_2 - H_1}{\Delta n'} \qquad \text{(Ec. 24)}$$

donde Δn ' es la distancia entre los centros celulares.

La orientación de la derivada es importante. En el siguiente ejemplo, la derivada está orientada desde la celda i1 a la celda i2, en la derecha de la imagen.




Si la dirección n ' es ortogonal a la cara entre las celdas, se dice que la cuadrícula es ortogonal localmente en esta cara. Esta es la situación que se muestra en la imagen de la izquierda en la imagen anterior. En este caso, la fórmula anterior es suficiente para calcular la derivada normal de la superficie del agua de la ecuación (20). En general, esta condición no se satisface y la técnica de diferencias finitas se complementa con una técnica de volumen finito, como se verá pronto

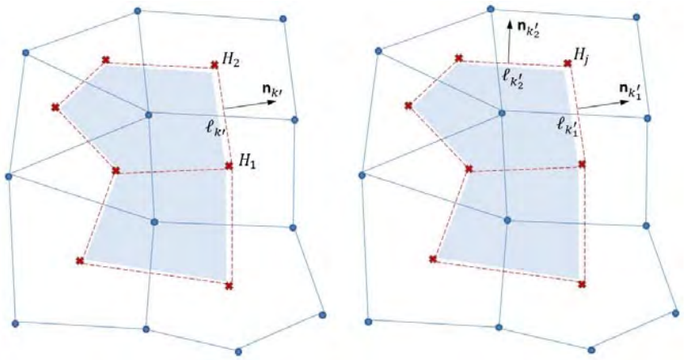
**B) <u>Aproximaciones finitas de volúmenes:</u>**

Se utiliza un enfoque de volumen finito para discretizar la ecuación (20) cuando la cuadrícula no es ortogonal local. Además, la técnica de volumen finito también se utilizará para aproximar otros términos diferenciales, como la viscosidad de Foucault.

En el espíritu de la técnica de volumen finito, el valor del término gradiente ∇ H en una cara de cuadrícula se aproxima como un promedio sobre celdas duales y se aplica el teorema de divergencia de Gauss para obtener la fórmula.

$$\nabla H \approx \frac{\oint_L H\, n\, dL}{A'} \qquad \text{(Ec. 25)}$$

Donde L es el límite de las celdas duales y A' es el área de las celdas duales, sombreada en la siguiente imagen. Como las celdas duales forman un polígono, la integral de línea se puede escribir como una suma sobre las caras de las celdas duales. La cara dual k' que une los nodos duales $j_1$ y $j_2$ contribuye con un término $n_{k'}\, l_{k'}$ (H1 + H2)/2 a la integral de línea, donde $l_{k'}$ es la longitud de la cara dual k ', $n_{k'}$ es el vector normal exterior de la unidad en la cara dual k 'y H1, H2 son los valores de elevación del agua en los centros de las celdas j1 y j2 como se muestra en la figura de la izquierda.




Agrupando los términos por el índice de celda j, la aproximación de volumen finito del gradiente se convierte en la fórmula multi-lineal

$$\nabla H \approx \sum_j c_j H_j$$

(Ec. 26)

Donde la suma está sobre todas las celdas (nodos duales) alrededor de la cara de cálculo, Hj es el valor de la elevación del agua en la celda j y las constantes vectoriales cj = ($n_{k1'}$ $l_{k1'}$ + $n_{k2'}$ $l_{k2'}$ ) / 2A' dependen de la geometría de la cuadrícula local en las caras duales k'1 y k'2 vecino dual nodo (celda) j y el área dual A ', como se ve en la figura. Los valores $l_{k1'}$, $l_{k2'}$ y los vectores unitarios $n_{k1'}$, $n_{k2'}$ representan respectivamente la longitud y la normal hacia el exterior de las caras duales k'1 y k'2.

Las derivadas direccionales en una dirección arbitraria T 'se calculan fácilmente mediante la fórmula.

$$\frac{\partial H}{\partial T'} = \nabla H \bullet T' \approx \sum_j c'_j H_j$$

(Ec. 27)

Donde las constantes escalares $c'_j$ = ($n_{k1'}$ $l_{k1'}$ + $n_{k2'}$ $l_{k2'}$) • T' / (2A') absorbieron el producto de puntos con T'.

Aplicando un argumento similar en la cuadrícula en lugar de la cuadrícula dual, el gradiente de la velocidad ∇V se puede calcular en una celda de cuadrícula. El argumento se puede repetir secuencialmente para calcular las derivadas de orden superior. Por ejemplo, una vez que se conoce ∇V en todas las celdas de la cuadrícula, los términos laplacianos $\nabla^2 V$ se pueden calcular en los nodos de la cuadrícula mediante el proceso descrito anteriormente.

**C) <u>Discretización híbrida</u>**

Como ha visto en las secciones anteriores, las derivadas normales en las caras de una cuadrícula ortogonal se pueden aproximar utilizando diferencias finitas. Si la cuadrícula no es localmente ortogonal, la derivada normal debe dividirse como la suma de una diferencia finita y una aproximación de volumen finito.

**D) <u>Solucionador numérico para ecuaciones ecuaciones de onda de difusión (DSW).</u>**

Las diferencias finitas se usan para discretizar derivadas de tiempo y las aproximaciones híbridas se usan para discretizar derivadas espaciales. El método generalizado de Crank-Nicolson se utiliza para ponderar la contribución de las variables en los pasos de tiempo n y n + 1.

**E) <u>Solucionador numérico para ecuaciones ecuaciones en aguas poco profundas (SW).</u>**

Las ecuaciones SW expresan el volumen y la conservación del momento. La ecuación de continuidad se discretiza utilizando aproximaciones de volumen finito. Para la ecuación de impulso, el tipo de discretización variará según el término. El método Crank-Nicolson también se usa para ponderar la contribución de las variables (Coriolis, Viscosidad, Rozamiento con el fondo…) en los pasos de tiempo n y n + 1. Sin embargo, la naturaleza diferente de las ecuaciones requerirá el uso de un esquema de solución más elaborado.

### 4.3.3 METODOLOGÍA DE CÁLCULO PARA LOS PASOS/CAÑOS.

HEC-RAS calcula las pérdidas de energía, causadas por estructuras como caños en tres partes. La primera parte consiste en pérdidas que ocurren en el alcance inmediatamente aguas abajo de la estructura, donde se produce una expansión del flujo. La segunda parte consiste en pérdidas que ocurren cuando el flujo viaja hacia adentro, a través y fuera de la alcantarilla. La última parte consiste en pérdidas que ocurren en el alcance inmediatamente aguas arriba de la estructura, donde el flujo se contrae hacia la apertura de la alcantarilla.

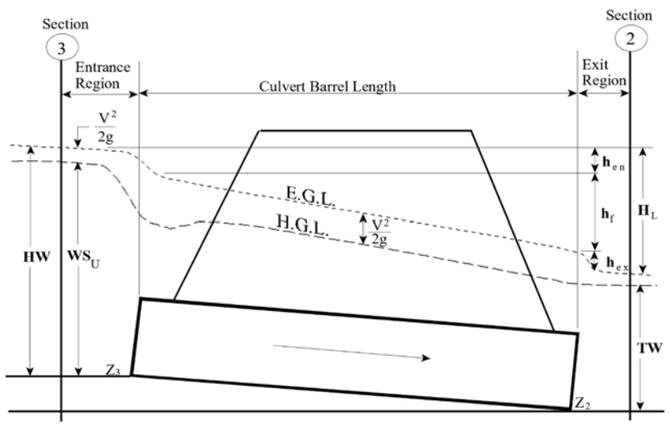
Los caños se componen de tres partes diferenciadas, una **entrada** que dota al caño de caudal, el propio **caño** que es una conducción completamente estanca en cuanto a sus paredes, y una **sálida** donde los caudales en el interior son evacuados.

**El "Tailwater" (**TW**)** o agua de cola es la altura de agua que existe aguas abajo del caño modelizado en su punto más bajo. Este factor depende del flujo por el interior del caño y las condiciones hidraulicas aguas abajo.

**"Headwater" (HW)** o agua de cabecera es la altura de agua en la entrada del caño en términos de energía (aplicado el $V^2/2g$). Representa la cantidad de energía que el flujo a su paso por el caño recibirá.

The **Upstream Water Surface (WSU)** es la altura aguas arriba del caño junto a su zona de entrada.

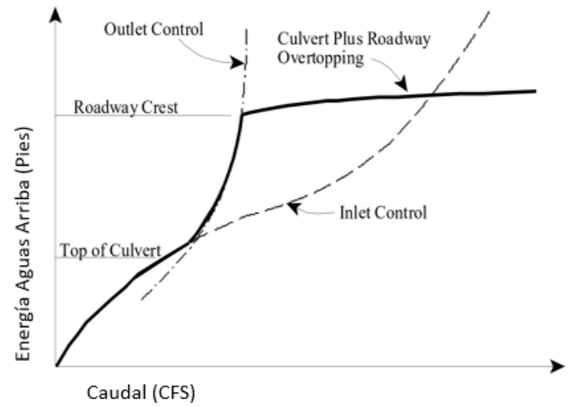
La energía total es la suma de las fuerzas estáticas de altura de agua (potenciales), más las fuerzas relacionadas con la cinemática y por tanto de la velocidad del flujo. Esto se cumple para cualquier punto de del cálculo.




**<u>Análisis Del Flujo Para Caños:</u>**

El análisis del flujo en caños es bastante complicado. Es común utilizar los conceptos de "control de entrada" y "control de salida" para simplificar el análisis. El flujo de control de entrada se produce cuando la capacidad de flujo de la entrada de los caños es menor que la capacidad de flujo de dentro del mismo. Para el control de entrada, la energía aguas arriba requerida se calcula al asumir que la entrada de los caños actúa como una compuerta o un vertedero. Por lo tanto, la capacidad de control de entrada depende principalmente de la geometría de la entrada de los caños.

El flujo de control de salida se produce cuando la capacidad de flujo de los caños está limitada por las condiciones aguas abajo (agua de alto caudal) o por la capacidad de flujo del interior del caño. Las rutinas de caños de HEC-RAS calculan la energía ascendente requerida para producir un caudal dado en relación a las condiciones de control de entrada y las condiciones de control de salida. En general, la energía "aguas arriba" controla y determina el tipo de flujo en los caños para un caudal y una condición de agua de cola determinados. Las rutinas de los caños de HEC-RAS consideran las pérdidas de entrada, las pérdidas por fricción en el interior de los caños y las pérdidas de salida en la salida al calcular el agua de salida de control de los caños.




Durante los cálculos, si la respuesta del control de entrada es superior a la respuesta del control de salida, el programa realizará algunos cálculos adicionales para evaluar si la respuesta del control de entrada puede persistir a través de el caño sin presionar el interior de los caños. El supuesto de control de entrada es que el flujo pasa a través de la profundidad crítica cerca de la entrada de el caño y las transiciones en flujo supercrítico. Si el flujo persiste como flujo bajo a través de la longitud de el caño, se asume que el control de entrada es válido. Si el flujo pasa a través de un salto hidráulico dentro del caño y se desarrolla completamente en toda el área del caño, se supone que esta condición hará que la tubería se presurice. Si esto ocurre, entonces se usa la respuesta de control de salida (bajo el supuesto de caudal máximo) en lugar de la respuesta de control de entrada.

**<u>Control de entrada del agua de cabecera:</u>**

Para las condiciones de control de entrada, la capacidad de el caño está limitada por la capacidad de apertura de el caño, en lugar de por las condiciones más alejadas de la corriente. Las exhaustivas pruebas de the National Bureau of Standards y the Bureau of Public Roads, así como otras entidades, resultaron en una serie de ecuaciones que describen el agua de cabecera de control de entrada en diversas condiciones. Estas ecuaciones forman la base de los nomogramas de control de entrada FHWA que se muestran en la publicación "Hydraulic Desing of Highway Culverts" [FHWA, 1985]. Las ecuaciones de control de entrada de FHWA son utilizadas por las rutinas de los caños de HEC-RAS

en el cálculo de la energía ascendente. Las ecuaciones de control de entrada se desarrollaron para condiciones de entrada sumergidas y no sumergidas. Estas ecuaciones son:

Entrada no sumergida:

$$\frac{HW_i}{D} = \frac{H_c}{D} + K\left[\frac{Q}{AD^{0.5}}\right]^M - 0.5S$$

$$\frac{HW_i}{D} = K\left[\frac{Q}{AD^{0.5}}\right]^M$$

Entrada sumergida:

$$\frac{HW_i}{D} = c\left[\frac{Q}{AD^{0.5}}\right]^2 + Y - 0.5S$$

Donde:

- $HW_i$ = Profundidad de energía del agua de cabeza por encima de la inversión del
- entrada de los caños, pies
- D = Altura interior del cañón de el caño, pies
- Hc = Cabezal específico en profundidad crítica (dc + Vc2 / 2g), pies
- Q = Descarga a través de el caño, cfs.
- A = Área de sección transversal completa del cañón de el caño, pies$^2$
- S = Pendiente del cañón de los caños, pies / pies
- K, M, c, Y = Constantes de ecuación, que varían según la forma de el caño y las condiciones de entrada

Existen dos ecuaciones para la no sumergida, la primera está mas contrastada, pero, sin embargo, no es apicable a todos los tipos de caños que ofrece el programa, por lo que es necesario aplicar la segunda ecuación para ciertas formas de caños dado que es la única que está realmente contrastada para esos casos específicos.

**Computación de control de salida de agua:**

Para el flujo de control de salida, la energía aguas arriba requerida para pasar el flujo, debe computarse considerando varias condiciones dentro de el caño y aguas abajo de el caño. Los cálculos de control de salida se basan en la energía. La ecuación utilizada por el programa es la siguiente:

$$Z_3 + Y_3 + \frac{a_3 V_3^2}{2g} = Z_2 + Y_2 + \frac{a_2 V_2^2}{2g} + H_L$$

Donde:

- Z3 = Elevación invertida aguas arriba de el caño
- Y3 = La profundidad del agua sobre la entrada de el caño aguas arriba
- V3 = La velocidad promedio aguas arriba de el caño
- a3 = El coeficiente de ponderación de la velocidad corriente arriba de el caño
- g = La aceleración de la gravedad.
- Z2 = Elevación invertida corriente abajo de el caño
- Y2 = La profundidad del agua sobre la entrada de el caño aguas abajo
- V2 = La velocidad promedio aguas abajo de el caño a2 = El coeficiente de ponderación de la velocidad aguas abajo de el caño
- HL = Pérdida total de energía a través de el caño (de la sección 2 a 3

**Calado Normal en caño:**

La profundidad normal es la profundidad a la que se producirá un flujo uniforme en un canal abierto. En otras palabras, para un canal uniforme de longitud infinita, que lleva un caudal constante, el flujo en el canal estaría a una profundidad constante en todos los puntos a lo largo del canal, y esta sería la profundidad normal.

La profundidad normal a menudo representa una buena aproximación de la profundidad real del flujo dentro de un segmento de canal. El programa calcula la profundidad normal utilizando un enfoque iterativo para llegar a un valor, que satisfaga la ecuación de Manning:

$$Q = \frac{1.486}{n} A R^{2/3} S_f^{1/2}$$

Donde:

- Q = caudal en el canal (cfs) n = coeficiente de rugosidad de Manning
- A = área de flujo (pies cuadrados)
- R = radio hidráulico (pies)
- S f = pendiente de la línea de grado energético (pies por pie)

**Calado crítico en caño:**

La profundidad crítica se produce cuando el flujo en un canal tiene una energía específica mínima. La energía específica se refiere a la suma de la profundidad de flujo y la velocidad de la cabeza. La profundidad crítica depende de la forma del canal y del caudal.

Se asume que la profundidad del flujo en la salida de el caño es igual a la profundidad crítica para los caños que operan bajo el control de la salida con agua de cola baja. La profundidad crítica también puede influir en el agua de cabecera de control de entrada para condiciones no sumergidas.

Las rutinas de los caños calculan la profundidad crítica en el caño mediante un procedimiento iterativo, que llega a un valor que satisface la siguiente ecuación:

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

Donde:

- Q = tasa de flujo en el canal (cfs)
- g = aceleración debido a la gravedad (32,2 ft / sec2)
- A = área de flujo transversal (pies cuadrados)
- T = ancho superior del flujo (pies)

La profundidad crítica para los caños de caja se puede resolver directamente con la siguiente ecuación [AISI, 1980]:

$$y_c = \sqrt[3]{\frac{q^2}{g}}$$

Donde:

- yc = profundidad crítica (pies)
- q = descarga de la unidad por pie lineal de ancho (cfs / ft)
- g = aceleración debida a la gravedad

**Flujo por el Caño:**

La primera solución a través de el caño está bajo el supuesto de que todo el flujo está pasando por los caños. Una vez que se obtiene una energía final aguas arriba, el programa verifica si la elevación de energía es mayor que la elevación mínima para que ocurra el flujo de vertedero. Si la energía calculada es menor que la elevación mínima para el flujo de vertedero, entonces la solución es definitiva. Si la energía calculada es mayor que la elevación mínima para el flujo de la presa, el programa realiza un procedimiento iterativo para determinar la cantidad de flujo sobre la presa y a través de los caños. Durante este procedimiento iterativo, el programa recalcula las soluciones de los caños de control de entrada y salida para cada estimación del flujo de los caños. En general, el más alto de los dos se usa para la porción de los caños de la solución, a menos que el programa sienta que el control de entrada no se puede mantener. El programa continuará iterando hasta que encuentre una división de flujo que produzca la misma energía corriente arriba (dentro de la tolerancia de error) tanto para el flujo de vertedero como de los caños.

**Coeficientes reductores de entrada:**

Las pérdidas de entrada se calculan como una función de la de la velocidad en cabecera dentro de el caño en el extremo corriente arriba. La pérdida de entrada para el caño se calcula como:

$$h_{en} = k_{en} \frac{V_{en}^2}{2g}$$

Donde:

- $h_{en}$ = Pérdida de energía debido a la entrada.
- $K_{en}$ = coeficiente de pérdida de entrada
- $V_{en}$ = Velocidad de flujo dentro de el caño en la entrada
- g = Aceleración debido a la gravedad

La velocidad en cabecera se multiplica por el coeficiente de pérdida de entrada para estimar la cantidad de energía perdida cuando el flujo ingresa a el caño. Un valor más alto para el coeficiente da una mayor pérdida de carga. Los coeficientes recomendados varían en función de la tipología de las embocaduras. Desde 0,2 para caños con embocaduras con angulos de aletas favorables hasta 0,5 para aletas dispuestas en formas mas desfavorables.

**Coeficientes de salida:**

Las pérdidas de salida se calculan como un coeficiente multiplicado por el cambio en la altura de la velocidad desde justo dentro de el caño, en el extremo corriente abajo, hasta la sección transversal justo corriente abajo de el caño. La ecuación para calcular las pérdidas de salida es la siguiente:

$$h_{ex} = k_{ex}\left(\frac{a_{ex}V_{ex}^2}{2g} - \frac{a_2V_2^2}{2g}\right)$$

Dónde:

- $h_{ex}$ = pérdida de energía debido a la salida $k_{ex}$ = coeficiente de pérdida de salida
- $V_{ex}$ = Velocidad dentro de el caño en la salida
- $V_2$ = Velocidad fuera de el caño en la sección transversal aguas abajo

Para una expansión repentina del flujo, como en un caño típico, el coeficiente de pérdida de salida ($k_{ex}$) normalmente se establece en 1.0 (FHWA, 1985). En general, los coeficientes de pérdida de salida pueden variar entre 0,3 y 1,0. El coeficiente de pérdida de salida debe reducirse ya que la transición se vuelve menos abrupta.

## 4.4 CARTOGRAFÍA EMPLEADA

La modelización de la brecha y el análisis de la rotura se ha realizado con el software de modelado en 2D HEC-RAS 5.0.5, desarrollado por el Army Corps of Engineers Norte Americano. Dicho software requiere de la introducción de un modelo digital del terreno para su posterior cálculo.

Dichos modelos topográficos han sido introducidos gracias a los modelos digitales del terreno (MDT02) facilitados por el Instituno Geografico Nacional en su centro de descargas:

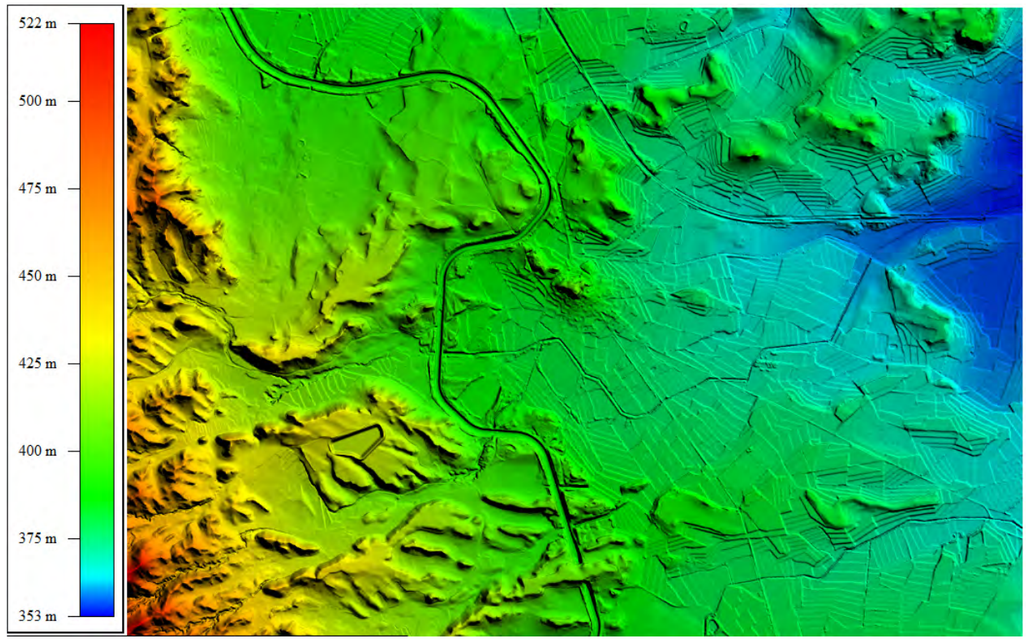
Centro de Descargas
Organismo Autónomo Centro Nacional de Información Geográfica

Modelo digital del terreno 2ª Cobertura (2015-Actualidad) con paso de malla de 2 m:

ETRS89 en la Península, Islas Baleares, Ceuta y Melilla, y REGCAN95 en las Islas Canarias (ambos sistemas compatibles con WGS84). Proyección UTM en el huso correspondiente. Alturas ortométricas.

Dicho modelo ha sido obtenido por interpolación a partir de la clase terreno de los vuelos LIDAR de la segunda cobertura del Plan Nacional de Ortofotografía Aérea (PNOA), a excepción de las hojas de Ceuta, Melilla e Isla de Alborán (1110, 1111, 1078B) obtenidas por estereocorrelación automática de vuelos fotogramétricos PNOA con resolución de 25 a 50 cm/píxel, revisada e interpolada con líneas de ruptura donde fuera viable.

A continuación, se presenta el modelo digital del terreno de la zona objeto de la presente clasificación:




La topografía, una vez procesada, se introduce en el formato cartográfico utilizado por HEC-RAS, HDF (Hierarchical Data Format) con una precisión en la malla de generación del archivo de 1 metros.

## 4.5 RUGOSIDAD APLICADA

En los modelos hidráulicos debe introducirse como dato de partida los valores del coeficiente de rugosidad o rozamiento de los terrenos de cauce y márgenes contenidos en la zona inundable por la rotura de la presa. Dichos valores dependen de un buen número de factores, como: rugosidad de la superficie, vegetación, irregularidades del cauce, sinuosidad del cauce, erosión y sedimentación, obstrucciones, tamaño y forma del cauce, sólidos en suspensión, etc.

En primer término, los tipos de cobertura del suelo en la zona de estudio se pueden identificar empleando la información contenida en el Sistema de Información sobre Ocupación del Suelo de España (SIOSE), cuyo objetivo es integrar la información de las bases de datos de coberturas y usos del suelo de las Comunidades Autónomas y de la Administración General del Estado. El SIOSE se enmarca dentro del Plan Nacional de Observación del Territorio en España (PNOT), que coordina y gestiona el Instituto Geográfico Nacional (IGN) y el Centro Nacional de Información Geográfica (CNIG).

Una vez identificadas las distintas coberturas del terreno, los valores del coeficiente de rozamiento se podrán obtener de la bibliografía disponible, como por ejemplo las conocidas tablas de Ven Te Chow, incluidas en su publicación *Open Channel Hydraulics*.

Para identificar las coberturas del terreno, resulta muy útil el empleo de la tabla nº 1 del Anejo V de la *Guía Metodológica para el desarrollo del Sistema Nacional de Cartografía de Zonas Inundables*, editada en el año 2011 por el entonces Ministerio de Medio Ambiente, y Medio Rural y Marino. En dicha tabla se relacionan los valores del coeficiente de rugosidad de Manning en función de las diversas coberturas del suelo clasificadas en el SIOSE y en el CORINE Land Cover (antecedente del SIOSE).

| CODIIGE | DESCRIPCIÓN | manning |
|---|---|---|
| 111 | Casco | 0,1 |
| 112 | Ensanche | 0,1 |
| 113 | Discontinuo | 0,09 |
| 114 | Zona verde urbana | 0,09 |
| 121 | Instalación agrícola y/o ganadera | 0,04 |
| 122 | Instalación forestal | 0,09 |
| 123 | Extracción minera | 0,04 |
| 130 | Industrial | 0,1 |
| 140 | Servicio dotacional | 0,1 |
| 150 | Asentamiento agrícola y huerta | 0,04 |
| 161 | Red viaria o ferroviaria | 0,1 |
| 162 | Puerto | 0,1 |
| 163 | Aeropuerto | 0,1 |
| 171 | Infraestructura de suministro | 0,1 |
| 172 | Infraestructura de residuos | 0,1 |
| 210 | Cultivo herbáceo | 0,04 |
| 220 | Invernadero | 0,1 |
| 231 | Frutal cítrico | 0,06 |
| 232 | Frutal no cítrico | 0,06 |
| 233 | Viñedo | 0,06 |
| 234 | Olivar | 0,06 |
| 235 | Otros cultivos leñosos | 0,06 |
| 236 | Combinación de cultivos leñosos | 0,06 |
| 240 | Prado | 0,035 |
| 250 | Combinación de cultivos | 0,05 |
| 260 | Combinación de cultivos con vegetación | 0,0425 |
| 311 | Bosque de frondosas | 0,07 |
| 313 | Bosque mixto | 0,07 |
| 312 | Bosque de coníferas | 0,07 |
| 320 | Pastizal o herbazal | 0,035 |
| 330 | Matorral | 0,0625 |
| 340 | Combinación de vegetación | 0,04875 |
| 351 | Playa, duna o arenal | 0,025 |
| 352 | Roquedo | 0,03 |
| 353 | Temporalmente desarbolado por incendios | 0,04 |
| 354 | Suelo desnudo | 0,03 |
| 411 | Zona húmeda y pantanosa | 0,04 |
| 412 | Turbera | 0,04 |
| 413 | Marisma | 0,04 |
| 414 | Salina | 0,04 |
| 514 | Lámina de agua artificial | 0,025 |
| 511 | Curso de agua | 0,04 |
| 512 | Lago o laguna | 0,025 |
| 513 | Embalse | 0,025 |
| 515 | Mar | 0,025 |
| 516 | Glaciar y/o nieve perpetua | 0,025 |

# 5 POSIBLES ESCENARIOS DE ROTURA

De acuerdo a la NST1, se considerarán distintos escenarios de posibles roturas de la presa, identificando en cada uno de ellos los riesgos potenciales, asignándose como clasificación aquélla que corresponda al escenario más desfavorable. En este apartado se analizará cuales de los escenarios expuestos en la norma deben ser considerados en función de las caracteristicas de la presa y sus afecciones aguas abajo.

| ESCENARIO | TIPO | ANALISIS |
|---|---|---|
| Rotura Individual | Escenario sin avenida | Siempre Procede |
| | Escenario Límite (con avenida) | No procede al tratarse de una Balsa |
| Rotura Encadenada | Recepción en N.A.M.O. | No procede al no encontrar presas aguas abajo |
| | Recepción en Escenario Límite | |

De acuerdo a los posibles escenarios de rotura, se analizará la rotura individual en los sucesivos apartados.

# 6 ESCENARIO DE ROTURA INDIVIDUAL SIN AVENIDA

Con el fin de analizar correctamente el riesgo potencial que se puediera derivarse de la rotura de la presente balsa, se realiza la simulación por el talud más desfavorable. En la siguiente imagen se recoge el punto más desfavorable para la rotura, así como su perfil.

**Punto de rotura más desfavorable (PERFIL 0)**

## 6.1 PARÁMETROS DE LA SIMULACIÓN

### 6.1.1 CONDICIONES INICIALES

Las condiciones iniciales del modelo propuesto antes de producirse la simulación de la rotura, son las siguientes:

El terreno se considera en condiciones secas y sin ningún tipo de acumulación previa de agua en la malla de calculo. Este parámetro de "humedad" del suelo debe ser cero dado que el programa no tiene en cuenta los efectos de infiltración, y, este hecho, ya de por sí, genera un resultado aguas abajo superior al esperado realmente.

El nivel de agua en la presa objeto de la clasificación se situa en la cota N.A.M.O. 428,00 m.s.n.m. de acuerdo a lo establecido en la norma para roturas individuales sin avenida.

### 6.1.2 CONDICIONES DE CONTORNO

Existen dos condiciones de contorno dentro de la modelización en el software de cálculo, una de entrada y otra de salida:

<u>Las condiciones de contorno de entrada serán de dos tipos:</u>

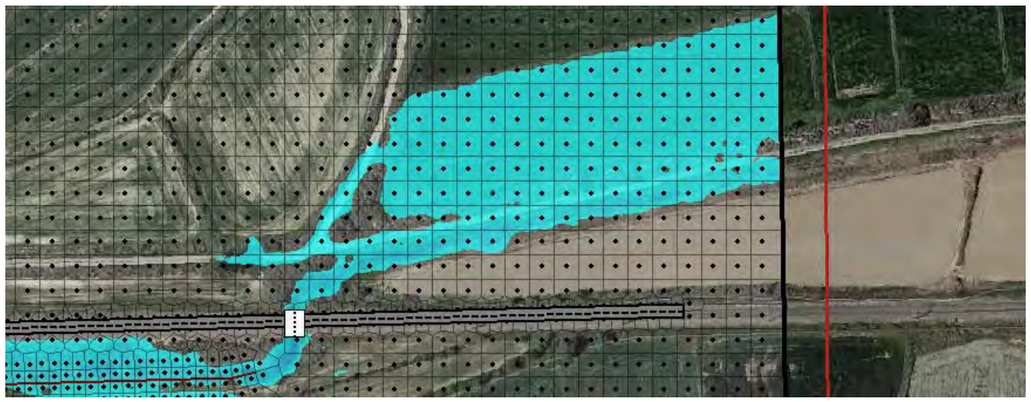
- Las condiciones generadas por la simulación de la brecha a partir de los datos introducidos en el programa de cálculo y generados a partir de las fórmulas expuestas por la guía técnica para su dimensionado.

- En adición a los caudales generados por el cálculo de la brecha, se determina un caudal de entrada en el Canal de Monegros en su capacidad habitual en las campañas de riego 57,8 $m^3/s$. Este caudal circulante por el canal de monegros será constante a lo largo de toda la simulación y tiene como fin determinar fielmente los efectos que aplica el canal lleno en su nivel de explotación, en su encuentro con la avenida provocada por la rotura de la balsa. Como se verá posteriormente en los sucesivos apartados, los caudales procedentes de la hipotética rotura de la balsa por su parte más desfavorable, se dirigen hacia dicho canal.

<u>De la misma manera, las condiciones de contorno de salida serán de dos tipos:</u>

La primera condición de contorno de salida se sitúa en la parte baja del Canal de Monegros con el fin de simular la continuidad del mismo aguas abajo. Se coloca suficientemente aguas abajo de la zona de estudio para que la simulación pueda realizarse aguas arriba y adoptar el calado que corresponda (Subcrítico/Crítico/Supercrítico). La condición de contorno está representada en color rojo en la siguiente imagen.

La segunda condición de contorno se sitúa aguas abajo de los drenajes transversales del Canal de Monegros concretamente en el encuentro del barranco de Valverada (D-20) con el ferrocarril Zaragoza-Tardienta-Lérida. La condición de contorno de salida, se sitúa en este punto, puesto que se vé lo suficientemente justificado que el desagüe situado a continuación tiene la capacidad suficiente para transportar los caudales asociados a la capacidad máxima de dicha obra de drenaje por lo que no tiene sentido alargar más la simulación en este punto. Adicionalmente, se considera que, a partir de este punto, no se encuentran afecciones significativas aguas abajo para continuar la simulación de la avenida. La condición de contorno está representada en color rojo en la siguiente imagen.



### 6.1.3 PARÁMETROS DE TIEMPO

Se han empleado los siguientes parámetros temporales para la simulación de la rotura.

| PARÁMETROS DE TIEMPO | |
|---|---|
| Inicio de la simulación | 0 horas y 0 minutos |
| Inicio de entrada de caudales en el Canal de Monegros | 0 horas y 0 minutos |
| Inicio de la formación de la brecha* | 0 horas y 30 minutos |
| Tiempo máximo de la simulación | 3 horas y 00 minutos |
| Intervalos de resultados | 60 segundos |
| Intervalos de computación | 1 segundo |

* La brecha se produce a la media hora de simulación para permitir que el caudal circulante por el Canal de Monegros se estabilice. De esta manera, se producirá la situación más desfavorable de concurrencia de eventos: Rotura de la balsa coincidente con el Canal de Monegros en su nivel normal de explotación.

### 6.1.4 CARACTERISTICAS DE LA BRECHA DE LA ROTURA

La tipología de la balsa a clasificar se encuentra recogida dentro de la categoría de presas de materiales sueltos.

- Tiempo de rotura (T, en h): a efectos de clasificación se define como tiempo de rotura de la presa el tiempo de desarrollo de la brecha, que es el tiempo que transcurre desde que se ha iniciado la brecha (o tubificación) hasta que ésta llega a su sección final. En este tiempo se produce la erosión y arrastre de material que dan lugar al agrandamiento progresivo de la rotura. Puede determinarse mediante la siguiente fórmula:

$$T = 5{,}62\ \frac{\sqrt{V_W}}{H_b}\ \textit{(Froehlich, 2008)}$$

  - Siendo $V_W$ el volumen de agua almacenado en el embalse en el momento de la rotura (en $hm^3$) y Hb la altura de la brecha (en m). A efectos de la aplicación de esta fórmula se considerará que la altura de la brecha es igual a la altura de la presa sobre el cauce.

- Forma de la brecha: trapecial. De manera genérica se considerará que los taludes laterales de la brecha son 1H/1V. Si bien, en base a la experiencia de roturas documentadas, se conoce que este parámetro puede variar desde el citado 1H/1V en materiales no cohesivos hasta 0,33H/1V en materiales cohesivos.

$$B = 22{,}46\ K_0 {V_w}^{0{,}32} {H_b}^{0{,}04}\ \textit{(Froehlich, 2008)}$$

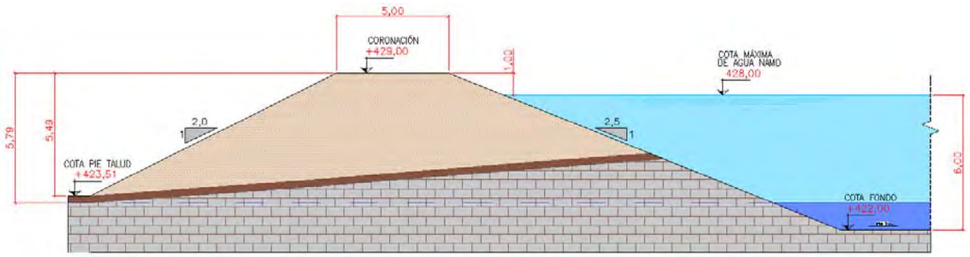
  Donde Ko es un coeficiente que depende de la causa que origina la rotura de la presa ($K_0$=1,3 para roturas por sobrevertido y $K_0$=1 para el resto de roturas), $V_W$ es el volumen de agua almacenado en el embalse en el momento de la rotura (en $hm^3$) y $H_b$ la altura de la brecha (en m).

En la aplicación de esta fórmula se utilizará $K_0$=1 para el análisis del escenario sin avenida y $K_0$=1,3 para el escenario límite y para el análisis de la rotura encadenada de presas de materiales sueltos situadas aguas abajo de la de estudio; y se considerará que la altura de la brecha es igual a la altura de la presa sobre el cauce ($H_b$=H).

El volumen máximo movilizable es el volumen utilizado para la simulación de la posible rotura de la balsa analizada. El volumen máximo movilizable considerado, es el comprendido entre la altura máxima hasta que podría elevarse el embalse en situaciones de episodios de precipitaciones extremas, y la cota de altura máxima sobre los cimientos, dado que, si se produjese una rotura, el agua almacenada entre la cota de fondo y la de los cimientos permanecería embalsada.

Volumen máximo movilizable = Volumen Cota NAMO – Volumen Cota Cimiento

**Volumen** máximo **movilizable** = 180.792,81 m³ – 39.223,29 m³ = **141.569,52 m³**




A continuación, se presenta la cubicación completa de la balsa hasta la cota NME:

| Descripción | | Cotas (m) | Superficie (m²) | Volumen acumulado (m³) |
|---|---|---|---|---|
| **Cota Fondo** | | 422,00 | 24.633,88 | 0,00 |
| | | 423,00 | 26.406,63 | 25.520,26 |
| **Cota de cimiento** | | 423,51 | 27.330,77 | 39.223,29 |
| **Movilizable** | | 424,00 | 28.218,66 | 52.832,90 |
| | | 425,00 | 30.069,96 | 81.977,21 |
| | | 426,00 | 31.960,52 | 112.992,45 |
| | | 427,00 | 33.890,36 | 145.917,90 |
| | **NAMO** | 428,00 | 35.859,47 | 180.792,81 |

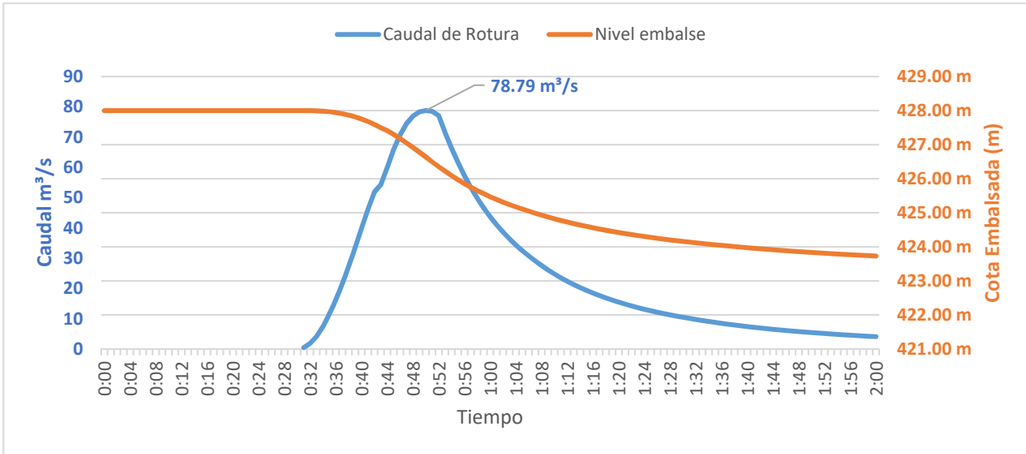
Dichos parámetros (tiempo de formación y ancho de la brecha), han sido introducidos debidamente en el apartado para simulación de brechas del software de cálculo HEC-RAS 5.0.5. La formación de la brecha en el programa de cálculo considera al igual que la citada Guía que la formación será trapecial. La rotura analizada según el riesgo potencial se recoge a continuación:

| **Dimensiones de la brecha de la rotura (FORMA DE ROTURA: Trapecial)** | | |
|---|---|---|
| **Localización** | **Cota (m)** | **Ancho (m)** |
| Zona superior de la brecha | 429,00 | 18,679 m |
| Zona media de la brecha | 426,11 | 12,889 m |
| Zona inferior de la brecha | 423,21 | 7,099 m |
| **Tiempo de rotura** | | |
| **h** | **min** | **s** |
| 0,365 | 21,91 | 1315 |
| **Volumen rotura (m³)** | **141.569,52** | |
| **Altura sobre cimientos (m)** | **5,79** | |
| **Cimiento (m.s.n.m.)** | **423,21** | |
| **Coronación (m.s.n.m.)** | **429,00** | |

## 6.2 RESULTADOS DE LA ROTURA

### 6.2.1 HIDROGRAMA DE LA ROTURA

La avenida obtenida según las características de la balsa analizada corresponde con el siguiente gráfico de evolución de caudales.




En la siguiente tabla se recogen los datos numéricos de los valores de caudal y tiempo que definen el hidrograma anterior.

| Tiempo (h:min) | Caudal (m³/s) | Nivel del agua embalsada |
|---|---|---|
| 0:00 | 0,00 | 428,00 |
| 0:01 | 0,00 | 428,00 |
| 0:02 | 0,00 | 428,00 |
| 0:03 | 0,00 | 428,00 |
| 0:04 | 0,00 | 428,00 |
| 0:05 | 0,00 | 428,00 |
| 0:06 | 0,00 | 428,00 |
| 0:07 | 0,00 | 428,00 |
| 0:08 | 0,00 | 428,00 |
| 0:09 | 0,00 | 428,00 |
| 0:10 | 0,00 | 428,00 |
| 0:11 | 0,00 | 428,00 |
| 0:12 | 0,00 | 428,00 |
| 0:13 | 0,00 | 428,00 |
| 0:14 | 0,00 | 428,00 |
| 0:15 | 0,00 | 428,00 |
| 0:16 | 0,00 | 428,00 |
| 0:17 | 0,00 | 428,00 |
| 0:18 | 0,00 | 428,00 |

| Tiempo (h:min) | Caudal ($m^3/s$) | Nivel del agua embalsada |
|---|---|---|
| 0:19 | 0,00 | 428,00 |
| 0:20 | 0,00 | 428,00 |
| 0:21 | 0,00 | 428,00 |
| 0:22 | 0,00 | 428,00 |
| 0:23 | 0,00 | 428,00 |
| 0:24 | 0,00 | 428,00 |
| 0:25 | 0,00 | 428,00 |
| 0:26 | 0,00 | 428,00 |
| 0:27 | 0,00 | 428,00 |
| 0:28 | 0,00 | 428,00 |
| 0:29 | 0,00 | 428,00 |
| 0:30 | 0,00 | 428,00 |
| 0:31 | 0,47 | 428,00 |
| 0:32 | 1,87 | 428,00 |
| 0:33 | 4,21 | 427,99 |
| 0:34 | 7,47 | 427,98 |
| 0:35 | 11,61 | 427,97 |
| 0:36 | 16,30 | 427,94 |
| 0:37 | 21,59 | 427,91 |
| 0:38 | 27,37 | 427,87 |
| 0:39 | 33,50 | 427,82 |
| 0:40 | 39,84 | 427,75 |
| 0:41 | 46,20 | 427,68 |
| 0:42 | 51,93 | 427,59 |
| 0:43 | 54,31 | 427,50 |
| 0:44 | 60,09 | 427,41 |
| 0:45 | 66,00 | 427,30 |
| 0:46 | 70,79 | 427,18 |
| 0:47 | 74,47 | 427,05 |
| 0:48 | 76,95 | 426,92 |
| 0:49 | 78,32 | 426,78 |
| **0:50** | **78,79** | **426,64** |
| 0:51 | 78,50 | 426,49 |
| 0:52 | 77,11 | 426,35 |
| 0:53 | 71,38 | 426,22 |
| 0:54 | 66,27 | 426,09 |
| 0:55 | 61,62 | 425,97 |
| 0:56 | 57,26 | 425,86 |
| 0:57 | 53,33 | 425,75 |
| 0:58 | 49,79 | 425,65 |
| 0:59 | 46,59 | 425,56 |
| 1:00 | 43,68 | 425,47 |
| 1:30 | 10,45 | 424,16 |
| 2:00 | 4,09 | 423,73 |

### 6.2.2 LLANURA DE INUNDACIÓN

A continuación, se presenta la simulación realizada y se analizan los resultados obtenidos.

La llanura de inundación es generada tras la rotura de la balsa por su muro de tierras situado en el este. El talud de este muro, es el que más desarrollo posee y por tanto genera una rotura más desfavorable. Se puede visualizar en la siguiente imagen y en los planos que se incluyen en el Apéndice N.º2.

Los resultados obtenidos en cuanto a calados y velocidades máximas pueden ser consultados en el Apéndice N.º2.

Aguas abajo de la balsa la orografía muestra una ligera pendiente siguiendo la dirección noreste, de aproximadamente 3,5 % de media hasta llegar al canal de Monegros (Km 29). Todo este recorrido, de unos 790 metros, transcurre por un campo de cultivo hasta alcanzar el barranco de Valverada.

Dicho barranco tiene continuidad a través de una obra de drenaje transversal bajo el canal de Monegros, y, por lo tanto, la avenida continuará por éste en la medida que la obra de drenaje lo permita. El exceso de caudal se irá acumulando hasta producirse un vertido sobre el Canal de Monegros.

Como se ha mencionado con anterioridad la avenida provocada por la rotura de la balsa se encauzará por el barranco de la Valverada hasta encontrarse con el siguiente drenaje transversal, consistente en cuatro caños de hormigón de 1 metro de diámetro.

| Vista aguas arriba | Vista aguas abajo |
|---|---|
| | |

La avenida discurrirá por tanto por el mencionado barranco en la medida de los posible, hasta alcanzar la línea de ferrocarril Zaragoza-Tardienta-Lérida donde se termina la simulación al no encontrarse aguas abajo más infraestructuras relevantes para la clasificación.

En los siguientes apartados se analizarán las afecciones derivadas de la rotura en función de las distintas categorías que maca la guía técnica.

### 6.2.3 AFECCIONES

A continuación, se recogen los criterios de valoración del daño provocado por la rotura de una balsa, recogidos en la Guía Técnica de Clasificación de presas de noviembre de 2021:

Siguiendo con las indicaciones del apartado 2.2 de la Guía Técnica para la definición de las categorías:

- Categoría A: presas cuya rotura o funcionamiento incorrecto puede afectar gravemente a núcleos urbanos o servicios esenciales, o producir daños materiales o medioambientales muy importantes.
- Categoría B: presas cuya rotura o funcionamiento incorrecto puede ocasionar daños materiales o medioambientales importantes o afectar a un reducido número de viviendas.
- Categoría C: presas cuya rotura o funcionamiento incorrecto puede producir daños materiales de moderada importancia y sólo incidentalmente pérdida de vidas humanas. En todo caso a esta categoría pertenecerán todas las presas no incluidas en las Categorías A o B.

Los aspectos que deben ser considerados en el proceso de valoración según la Guía son:

- Riesgo potencial a vidas humanas. Población en riesgo.
- Afecciones a servicios esenciales
- Daños materiales
- Daños medioambientales

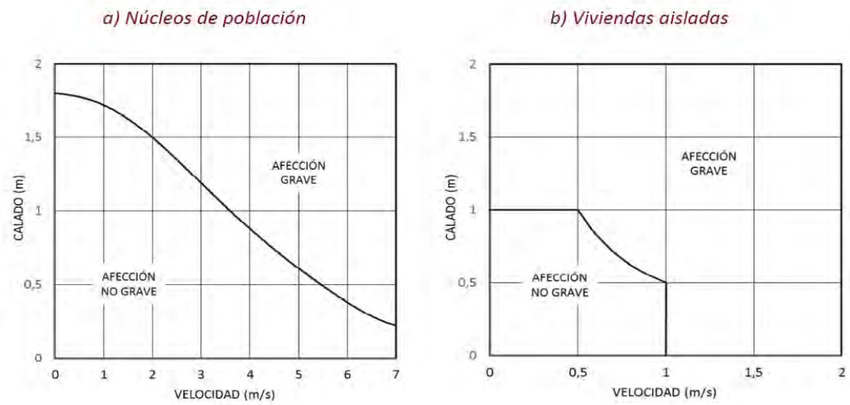
Se evaluarán los daños potenciales para cada uno de los citados grupos, correspondiendo la categoría de la presa a la categoría máxima asignada a cada uno de los aspectos individuales, sin estudiar posibles combinaciones de ellos.

#### 6.2.3.1 AFECCIÓN POTENCIAL A LAS VIDAS HUMANAS

De acuerdo con lo expuesto en la guía técnica se define el riesgo potencial para las vidas humanas en función de la población en riesgo a lo largo de la avenida. La guía expone tres definiciones correspondientes con cada una de las categorías de clasificación:

| CATEGORÍA | DEFINICIÓN RIESGO |
|---|---|
| A | Se asignará la categoría A cuando se produzca "afección grave" a más de cinco viviendas |
| B | Se asignará la categoría B cuando se produzca "afección grave" a un número comprendido entre una y cinco viviendas. |
| C | El calificativo de incidental -asociado a la clasificación en la categoría C- se aplicará a la presencia ocasional, y no previsible en el tiempo, de personas en la llanura de inundación. No podrá admitirse la clasificación como incidental de las potenciales pérdidas de vidas humanas asociadas a la afección a residencias establecidas permanentes, áreas de acampada estables, zonas en que habitualmente se produzcan concentraciones de personas por cualquier motivo, etc. |

La categoría de afección grave o no grave se aplicará en función de los parámetros de calado y velocidad recogidos en la "Figura 1. Evaluación de la gravedad de las afecciones en núcleos de población y en viviendas aisladas" de la mencionada guía




Una vez analizado con detalle las posibles edificaciones habitables, y habiendo comprobado que en la trayectoria del flujo del agua procedente de la balsa no se encuentra con ninguna vivienda, y a su vez, con ninguna zona de acampada estable o zona en la que se produzcan aglomeraciones de personas de manera habitual, se puede determinar que **solo podría causar pérdida de vidas humanas de manera incidental.**

#### 6.2.3.2 AFECCIÓN A SERVICIOS ESENCIALES

Se entenderán como tales aquéllos que son indispensables para el desarrollo de las actividades humanas y económicas de conjuntos de población mayores de 10.000 habitantes, y siempre que el servicio que brinden no pueda restablecerse de manera inmediata ni prestarse de forma alternativa. Entre los posibles servicios esenciales se incluyen, al menos, los siguientes:

- Abastecimiento y saneamiento.
- Suministro de energía.
- Sistema sanitario.
- Sistema de comunicaciones.
- Sistema de transporte

La guía expone la siguiente clasificación, en función de las afecciones a servicios senciales:

| CATEGORÍA | DEFINICIÓN RIESGO |
|---|---|
| A | La "afección grave" a un servicio esencial dará lugar a la clasificación en la categoría A. |
| NO A | No se producen "afecciones graves" a servicios esenciales |

La asignación del calificativo "grave" se efectuará en función del calado y la velocidad de la onda de rotura en el punto de afección, de acuerdo al criterio recogido en la "Figura 2. Evaluación de la gravedad de las afecciones del tipo servicios esenciales, daños materiales, aspectos medioambientales, histórico-artísticos o culturales u otros". Dicha figura Corresponde con la ya presentada anteriormente para las afecciones sobre viviendas aisaldas (Art. 9.2 del RDPH.)

El Canal de Monegros no se considera como servicio esencial debido a que su mal funcionamiento no afectaría a poblaciones mayores de 10.000 habitantes. Para realizar este análisis se realiza un estudio de las poblaciones situadas aguas abajo constatando que, de la suma de las 17 poblaciones que se verían afectadas, apenas se alcanzarían los 6.500 habitantes. A continuación, se presenta la relación de los habitantes por población:

| Población | Habitantes |
|---|---|
| Bujaraloz | 1.005 |
| La Almolda | 567 |
| Pallaruelo | 105 |
| Cartuja de Monegros | 259 |
| Lanaja | 1.202 |
| Robres | 541 |
| Senés de Alcubierre | 41 |
| Frula | 309 |
| Torralba de Aragón | 103 |
| Valfonda de Santa Ana | 215 |
| Torres de Barbués | 266 |
| Almuniente | 471 |
| Montesusín | 241 |
| Algayón | 239 |
| Orillena | 205 |
| San juan de flumen | 343 |
| Cantalobos | 101 |
| **Totales** | **6.213** |

La población de Sariñena no se incluye en el listado anterior al no abastecerse desde el canal de Monegros. Su abastecimiento natural corresponde a la captación ubicada en la Acequia de Valdera y, en caso de mal funcionamiento, desde el Canal del Flumen.

Por todo lo anterior, respecto a las afecciones sobre servicios esenciales, la avenida **NO produce afecciones graves a ningún servicio esencial a lo largo de su recorrido.**

#### 6.2.3.3 DAÑOS MATERIALES

Se entenderán como daños materiales aquéllos cuantificables directamente en términos económicos, sean directos (destrucción de elementos) o indirectos (reducción de la producción u otros).

Los daños materiales se evaluarán en función de los siguientes grupos:

- Daños a industrias y polígonos industriales.
- Daños a propiedades rústicas.
- Daños a cultivos.
- Daños a infraestructuras.

La guía expone tres definiciones correspondientes con cada una de las categorías de clasificación:

| CATEGORÍA | DEFINICIÓN RIESGO |
|---|---|
| A | tendrán la consideración de daños muy importantes -clasificación en la categoría A- la afección grave a más de 50 instalaciones/propiedades, a más de 5.000 ha de regadío, a más de 10.000 ha de secano, a carreteras de la Red de Carreteras del Estado, a carreteras autonómicas de primer nivel, o a ferrocarriles de vía ancha o de alta velocidad. |
| B | Tendrán la consideración de daños importantes -clasificación en la categoría B- la afección grave a más de 10 instalaciones/propiedades, a más de 1.000 ha de regadío, a más de 3.000 ha de secano, a carreteras autonómicas de segundo o tercer nivel, o a ferrocarriles de vía estrecha. |
| C | Los daños materiales que no rebasen estos últimos umbrales tendrán la consideración de moderados -clasificación en la categoría C-. |

La asignación del calificativo "grave" se efectuará en función del calado y la velocidad de la onda de rotura en el punto de afección, de acuerdo al criterio recogido en la "Figura 2. Evaluación de la gravedad de las afecciones del tipo servicios esenciales, daños materiales, aspectos medioambientales, histórico-artísticos o culturales u otros". Dicha figura Corresponde con la ya presentada anteriormente para las afecciones sobre viviendas aisaldas (Art. 9.2 del RDPH.)

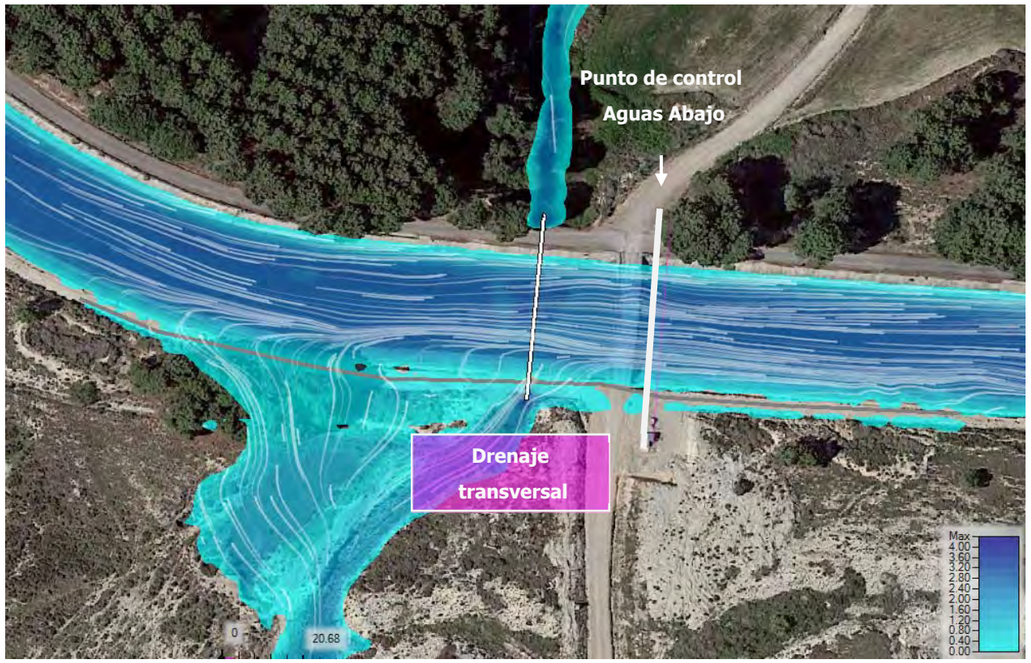
La llanura de inundación afecta a una superficie inferiror 1.000 hectáreas por lo que los daños materiales son de carácter moderado.

La llanura de inundación no afecta a ninguna propiedad rústica, por lo que el daño se considera nulo.

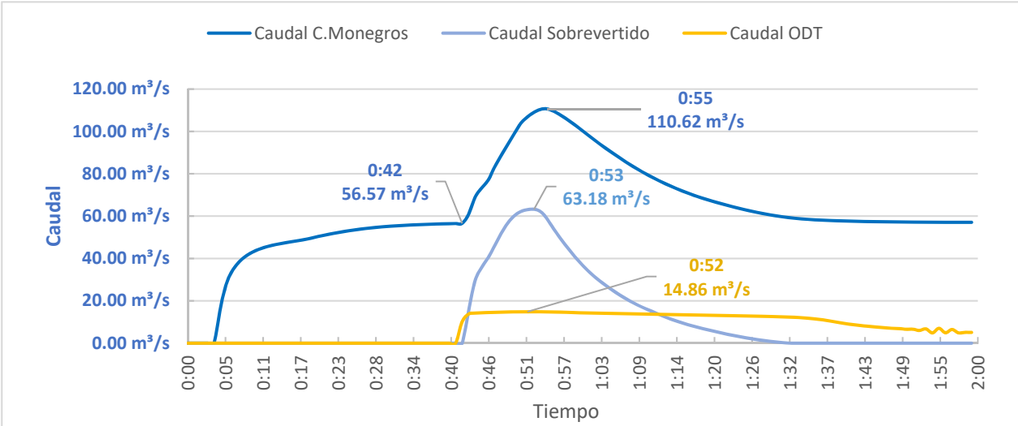
En relación a las infraestructuras, las únicas que se ven afectadas son el canal de Monegros y la carretera A-1211. Ambas se analizan a continuación:

<u>CANAL DE MONEGROS:</u>

Se exponen los datos correspondientes a la interacción de la avenida con el drenaje transversal del Canal de Monegros y su posterior vertido sobre este, con el fin de justificar que dicha infraestructura es capaz de gestionar las avenidas que provocaría la hipótesis de rotura y que, por lo tanto, no se producirían afecciones. Para ello se establece, además del punto de control propio del drenaje transversal, un punto aguas abajo del canal con el fin de conocer los caudales que circulan por el mismo.

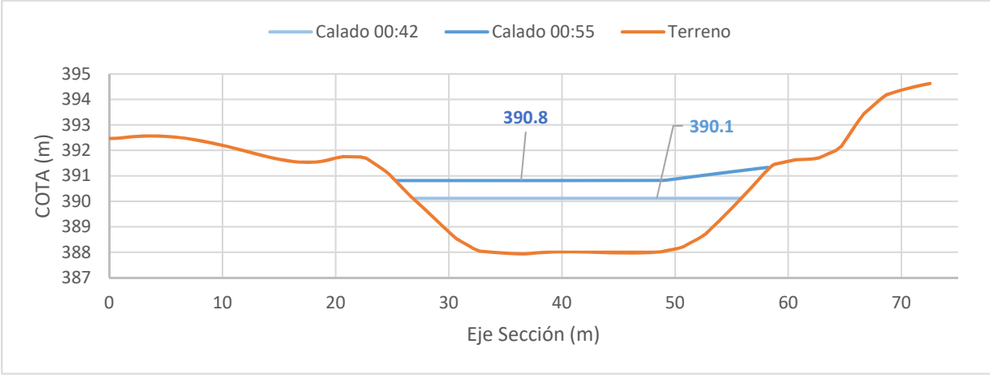


En el siguiente gráfico se representan los datos obetenidos de la simulación:




Como se puede apreciar en el anterior gráfico, el caudal circulante a través del drenaje transversal corresponde con su capacidad máxima (14,78 m$^3$/s) dado que no es capaz de absorber toda la onda procedente de la avenida. La diferencia entre el caudal circulante por el drenaje transversal, y el caudal de la avenida, se vierte sobre el Canal de Monegros (63,28 m$^3$/s). Este hecho se puede comprobar en los crecimientos de caudal observados en el punto de control representado inmediatamente aguas abajo. En los primeros instantes circula un caudal mayor a 57 m$^3$/s hasta el minuto 42 correspondientes con el caudal circulante por el canal de Monegros en la campaña de riego. En el momento que se produce el sobrevertido aumenta hasta el minuto 55 hasta alcanzar los 113,07 m$^3$/s.

En la siguiente gráfica adjunta se aprecia que la avenida supondría un aumento del calado del canal de 0,7 metros cuando, sobre este, circulará el caudal habitual para una campaña de riego valorado en 57 m$^3$/s. En los planos Adjuntos donde se refleja la simulación se constata que dicho aumento no supondría un desbordamiento del canal y no se producirían afecciones.




Por todo lo anterior, se determina que la avenida no supondría un impacto significativo sobre el Canal de Monegros.

Se analiza de la misma forma las afecciones sobre el camino de servicio del Canal de Monegros que se vería afectado debido a los mencionados desbordamientos. Se producen unas afecciones cuya categoría se califica como grave dentro de la guía técnica 0,17 m de calado y 1,36 m/s de velocidad. Sin embargo, al tratarse en el punto de daños materiales puesto que no se podría tener en cuenta como un servicio esencial, los daños serían moderados al únicamente encontrarse dicha afección grave.

CARRETERA AUTONÓMICA A-1211:

Respecto a la carretera Autonómica de tercer orden denominada A-1211, se producen ciertas afecciones cuya gravedad se tipifican según la guía técnica como moderadas. Sobre esta se producen leves desbordamietos como se puede apreciar en los planos del apéndice 3 alcanzando unos valores máximos de 0,13 m de calado y 0,45 m/s de velocidad. Estos valores también pueden ser consultados en el apéndice 4 correspondiente a la tabla de afecciones.

Por todo lo anterior, y dado que únicamente se afecta de manera grave el camino de servicio del Canal de Monegros, los daños materiales serían de carácter moderado.

#### 6.2.3.4 DAÑOS MEDIOAMBIENTALES, HISTÓRICO-ARTÍSTICOS O CULTURALES.

Se entenderán como daños medioambientales o al patrimonio histórico-artístico o cultural, las afecciones "graves" sobre los elementos o territorios que gocen de alguna figura legal de protección a nivel estatal (Red Natura 2000, Parques Nacionales, Bienes de Interés Cultural u otros) o autonómico (Parques Naturales, Parques Regionales u otros). De esta manera, la guía expone tres definiciones correspondientes con cada una de las categorías de clasificación:

| CATEGORÍA | DEFINICIÓN RIESGO |
|---|---|
| A | Tendrán la consideración de daños muy importantes -clasificación en la categoría A- la afección "grave" a elementos con figuras de protección a nivel estatal. |
| B | Tendrán la consideración de daños importantes -clasificación en la categoría B- la afección "grave" a elementos catalogados a nivel autonómico. |
| C | Los daños materiales que no rebasen estos últimos umbrales tendrán la consideración de moderados -clasificación en la categoría C-. |

La asignación del calificativo "grave" se efectuará en función del calado y la velocidad de la onda de rotura cuando se se supere el umbral representando en "Figura 2. Evaluación de la gravedad de las afecciones del tipo servicios esenciales, daños materiales, aspectos medioambientales, histórico-artísticos o culturales u otros" en una superficie superior a 1.000 ha. Dicha figura corresponde con la ya presentada anteriormente para las afecciones sobre viviendas aisaldas (Art. 9.2 del RDPH)

Han sido consultadas los bienes de interés cultural de la zona se ha podido comprobar que no existe una zona de afección sobre el mismo a lo largo de la avenida.

De la misma manera, han sido consultadas las zonas protegidas medioambientalmente y se ha podido comprobar que no existe ninguna zona protegida. Las afeciones catalogadas como graves son mínimas y no se supera en ningún caso las 1.000 ha.

No se producen afecciones de carácter general superiores a las 1.000 ha por lo que no se producirá una afección de caracter grave en ningún caso.

### 6.3 PLANOS DEL ANÁLISIS DE LA AVENIDA

En el apéndice 3. Planos del análisis de la avenida que se adjunta con el presente informe, se incluyen los siguientes planos con el objeto de complementar la descripción de las afecciones:

- Plano de calados de la avenida.
- Plano de velocidades de la avenida.

## 7 PROPUESTA DE CLASIFICACIÓN

A continuación, se recoge el cuadro resumen sobre las afecciones descritas con anterioridad:

| AFECCIONES | | CUANTIFICACIÓN | VALORACIÓN | CATEGORÍA |
|---|---|---|---|---|
| Riesgo potencial a vidas humanas. (Nº viviendas) | | 0 | INCIDENTAL | C |
| Afecciones a servicios esenciales | | 0 | NO GRAVE | NO es A |
| Daños materiales | Industrias, polígonos industriales y propiedades rusticas | 1 camino de servicio del Canal de Monegros | MODERADA | C |
| | Superficie de cultivo | < 1.000 ha | MODERADA | C |
| | Carreteras | 1 | MODERADA | C |
| | Ferrocarriles | 0 | NULA | C |
| Daños medioambientales | Patrimonio (Nº BICs) | 0 | NULA | C |
| | Medioambiente (Nº figuras protegidas ) | 1 | NO GRAVE | C |

Por los mencionados criterios mencionados en los apartados desarrollados con anterioridad de acuerdo con la guía técnica para la clasificación de presas en fnción del riesgo potencial, se extraen las siguientes conclusiones.

- En cuanto a la afección potencial a las vidas humanas existe exclusivamente un riesgo incidental.
- No se producen afecciones graves sobre servicios esenciales.
- Los daños materiales son de carácter moderado.
- Los daños medioambientales son de carácter moderado y reversible.

Atendiendo a lo expuesto anteriormente, se puede concretar que queda suficientemente justificada la clasificación propuesta para la balsa estudiada de **Categoría C**, pues se cumplen con las condiciones exigibles para esta categoría.

Torralba de Aragón, diciembre de 2022

Por CINGRAL, S.L Empresa Consultora

D. Javier Mur Satué

Colegiado Nº 25.555 del Colegio Oficial de Ingenieros Técnicos de Obras Públicas

# APÉNDICE 1.- REPORTAJE FOTOGRÁFICO

# ÍNDICE

## APÉNDICE 1.- REPORTAJE FOTOGRÁFICO

**1 INTRODUCCIÓN Y OBJETO DEL PRESENTE APÉNDICE ..... 1**

**2 FOTOGRAFÍAS DE LA ZONA DE ESTUDIO. ..... 1**

# APÉNDICE 1.- REPORTAJE FOTOGRÁFICO

## 1 INTRODUCCIÓN Y OBJETO DEL PRESENTE APÉNDICE

En este apéndice se documentan de forma gráfica las características actuales de algunas de las infraestructuras o edificaciones existentes en la zona y que, de una u otra forma, pudieran verse afectadas por la avenida considerada en la hipótesis de rotura analizada en esta Propuesta de Clasificación.

Las fotografías han sido tomadas a lo largo de las distintas visitas realizadas al entorno de la zona de actuación.

## 2 FOTOGRAFÍAS DE LA ZONA DE ESTUDIO.

**ODT 1. Drenaje transversal Canal Monegros**

**ODT 2. Drenaje transversal camino rural**

**ODT 3. Drenaje transversal camino rural**

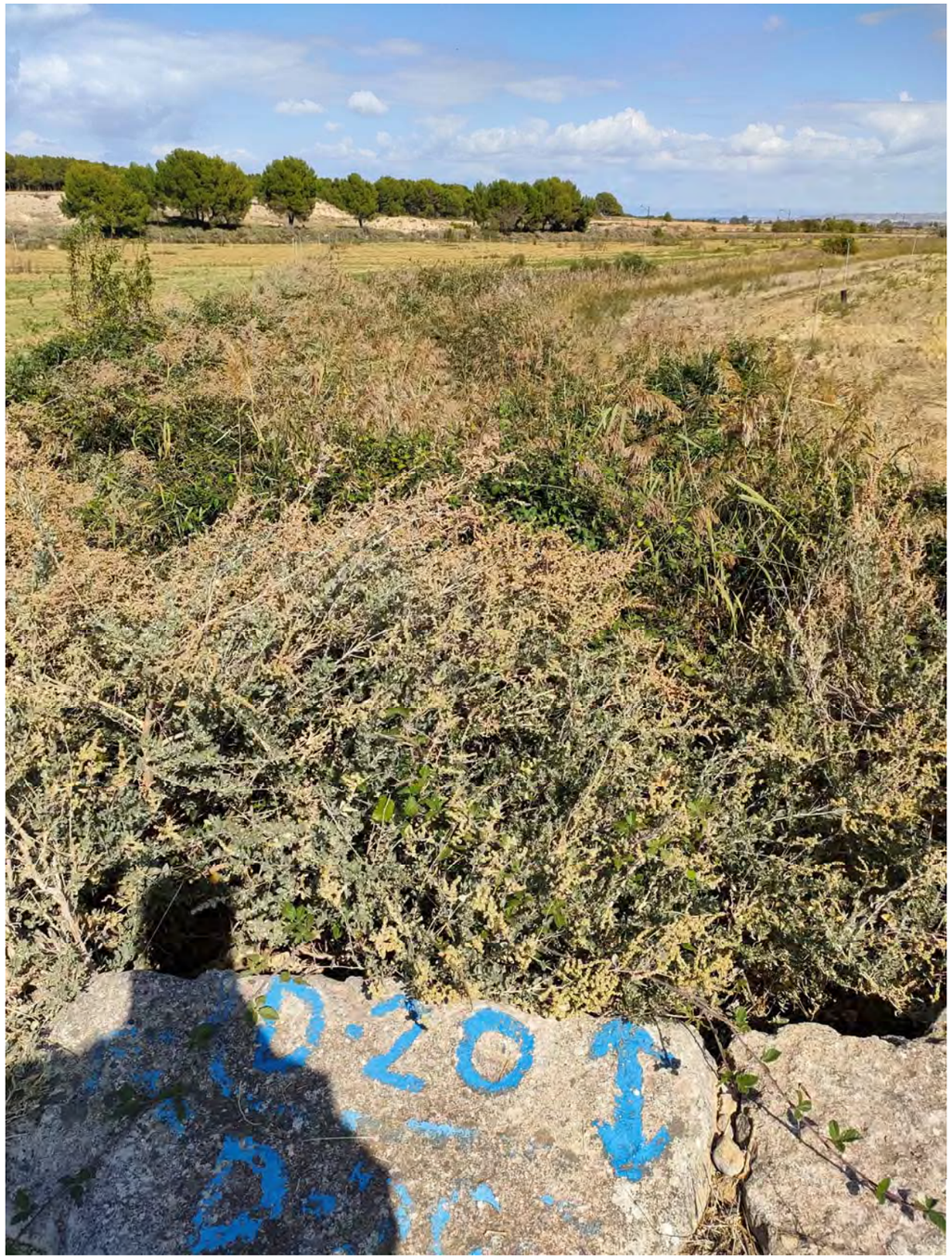
**ODT 4. Drenaje transversal A-1211**

**ODT 5. Drenaje transversal camino rural**

**ODT 6. Drenaje transversal CHE-1407**

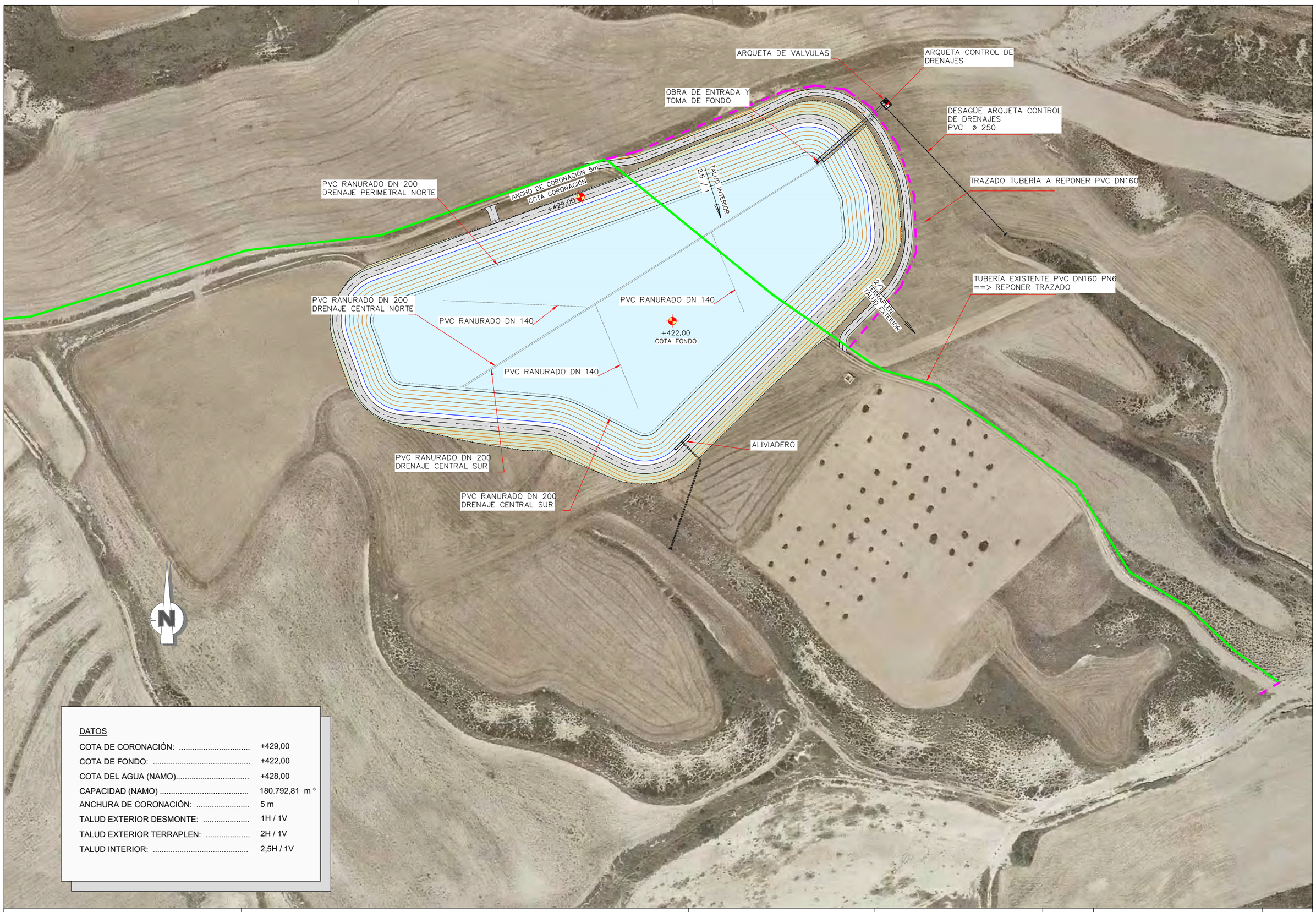
**ODT 7. Drenaje transversal camino rural**

**ODT 8. Drenaje transversal CHE-1433**




**ODT 9. Drenaje transversal línea férrea**

# APÉNDICE 2.- PLANOS: CARACTERÍSTICAS CONSTRUCTIVAS




DATOS

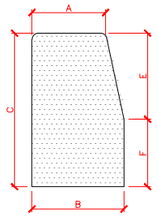
| | |
|---|---|
| COTA DE CORONACIÓN: ..... | +429,00 |
| COTA DE FONDO: ..... | +422,00 |
| COTA DEL AGUA (NAMO)..... | +428,00 |
| CAPACIDAD (NAMO) ..... | 180.792,81 m ³ |
| ANCHURA DE CORONACIÓN: ..... | 5 m |
| TALUD EXTERIOR DESMONTE: ..... | 1H / 1V |
| TALUD EXTERIOR TERRAPLEN: ..... | 2H / 1V |
| TALUD INTERIOR: ..... | 2,5H / 1V |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORIA DE INGENIERÍA | 1 : 2.000<br>0 10 20 30 40 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>PLANTA GENERAL | 09.01<br>Nº DE HOJA: 1 de 1 |

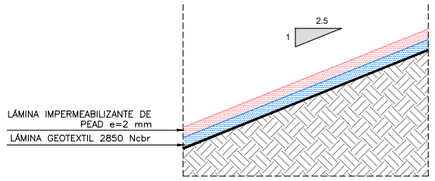
## BORDILLO T
ESCALA 1/10

| TIPO | A | B | C | D | E | F | Kg/ml |
|---|---|---|---|---|---|---|---|
| T2 | 12 | 15 | 25 | 100 | 14 | 11 | 85 |
| T3 | 14 | 17 | 28 | 100 | 14 | 14 | 117 |

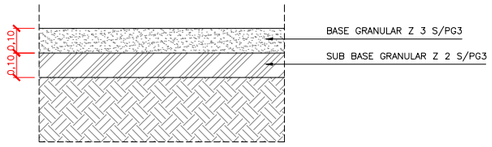
D= LONGITUD



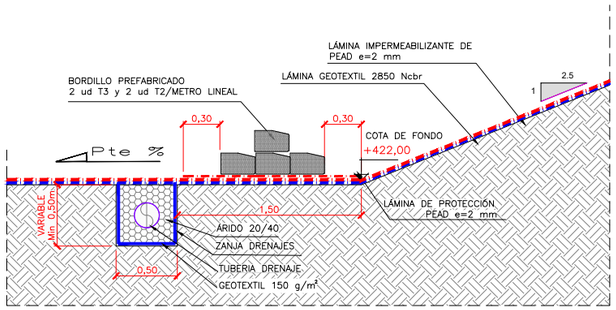

## DETALLE DE LAS LÁMINAS
SIN ESCALA



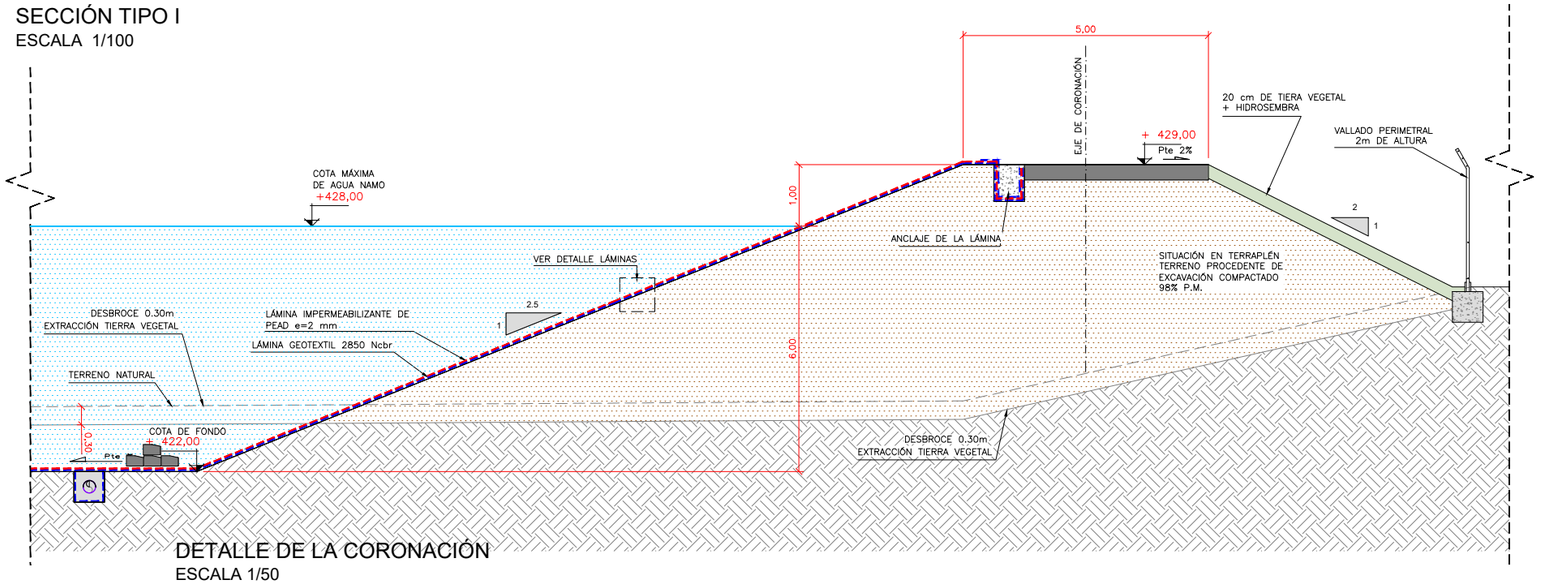

## DETALLE DEL FIRME
SIN ESCALA



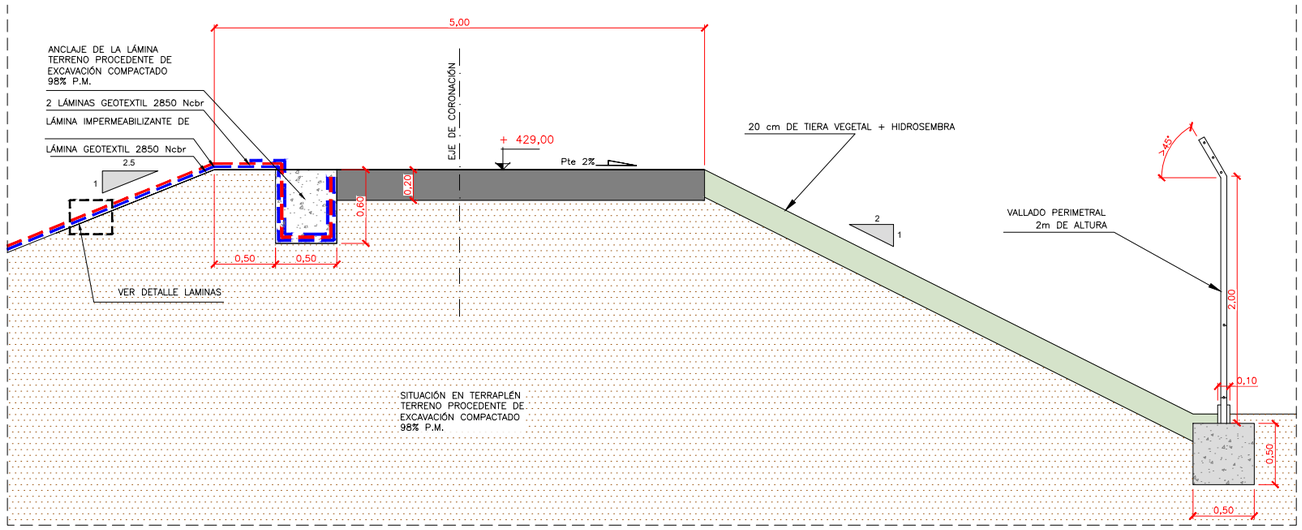

## DETALLE ANCLAJE DE LA LÁMINA
ESCALA 1/50



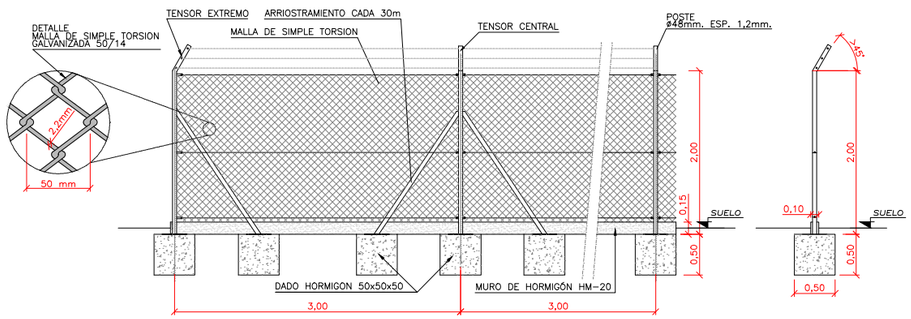

## SECCIÓN TIPO I
ESCALA 1/100




## DETALLE DE LA CORONACIÓN
ESCALA 1/50

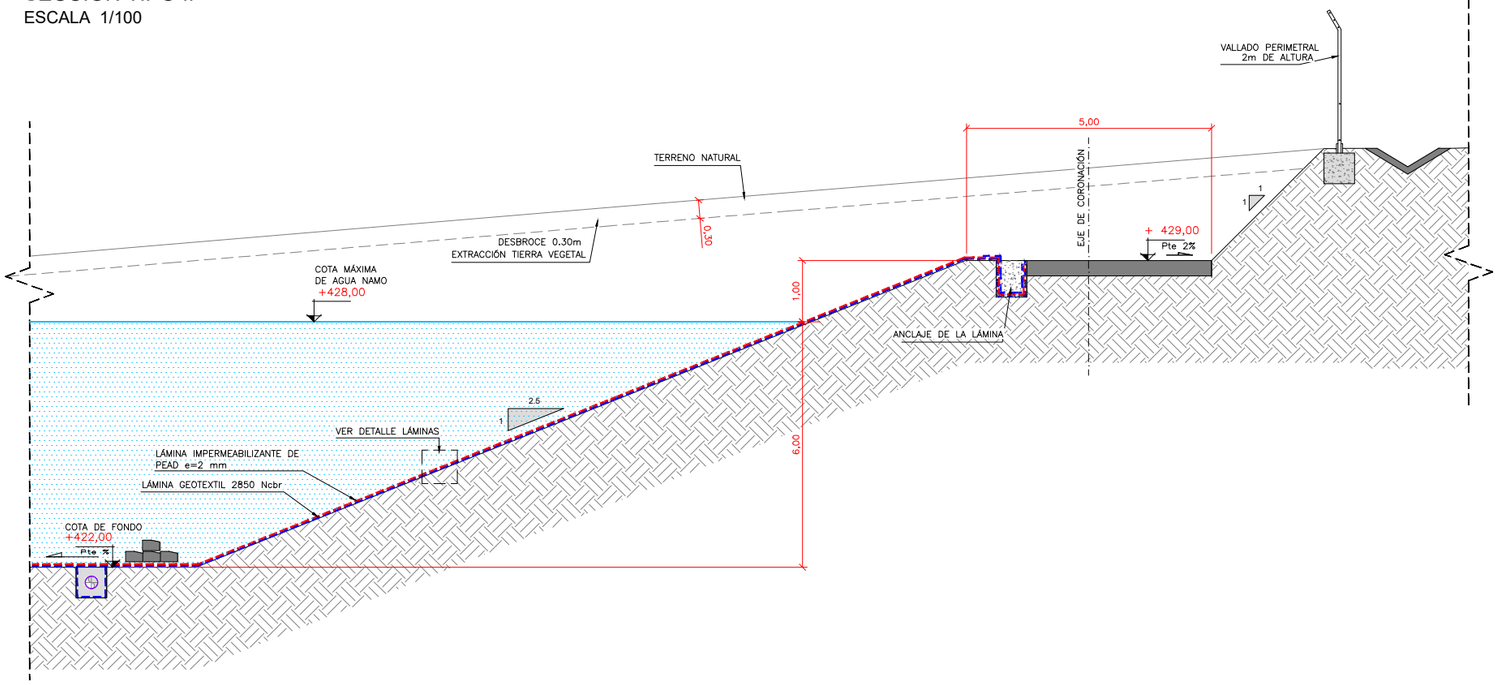



## VALLADO PERIMETRAL
ALZADO
ESCALA 1/75

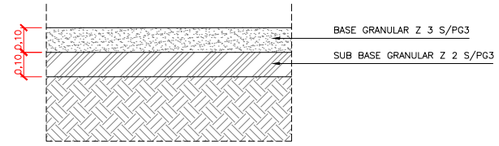



| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO AGRÓNOMO | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORIA DE INGENIERÍA | INDICADAS<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>SECCIONES TIPO<br>SECCION TIPO I | 09.07<br>Nº DE HOJA: 1 de 2 |

## SECCIÓN TIPO II
ESCALA 1/100



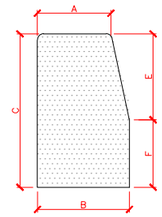

## DETALLE DEL FIRME
SIN ESCALA



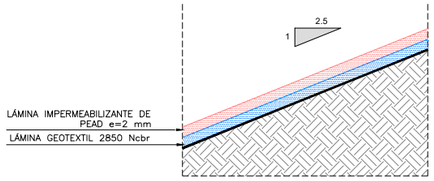

## BORDILLO T
ESCALA 1/10

| TIPO | A | B | C | D | E | F | Kg/ml |
|---|---|---|---|---|---|---|---|
| T2 | 12 | 15 | 25 | 100 | 14 | 11 | 85 |
| T3 | 14 | 17 | 28 | 100 | 14 | 14 | 117 |

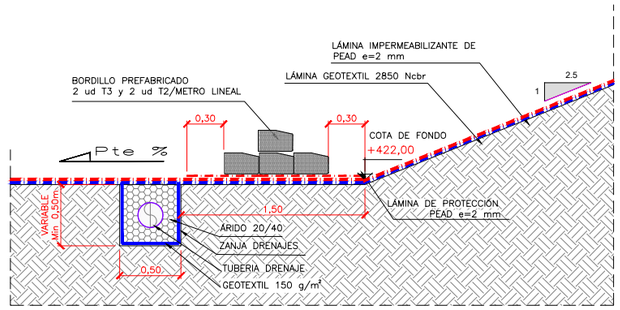
D= LONGITUD



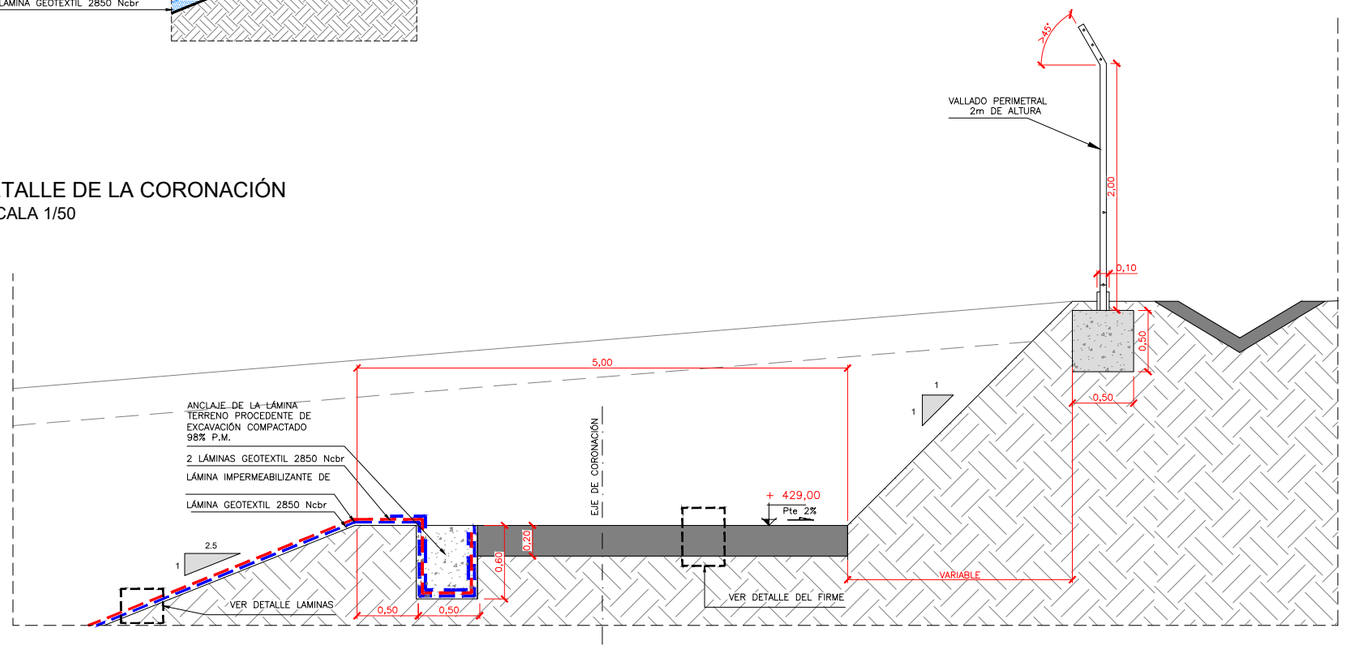

## DETALLE DE LAS LÁMINAS
SIN ESCALA



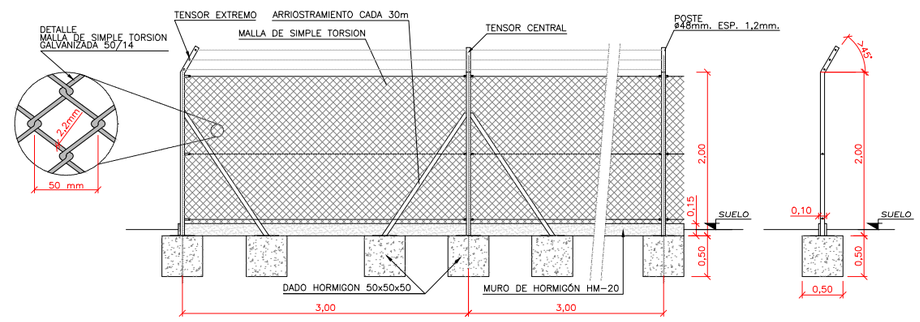

## DETALLE ANCLAJE DE LA LÁMINA
ESCALA 1/50



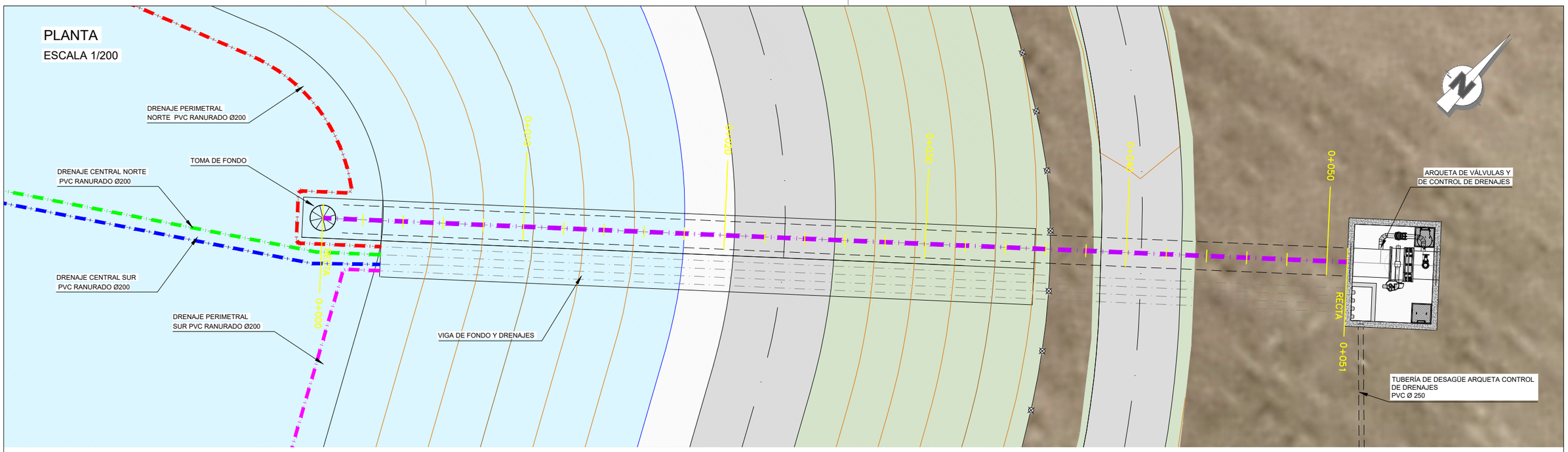

## DETALLE DE LA CORONACIÓN
ESCALA 1/50




## VALLADO PERIMETRAL
ALZADO
ESCALA 1/75

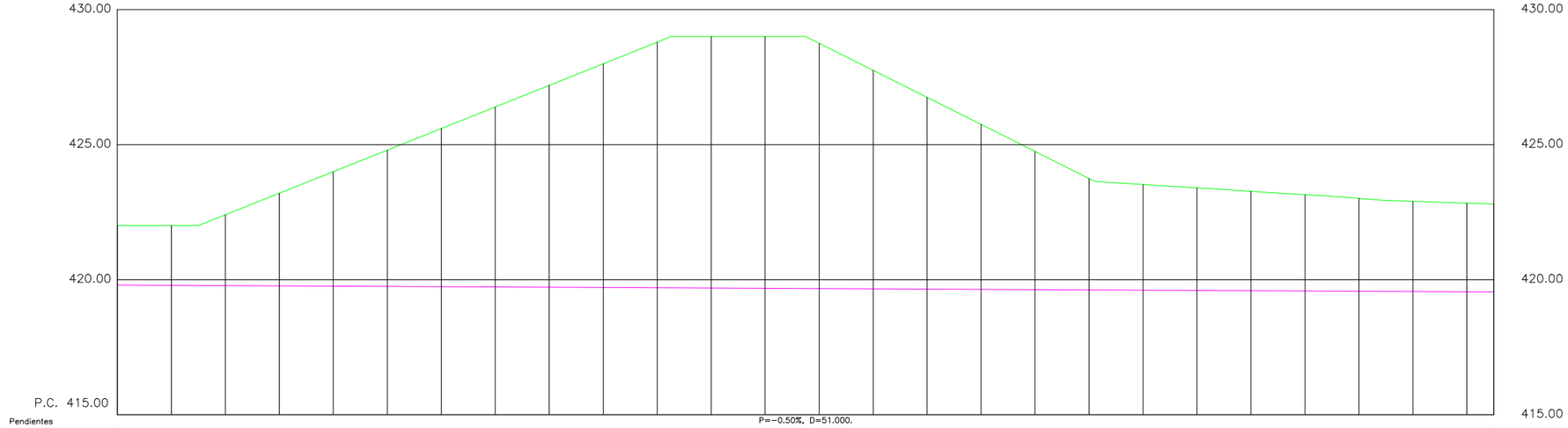



| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORA DE INGENIERÍA | INDICADAS<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>SECCIONES TIPO<br>SECCION TIPO II | 09.07<br>Nº DE HOJA: 2 de 2 |




## PERFIL LONGITUDINAL

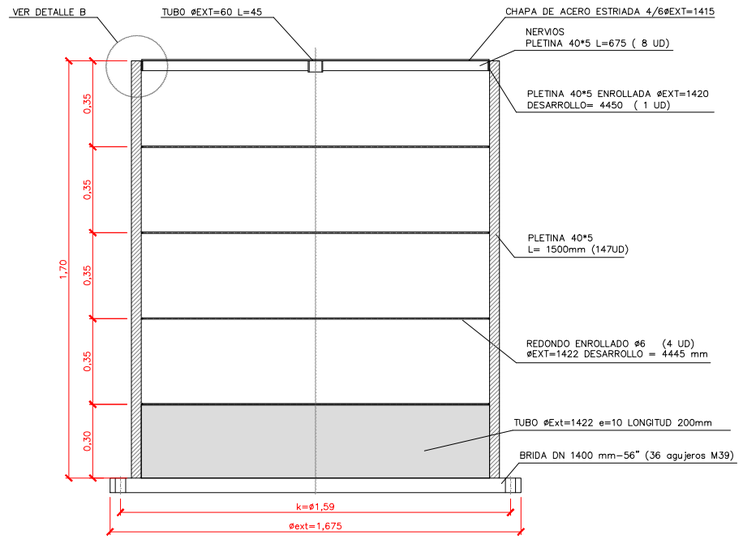
ESCALAS { HORIZONTAL = 200 / VERTICAL = 200




| | | |

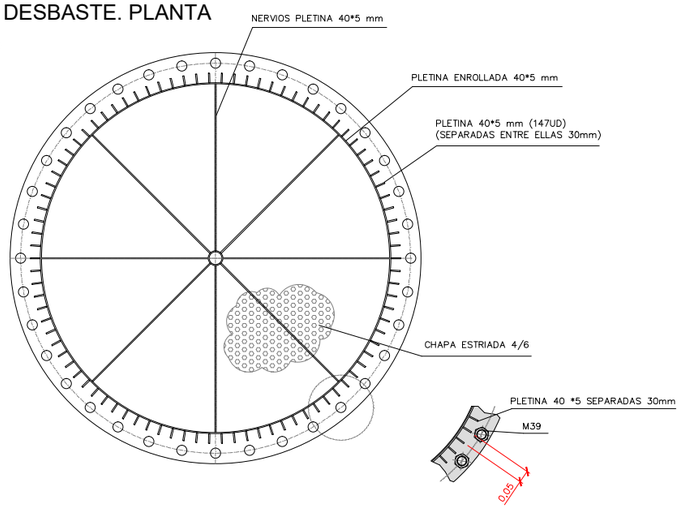
## JAULA DE DESBASTE. SECCIÓN

ESCALA 1/25



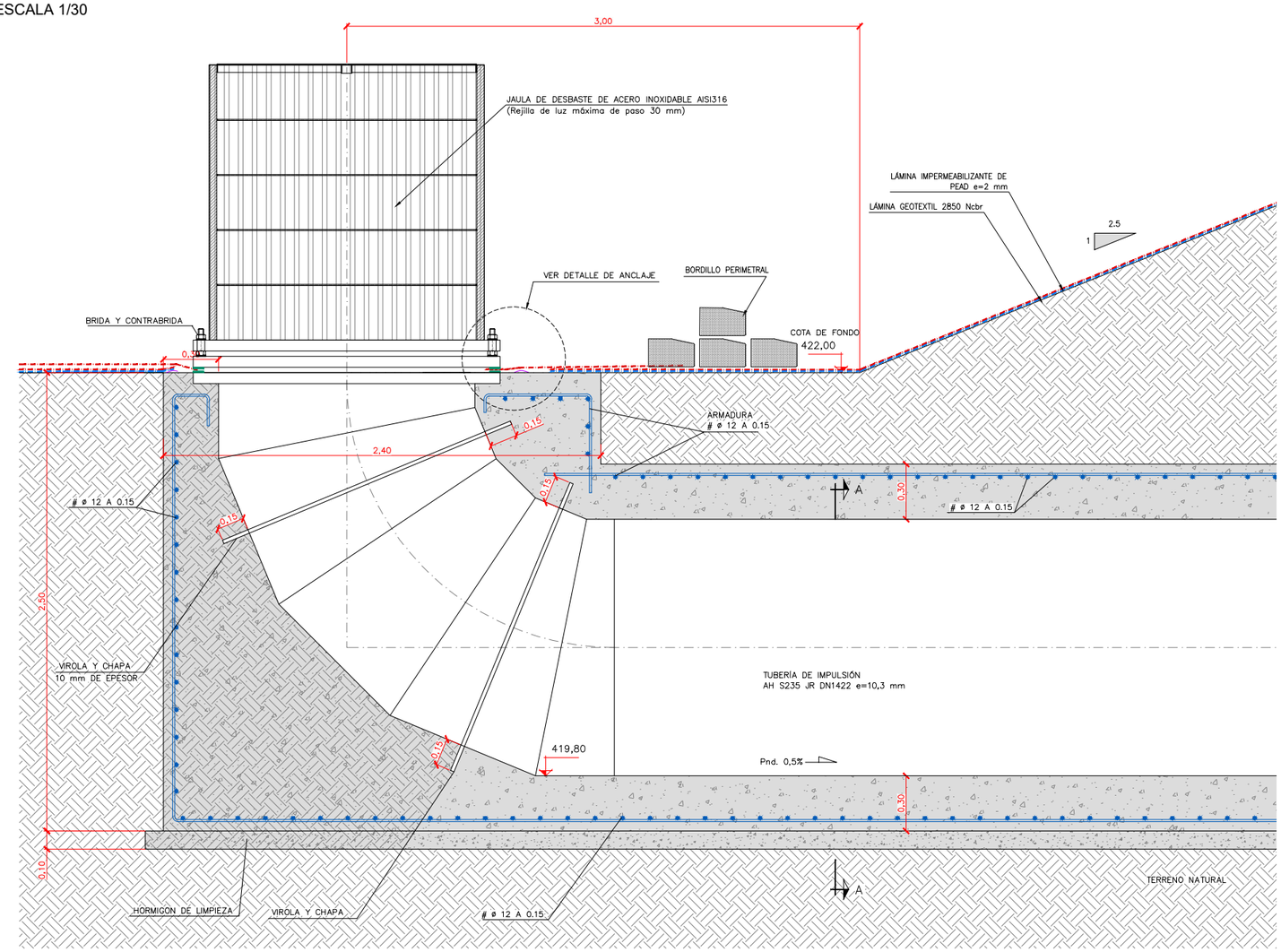

## JAULA DE DESBASTE. PLANTA

ESCALA 1/25



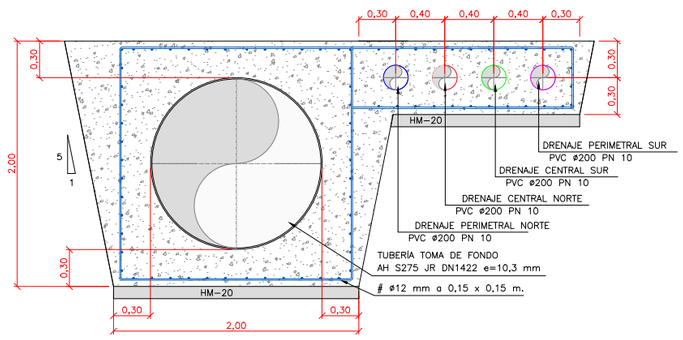

## DETALLE SECCIÓN TOMA DE FONDO

ESCALA 1/30



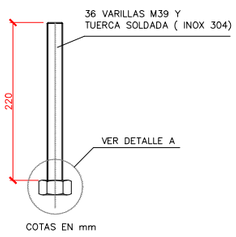

## VIGA DE FONDO. SECCIÓN AA

ESCALA 1/50



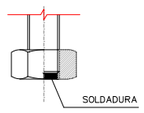

## DETALLE ESPERAS

SIN ESCALA



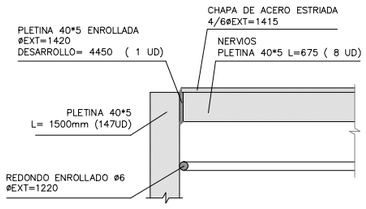

## DETALLE A

SIN ESCALA



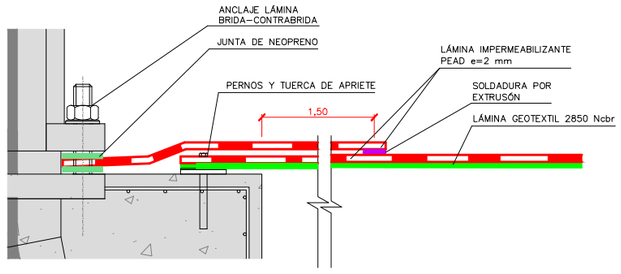

## DETALLE B

SIN ESCALA




## ANCLAJE DE LAMINAS. DETALLE

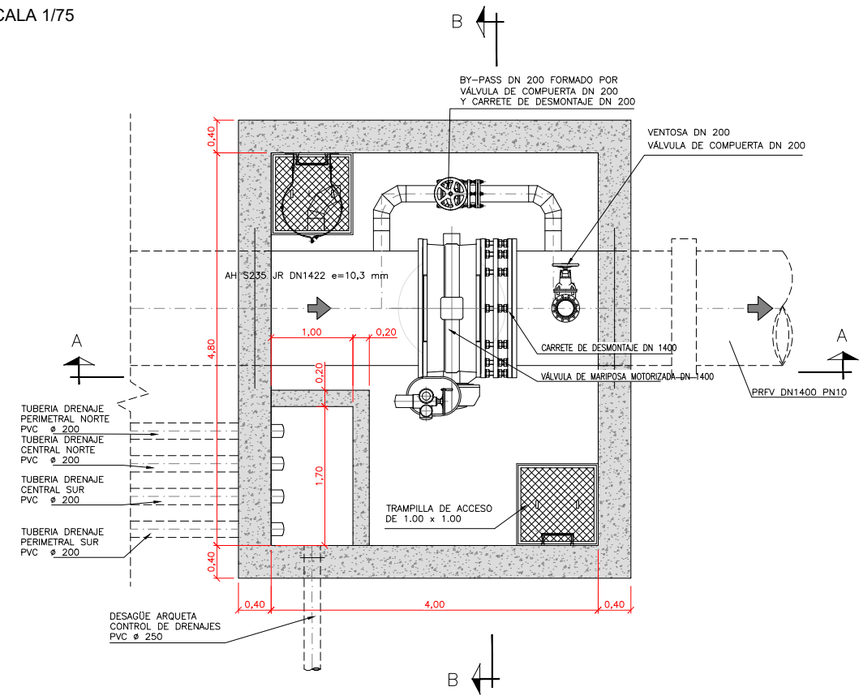
ESCALA 1/25




| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORA DE INGENIERÍA | INDICADAS<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>OBRA DE ENTRADA Y TOMA DE FONDO<br>DETALLES | 09.08<br>Nº DE HOJA: 2 de 3 |

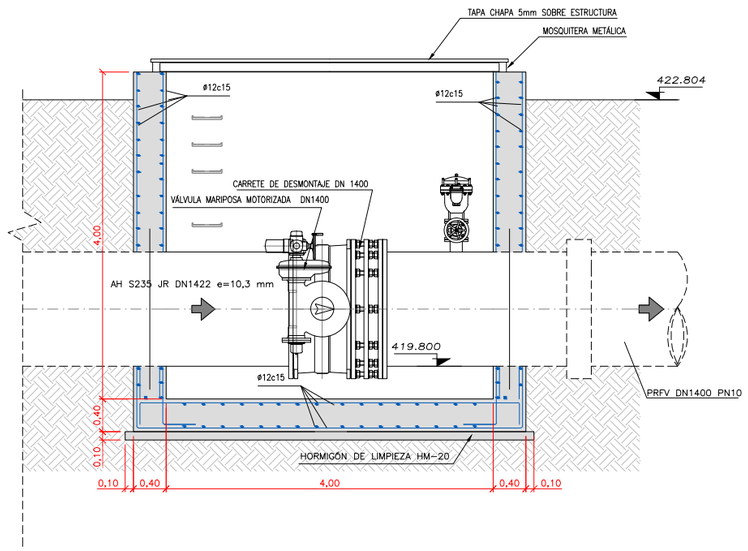
## ARQUETA DE VÁLVULAS. PLANTA

ESCALA 1/75



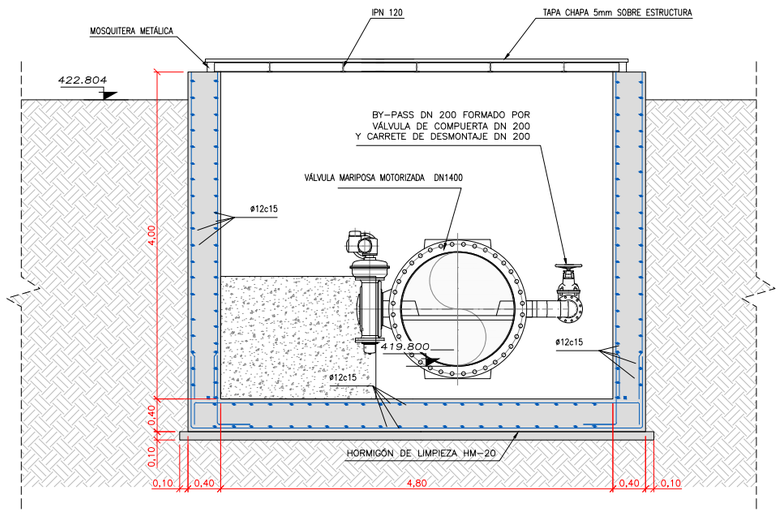

## ARQUETA DE VÁLVULAS. SECCIÓN AA

ESCALA 1/75



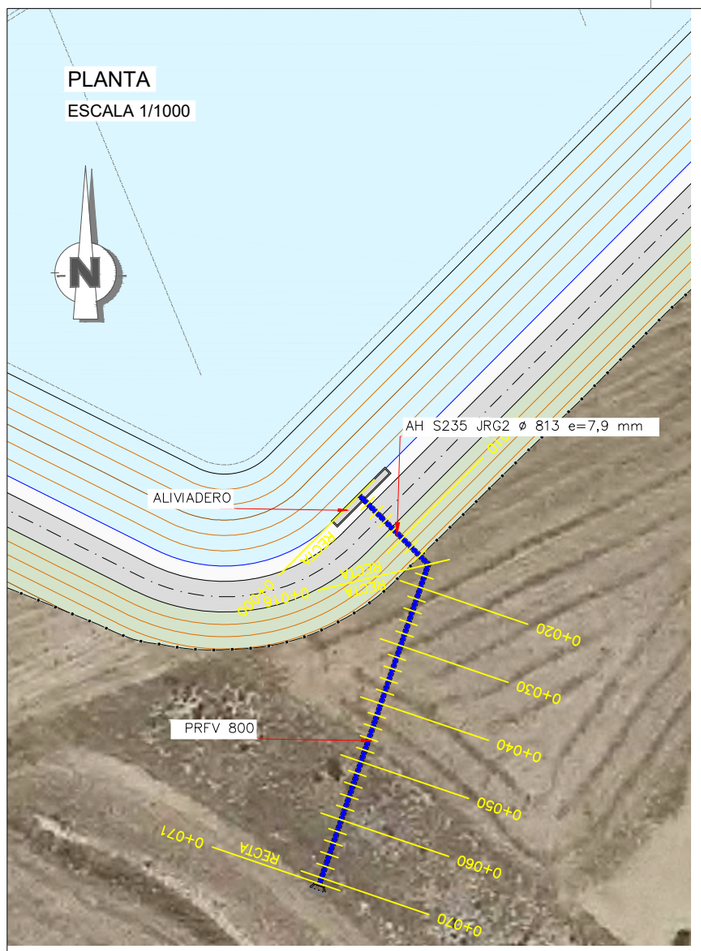

## ARQUETA DE VÁLVULAS. SECCIÓN BB

ESCALA 1/75

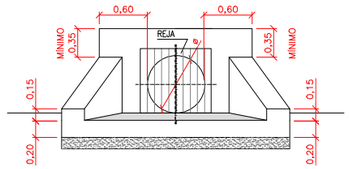



| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORIA DE INGENIERÍA | INDICADAS<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>OBRA DE ENTRADA Y TOMA DE FONDO<br>DETALLES | 09.08<br>Nº DE HOJA: 3 de 3 |

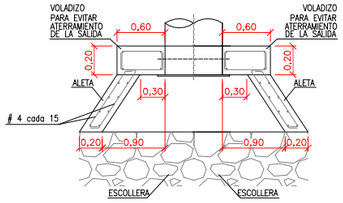
## PLANTA
ESCALA 1/1000



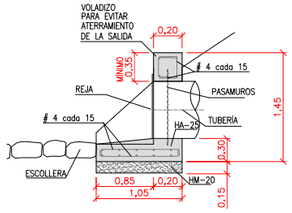

## OBRA DE SALIDA ALIVIADERO, ALZADO
ESCALA 1/75



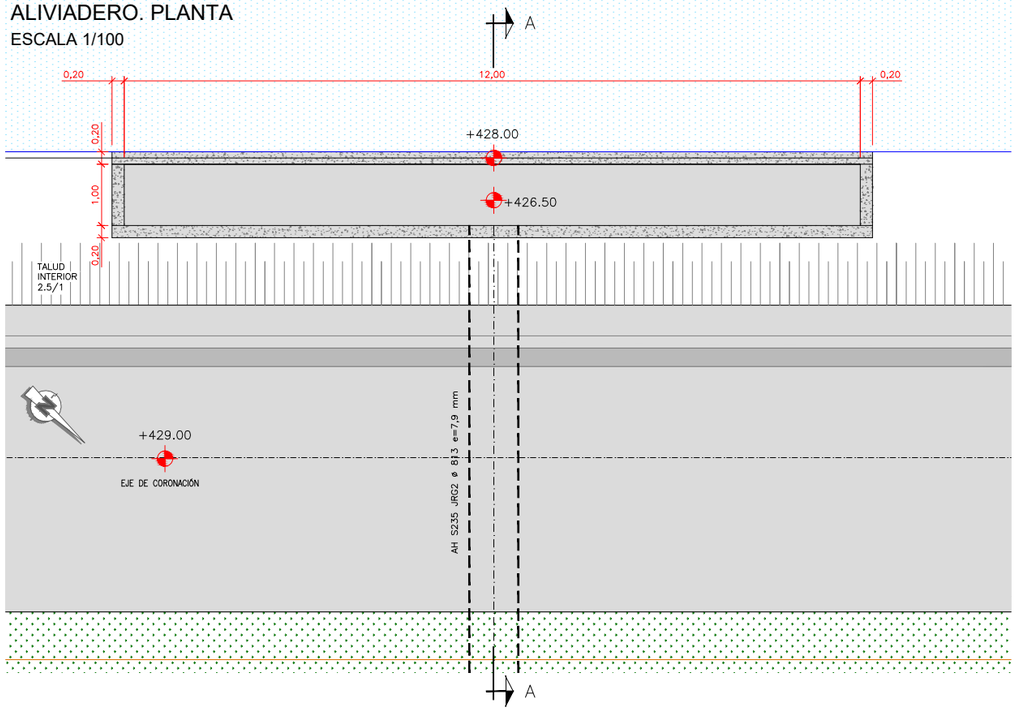

## OBRA DE SALIDA ALIVIADERO, PLANTA
ESCALA 1/75



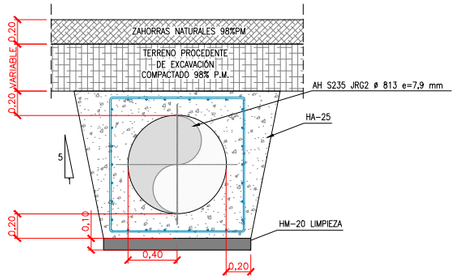

## OBRA DE SALIDA ALIVIADERO, SECCIÓN
ESCALA 1/75



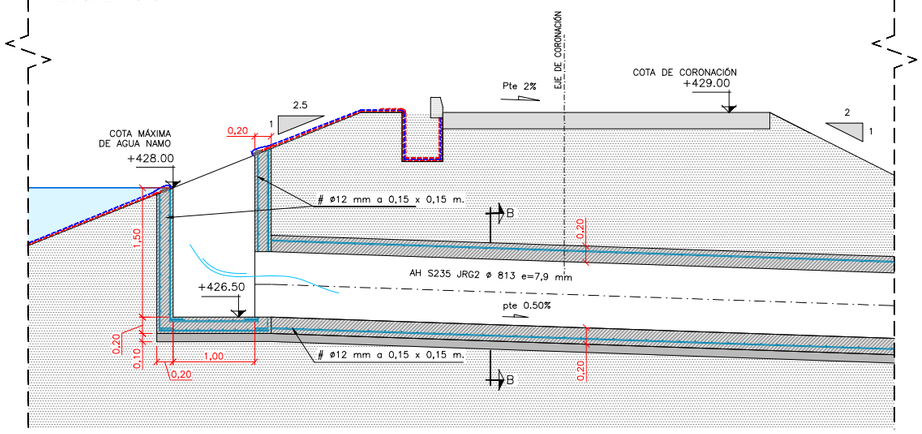

## ALIVIADERO. PLANTA
ESCALA 1/100




## SECCIÓN BB
ESCALA 1/50

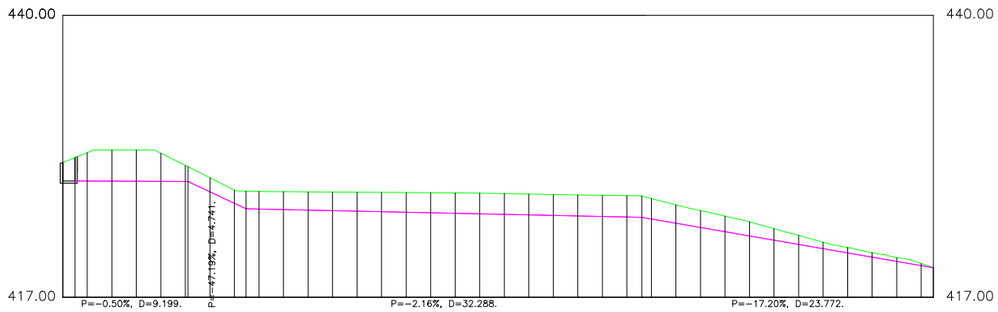



## ALIVIADERO. SECCIÓN AA
ESCALA 1/75




## PERFIL LONGITUDINAL

ESCALAS { HORIZONTAL = 500 / VERTICAL = 500



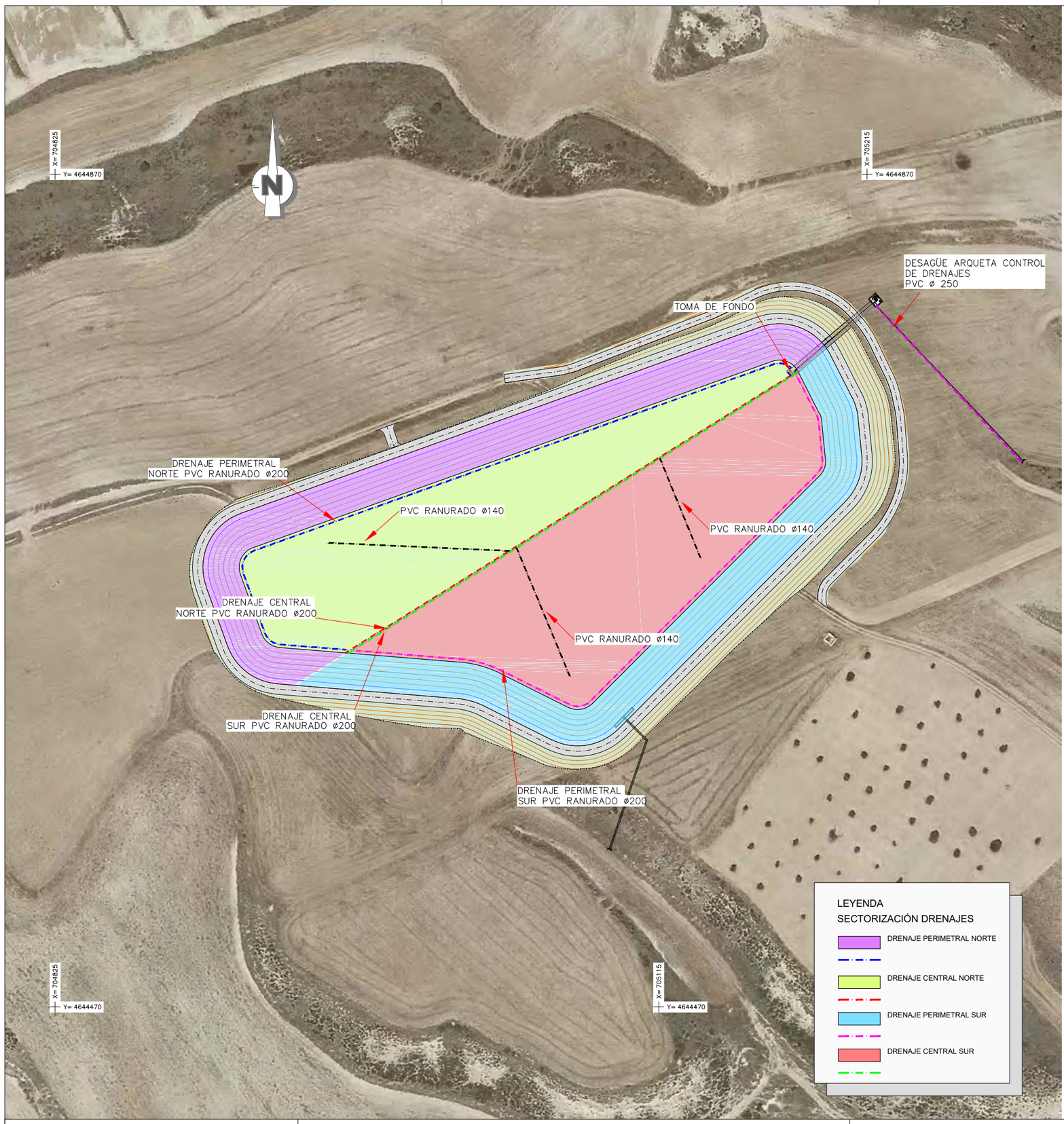

OBRA DE SALIDA

Pendientes: P=-0.50%, D=9.199. | P=-47.19%, D=4.741. | P=-2.16%, D=32.288. | P=-17.20%, D=23.772.

Tipo Tubería: AH S235 JRG2 ø 813 e=7,9 mm | PRFV 800

| Distancias a Origen | Cotas Rojas Desmonte | Cotas de Rasante | Cotas de Terreno | Distancias Parciales |
|---|---|---|---|---|
| 0.000 | 1.900 | 426.500 | 428.000 | 0.000 |
| 1.000 | 2.365 | 426.495 | 428.400 | 1.000 |
| 2.000 | 2.515 | 426.485 | 429.000 | 1.000 |
| 4.000 | 2.525 | 426.475 | 429.000 | 2.000 |
| 6.000 | 2.285 | 426.465 | 428.750 | 2.000 |
| 8.000 | 1.395 | 426.455 | 427.551 | 2.000 |
| 10.000 | 1.146 | 426.750 | 426.750 | 1.801 |
| 12.000 | 1.090 | 425.604 | 425.750 | 2.000 |
| 14.000 | 1.447 | 424.660 | 425.664 | 0.939 |
| 14.939 | 1.441 | 424.217 | 425.635 | 1.061 |
| 16.000 | 1.470 | 424.194 | 425.621 | 2.000 |
| 18.000 | 1.498 | 424.150 | 425.605 | 2.000 |
| 20.000 | 1.527 | 424.107 | 425.590 | 2.000 |
| 22.000 | 1.555 | 424.064 | 425.576 | 2.000 |
| 24.000 | 1.584 | 424.021 | 425.561 | 2.000 |
| 26.000 | 1.613 | 423.977 | 425.547 | 2.000 |
| 28.000 | 1.641 | 423.934 | 425.532 | 2.000 |
| 30.000 | 1.670 | 423.891 | 425.517 | 2.000 |
| 32.000 | 1.699 | 423.847 | 425.503 | 2.000 |
| 34.000 | 1.706 | 423.804 | 425.467 | 2.000 |
| 36.000 | 1.711 | 423.761 | 425.429 | 2.000 |
| 38.000 | 1.717 | 423.718 | 425.391 | 2.000 |
| 40.000 | 1.722 | 423.674 | 425.353 | 2.000 |
| 42.000 | 1.737 | 423.631 | 425.325 | 2.000 |
| 44.000 | 1.753 | 423.588 | 425.297 | 2.000 |
| 46.000 | 1.738 | 423.545 | 425.256 | 1.228 |
| 47.228 | 1.675 | 423.518 | 425.060 | 0.772 |
| 48.000 | 1.510 | 423.365 | 424.551 | 2.000 |
| 50.000 | 1.381 | 423.041 | 424.078 | 2.000 |
| 52.000 | 1.280 | 422.697 | 423.633 | 2.000 |
| 54.000 | 1.154 | 422.353 | 423.163 | 2.000 |
| 56.000 | 0.951 | 422.009 | 422.616 | 2.000 |
| 58.000 | 0.736 | 421.665 | 422.057 | 2.000 |
| 60.000 | 0.520 | 421.321 | 421.497 | 2.000 |
| 62.000 | 0.432 | 420.977 | 421.065 | 2.000 |
| 64.000 | 0.352 | 420.633 | 420.642 | 2.000 |
| 66.000 | 0.288 | 420.289 | 420.233 | 2.000 |
| 68.000 | 0.166 | 419.945 | 419.767 | 2.000 |
| 70.000 | | 419.601 | 419.601 | 1.000 |
| 71.000 | | 419.429 | 419.429 | |

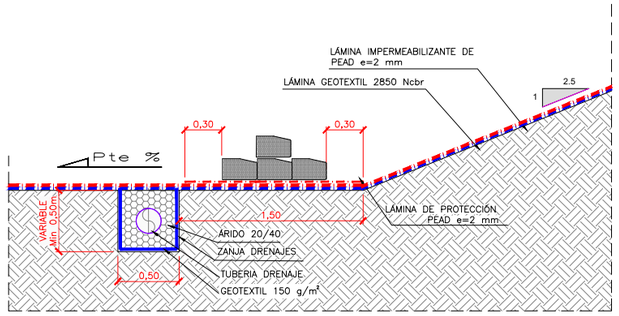
| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORA DE INGENIERÍA | INDICADAS<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>ALIVIADERO | 09.09<br>Nº DE HOJA: 1 de 1 |




## DRENAJE PERIMETRAL

SECCION TIPO

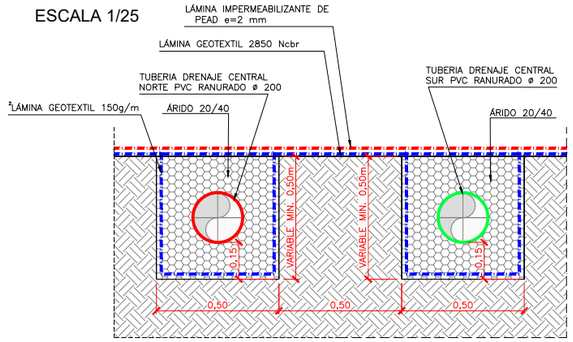
ESCALA 1/50




## DRENAJE CENTRAL

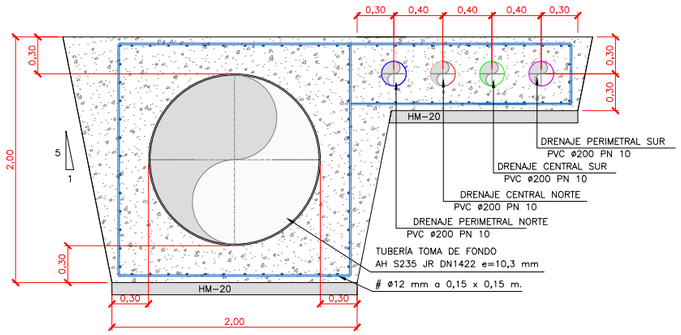
SECCION TIPO

ESCALA 1/25



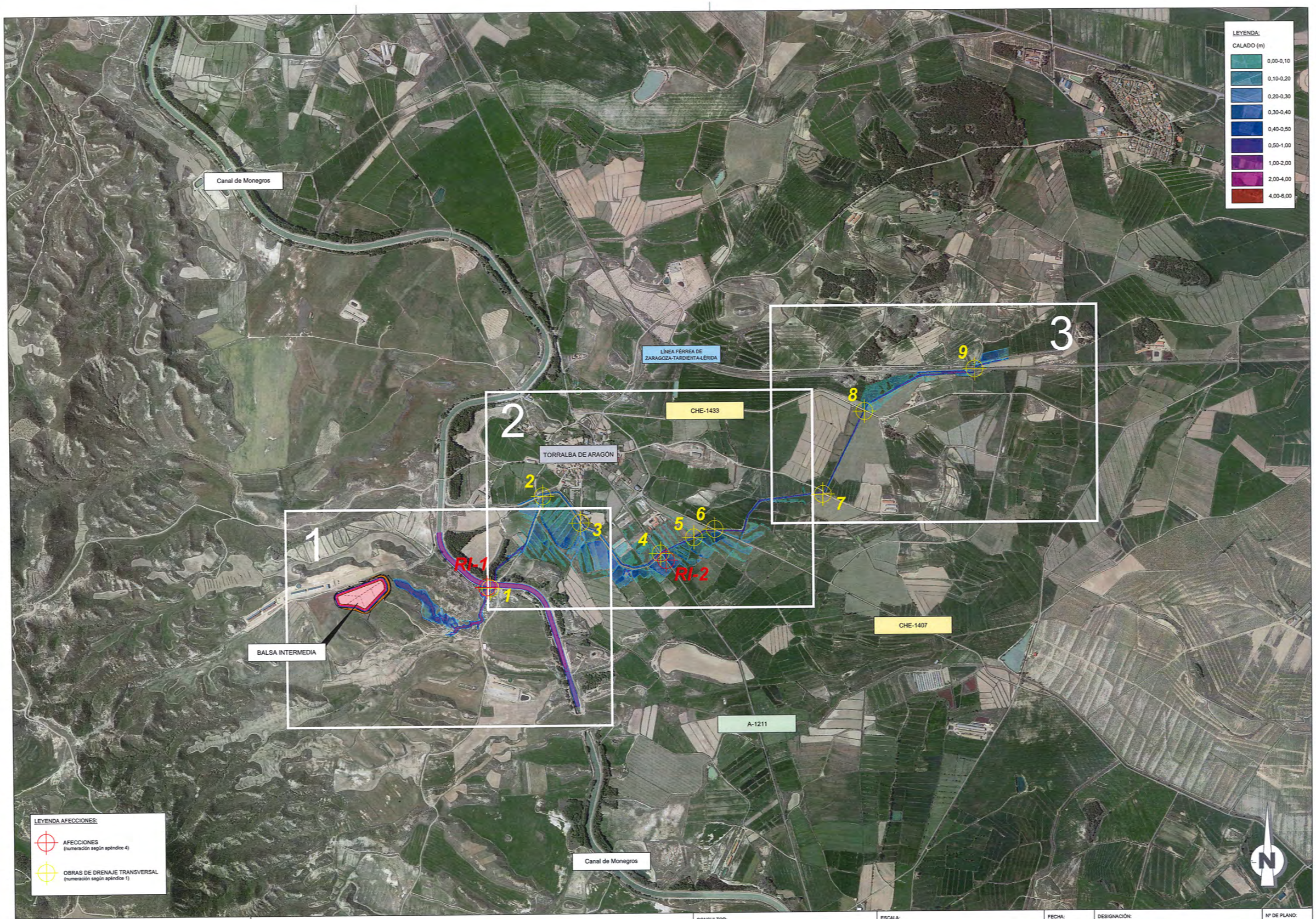

## VIGA DE FONDO

ESCALA 1/50

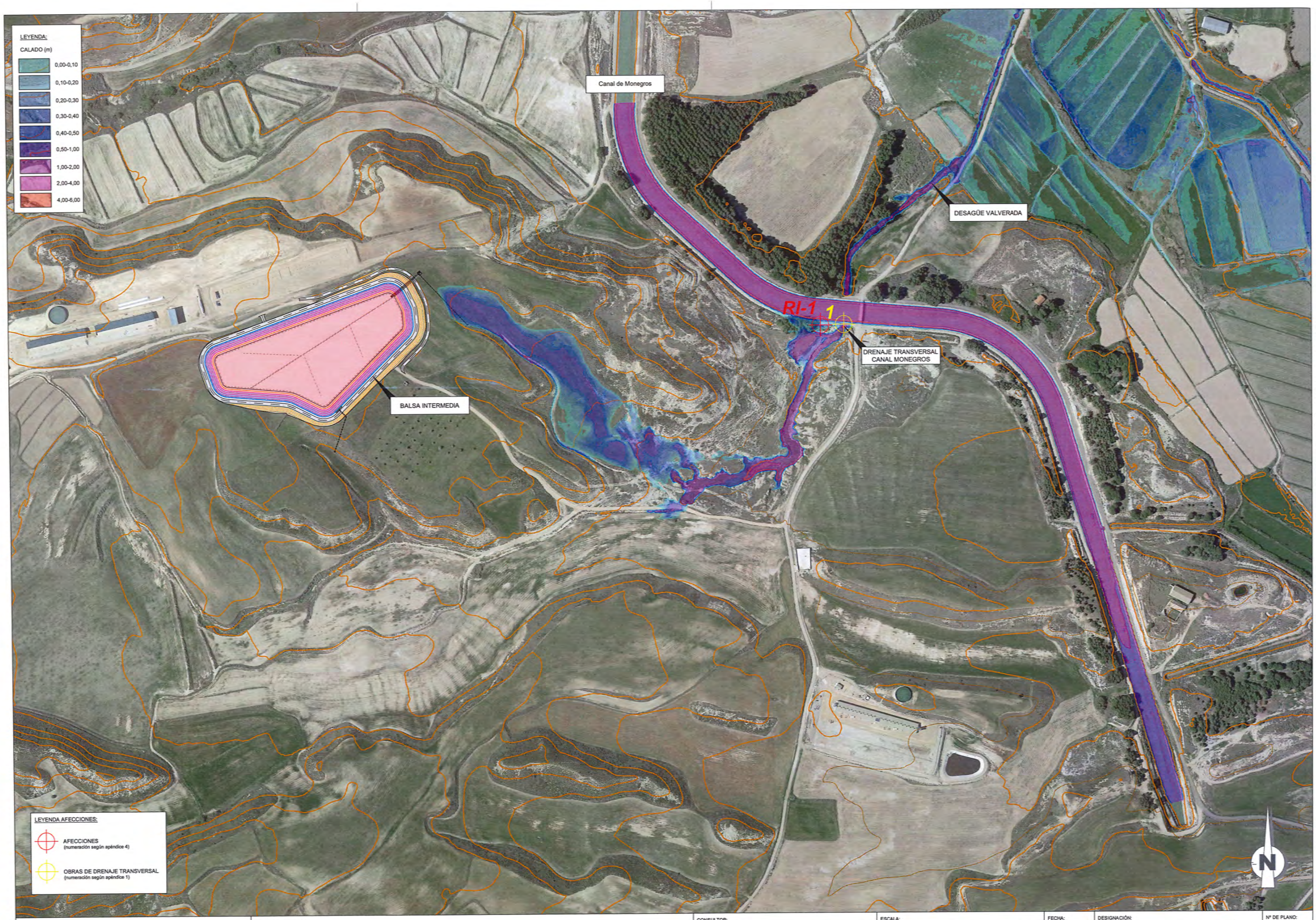



| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| C.R. DE SANTA ANA | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO AGRÓNOMO<br>Fdo. DANIEL CAMEO MORENO<br>Cingral CONSULTORA DE INGENIERÍA | INDICADAS<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | BALSA INTERMEDIA<br>DRENAJES | 09.10<br>Nº DE HOJA: 1 de 1 |

# APÉNDICE 3.- PLANOS: ANÁLISIS DE LA AVENIDA

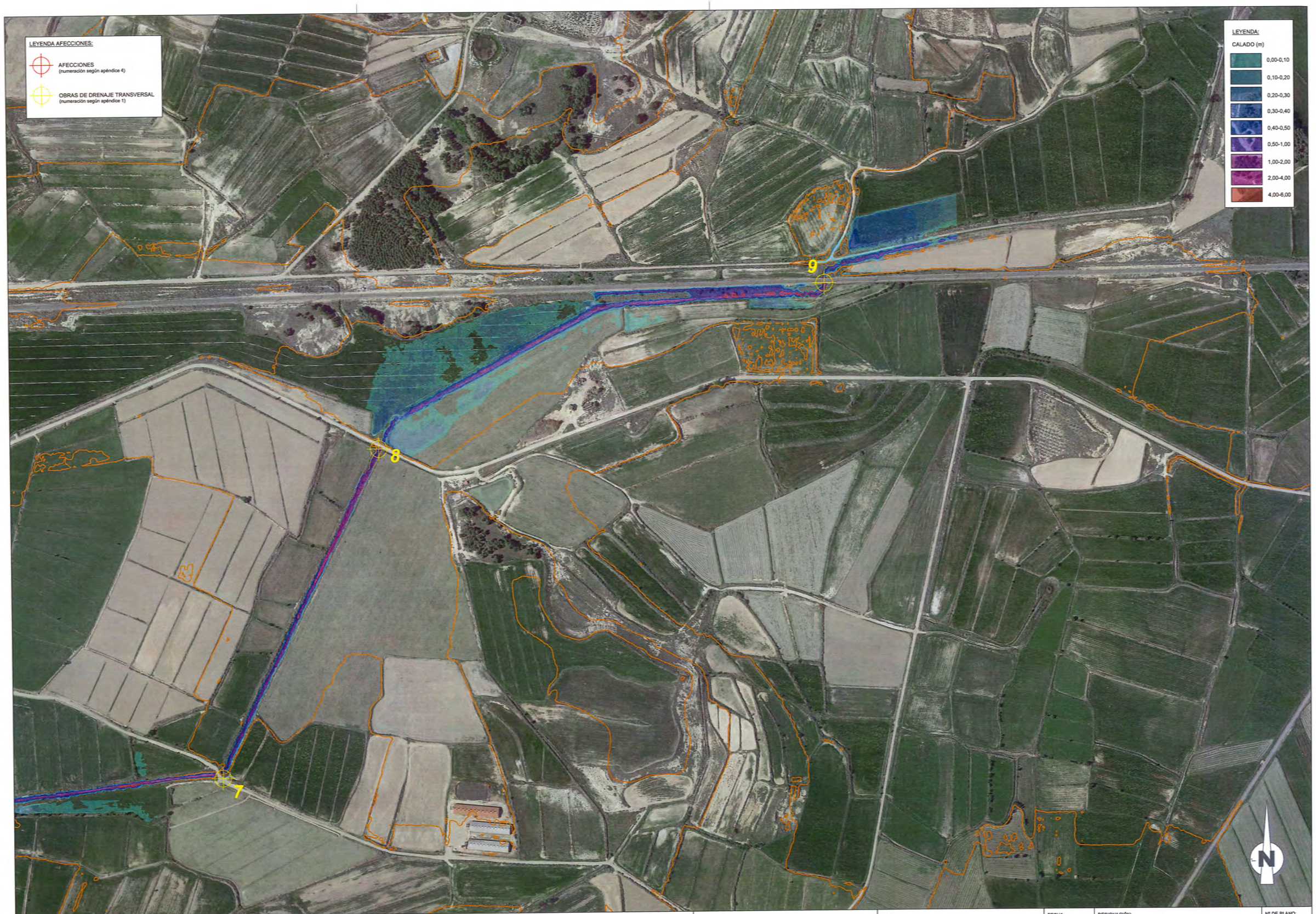



| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 20.000<br>0 100 200 300 400 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 01<br>Nº DE HOJA: 0 de 3 |

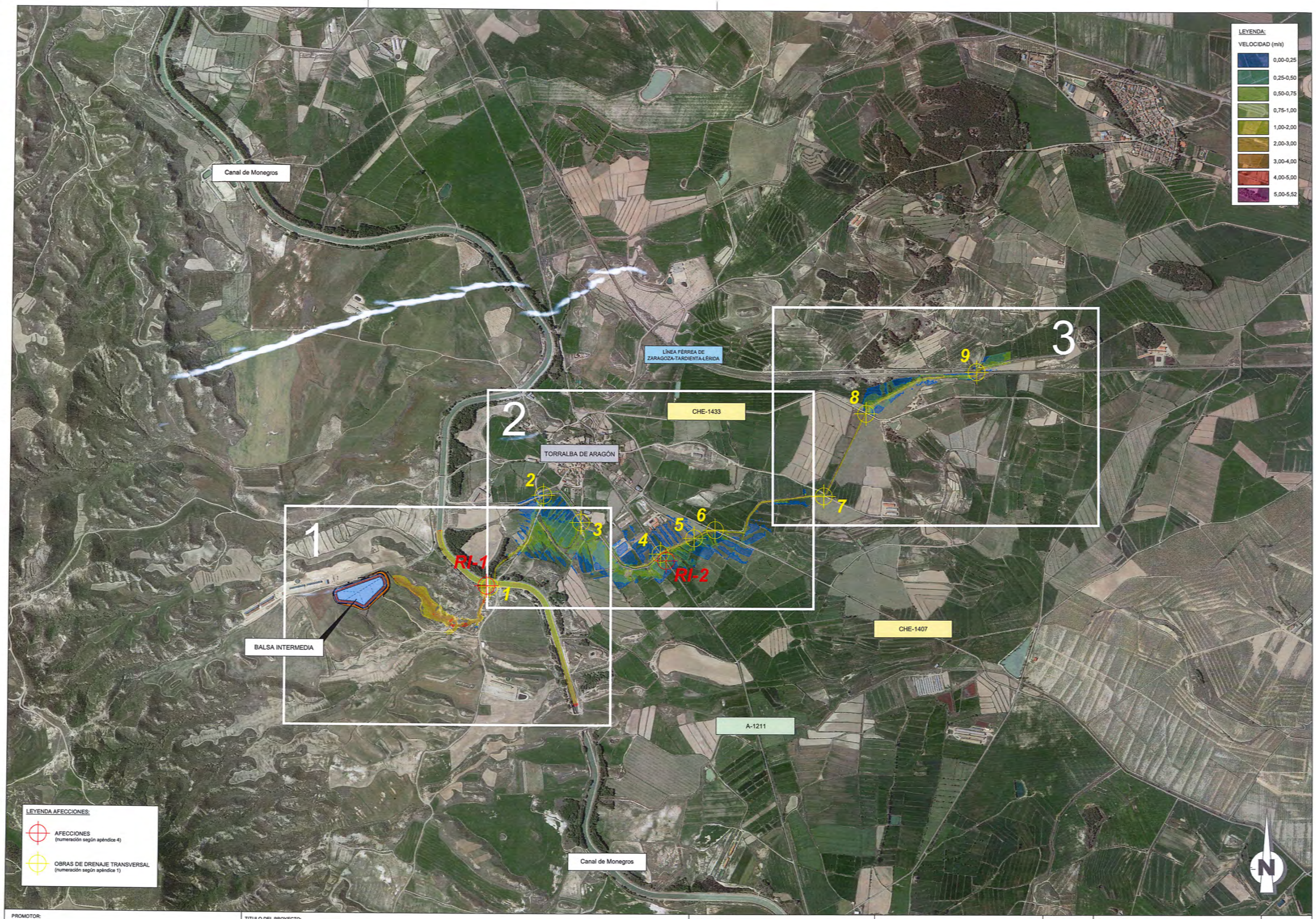



| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 01<br>Nº DE HOJA: 1 de 3 |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO CIVIL<br>FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 01<br>Nº DE HOJA: 2 de 3 |



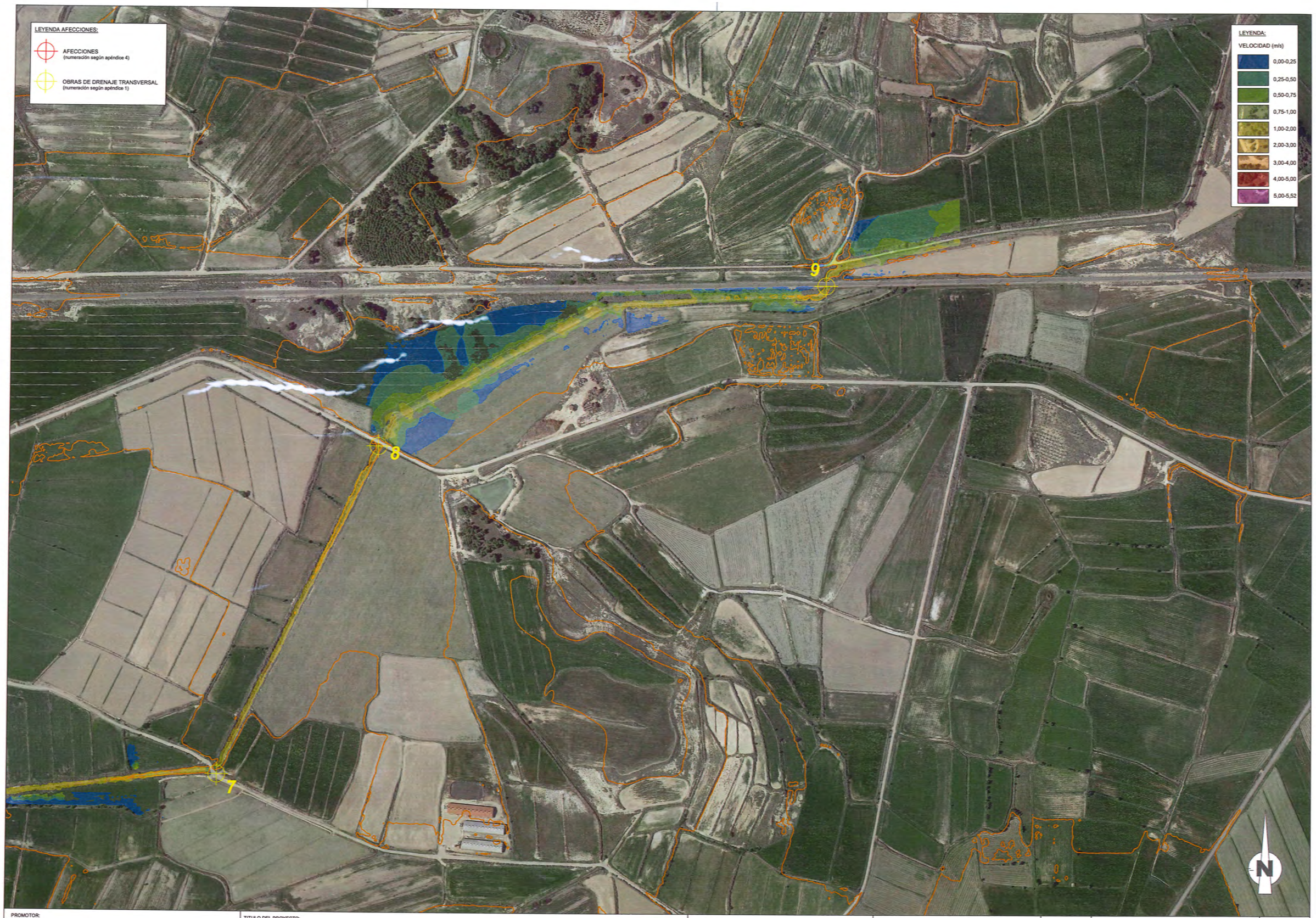

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 01<br>Nº DE HOJA: 3 de 3 |



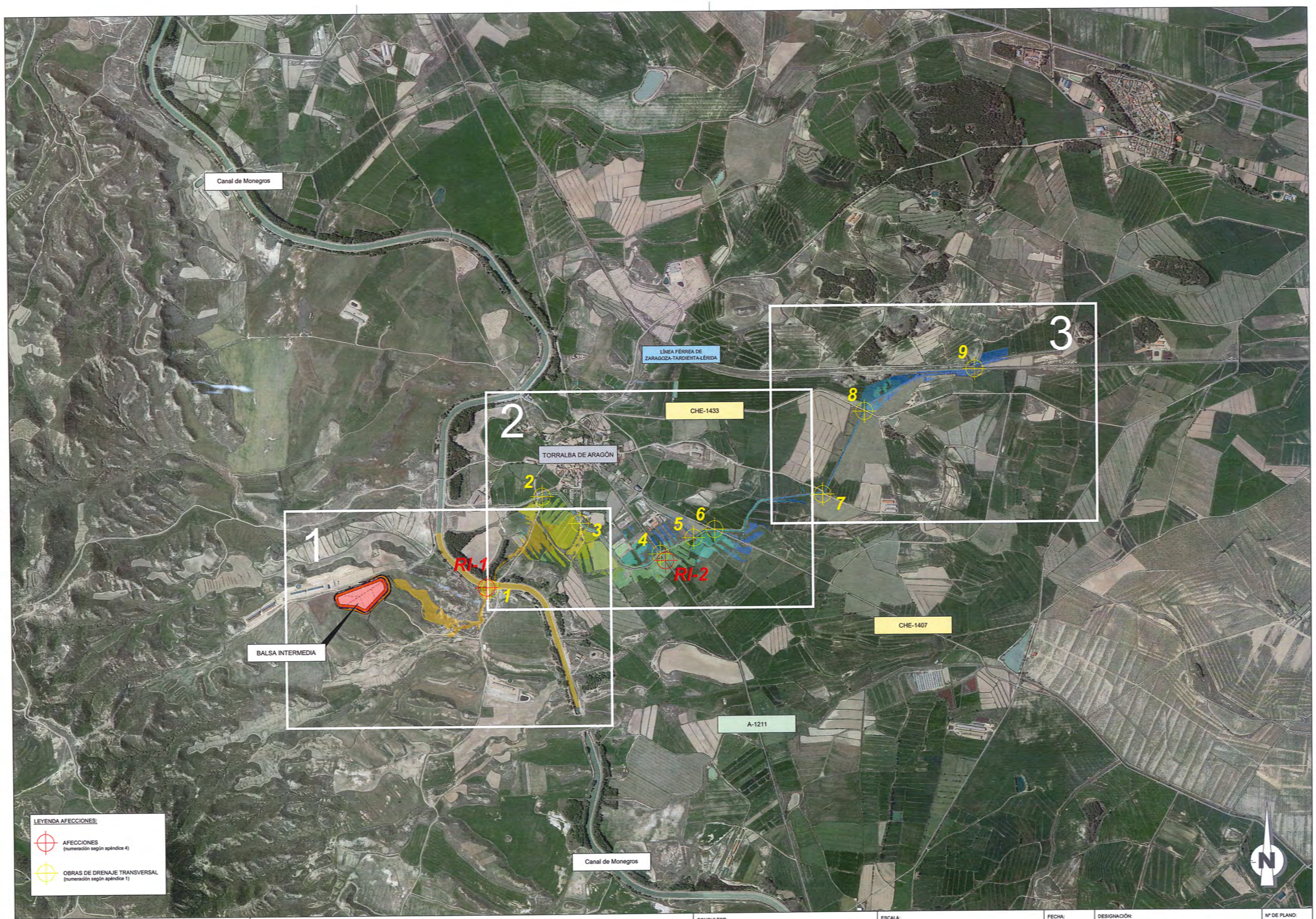

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 20.000<br>0 100 200 300 400 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN VELOCIDAD HEC-RAS | 02<br>Nº DE HOJA: 0 de 3 |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 02<br>Nº DE HOJA: 1 de 3 |

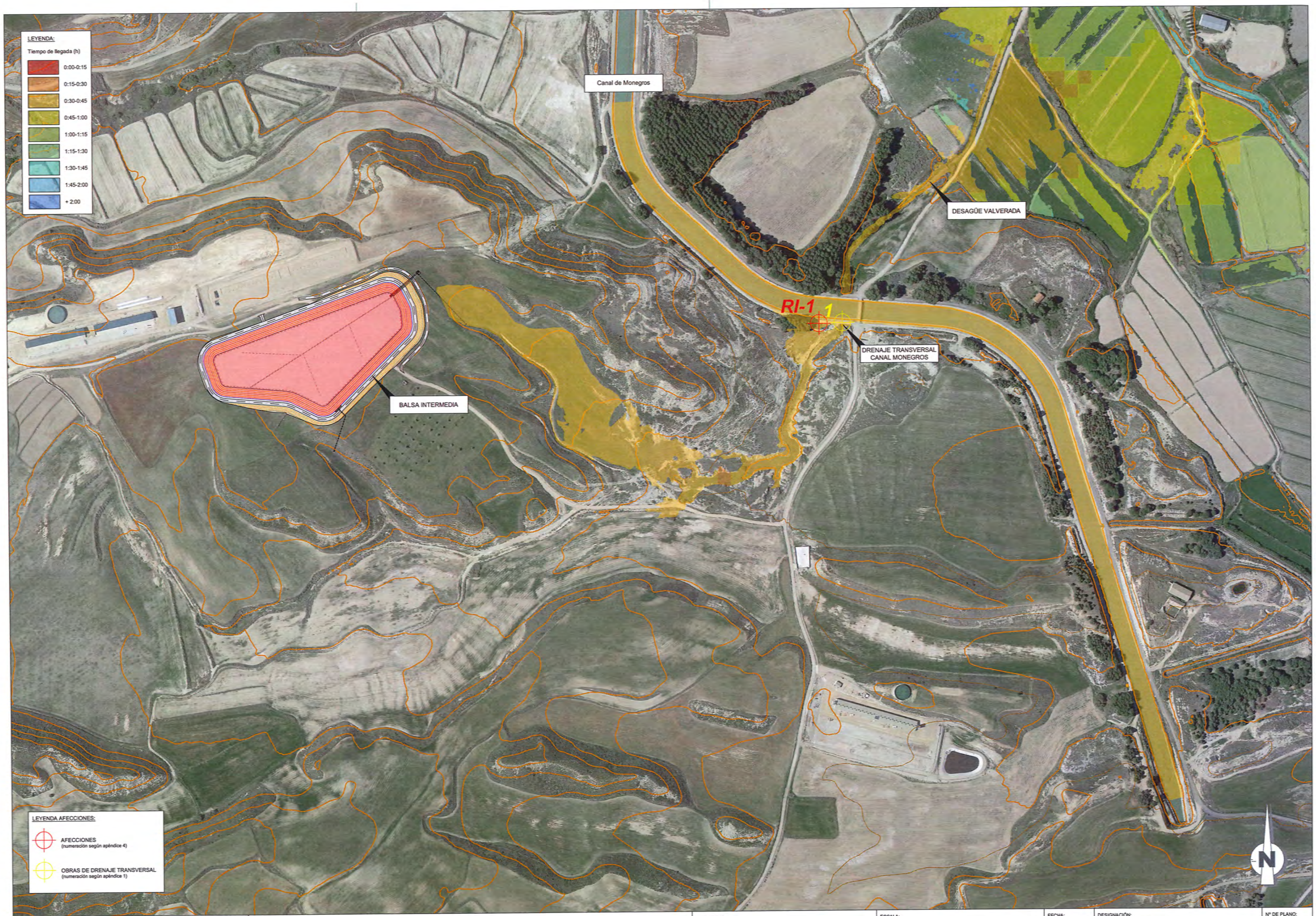
| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO CIVIL<br>FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 02<br>Nº DE HOJA: 2 de 3 |




| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO CIVIL<br>FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN CALADO HEC-RAS | 02<br>Nº DE HOJA: 3 de 3 |




| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 20.000<br>0 100 200 300 400 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN TIEMPO HEC-RAS | 03<br>Nº DE HOJA: 0 de 3 |




| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN TIEMPO HEC-RAS | 03<br>Nº DE HOJA: 1 de 3 |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: EL INGENIERO CIVIL | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN TIEMPO HEC-RAS | 03<br>Nº DE HOJA: 2 de 3 |

| PROMOTOR: | TITULO DEL PROYECTO: | CONSULTOR: | ESCALA: | FECHA: | DESIGNACIÓN: | Nº DE PLANO: |
|---|---|---|---|---|---|---|
| SOCIEDAD MERCANTIL DE INFRAESTRUCTURAS AGRARIAS S.A. | PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA) | EL INGENIERO CIVIL<br>FDO. JAVIER MUR SATUÉ<br>Cingral CONSULTORA DE INGENIERÍA | 1 : 5.000<br>0 25 50 75 100 m<br>UNE A3 GRÁFICAS | MAYO DE 2022<br>REFERENCIA: 20-013 | PROPUESTA CLASIFICACIÓN TIEMPO HEC-RAS | 03<br>Nº DE HOJA: 3 de 3 |

# APÉNDICE 4.- TABLA DE AFECCIONES

**Tabla nº 1. Modelo de tabla para el análisis de afecciones a núcleos de población, viviendas y vidas humanas en general**

| IDENTIFICACIÓN Y LOCALIZACIÓN DE LA AFECCIÓN POTENCIAL | | | | | | | | | RESULTADOS DEL MODELO HIDRÁULICO | | | | | | CLASIFICACIÓN DEL DAÑO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nº | Denominación | Tipo de elemento afectado [1] | Distancia a la presa (km) | Cauce | Margen | Coordenadas UTM | | Cota (msnm) | Caudal máximo ($m^3/s$) | Cota máxima agua (msnm) | Tiempo llegada onda (h:mm) | Tiempo valores máximos (h:mm) | Calado máximo (m) | Velocidad máxima (m/s) | Grado de afección[2] | Nº viviendas afectadas |
| | | | | | | X | Y | | | | | | | | | |
| - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

**Tabla nº 2. Modelo de tabla para el análisis de afecciones a servicios esenciales**

| IDENTIFICACIÓN Y LOCALIZACIÓN DE LA AFECCIÓN POTENCIAL | | | | | | | | | RESULTADOS DEL MODELO HIDRÁULICO | | | | | | CLASIFICACIÓN DEL DAÑO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nº | Denominación | Tipo de elemento afectado [1] | Distancia a la presa (km) | Cauce | Margen | Coordenadas UTM | | Cota (msnm) | Caudal máximo ($m^3/s$) | Cota máxima agua (msnm) | Tiempo llegada onda (h:mm) | Tiempo valores máximos (h:mm) | Calado máximo (m) | Velocidad máxima (m/s) | Grado de afección[2] |
| | | | | | | X | Y | | | | | | | | |
| - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

**Tabla nº 3. Modelo de tabla para el análisis de los daños materiales ocasionados por la onda de rotura**

| IDENTIFICACIÓN Y LOCALIZACIÓN DE LA AFECCIÓN POTENCIAL | | | | | | | | | RESULTADOS DEL MODELO HIDRÁULICO | | | | | | CLASIFICACIÓN DEL DAÑO | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nº | Denominación | Tipo de elemento afectado [1] | Distancia a la presa (km) | Cauce | Margen | Coordenadas UTM | | Cota (msnm) | Caudal máximo ($m^3/s$) | Cota máxima agua (msnm) | Tiempo llegada onda (h:mm) | Tiempo valores máximos (h:mm) | Calado máximo (m) | Velocidad máxima (m/s) | Grado de afección[2] | Nº de instalaciones afectadas[3] | Superficie de cultivo afectada[4] | Daños potenciales[5] |
| | | | | | | X | Y | | | | | | | | | | | |
| RI-1 | Camino de servicio Canal de monegros | Infraestrcutura regadío | 0,85 km | Barranco de Valverada | - | 705.802 | 4.644.734 | 391,56 | - | 391,73 | 0:42 | 00:46 | 0,17 | 1.36 | Grave | 1 | - | Moderados |
| RI-2 | A-1211 | Carretera autonómica tercer nivel | 2,30 km | - | - | 706.869 | 4.644.894 | 377,08 | - | 377,21 | 01:30 | 01:38 | 0,13 | 0,49 | No Grave | 1 | - | Moderados |

**Tabla nº 4. Modelo de tabla para el análisis de las afecciones a elementos medioambientales, histórico-artísticos o culturales**

| IDENTIFICACIÓN Y LOCALIZACIÓN DE LA AFECCIÓN POTENCIAL | | | | | | | | | RESULTADOS DEL MODELO HIDRÁULICO | | | | | | CLASIFICACIÓN DEL DAÑO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nº | Denominación | Tipo de elemento afectado [1] | Distancia a la presa (km) | Cauce | Margen | Coordenadas UTM | | Cota (msnm) | Caudal máximo ($m^3/s$) | Cota máxima agua (msnm) | Tiempo llegada onda (h:mm) | Tiempo valores máximos (h:mm) | Calado máximo (m) | Velocidad máxima (m/s) | Superficie Afectada[2] | Grado de afección[3] | Evaluación tipo de afección[4] |
| | | | | | | X | Y | | | | | | | | | | |
| - | ZONAS DE ALIMENTACIÓN ESPECIES NECRÓFAGAS | DECRETO 170/2013, de 22 de octubre, del Gobierno de Aragón | El ámbito de protección se encuentra en toda la zona | | | | | - | - | - | - | - | - | - | 60 ha | No Grave | No Grave |

# ANEJO Nº 12.- CÁLCULOS ESTRUCTURALES

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# ANEJO 12.- CÁLCULOS ESTRUCTURALES

## 1 INTRODUCCIÓN Y OBJETO DEL PRESENTE ANEJO

En el presente anejo se desarrollan los cálculos correspondientes al dimensionado de los elementos constructivos de la edificación a realizar para la estación de bombeo junto con una nave adosada para almacenamiento de equipos y maquinaria de la CR.

## 2 ESTACIÓN DE BOMBEO

El cálculo de la nave se ha realizado con el programa CYPE 2020, concretamente con sus aplicaciones: generador de pórticos y cype metal 3D. Empleándose para ello el citado programa bajo la licencia nº 68665.

El dimensionamiento se ha realizado considerando la estructura completa de la nave compuesta por 6 pórticos centrales y dos pórticos hastiales, además de una nave adosada a un agua con dos pórticos centrales y dos hastiales. Uno de los hastiales se ubica en una de las fachadas hastiales de la nave principal.

Las dimensiones de los pórticos y las barras pueden consultarse en los planos correspondientes, así como las placas base, los pernos y las zapatas. Aunque en el presente anejo se describen los diferentes elementos que conforman la estructura.

Para el diseño de la cimentación, se basan los cálculos en los datos disponibles en el estudio geotécnico que forma parte del presente proyecto.

### 2.1 DESCRIPCIÓN DE LA ESTRUCTURA Y CIMENTACIÓN

Para la ubicación de los equipos de bombeo se prevé la construcción de una edificación a la que se denominará Estación de Bombeo.

Su estructura estará formada por un pórtico de 18 m de luz, en total se colocarán 8 pórticos separados 6,1 m consiguiendo de esta forma una longitud de nave de 42,7 m aproximadamente. La estructura de la edificación se ha decidido realizar mediante perfiles metálicos, empleándose un cerramiento de cubierta de panel sándwich de 30 mm de espesor y cerramientos laterales resueltos mediante fábrica de bloque prefabricado de hormigón.

Adosada a la nave principal se dispone una nave de almacén, con separación entre pórticos, igual a la nave principal y aprovechando pilares de esta estructura principal. En longitud la nave se realiza de 18,3 m y con una luz de pórtico de 8 m. Solucionado ello con el pórtico a un agua, y una altura mínima de pilar de 5,2 m.

Debido a los equipos que alberga la nave, y a la necesidad de reparación o sustitución de equipos que se dará en el futuro, se decide realizar la instalación de un puente grúa. A la vista de los elementos que conforman la estación de bombeo, se considera suficiente la instalación de un puente grúa con capacidad de carga de 2,5 tn.

La nave compuesta por pórticos de estructura metálica, se puede agrupar o dividir en dos por la tipología de los mismos, entre pórticos centrales y hastiales, aunque debido a que se dispone la nave adosada y no dispone de la misma longitud que la estación de bombeo, se puede agrupar mejor en 4. El hastial con nave adosada, el hastial sin nave adosada, el central con nave adosada, y el hastial sin nave adosada.

Los pórticos centrales estarán ejecutados mediante perfiles IPE-300 con cartelas en los dinteles y HEB-220 en los pilares. En el caso de la nave adosada se añade a un lado de este pórtico un dintel mediante perfil IPE 220, y pilares HEB200. Los pórticos hastiales estarán ejecutados mediante perfiles IPE-200 con cartelas en los dinteles y HEB-200 en los pilares de esquina y en los hastiales. En los siguientes apartados se presentarán los datos de un pórtico de cada tipo de los enumerados con anterioridad.

Los pilares centrales y de esquina, cuentan con una ménsula a aproximadamente 4,5 m que sirve de apoyo para la viga carril del puente grúa. Esta viga carril no se dimensiona en el presente anejo al ser un elemento del puente grúa aunque se considera para las cargas la instalación de un perfil IPE 360 según documentación disponible, al igual que se considerarán las

cargas indicadas en los documentos de puentes grúas de una casa comercial de referencia para la capacidad de carga deseada y para la luz de la nave.

Además la estructura cuenta con unos elementos de arriostramiento conformados por perfiles IPE 160 entre pórticos y arriostrados en forma de cruz de San Andrés mediante perfiles tipo redondos de 14 mm. Este arriostrado se presenta en el primer y último vano de la estructura del edificio, no instalándose en los centrales. En el caso de la nave adosada se disponen también arriostrados en la parte inicial y final.

Las correas de cubierta estarán separadas 1 m y serán ejecutadas mediante perfil metálico CF 225x2.5 mm atornilladas al dintel y dándoles continuidad en toda la longitud de la nave mediante una unión rígida entre correas.

Las zapatas se dividen en un total de cinco tipologías. Una tipología para los pilares centrales (3,5x2,5), otro para los de esquina (2,45x1,7), otro para los hastiales (2,8x1,85), otro para los de los pilares del almacén (2,75x1,7), y un último tipo para un pilar hastial, anexo al almacén (2,8x2,3). En todos los casos las zapatas se ejecutan de 1 m de profundidad, y construidas a base de hormigón HA-35/B/20/IIa+Qc, armado con redondos Ø de 16 mm cada 0,20 m. Bajo las mismas en algunos de los casos se requiere la ejecución de pozos de cimentación mediante hormigón ciclópeo para alcanzar el terreno sano, de adecuadas características para el apoyo de la estructura. En alguno de los casos se deberán ejecutar pozos de hasta 2 metros de profundidad. Durante la ejecución de la cimentación, deberá cerciorarse que se alcanza el nivel adecuado de cimentación.

Todas las zapatas estarán conectadas por una viga riostra de 0,40 x 0,40 m. y 4 Ø de 12 mm longitudinalmente y redondos de atado de Ø 8 mm, cada 0,30 metros. Las vigas de atado se disponen por el contorno de la nave. A su vez también por el contorno del almacén y conectando estas zapatas con sus anexas de la estación de bombeo.

Las placas de anclaje se dividen en tres grupos placas de los pilares centrales y el pilar hastial anexo al almacén, otro tipo los pilares de esquina y hastiales. Y por último la nave de almacén.

**Figura 1:** Esquema 3D de estructura, nudos.

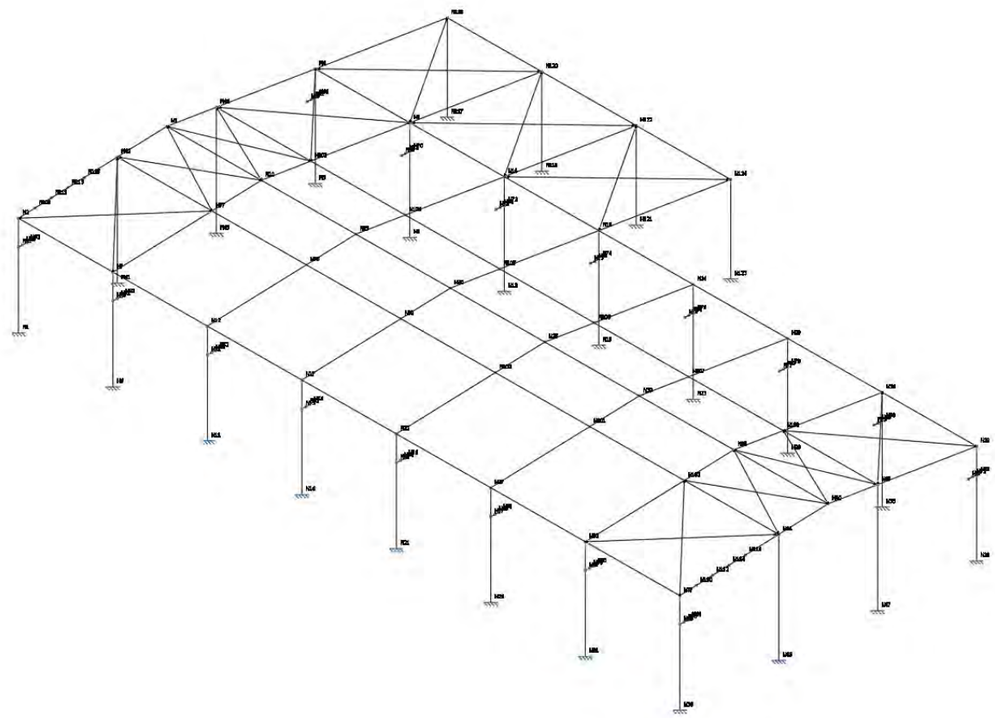


**Figura 2:** Esquema 2D de estructura del pórtico central sin almacén, nudos.

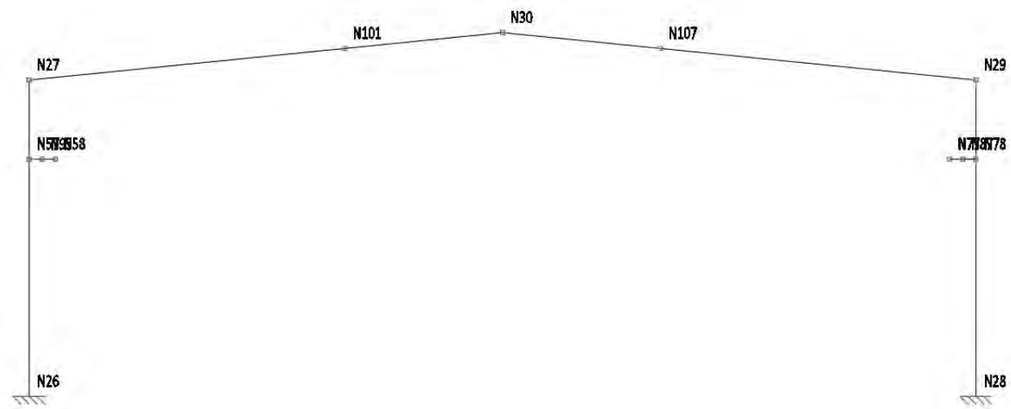


**Figura 3:** Esquema 2D de estructura del pórtico central con almacén, nudos.

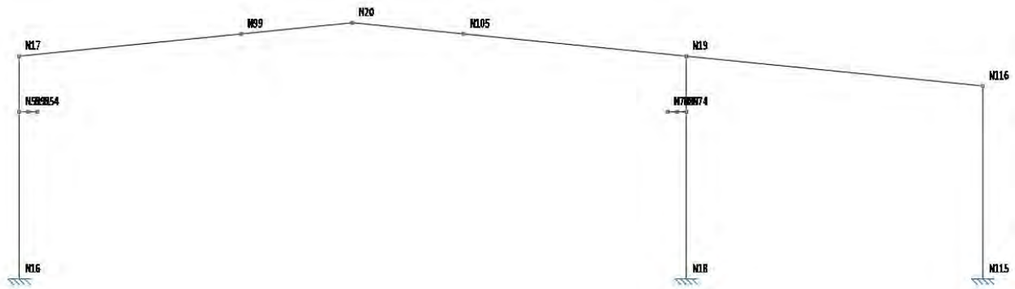



**Figura 4:** Esquema 2D de estructura del pórtico hastial sin almacén, nudos.

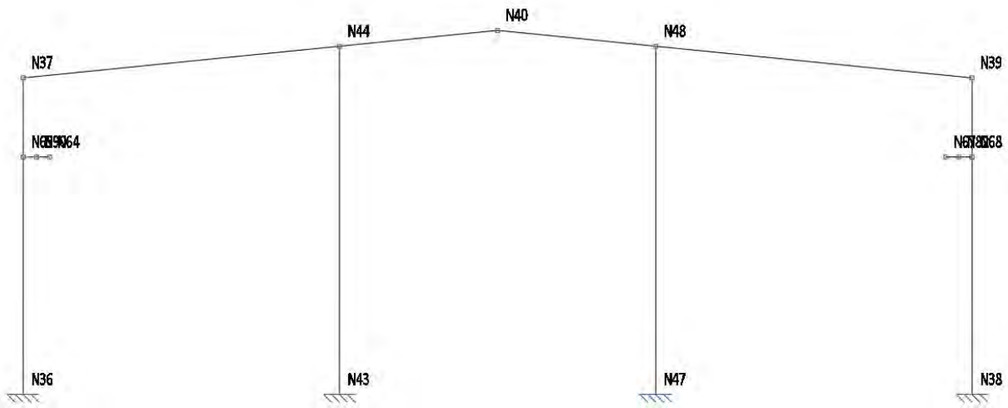
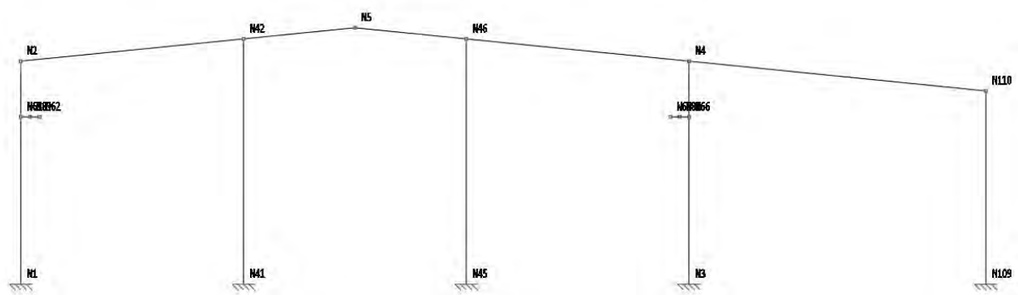



**Figura 5:** Esquema 2D de estructura del pórtico hastial con almacén, nudos.




## 2.2 CÁLCULO ESTRUCTURAL DE LA NAVE DE BOMBEO

### 2.2.1 ACCIONES Y CORREAS

En el presente subapartado se indican las acciones que se han considerado para el cálculo de la estructura de la nave, sin incluir las acciones del puente grúa que se observa posteriormente. En las acciones recogidas a continuación se recogen las acciones climáticas (viento, nieve,…) considerando la zona en la que se va a ubicar la nave. Además se considera el peso propio de los elementos que sustenta la estructura, en este caso la chapa tipo sándwich de 30 mm de espesor, considerándose la carga en base datos de casas comerciales. El cerramiento lateral se realiza mediante fábrica de bloque que podrá transmitir acciones laterales debidas al viento, aunque no transmitirá cargas verticales a los elementos de la estructura.

Datos de la obra

Separación entre pórticos: 6.10 m
Con cerramiento en cubierta
- Peso del cerramiento: 9.40 kg/m²
- Sobrecarga del cerramiento: 40.00 kg/m²

Con cerramiento en laterales
- Peso del cerramiento: 0.00 kg/m²

Normas y combinaciones

| | |
|---|---|
| Perfiles | CTE<br>Cota de nieve: Altitud inferior o igual a 1000 |
| Perfiles laminados | CTE<br>Cota de nieve: Altitud inferior o igual a 1000 |
| Desplazamientos | Acciones características |

Datos de viento

Normativa: CTE DB SE-AE (España)

Zona eólica: C
Grado de aspereza: II. Terreno rural llano sin obstáculos
Periodo de servicio (años): 50
Profundidad nave industrial: 42.70
Sin huecos.
1 - V(0°) H1: Viento a 0°, presión exterior tipo 1 sin acción en el interior

2 - V(0°) H2: Viento a 0°, presión exterior tipo 2 sin acción en el interior
3 - V(90°) H1: Viento a 90°, presión exterior tipo 1 sin acción en el interior
4 - V(180°) H1: Viento a 180°, presión exterior tipo 1 sin acción en el interior
5 - V(180°) H2: Viento a 180°, presión exterior tipo 2 sin acción en el interior
6 - V(270°) H1: Viento a 270°, presión exterior tipo 1 sin acción en el interior

Datos de nieve

Normativa: CTE DB-SE AE (España)

Zona de clima invernal: 2
Altitud topográfica: 389.00 m
Cubierta sin resaltos
Exposición al viento: Normal

Hipótesis aplicadas:
1 - N(EI): Nieve (estado inicial)
2 - N(R) 1: Nieve (redistribución) 1
3 - N(R) 2: Nieve (redistribución) 2

Aceros en perfiles

| Tipo acero | Acero | Lim. elástico kp/cm² | Módulo de elasticidad |
|---|---|---|---|
| Acero conformado | S235 | 2396 | 2140673 |

| Datos de pórticos | | | |
|---|---|---|---|
| Pórtico | Tipo | Geometría | Tipo interior |
| 1 | Dos aguas | Luz izquierda: 9.00 m<br>Luz derecha: 9.00 m<br>Alero izquierdo: 6.00 m<br>Alero derecho: 6.00 m | Pórtico rígido |
| 2 | Un agua | Luz total: 8.00 m<br>Alero izquierdo: 6.00 m<br>Alero derecho: 5.20 m | Pórtico rígido |

A continuación se indicas las cargas sobre barras de un pórtico hastial y de un pórtico central, ambos en la situación de disponer el almacén anexo.

Pórtico hastial

| Barra | Hipótesis | Tipo | Posición | Valor | Orientación |
|---|---|---|---|---|---|
| Pilar | V(0°) H1 | Uniforme | --- | 0.29 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(0°) H2 | Uniforme | --- | 0.29 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(90°) H1 | Uniforme | --- | 0.45 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(180°) H1 | Uniforme | --- | 0.13 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(180°) H2 | Uniforme | --- | 0.13 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(270°) H1 | Uniforme | --- | 0.21 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | G | Uniforme | --- | 0.05 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | Q | Uniforme | --- | 0.12 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H1 | Faja | 0.00/0.15 (R) | 0.65 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H1 | Faja | 0.15/1.00 (R) | 0.24 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H2 | Faja | 0.00/0.15 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H2 | Faja | 0.15/1.00 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(90°) H1 | Faja | 0.00/0.38 (R) | 0.26 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Faja | 0.38/1.00 (R) | 0.22 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Uniforme | --- | 0.17 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.00/0.85 (R) | 0.24 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.85/1.00 (R) | 0.05 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(180°) H2 | Faja | 0.00/0.85 (R) | 0.23 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H2 | Faja | 0.85/1.00 (R) | 0.23 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(270°) H1 | Uniforme | --- | 0.25 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | N(EI) | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 1 | Uniforme | --- | 0.09 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 2 | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | G | Uniforme | --- | 0.05 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | Q | Uniforme | --- | 0.12 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H1 | Faja | 0.00/0.85 (R) | 0.24 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H1 | Faja | 0.85/1.00 (R) | 0.05 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H2 | Faja | 0.00/0.85 (R) | 0.23 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H2 | Faja | 0.85/1.00 (R) | 0.23 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Uniforme | --- | 0.39 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Uniforme | --- | 0.24 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H2 | Uniforme | --- | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(270°) H1 | Uniforme | --- | 0.26 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | N(EI) | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 1 | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 2 | Uniforme | --- | 0.09 t/m | EG: (0.00, 0.00, -1.00) |
| Pilar | V(0°) H1 | Uniforme | --- | 0.13 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(0°) H2 | Uniforme | --- | 0.13 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(90°) H1 | Uniforme | --- | 0.45 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(180°) H1 | Uniforme | --- | 0.29 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(180°) H2 | Uniforme | --- | 0.29 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(270°) H1 | Uniforme | --- | 0.21 t/m | EXB: (0.00, 0.00, 1.00) |

| Barra | Hipótesis | Tipo | Posición | Valor | Orientación |
|---|---|---|---|---|---|
| Cubierta | G | Uniforme | --- | 0.05 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | Q | Uniforme | --- | 0.12 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H1 | Uniforme | --- | 0.24 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H2 | Uniforme | --- | 0.23 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Faja | 0.00/0.43 (R) | 0.26 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Faja | 0.43/1.00 (R) | 0.22 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Uniforme | --- | 0.17 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.00/0.17 (R) | 0.65 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.17/1.00 (R) | 0.24 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H2 | Faja | 0.00/0.17 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(180°) H2 | Faja | 0.17/1.00 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(270°) H1 | Uniforme | --- | 0.25 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | N(EI) | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 1 | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 2 | Uniforme | --- | 0.09 t/m | EG: (0.00, 0.00, -1.00) |

Pórtico central

| Barra | Hipótesis | Tipo | Posición | Valor | Orientación |
|---|---|---|---|---|---|
| Pilar | V(0°) H1 | Uniforme | --- | 0.59 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(0°) H2 | Uniforme | --- | 0.59 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(90°) H1 | Uniforme | --- | 0.43 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(180°) H1 | Uniforme | --- | 0.25 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(180°) H2 | Uniforme | --- | 0.25 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(270°) H1 | Uniforme | --- | 0.42 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | G | Uniforme | --- | 0.11 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | Q | Uniforme | --- | 0.24 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H1 | Faja | 0.00/0.15 (R) | 0.98 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H1 | Faja | 0.15/1.00 (R) | 0.48 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H2 | Faja | 0.00/0.15 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H2 | Faja | 0.15/1.00 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(90°) H1 | Uniforme | --- | 0.50 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.00/0.85 (R) | 0.49 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.85/1.00 (R) | 0.10 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(180°) H2 | Faja | 0.00/0.85 (R) | 0.47 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H2 | Faja | 0.85/1.00 (R) | 0.47 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(270°) H1 | Uniforme | --- | 0.50 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | N(EI) | Uniforme | --- | 0.37 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 1 | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 2 | Uniforme | --- | 0.37 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | G | Uniforme | --- | 0.11 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | Q | Uniforme | --- | 0.24 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H1 | Faja | 0.00/0.85 (R) | 0.49 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H1 | Faja | 0.85/1.00 (R) | 0.10 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H2 | Faja | 0.00/0.85 (R) | 0.47 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H2 | Faja | 0.85/1.00 (R) | 0.47 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Uniforme | --- | 0.51 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Uniforme | --- | 0.48 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H2 | Uniforme | --- | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(270°) H1 | Uniforme | --- | 0.51 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | N(EI) | Uniforme | --- | 0.37 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 1 | Uniforme | --- | 0.37 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 2 | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |
| Pilar | V(0°) H1 | Uniforme | --- | 0.25 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(0°) H2 | Uniforme | --- | 0.25 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(90°) H1 | Uniforme | --- | 0.43 t/m | EXB: (0.00, 0.00, 1.00) |
| Pilar | V(180°) H1 | Uniforme | --- | 0.59 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(180°) H2 | Uniforme | --- | 0.59 t/m | EXB: (0.00, 0.00, -1.00) |
| Pilar | V(270°) H1 | Uniforme | --- | 0.42 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | G | Uniforme | --- | 0.11 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | Q | Uniforme | --- | 0.24 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | V(0°) H1 | Uniforme | --- | 0.49 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(0°) H2 | Uniforme | --- | 0.47 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(90°) H1 | Uniforme | --- | 0.50 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.00/0.17 (R) | 0.98 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H1 | Faja | 0.17/1.00 (R) | 0.48 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | V(180°) H2 | Faja | 0.00/0.17 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(180°) H2 | Faja | 0.17/1.00 (R) | 0.01 t/m | EXB: (0.00, 0.00, -1.00) |
| Cubierta | V(270°) H1 | Uniforme | --- | 0.50 t/m | EXB: (0.00, 0.00, 1.00) |
| Cubierta | N(EI) | Uniforme | --- | 0.37 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 1 | Uniforme | --- | 0.37 t/m | EG: (0.00, 0.00, -1.00) |
| Cubierta | N(R) 2 | Uniforme | --- | 0.18 t/m | EG: (0.00, 0.00, -1.00) |

Descripción de las abreviaturas:

R : Posición relativa a la longitud de la barra.

EG : Ejes de la carga coincidentes con los globales de la estructura.

EXB : Ejes de la carga en el plano de definición de la misma y con el eje X coincidente con la barra.

**Correas**

A continuación se presenta la comprobación de las correas de cubierta. Estas correas se dimensionan considerando que en la ejecución se les dará continuidad a las mismas a lo largo de toda la nave, además de tener en consideración que se dispondrá de una cubierta de chapa tipo sándwich que presenta una flecha máxima relativamente elevada, y una fijación fuerte.

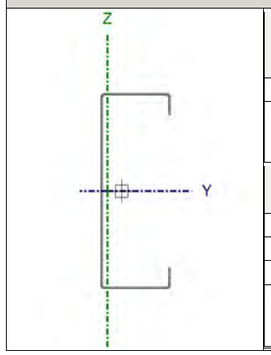
| Datos de correas de cubierta | |
|---|---|
| Descripción de correas | Parámetros de cálculo |
| Tipo de perfil: CF-225x2.5 | Límite flecha: L / 300 |
| Separación: 1.00 m | Número de vanos: Un vano |
| Tipo de Acero: S235 | Tipo de fijación: Fijación rígida |

Comprobación de resistencia _____

| Comprobación de resistencia |
|---|
| El perfil seleccionado cumple todas las comprobaciones. |
| Aprovechamiento: 85.46 % |

Barra pésima en cubierta

**Perfil: CF-225x2.5Material: S235**




| Nudos | | Longitud (m) | Características mecánicas | | | | | |
|---|---|---|---|---|---|---|---|---|
| Inicial | Final | | Área (cm²) | $I_y$(1) (cm4) | $I_z$(1) (cm4) | $I_t$(2) (cm4) | $y_g$(3) (mm) | $z_g$(3) (mm) |
| 0.498, 42.700, 6.050 | 0.498, 36.600, 6.050 | 6.100 | 10.46 | 806.27 | 90.72 | 0.22 | -16.21 | 0.00 |

*Notas:*
*(1) Inercia respecto al eje indicado*
*(2) Momento de inercia a torsión uniforme*
*(3) Coordenadas del centro de gravedad*

| | Pandeo | | Pandeo lateral | |
|---|---|---|---|---|
| | Plano XY | Plano XZ | Ala sup. | Ala inf. |
| β | 0.00 | 1.00 | 0.00 | 0.00 |
| $L_K$ | 0.000 | 6.100 | 0.000 | 0.000 |
| $C_1$ | - | | 1.000 | |

*Notación:*
*β: Coeficiente de pandeo*
*$L_K$: Longitud de pandeo (m)*
*$C_1$: Factor de modificación para el momento crítico*

| Barra | COMPROBACIONES (CTE DB SE-A) | | | | | | | | | | | | | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b / t | $\bar{\lambda}$ | $N_t$ | $N_c$ | $M_y$ | $M_z$ | $M_yM_z$ | $V_y$ | $V_z$ | $N_tM_yM_z$ | $N_cM_yM_z$ | $NM_yM_zV_yV_z$ | $M_tNM_yM_zV_yV_z$ | |
| pésima en cubierta | b / t ≤ (b / t)Máx. Cumple | N.P.(1) | N.P.(2) | N.P.(3) | x: 3.05 m η = 85.5 | N.P.(4) | N.P.(5) | N.P.(6) | x: 0 m η = 15.7 | N.P.(7) | N.P.(8) | N.P.(9) | N.P.(10) | **CUMPLE η = 85.5** |

*Notación:*
*b / t: Relación anchura / espesor*
*$\bar{\lambda}$: Limitación de esbeltez*
*$N_t$: Resistencia a tracción*
*$N_c$: Resistencia a compresión*
*$M_y$: Resistencia a flexión. Eje Y*
*$M_z$: Resistencia a flexión. Eje Z*
*$M_yM_z$: Resistencia a flexión biaxial*
*$V_y$: Resistencia a corte Y*
*$V_z$: Resistencia a corte Z*
*$N_tM_yM_z$: Resistencia a tracción y flexión*
*$N_cM_yM_z$: Resistencia a compresión y flexión*
*$NM_yM_zV_yV_z$: Resistencia a cortante, axil y flexión*
*$M_tNM_yM_zV_yV_z$: Resistencia a torsión combinada con axil, flexión y cortante*
*x: Distancia al origen de la barra*
*η: Coeficiente de aprovechamiento (%)*
*N.P.: No procede*

*Comprobaciones que no proceden (N.P.):*
*(1) La comprobación no procede, ya que no hay axil de compresión ni de tracción.*
*(2) La comprobación no procede, ya que no hay axil de tracción.*
*(3) La comprobación no procede, ya que no hay axil de compresión.*
*(4) La comprobación no procede, ya que no hay momento flector.*
*(5) La comprobación no procede, ya que no hay flexión biaxial para ninguna combinación.*
*(6) La comprobación no procede, ya que no hay esfuerzo cortante.*
*(7) No hay interacción entre axil de tracción y momento flector para ninguna combinación. Por lo tanto, la comprobación no procede.*
*(8) No hay interacción entre axil de compresión y momento flector para ninguna combinación. Por lo tanto, la comprobación no procede.*
*(9) No hay interacción entre momento flector, axil y cortante para ninguna combinación. Por lo tanto, la comprobación no procede.*
*(10) La comprobación no procede, ya que no hay momento torsor.*

## Relación anchura / espesor (CTE DB SE-A, Tabla 5.5 y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 5.2)

Se debe satisfacer:

$h/t \leq 250$ — **h / t** : *86.0* ✓

$b/t \leq 90$ — **b / t** : *28.0* ✓

$c/t \leq 30$ — **c / t** : *8.0* ✓

Los rigidizadores proporcionan suficiente rigidez, ya que se cumple:

$0.2 \leq c/b \leq 0.6$ — **c / b** : *0.286*

Donde:

**h**: Altura del alma. — **h** : *215.00* mm
**b**: Ancho de las alas. — **b** : *70.00* mm
**c**: Altura de los rigidizadores. — **c** : *20.00* mm
**t**: Espesor. — **t** : *2.50* mm

Nota: Las dimensiones no incluyen el acuerdo entre elementos.

## Limitación de esbeltez (CTE DB SE-A, Artículos 6.3.1 y 6.3.2.1 - Tabla 6.3)

La comprobación no procede, ya que no hay axil de compresión ni de tracción.

## Resistencia a tracción (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.2)

La comprobación no procede, ya que no hay axil de tracción.

## Resistencia a compresión (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.3)

La comprobación no procede, ya que no hay axil de compresión.

## Resistencia a flexión. Eje Y (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.4.1)

Se debe satisfacer:

$$\eta = \frac{M_{Ed}}{M_{c,Rd}} \leq 1$$

**η** : ***0.855*** ✓

Para flexión positiva:

$M_{y,Ed}$: Momento flector solicitante de cálculo pésimo. — $M_{y,Ed}^{+}$ : *0.000* t·m

Para flexión negativa:

El esfuerzo solicitante de cálculo pésimo se produce en un punto situado a una distancia de 3.050 m del nudo 0.498, 42.700, 6.050, para la combinación de acciones 0.80*G1 + 0.80*G2 + 1.50*V(0°) H1.

$M_{y,Ed}$: Momento flector solicitante de cálculo pésimo. — $M_{y,Ed}^{-}$ : *1.330* t·m

La resistencia de cálculo a flexión $M_{c,Rd}$ viene dada por:

$$M_{c,Rd} = \frac{W_{eff} \cdot f_{yb}}{\gamma_{M0}}$$

$M_{c,Rd}$ : *1.556* t·m

Donde:

**$W_{eff}$**: Módulo resistente eficaz correspondiente a la fibra de mayor tensión. $W_{eff}$ : *68.21* cm³

**$f_{yb}$**: Límite elástico del material base. (CTE DB SE-A, Tabla 4.1) $f_{yb}$ : *2395.51* kp/cm²

**$\gamma_{M0}$**: Coeficiente parcial de seguridad del material. $\gamma_{M0}$ : *1.05*

**Resistencia a pandeo lateral del ala superior:** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.2.4)

La comprobación a pandeo lateral no procede, ya que no hay momento flector.

**Resistencia a pandeo lateral del ala inferior:** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.2.4)

La comprobación a pandeo lateral no procede, ya que la longitud de pandeo lateral es nula.

**Resistencia a flexión. Eje Z** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.4.1)

La comprobación no procede, ya que no hay momento flector.

**Resistencia a flexión biaxial** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.4.1)

La comprobación no procede, ya que no hay flexión biaxial para ninguna combinación.

**Resistencia a corte Y** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.5)

La comprobación no procede, ya que no hay esfuerzo cortante.

**Resistencia a corte Z** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.5)

Se debe satisfacer:

$$\eta = \frac{V_{Ed}}{V_{b,Rd}} \leq 1$$

$\eta$ : ***0.157*** ✓

El esfuerzo solicitante de cálculo pésimo se produce en el nudo 0.498, 42.700, 6.050, para la combinación de acciones 0.80*G1 + 0.80*G2 + 1.50*V(0°) H1.

**$V_{Ed}$**: Esfuerzo cortante solicitante de cálculo pésimo. $V_{Ed}$ : *0.928* t

El esfuerzo cortante resistente de cálculo **$V_{b,Rd}$** viene dado por:

$$V_{b,Rd} = \frac{\frac{h_w}{\sin\phi} \cdot t \cdot f_{bv}}{\gamma_{M0}}$$

$V_{b,Rd}$ : *5.913* t

Donde:

**$h_w$**: Altura del alma. $h_w$ : *220.30* mm

**t**: Espesor. $t$ : *2.50* mm

**$\phi$**: Ángulo que forma el alma con la horizontal. $\phi$ : *90.0* grados

**$f_{bv}$**: Resistencia a cortante, teniendo en cuenta el pandeo.

$$0.83 < \bar{\lambda}_w < 1.40 \rightarrow f_{bv} = 0.48 \cdot f_{yb} / \bar{\lambda}_w$$

$f_{bv}$ : *1127.35* kp/cm²

Siendo:

**$\bar{\lambda}_w$**: Esbeltez relativa del alma.

$$\bar{\lambda}_w = 0.346 \cdot \frac{h_w}{t} \cdot \sqrt{\frac{f_{yb}}{E}}$$

$\bar{\lambda}_w$ : *1.02*

Donde:

**$f_{yb}$**: Límite elástico del material base. (CTE DB SE-A, Tabla 4.1) $f_{yb}$ : *2395.51* kp/cm²

**E**: Módulo de elasticidad. **E** : *2140672.78* kp/cm²

**$\gamma_{M0}$**: Coeficiente parcial de seguridad del material. $\gamma_{M0}$ : *1.05*

**Resistencia a tracción y flexión** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículos 6.1.8 y 6.3)

No hay interacción entre axil de tracción y momento flector para ninguna combinación. Por lo tanto, la comprobación no procede.

**Resistencia a compresión y flexión** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículos 6.1.9 y 6.2.5)

No hay interacción entre axil de compresión y momento flector para ninguna combinación. Por lo tanto, la comprobación no procede.

**Resistencia a cortante, axil y flexión** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.10)

No hay interacción entre momento flector, axil y cortante para ninguna combinación. Por lo tanto, la comprobación no procede.

**Resistencia a torsión combinada con axil, flexión y cortante** (CTE DB SE-A y Eurocódigo 3 EN 1993-1-3: 2006, Artículo 6.1.6)

La comprobación no procede, ya que no hay momento torsor.

Comprobación de flecha _____

| Comprobación de flecha |
|---|
| El perfil seleccionado cumple todas las comprobaciones. |
| Porcentajes de aprovechamiento: |
| - Flecha: 93.12 % |

### 2.2.2 PÓRTICO CENTRAL SIN ALMACEN

Nudos

| Nudos | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Referencia | Coordenadas | | | Vinculación exterior | | | | | | Vinculación interior |
| | X (m) | Y (m) | Z (m) | $\delta_x$ | $\delta_y$ | $\delta_z$ | $\delta_x$ | $\delta_y$ | $\delta_z$ | |
| N26 | 30.500 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N27 | 30.500 | 0.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N28 | 30.500 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N29 | 30.500 | 18.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N30 | 30.500 | 9.000 | 6.900 | - | - | - | - | - | - | Empotrado |
| N57 | 30.500 | 0.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N58 | 30.500 | 0.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N77 | 30.500 | 17.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N78 | 30.500 | 18.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N87 | 30.500 | 17.750 | 4.500 | - | - | - | - | - | - | Empotrado |
| N95 | 30.500 | 0.250 | 4.500 | - | - | - | - | - | - | Empotrado |
| N101 | 30.500 | 6.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N107 | 30.500 | 12.000 | 6.600 | - | - | - | - | - | - | Empotrado |

Descripción de barras

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| Acero laminado | | N26/N57 | N26/N27 | HE 220 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.70 | 4.500 | 4.500 |
| | | N57/N27 | N26/N27 | HE 220 B (HEB) | 0.100 | 1.249 | 0.151 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N28/N78 | N28/N29 | HE 220 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.70 | 4.500 | 4.500 |
| | | N78/N29 | N28/N29 | HE 220 B (HEB) | 0.100 | 1.249 | 0.151 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N27/N101 | N27/N30 | IPE 300 (IPE) | 0.111 | 5.919 | - | 0.17 | 1.00 | 1.000 | 2.000 |
| | | N101/N30 | N27/N30 | IPE 300 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N29/N107 | N29/N30 | IPE 300 (IPE) | 0.111 | 5.919 | - | 0.17 | 1.00 | 1.000 | 2.000 |
| | | N107/N30 | N29/N30 | IPE 300 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N57/N95 | N57/N58 | IPE 200 (IPE) | 0.110 | 0.140 | - | 1.00 | 1.00 | - | - |
| | | N95/N58 | N57/N58 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N77/N87 | N77/N78 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N87/N78 | N77/N78 | IPE 200 (IPE) | - | 0.140 | 0.110 | 1.00 | 1.00 | - | - |

*Notación:*

*Ni: Nudo inicial*
*Nf: Nudo final*
*$\beta_{xy}$: Coeficiente de pandeo en el plano 'XY'*
*$\beta_{xz}$: Coeficiente de pandeo en el plano 'XZ'*
*$Lb_{Sup.}$: Separación entre arriostramientos del ala superior*
*$Lb_{Inf.}$: Separación entre arriostramientos del ala inferior*

Cargas

A continuación se exponen las cargas sobre las barras y se indican las cargas sobre los nudos aplicadas. En estas cargas sobre nudos se consideran las cargas relativas al puente grúa y su viga carril. A continuación se indican las cargas consideradas debidas al puente grúa.

Datos de cargas del puente grúa considerados:

Puente grúa de 18 m de luz con capacidad máxima de carga de 2,5 Tn

Reacción máxima por rueda (kg): 2.420 Kg.

Reacción mínima por rueda (kg): 770 kg.

Se consideran dos ruedas en cada uno de los lados. Estos datos provienen de la ficha técnica facilitada por un fabricante de puentes grúa.

Reacción vertical

Reacción máxima 2.035 x 2 = 4.070 kg

Reacción mínima 745 x 2= 1.490 Kg

Reacción transversal

Reacción máxima 4.070 kg/10 = 407 Kg

Reacción mínima 1.490 Kg/10 = 149 Kg

Reacción longitudinal (dirección desplazamiento)

Reacción máxima 4.070 kg/7 = 581,4 Kg

Reacción mínima 1.490 Kg/7= 212,9 Kg

Peso viga carril IPE-300 + Cuadradillo 40x30 (el peso lineal del conjunto de la viga carril es de 45,5 kg/m, aplicándose una carga en nudo de 278 kg en los pilares centrales y de 139 kg en los pilares de esquina, siendo la diferencia función de la longitud de viga carril que apoya sobre la ménsula del pilar).

Las anteriores cargas, se mayoran siguiendo con las indicaciones del CTE, considerando una mayoración de 1,35 para cargas fijas como el peso propio de la viga carril, y de 1,5 para sobrecargas como las acciones horizontales y vertical del puente grúa con su movimiento en el espacio.

A la hora del cálculo, el puente grúa se considera como dos acciones no combinables formadas por 3 grupos de cargas, acciones verticales y horizontales en una y otra direcciones, aplicándose las cargas considerando que el puente grúa se ubique en un lado u otro, próximo al eje de pilares, siendo la posición centrada de la grúa un valor intermedio y más favorable al repartir de forma uniforme la carga entre los pilares de ambos ejes. A su vez se considera de la forma más pésima en cuanto a carga, considerando la ubicación del puente sobre un pórtico, repartiendo la carga sobre un pilar y no sobre dos pórticos como sería la situación de ubicarse el carro entre dos pórticos.

**Cargas en nudos**

| Referencia | Hipótesis | Cargas puntuales (t) | Dirección | | |
|---|---|---|---|---|---|
| | | | X | Y | Z |
| N87 | Peso propio | 0.280 | 0.000 | 0.000 | -1.000 |
| N87 | PUENTE1 | 0.220 | 1.000 | 0.000 | 0.000 |
| N87 | PUENTE1 | 0.154 | 0.000 | 1.000 | 0.000 |
| N87 | PUENTE1 | 1.540 | 0.000 | 0.000 | -1.000 |
| N87 | PUENTE2 | 0.484 | 0.000 | 1.000 | 0.000 |
| N87 | PUENTE2 | 0.691 | -1.000 | 0.000 | 0.000 |
| N87 | PUENTE2 | 4.840 | 0.000 | 0.000 | -1.000 |
| N95 | Peso propio | 0.280 | 0.000 | 0.000 | -1.000 |
| N95 | PUENTE1 | 0.691 | 1.000 | 0.000 | 0.000 |
| N95 | PUENTE1 | 0.484 | 0.000 | -1.000 | 0.000 |
| N95 | PUENTE1 | 4.840 | 0.000 | 0.000 | -1.000 |
| N95 | PUENTE2 | 0.154 | 0.000 | -1.000 | 0.000 |
| N95 | PUENTE2 | 0.220 | -1.000 | 0.000 | 0.000 |
| N95 | PUENTE2 | 1.540 | 0.000 | 0.000 | -1.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N26/N57 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N26/N57 | V(0°) H1 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N26/N57 | V(0°) H2 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N26/N57 | V(90°) H1 | Uniforme | 0.418 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N26/N57 | V(180°) H1 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N26/N57 | V(180°) H2 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N26/N57 | V(270°) H1 | Uniforme | 0.487 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N26/N57 | V(270°) H1 | Uniforme | 0.114 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N57/N27 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N57/N27 | V(0°) H1 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N57/N27 | V(0°) H2 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N57/N27 | V(90°) H1 | Uniforme | 0.418 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N57/N27 | V(180°) H1 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N57/N27 | V(180°) H2 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N57/N27 | V(270°) H1 | Uniforme | 0.487 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N57/N27 | V(270°) H1 | Uniforme | 0.114 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N28/N78 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N28/N78 | V(0°) H1 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N28/N78 | V(0°) H1 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N28/N78 | V(0°) H2 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N28/N78 | V(90°) H1 | Uniforme | 0.418 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N28/N78 | V(180°) H1 | Uniforme | 0.600 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N28/N78 | V(180°) H2 | Uniforme | 0.600 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N28/N78 | V(270°) H1 | Uniforme | 0.114 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N28/N78 | V(270°) H1 | Uniforme | 0.487 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N78/N29 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N78/N29 | V(0°) H1 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N78/N29 | V(0°) H1 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N78/N29 | V(0°) H2 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N78/N29 | V(90°) H1 | Uniforme | 0.418 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N78/N29 | V(180°) H1 | Uniforme | 0.600 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N78/N29 | V(180°) H2 | Uniforme | 0.600 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N78/N29 | V(270°) H1 | Uniforme | 0.114 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N78/N29 | V(270°) H1 | Uniforme | 0.487 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N27/N101 | Peso propio | Trapezoidal | 0.070 | 0.055 | 0.000 | 0.900 | Globales | 0.000 | 0.000 | -1.000 |
| N27/N101 | Peso propio | Faja | 0.042 | - | 0.900 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N27/N101 | Peso propio | Uniforme | 0.096 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N27/N101 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N27/N101 | V(0°) H1 | Faja | 0.979 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | 0.995 |
| N27/N101 | V(0°) H1 | Faja | 0.484 | - | 1.387 | 6.030 | Globales | 0.000 | -0.100 | 0.995 |
| N27/N101 | V(0°) H2 | Faja | 0.012 | - | 1.387 | 6.030 | Globales | -0.000 | 0.100 | -0.995 |
| N27/N101 | V(0°) H2 | Faja | 0.012 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | -0.995 |
| N27/N101 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N27/N101 | V(180°) H1 | Uniforme | 0.490 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N27/N101 | V(180°) H2 | Uniforme | 0.466 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N27/N101 | V(270°) H1 | Uniforme | 0.491 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N27/N101 | V(270°) H1 | Uniforme | 0.005 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N27/N101 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N27/N101 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N27/N101 | N(R) 2 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N101/N30 | Peso propio | Uniforme | 0.042 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N101/N30 | Peso propio | Uniforme | 0.096 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N101/N30 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N101/N30 | V(0°) H1 | Uniforme | 0.484 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | V(0°) H2 | Uniforme | 0.012 | - | - | - | Globales | -0.000 | 0.100 | -0.995 |
| N101/N30 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | V(180°) H1 | Faja | 0.096 | - | 1.635 | 3.015 | Globales | -0.000 | 0.100 | -0.995 |
| N101/N30 | V(180°) H1 | Faja | 0.490 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | V(180°) H2 | Faja | 0.466 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | V(180°) H2 | Faja | 0.466 | - | 1.635 | 3.015 | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | V(270°) H1 | Uniforme | 0.491 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | V(270°) H1 | Uniforme | 0.005 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N101/N30 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N101/N30 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N101/N30 | N(R) 2 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | Peso propio | Trapezoidal | 0.070 | 0.055 | 0.000 | 0.900 | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | Peso propio | Faja | 0.042 | - | 0.900 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | Peso propio | Uniforme | 0.110 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | V(0°) H1 | Uniforme | 0.490 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N29/N107 | V(0°) H2 | Uniforme | 0.466 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N29/N107 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N29/N107 | V(180°) H1 | Faja | 0.979 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | 0.995 |
| N29/N107 | V(180°) H1 | Faja | 0.484 | - | 1.387 | 6.030 | Globales | 0.000 | 0.100 | 0.995 |
| N29/N107 | V(180°) H2 | Faja | 0.012 | - | 1.387 | 6.030 | Globales | -0.000 | -0.100 | -0.995 |
| N29/N107 | V(180°) H2 | Faja | 0.012 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | -0.995 |
| N29/N107 | V(270°) H1 | Uniforme | 0.491 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N29/N107 | V(270°) H1 | Uniforme | 0.005 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N29/N107 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | N(R) 1 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N29/N107 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N107/N30 | Peso propio | Uniforme | 0.042 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N107/N30 | Peso propio | Uniforme | 0.110 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N107/N30 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N107/N30 | V(0°) H1 | Faja | 0.096 | - | 1.635 | 3.015 | Globales | -0.000 | -0.100 | -0.995 |
| N107/N30 | V(0°) H1 | Faja | 0.490 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N107/N30 | V(0°) H2 | Faja | 0.466 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N107/N30 | V(0°) H2 | Faja | 0.466 | - | 1.635 | 3.015 | Globales | 0.000 | 0.100 | 0.995 |
| N107/N30 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N107/N30 | V(180°) H1 | Uniforme | 0.484 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N107/N30 | V(180°) H2 | Uniforme | 0.012 | - | - | - | Globales | -0.000 | -0.100 | -0.995 |
| N107/N30 | V(270°) H1 | Uniforme | 0.491 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N107/N30 | V(270°) H1 | Uniforme | 0.005 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N107/N30 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N107/N30 | N(R) 1 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N107/N30 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N57/N95 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N95/N58 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N77/N87 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N87/N78 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |

## Tensiones

| Comprobación de resistencia | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | η (%) | Posición (m) | Esfuerzos pésimos | | | | | | Origen | Estado |
| | | | N (t) | Vy (t) | Vz (t) | Mt (t·m) | My (t·m) | Mz (t·m) | | |
| N26/N57 | 94.15 | 0.000 | 5.671 | 0.021 | 8.278 | 0.000 | 17.926 | 0.068 | GV | Cumple |
| N57/N27 | 83.03 | 1.349 | -7.197 | -0.011 | -4.842 | 0.000 | 17.625 | 0.025 | G | Cumple |
| N28/N78 | 85.00 | 0.000 | 5.518 | -0.002 | -7.851 | 0.000 | -16.183 | -0.021 | GV | Cumple |
| N78/N29 | 84.13 | 1.349 | -7.292 | 0.045 | 4.843 | 0.000 | -17.700 | -0.101 | G | Cumple |
| N27/N101 | 86.27 | 1.012 | -5.445 | -0.002 | -5.768 | 0.000 | -12.125 | -0.004 | G | Cumple |
| N101/N30 | 62.51 | 2.450 | -4.887 | 0.001 | -0.036 | -0.001 | 9.863 | -0.003 | G | Cumple |
| N29/N107 | 86.17 | 1.012 | -5.453 | 0.000 | -5.846 | 0.000 | -12.113 | -0.003 | G | Cumple |
| N107/N30 | 62.82 | 2.450 | -4.880 | -0.004 | 0.037 | 0.001 | 9.907 | 0.006 | G | Cumple |
| N57/N95 | 35.41 | 0.110 | -0.726 | -1.036 | -7.650 | 0.000 | -1.072 | -0.145 | G | Cumple |
| N95/N58 | 0.03 | 0.000 | 0.000 | 0.000 | -0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N77/N87 | 0.03 | 0.250 | 0.000 | 0.000 | 0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N87/N78 | 35.41 | 0.140 | -0.726 | -1.036 | 7.650 | 0.000 | -1.072 | 0.145 | G | Cumple |

## Flechas

| Flechas | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grupo | Flecha máxima absoluta xy<br>Flecha máxima relativa xy | | Flecha máxima absoluta xz<br>Flecha máxima relativa xz | | Flecha activa absoluta xy<br>Flecha activa relativa xy | | Flecha activa absoluta xz<br>Flecha activa relativa xz | |
| | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) |
| N26/N27 | 1.650<br>1.650 | 4.36<br>L/982.1 | 3.850<br>3.850 | 10.97<br>L/450.7 | 1.650<br>1.650 | 7.36<br>L/982.1 | 3.850<br>4.125 | 14.81<br>L/454.6 |
| N28/N29 | 1.650<br>1.650 | 4.49<br>L/957.5 | 3.850<br>3.850 | 11.08<br>L/450.7 | 1.650<br>1.650 | 8.05<br>L/958.5 | 4.125<br>3.850 | 15.25<br>L/452.5 |
| N27/N30 | 2.376<br>1.786 | 2.33<br>L/(>1000) | 5.328<br>0.901 | 28.18<br>L/300.8 | 2.671<br>1.786 | 3.47<br>L/(>1000) | 5.033<br>0.901 | 43.82<br>L/300.9 |
| N57/N58 | 0.070<br>0.070 | 0.00<br>L/(>1000) | 0.140<br>0.140 | 0.06<br>L/(>1000) | 0.070<br>0.070 | 0.01<br>L/(>1000) | 0.140<br>0.140 | 0.05<br>L/(>1000) |
| N77/N78 | 0.320<br>0.320 | 0.00<br>L/(>1000) | 0.250<br>0.250 | 0.06<br>L/(>1000) | 0.320<br>0.320 | 0.01<br>L/(>1000) | 0.250<br>0.250 | 0.05<br>L/(>1000) |

### 2.2.3 PÓRTICO CENTRAL CON ALMACÉN

Nudos

| Nudos | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Referencia | Coordenadas | | | Vinculación exterior | | | | | | Vinculación interior |
| | X (m) | Y (m) | Z (m) | $\Delta_x$ | $\Delta_y$ | $\Delta_z$ | $\theta_x$ | $\theta_y$ | $\theta_z$ | |
| N16 | 18.300 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N17 | 18.300 | 0.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N18 | 18.300 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N19 | 18.300 | 18.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N20 | 18.300 | 9.000 | 6.900 | - | - | - | - | - | - | Empotrado |
| N53 | 18.300 | 0.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N54 | 18.300 | 0.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N73 | 18.300 | 17.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N74 | 18.300 | 18.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N85 | 18.300 | 17.750 | 4.500 | - | - | - | - | - | - | Empotrado |
| N93 | 18.300 | 0.250 | 4.500 | - | - | - | - | - | - | Empotrado |
| N99 | 18.300 | 6.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N105 | 18.300 | 12.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N115 | 18.300 | 26.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N116 | 18.300 | 26.000 | 5.200 | - | - | - | - | - | - | Empotrado |

Descripción de barras

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| Acero laminado | | N16/N53 | N16/N17 | HE 220 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.70 | 4.500 | 4.500 |
| | | N53/N17 | N16/N17 | HE 220 B (HEB) | 0.100 | 1.249 | 0.151 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N18/N74 | N18/N19 | HE 220 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.50 | 4.500 | 4.500 |
| | | N74/N19 | N18/N19 | HE 220 B (HEB) | 0.100 | 1.249 | 0.151 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N17/N99 | N17/N20 | IPE 300 (IPE) | 0.111 | 5.919 | - | 0.17 | 1.00 | 1.000 | 2.000 |
| | | N99/N20 | N17/N20 | IPE 300 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N19/N105 | N19/N20 | IPE 300 (IPE) | 0.111 | 5.919 | - | 0.17 | 1.00 | 1.000 | 2.000 |
| | | N105/N20 | N19/N20 | IPE 300 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N53/N93 | N53/N54 | IPE 200 (IPE) | 0.110 | 0.140 | - | 1.00 | 1.00 | - | - |
| | | N93/N54 | N53/N54 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N73/N85 | N73/N74 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N85/N74 | N73/N74 | IPE 200 (IPE) | - | 0.140 | 0.110 | 1.00 | 1.00 | - | - |
| | | N115/N116 | N115/N116 | HE 200 B (HEB) | - | 5.099 | 0.101 | 0.50 | 0.70 | 2.600 | 2.600 |

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| | | N116/N19 | N116/N19 | IPE 220 (IPE) | 0.101 | 7.828 | 0.111 | 0.12 | 1.00 | 1.000 | 2.000 |

*Notación:*
*Ni: Nudo inicial*
*Nf: Nudo final*
*$\beta_{xy}$: Coeficiente de pandeo en el plano 'XY'*
*$\beta_{xz}$: Coeficiente de pandeo en el plano 'XZ'*
*$Lb_{Sup.}$: Separación entre arriostramientos del ala superior*
*$Lb_{Inf.}$: Separación entre arriostramientos del ala inferior*

Cargas

A continuación se exponen las cargas sobre las barras y se indican las cargas sobre los nudos aplicadas. En estas cargas sobre nudos se consideran las cargas relativas al puente grúa y su viga carril, de igual forma a lo indicado en el primer subapartado de cargas.

| Cargas en nudos | | | | | |
|---|---|---|---|---|---|
| Referencia | Hipótesis | Cargas puntuales (t) | Dirección | | |
| | | | X | Y | Z |
| N85 | Peso propio | 0.280 | 0.000 | 0.000 | -1.000 |
| N85 | PUENTE1 | 0.220 | 1.000 | 0.000 | 0.000 |
| N85 | PUENTE1 | 0.154 | 0.000 | 1.000 | 0.000 |
| N85 | PUENTE1 | 1.540 | 0.000 | 0.000 | -1.000 |
| N85 | PUENTE2 | 0.484 | 0.000 | 1.000 | 0.000 |
| N85 | PUENTE2 | 0.691 | -1.000 | 0.000 | 0.000 |
| N85 | PUENTE2 | 4.840 | 0.000 | 0.000 | -1.000 |
| N93 | Peso propio | 0.280 | 0.000 | 0.000 | -1.000 |
| N93 | PUENTE1 | 0.691 | 1.000 | 0.000 | 0.000 |
| N93 | PUENTE1 | 0.484 | 0.000 | -1.000 | 0.000 |
| N93 | PUENTE1 | 4.840 | 0.000 | 0.000 | -1.000 |
| N93 | PUENTE2 | 0.154 | 0.000 | -1.000 | 0.000 |
| N93 | PUENTE2 | 0.220 | -1.000 | 0.000 | 0.000 |
| N93 | PUENTE2 | 1.540 | 0.000 | 0.000 | -1.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N16/N53 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N16/N53 | V(0°) H1 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N16/N53 | V(0°) H2 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N16/N53 | V(90°) H1 | Uniforme | 0.023 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N16/N53 | V(90°) H1 | Uniforme | 0.404 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N16/N53 | V(180°) H1 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N16/N53 | V(180°) H2 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N16/N53 | V(270°) H1 | Uniforme | 0.418 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N53/N17 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N53/N17 | V(0°) H1 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N53/N17 | V(0°) H2 | Uniforme | 0.600 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N53/N17 | V(90°) H1 | Uniforme | 0.023 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N53/N17 | V(90°) H1 | Uniforme | 0.404 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N53/N17 | V(180°) H1 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N53/N17 | V(180°) H2 | Uniforme | 0.280 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N53/N17 | V(270°) H1 | Uniforme | 0.418 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N18/N74 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N18/N74 | V(0°) H1 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N18/N74 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N18/N74 | V(0°) H1 | Uniforme | 0.276 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N18/N74 | V(0°) H2 | Uniforme | 0.276 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N18/N74 | V(0°) H2 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N18/N74 | V(90°) H1 | Uniforme | 0.164 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N18/N74 | V(90°) H1 | Uniforme | 0.209 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N18/N74 | V(180°) H1 | Uniforme | 0.656 | - | - | - | Globales | 1.000 | 0.000 | -0.000 |
| N18/N74 | V(180°) H1 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N18/N74 | V(180°) H2 | Uniforme | 0.656 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N18/N74 | V(180°) H2 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N18/N74 | V(270°) H1 | Uniforme | 0.418 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N18/N74 | V(270°) H1 | Uniforme | 0.384 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N74/N19 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N74/N19 | V(0°) H1 | Uniforme | 0.280 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N74/N19 | V(0°) H1 | Triangular Izq. | 0.276 | - | 0.700 | 1.500 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(0°) H1 | Faja | 0.276 | - | 0.000 | 0.700 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N74/N19 | V(0°) H2 | Triangular Izq. | 0.276 | - | 0.700 | 1.500 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(0°) H2 | Faja | 0.276 | - | 0.000 | 0.700 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(0°) H2 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N74/N19 | V(90°) H1 | Uniforme | 0.209 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N74/N19 | V(90°) H1 | Faja | 0.164 | - | 0.000 | 0.700 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(90°) H1 | Triangular Izq. | 0.164 | - | 0.700 | 1.500 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(180°) H1 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N74/N19 | V(180°) H1 | Triangular Izq. | 0.656 | - | 0.700 | 1.500 | Globales | 1.000 | 0.000 | -0.000 |
| N74/N19 | V(180°) H1 | Faja | 0.656 | - | 0.000 | 0.700 | Globales | 1.000 | 0.000 | -0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N74/N19 | V(180°) H2 | Triangular Izq. | 0.656 | - | 0.700 | 1.500 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(180°) H2 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N74/N19 | V(180°) H2 | Faja | 0.656 | - | 0.000 | 0.700 | Globales | 1.000 | -0.000 | -0.000 |
| N74/N19 | V(270°) H1 | Uniforme | 0.418 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N74/N19 | V(270°) H1 | Faja | 0.384 | - | 0.000 | 0.700 | Globales | -1.000 | 0.000 | 0.000 |
| N74/N19 | V(270°) H1 | Triangular Izq. | 0.384 | - | 0.700 | 1.500 | Globales | -1.000 | 0.000 | 0.000 |
| N17/N99 | Peso propio | Trapezoidal | 0.070 | 0.055 | 0.000 | 0.900 | Globales | 0.000 | 0.000 | -1.000 |
| N17/N99 | Peso propio | Faja | 0.042 | - | 0.900 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N17/N99 | Peso propio | Uniforme | 0.096 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N17/N99 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N17/N99 | V(0°) H1 | Faja | 0.979 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | 0.995 |
| N17/N99 | V(0°) H1 | Faja | 0.484 | - | 1.387 | 6.030 | Globales | 0.000 | -0.100 | 0.995 |
| N17/N99 | V(0°) H2 | Faja | 0.012 | - | 1.387 | 6.030 | Globales | -0.000 | 0.100 | -0.995 |
| N17/N99 | V(0°) H2 | Faja | 0.012 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | -0.995 |
| N17/N99 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N17/N99 | V(180°) H1 | Uniforme | 0.490 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N17/N99 | V(180°) H2 | Uniforme | 0.466 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N17/N99 | V(270°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N17/N99 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N17/N99 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N17/N99 | N(R) 2 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N99/N20 | Peso propio | Uniforme | 0.042 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N99/N20 | Peso propio | Uniforme | 0.096 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N99/N20 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N99/N20 | V(0°) H1 | Uniforme | 0.484 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N99/N20 | V(0°) H2 | Uniforme | 0.012 | - | - | - | Globales | -0.000 | 0.100 | -0.995 |
| N99/N20 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N99/N20 | V(180°) H1 | Faja | 0.490 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N99/N20 | V(180°) H1 | Faja | 0.096 | - | 1.635 | 3.015 | Globales | -0.000 | 0.100 | -0.995 |
| N99/N20 | V(180°) H2 | Faja | 0.466 | - | 1.635 | 3.015 | Globales | 0.000 | -0.100 | 0.995 |
| N99/N20 | V(180°) H2 | Faja | 0.466 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N99/N20 | V(270°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N99/N20 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N99/N20 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N99/N20 | N(R) 2 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | Peso propio | Trapezoidal | 0.070 | 0.055 | 0.000 | 0.900 | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | Peso propio | Faja | 0.042 | - | 0.900 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | Peso propio | Uniforme | 0.110 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | V(0°) H1 | Uniforme | 0.490 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N19/N105 | V(0°) H2 | Uniforme | 0.466 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N19/N105 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N19/N105 | V(180°) H1 | Faja | 0.484 | - | 1.387 | 6.030 | Globales | 0.000 | 0.100 | 0.995 |
| N19/N105 | V(180°) H1 | Faja | 0.979 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | 0.995 |

| Cargas en barras | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N19/N105 | V(180°) H2 | Faja | 0.012 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | -0.995 |
| N19/N105 | V(180°) H2 | Faja | 0.012 | - | 1.387 | 6.030 | Globales | -0.000 | -0.100 | -0.995 |
| N19/N105 | V(270°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N19/N105 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | N(R) 1 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N19/N105 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N105/N20 | Peso propio | Uniforme | 0.042 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N105/N20 | Peso propio | Uniforme | 0.110 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N105/N20 | QCubierta | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N105/N20 | V(0°) H1 | Faja | 0.096 | - | 1.635 | 3.015 | Globales | -0.000 | -0.100 | -0.995 |
| N105/N20 | V(0°) H1 | Faja | 0.490 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N105/N20 | V(0°) H2 | Faja | 0.466 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N105/N20 | V(0°) H2 | Faja | 0.466 | - | 1.635 | 3.015 | Globales | 0.000 | 0.100 | 0.995 |
| N105/N20 | V(90°) H1 | Uniforme | 0.496 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N105/N20 | V(180°) H1 | Uniforme | 0.484 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N105/N20 | V(180°) H2 | Uniforme | 0.012 | - | - | - | Globales | -0.000 | -0.100 | -0.995 |
| N105/N20 | V(270°) H1 | Uniforme | 0.496 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N105/N20 | N(EI) | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N105/N20 | N(R) 1 | Uniforme | 0.368 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N105/N20 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N53/N93 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N93/N54 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N73/N85 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N85/N74 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N115/N116 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N115/N116 | V(0°) H1 | Uniforme | 0.276 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N115/N116 | V(0°) H2 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N115/N116 | V(0°) H2 | Uniforme | 0.276 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N115/N116 | V(90°) H1 | Uniforme | 0.334 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N115/N116 | V(90°) H1 | Uniforme | 0.164 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N115/N116 | V(180°) H1 | Uniforme | 0.656 | - | - | - | Globales | 1.000 | 0.000 | -0.000 |
| N115/N116 | V(180°) H1 | Uniforme | 0.299 | - | - | - | Globales | -0.000 | -1.000 | -0.000 |
| N115/N116 | V(180°) H2 | Uniforme | 0.299 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N115/N116 | V(180°) H2 | Uniforme | 0.656 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N115/N116 | V(270°) H1 | Uniforme | 0.384 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N115/N116 | V(270°) H1 | Uniforme | 0.500 | - | - | - | Globales | 0.000 | 1.000 | 0.000 |
| N116/N19 | Peso propio | Faja | 0.026 | - | 0.000 | 7.240 | Globales | 0.000 | 0.000 | -1.000 |
| N116/N19 | Peso propio | Trapezoidal | 0.034 | 0.044 | 7.240 | 8.040 | Globales | 0.000 | 0.000 | -1.000 |
| N116/N19 | Peso propio | Uniforme | 0.055 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N116/N19 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N116/N19 | V(0°) H1 | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N116/N19 | V(0°) H1 | Triangular Izq. | 0.027 | - | 0.000 | 8.040 | Globales | 1.000 | -0.000 | -0.000 |
| N116/N19 | V(0°) H2 | Uniforme | 0.232 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N116/N19 | V(0°) H2 | Triangular Izq. | 0.027 | - | 0.000 | 8.040 | Globales | 1.000 | -0.000 | -0.000 |

| Cargas en barras | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N116/N19 | V(90°) H1 | Uniforme | 0.247 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N116/N19 | V(90°) H1 | Triangular Izq. | 0.016 | - | 0.000 | 8.040 | Globales | 1.000 | -0.000 | -0.000 |
| N116/N19 | V(180°) H1 | Triangular Izq. | 0.065 | - | 0.000 | 8.040 | Globales | 1.000 | 0.000 | -0.000 |
| N116/N19 | V(180°) H1 | Faja | 0.687 | - | 0.000 | 1.387 | Globales | 0.000 | 0.100 | 0.995 |
| N116/N19 | V(180°) H1 | Faja | 0.241 | - | 1.387 | 8.040 | Globales | 0.000 | 0.100 | 0.995 |
| N116/N19 | V(180°) H2 | Uniforme | 0.006 | - | - | - | Globales | 0.000 | -0.100 | -0.995 |
| N116/N19 | V(180°) H2 | Triangular Izq. | 0.065 | - | 0.000 | 8.040 | Globales | 1.000 | -0.000 | -0.000 |
| N116/N19 | V(270°) H1 | Trapezoidal | 0.131 | 0.127 | 0.000 | 8.040 | Globales | -0.000 | 0.100 | 0.995 |
| N116/N19 | V(270°) H1 | Trapezoidal | 0.361 | 0.371 | 0.000 | 8.040 | Globales | 0.000 | 0.100 | 0.995 |
| N116/N19 | V(270°) H1 | Triangular Izq. | 0.038 | - | 0.000 | 8.040 | Globales | -1.000 | 0.000 | 0.000 |
| N116/N19 | N(EI) | Uniforme | 0.183 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N116/N19 | N(R) 1 | Uniforme | 0.183 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N116/N19 | N(R) 2 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |

## Tensiones

| Comprobación de resistencia | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | η (%) | Posición (m) | Esfuerzos pésimos | | | | | | Origen | Estado |
| | | | N (t) | Vy (t) | Vz (t) | Mt (t·m) | My (t·m) | Mz (t·m) | | |
| N16/N53 | 75.92 | 0.000 | 5.294 | 0.012 | 7.331 | 0.000 | 14.455 | 0.044 | GV | Cumple |
| N53/N17 | 78.58 | 1.349 | -6.975 | -0.019 | -4.501 | 0.000 | 16.625 | 0.044 | G | Cumple |
| N18/N74 | 91.36 | 0.000 | -1.403 | 3.427 | -4.188 | -0.003 | -10.249 | 3.870 | GV | Cumple |
| N74/N19 | 68.94 | 1.349 | -9.306 | 0.036 | 4.005 | 0.000 | -14.211 | -0.079 | G | Cumple |
| N17/N99 | 80.01 | 1.012 | -5.078 | 0.000 | -5.583 | 0.000 | -11.262 | -0.001 | G | Cumple |
| N99/N20 | 60.76 | 2.450 | -4.512 | -0.001 | 0.033 | 0.000 | 9.626 | 0.000 | G | Cumple |
| N19/N105 | 94.58 | 1.012 | -5.099 | -0.004 | -5.931 | 0.000 | -13.386 | -0.012 | G | Cumple |
| N105/N20 | 60.28 | 2.638 | -4.513 | 0.000 | -0.009 | 0.000 | 9.540 | 0.002 | G | Cumple |
| N53/N93 | 35.41 | 0.110 | -0.726 | -1.036 | -7.650 | 0.000 | -1.072 | -0.145 | G | Cumple |
| N93/N54 | 0.03 | 0.000 | 0.000 | 0.000 | -0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N73/N85 | 0.03 | 0.250 | 0.000 | 0.000 | 0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N85/N74 | 35.41 | 0.140 | -0.726 | -1.036 | 7.650 | 0.000 | -1.072 | 0.145 | G | Cumple |
| N115/N116 | 86.74 | 0.000 | 0.209 | 3.135 | -3.009 | 0.010 | -7.311 | 3.348 | GV | Cumple |
| N116/N19 | 70.97 | 7.130 | -0.015 | -0.087 | 2.033 | -0.005 | -4.130 | 0.081 | GV | Cumple |

## Flechas

| Flechas | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grupo | Flecha máxima absoluta xy<br>Flecha máxima relativa xy | | Flecha máxima absoluta xz<br>Flecha máxima relativa xz | | Flecha activa absoluta xy<br>Flecha activa relativa xy | | Flecha activa absoluta xz<br>Flecha activa relativa xz | |
| | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) |
| N16/N17 | 1.650<br>1.650 | 4.41<br>L/983.4 | 3.850<br>3.850 | 10.90<br>L/476.1 | 1.650<br>1.650 | 7.44<br>L/983.6 | 3.850<br>3.850 | 15.22<br>L/478.2 |
| N18/N19 | 2.750<br>1.100 | 6.12<br>L/877.2 | 3.850<br>3.850 | 8.43<br>L/567.4 | 2.200<br>1.100 | 7.99<br>L/878.4 | 4.125<br>3.850 | 11.42<br>L/571.3 |
| N17/N20 | 2.376<br>1.195 | 2.43<br>L/(>1000) | 5.328<br>5.328 | 25.47<br>L/350.8 | 2.967<br>1.195 | 3.46<br>L/(>1000) | 5.328<br>5.328 | 37.48<br>L/352.0 |
| N19/N20 | 1.786<br>1.786 | 4.13<br>L/(>1000) | 5.624<br>0.901 | 21.19<br>L/305.2 | 1.786<br>1.786 | 4.76<br>L/(>1000) | 5.624<br>0.901 | 31.29<br>L/305.2 |
| N53/N54 | 0.070<br>0.070 | 0.00<br>L/(>1000) | 0.140<br>0.140 | 0.06<br>L/(>1000) | 0.070<br>0.070 | 0.01<br>L/(>1000) | 0.140<br>0.140 | 0.05<br>L/(>1000) |
| N73/N74 | 0.320<br>0.320 | 0.00<br>L/(>1000) | 0.250<br>0.250 | 0.06<br>L/(>1000) | 0.320<br>0.320 | 0.01<br>L/(>1000) | 0.250<br>0.250 | 0.05<br>L/(>1000) |
| N115/N116 | 2.550<br>2.550 | 6.62<br>L/769.7 | 1.593<br>1.593 | 4.88<br>L/(>1000) | 2.231<br>2.550 | 8.71<br>L/771.8 | 1.593<br>1.912 | 7.67<br>L/(>1000) |
| N116/N19 | 3.514<br>3.514 | 16.93<br>L/462.4 | 3.904<br>7.029 | 10.25<br>L/448.8 | 3.514<br>3.514 | 26.90<br>L/464.1 | 3.124<br>7.029 | 14.01<br>L/449.7 |

### 2.2.1 PÓRTICO HASTIAL SIN ALMACÉN

## Nudos

| Nudos | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Referencia | Coordenadas | | | Vinculación exterior | | | | | | Vinculación interior |
| | X (m) | Y (m) | Z (m) | $\Delta_x$ | $\Delta_y$ | $\Delta_z$ | $\theta_x$ | $\theta_y$ | $\theta_z$ | |
| N36 | 42.700 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N37 | 42.700 | 0.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N38 | 42.700 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N39 | 42.700 | 18.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N40 | 42.700 | 9.000 | 6.900 | - | - | - | - | - | - | Empotrado |
| N43 | 42.700 | 6.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N44 | 42.700 | 6.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N47 | 42.700 | 12.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N48 | 42.700 | 12.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N63 | 42.700 | 0.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N64 | 42.700 | 0.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N67 | 42.700 | 17.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N68 | 42.700 | 18.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N82 | 42.700 | 17.750 | 4.500 | - | - | - | - | - | - | Empotrado |
| N90 | 42.700 | 0.250 | 4.500 | - | - | - | - | - | - | Empotrado |

## Descripción de barras

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| Acero laminado | | N36/N63 | N36/N37 | HE 200 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.70 | 4.500 | 4.500 |
| | | N63/N37 | N36/N37 | HE 200 B (HEB) | 0.100 | 1.107 | 0.293 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N38/N68 | N38/N39 | HE 200 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.70 | 4.500 | 4.500 |
| | | N68/N39 | N38/N39 | HE 200 B (HEB) | 0.100 | 1.107 | 0.293 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N37/N44 | N37/N40 | IPE 200 (IPE) | 0.101 | 5.929 | - | 0.17 | 1.00 | 1.000 | 2.000 |
| | | N44/N40 | N37/N40 | IPE 200 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N39/N48 | N39/N40 | IPE 200 (IPE) | 0.101 | 5.929 | - | 0.17 | 1.00 | 1.000 | 3.000 |
| | | N48/N40 | N39/N40 | IPE 200 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N43/N44 | N43/N44 | HE 200 B (HEB) | - | 6.499 | 0.101 | 0.50 | 0.70 | - | - |
| | | N47/N48 | N47/N48 | HE 200 B (HEB) | - | 6.499 | 0.101 | 0.50 | 0.70 | - | - |
| | | N63/N90 | N63/N64 | IPE 200 (IPE) | 0.100 | 0.150 | - | 1.00 | 1.00 | - | - |
| | | N90/N64 | N63/N64 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N67/N82 | N67/N68 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N82/N68 | N67/N68 | IPE 200 (IPE) | - | 0.150 | 0.100 | 1.00 | 1.00 | - | - |

*Notación:*
*Ni: Nudo inicial*
*Nf: Nudo final*
*$\beta_{xy}$: Coeficiente de pandeo en el plano 'XY'*
*$\beta_{xz}$: Coeficiente de pandeo en el plano 'XZ'*
*$Lb_{Sup.}$: Separación entre arriostramientos del ala superior*
*$Lb_{Inf.}$: Separación entre arriostramientos del ala inferior*

## Cargas

A continuación se exponen las cargas sobre las barras y se indican las cargas sobre los nudos aplicadas. En estas cargas sobre nudos se consideran las cargas relativas al puente grúa y su viga carril, de igual forma a lo indicado en el primer subapartado del tema de cargas.

| Cargas en nudos | | | | | |
|---|---|---|---|---|---|
| Referencia | Hipótesis | Cargas puntuales (t) | Dirección | | |
| | | | X | Y | Z |
| N82 | Peso propio | 0.140 | 0.000 | 0.000 | -1.000 |
| N82 | PUENTE1 | 0.220 | 1.000 | 0.000 | 0.000 |
| N82 | PUENTE1 | 0.154 | 0.000 | 1.000 | 0.000 |
| N82 | PUENTE1 | 1.540 | 0.000 | 0.000 | -1.000 |
| N82 | PUENTE2 | 0.484 | 0.000 | 1.000 | 0.000 |
| N82 | PUENTE2 | 0.691 | -1.000 | 0.000 | 0.000 |

**Cargas en nudos**

| Referencia | Hipótesis | Cargas puntuales (t) | Dirección | | |
|---|---|---|---|---|---|
| | | | X | Y | Z |
| N82 | PUENTE2 | 4.840 | 0.000 | 0.000 | -1.000 |
| N90 | Peso propio | 0.140 | 0.000 | 0.000 | -1.000 |
| N90 | PUENTE1 | 0.691 | 1.000 | 0.000 | 0.000 |
| N90 | PUENTE1 | 0.484 | 0.000 | -1.000 | 0.000 |
| N90 | PUENTE1 | 4.840 | 0.000 | 0.000 | -1.000 |
| N90 | PUENTE2 | 0.154 | 0.000 | -1.000 | 0.000 |
| N90 | PUENTE2 | 0.220 | -1.000 | 0.000 | 0.000 |
| N90 | PUENTE2 | 1.540 | 0.000 | 0.000 | -1.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N36/N63 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N36/N63 | V(0°) H1 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(0°) H1 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(0°) H1 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N36/N63 | V(0°) H2 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(0°) H2 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(0°) H2 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N36/N63 | V(90°) H1 | Uniforme | 0.123 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(90°) H1 | Uniforme | 0.209 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N36/N63 | V(180°) H1 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N36/N63 | V(180°) H1 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(180°) H1 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(180°) H2 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(180°) H2 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N36/N63 | V(180°) H2 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N36/N63 | V(270°) H1 | Uniforme | 0.288 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N36/N63 | V(270°) H1 | Uniforme | 0.351 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N36/N63 | V(270°) H1 | Uniforme | 0.100 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N63/N37 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N63/N37 | V(0°) H1 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(0°) H1 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(0°) H1 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N63/N37 | V(0°) H2 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(0°) H2 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(0°) H2 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N63/N37 | V(90°) H1 | Uniforme | 0.123 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(90°) H1 | Uniforme | 0.209 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N63/N37 | V(180°) H1 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N63/N37 | V(180°) H1 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(180°) H1 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(180°) H2 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N63/N37 | V(180°) H2 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N63/N37 | V(180°) H2 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N63/N37 | V(270°) H1 | Uniforme | 0.288 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N63/N37 | V(270°) H1 | Uniforme | 0.351 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N63/N37 | V(270°) H1 | Uniforme | 0.100 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N38/N68 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N38/N68 | V(0°) H1 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(0°) H1 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N38/N68 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N38/N68 | V(0°) H2 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N38/N68 | V(0°) H2 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(0°) H2 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(90°) H1 | Uniforme | 0.123 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(90°) H1 | Uniforme | 0.209 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N38/N68 | V(180°) H1 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N38/N68 | V(180°) H1 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | -0.000 |
| N38/N68 | V(180°) H1 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(180°) H2 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N38/N68 | V(180°) H2 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | -0.000 |
| N38/N68 | V(180°) H2 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N38/N68 | V(270°) H1 | Uniforme | 0.351 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N38/N68 | V(270°) H1 | Uniforme | 0.100 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N38/N68 | V(270°) H1 | Uniforme | 0.288 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N68/N39 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N68/N39 | V(0°) H1 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(0°) H1 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N68/N39 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N68/N39 | V(0°) H2 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N68/N39 | V(0°) H2 | Uniforme | 0.030 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(0°) H2 | Uniforme | 0.187 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(90°) H1 | Uniforme | 0.123 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(90°) H1 | Uniforme | 0.209 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N68/N39 | V(180°) H1 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N68/N39 | V(180°) H1 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | -0.000 |
| N68/N39 | V(180°) H1 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(180°) H2 | Uniforme | 0.096 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N68/N39 | V(180°) H2 | Uniforme | 0.349 | - | - | - | Globales | 1.000 | 0.000 | -0.000 |
| N68/N39 | V(180°) H2 | Uniforme | 0.300 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N68/N39 | V(270°) H1 | Uniforme | 0.351 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N68/N39 | V(270°) H1 | Uniforme | 0.100 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N68/N39 | V(270°) H1 | Uniforme | 0.288 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N37/N44 | Peso propio | Trapezoidal | 0.037 | 0.029 | 0.000 | 0.800 | Globales | 0.000 | 0.000 | -1.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N37/N44 | Peso propio | Faja | 0.022 | - | 0.800 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N37/N44 | Peso propio | Uniforme | 0.048 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N37/N44 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N37/N44 | V(0°) H1 | Faja | 0.557 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(0°) H1 | Faja | 0.242 | - | 1.387 | 6.030 | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(0°) H1 | Faja | 0.092 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(0°) H1 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(0°) H1 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(0°) H1 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(0°) H2 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(0°) H2 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(0°) H2 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(0°) H2 | Faja | 0.006 | - | 1.387 | 6.030 | Globales | -0.000 | 0.100 | -0.995 |
| N37/N44 | V(0°) H2 | Faja | 0.001 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | -0.995 |
| N37/N44 | V(0°) H2 | Faja | 0.005 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | -0.995 |
| N37/N44 | V(90°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(90°) H1 | Uniforme | 0.248 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(180°) H1 | Uniforme | 0.245 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(180°) H1 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(180°) H1 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(180°) H1 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(180°) H2 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(180°) H2 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(180°) H2 | Uniforme | 0.233 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(180°) H2 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N37/N44 | V(270°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N37/N44 | V(270°) H1 | Faja | 0.218 | - | 3.467 | 6.030 | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(270°) H1 | Faja | 0.265 | - | 0.000 | 3.467 | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | V(270°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N37/N44 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N37/N44 | N(R) 1 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N37/N44 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N44/N40 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N44/N40 | Peso propio | Uniforme | 0.048 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N44/N40 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N44/N40 | V(0°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N44/N40 | V(0°) H1 | Uniforme | 0.242 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N44/N40 | V(0°) H2 | Uniforme | 0.006 | - | - | - | Globales | -0.000 | 0.100 | -0.995 |
| N44/N40 | V(0°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N44/N40 | V(90°) H1 | Uniforme | 0.248 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N44/N40 | V(90°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N44/N40 | V(180°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N44/N40 | V(180°) H1 | Faja | 0.048 | - | 1.635 | 3.015 | Globales | -0.000 | 0.100 | -0.995 |
| N44/N40 | V(180°) H1 | Faja | 0.245 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N44/N40 | V(180°) H2 | Faja | 0.233 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N44/N40 | V(180°) H2 | Faja | 0.233 | - | 1.635 | 3.015 | Globales | 0.000 | -0.100 | 0.995 |
| N44/N40 | V(180°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N44/N40 | V(270°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N44/N40 | V(270°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N44/N40 | V(270°) H1 | Uniforme | 0.218 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N44/N40 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N44/N40 | N(R) 1 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N44/N40 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | Peso propio | Trapezoidal | 0.037 | 0.029 | 0.000 | 0.800 | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | Peso propio | Faja | 0.022 | - | 0.800 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | Peso propio | Uniforme | 0.055 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | V(0°) H1 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(0°) H1 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(0°) H1 | Uniforme | 0.245 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | V(0°) H1 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(0°) H2 | Uniforme | 0.233 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | V(0°) H2 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(0°) H2 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(0°) H2 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(90°) H1 | Uniforme | 0.248 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | V(90°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(180°) H1 | Faja | 0.092 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | V(180°) H1 | Faja | 0.557 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | V(180°) H1 | Faja | 0.242 | - | 1.387 | 6.030 | Globales | 0.000 | 0.100 | 0.995 |
| N39/N48 | V(180°) H1 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | 1.000 | 0.000 | -0.000 |
| N39/N48 | V(180°) H1 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(180°) H1 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(180°) H2 | Faja | 0.005 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | -0.995 |
| N39/N48 | V(180°) H2 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(180°) H2 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | 1.000 | 0.000 | 0.000 |
| N39/N48 | V(180°) H2 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | 1.000 | 0.000 | -0.000 |
| N39/N48 | V(180°) H2 | Faja | 0.001 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | -0.995 |
| N39/N48 | V(180°) H2 | Faja | 0.006 | - | 1.387 | 6.030 | Globales | -0.000 | -0.100 | -0.995 |
| N39/N48 | V(270°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N39/N48 | V(270°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N39/N48 | V(270°) H1 | Faja | 0.265 | - | 0.000 | 3.467 | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | V(270°) H1 | Faja | 0.218 | - | 3.467 | 6.030 | Globales | -0.000 | 0.100 | 0.995 |
| N39/N48 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N39/N48 | N(R) 2 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N48/N40 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N48/N40 | Peso propio | Uniforme | 0.055 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N48/N40 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N48/N40 | V(0°) H1 | Faja | 0.048 | - | 1.635 | 3.015 | Globales | -0.000 | -0.100 | -0.995 |
| N48/N40 | V(0°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N48/N40 | V(0°) H1 | Faja | 0.245 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N48/N40 | V(0°) H2 | Faja | 0.233 | - | 1.635 | 3.015 | Globales | 0.000 | 0.100 | 0.995 |
| N48/N40 | V(0°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N48/N40 | V(0°) H2 | Faja | 0.233 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N48/N40 | V(90°) H1 | Uniforme | 0.248 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N48/N40 | V(90°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N48/N40 | V(180°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N48/N40 | V(180°) H1 | Uniforme | 0.242 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N48/N40 | V(180°) H2 | Uniforme | 0.006 | - | - | - | Globales | -0.000 | -0.100 | -0.995 |
| N48/N40 | V(180°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N48/N40 | V(270°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N48/N40 | V(270°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N48/N40 | V(270°) H1 | Uniforme | 0.218 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N48/N40 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N48/N40 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N48/N40 | N(R) 2 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N43/N44 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N43/N44 | V(0°) H1 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H1 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H1 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H1 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H1 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H2 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H2 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H2 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H2 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(0°) H2 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(90°) H1 | Faja | 0.247 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(90°) H1 | Trapezoidal | 0.247 | 0.123 | 6.000 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H1 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N43/N44 | V(180°) H2 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(180°) H2 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N43/N44 | V(270°) H1 | Faja | 0.575 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N43/N44 | V(270°) H1 | Trapezoidal | 0.575 | 0.288 | 6.000 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N47/N48 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N47/N48 | V(0°) H1 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H1 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(0°) H2 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(90°) H1 | Faja | 0.247 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(90°) H1 | Trapezoidal | 0.247 | 0.123 | 6.000 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(180°) H1 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | -0.000 |
| N47/N48 | V(180°) H1 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | 1.000 | 0.000 | -0.000 |
| N47/N48 | V(180°) H1 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(180°) H1 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(180°) H1 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(180°) H2 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | -0.000 |
| N47/N48 | V(180°) H2 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | 1.000 | 0.000 | -0.000 |
| N47/N48 | V(180°) H2 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(180°) H2 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(180°) H2 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N47/N48 | V(270°) H1 | Faja | 0.575 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N47/N48 | V(270°) H1 | Trapezoidal | 0.575 | 0.288 | 6.000 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N63/N90 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N90/N64 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N67/N82 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N82/N68 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |

Tensiones

| Comprobación de resistencia | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | η (%) | Posición (m) | Esfuerzos pésimos | | | | | | Origen | Estado |
| | | | N (t) | Vy (t) | Vz (t) | Mt (t·m) | My (t·m) | Mz (t·m) | | |
| N36/N63 | 78.57 | 0.000 | 0.039 | 2.396 | 2.739 | -0.005 | 6.448 | 2.799 | GV | Cumple |
| N63/N37 | 32.96 | 0.100 | -1.097 | -0.306 | -0.027 | 0.202 | 0.301 | -1.133 | G | Cumple |
| N38/N68 | 78.93 | 0.000 | -0.800 | 2.401 | -2.660 | 0.004 | -6.408 | 2.808 | GV | Cumple |
| N68/N39 | 32.66 | 0.100 | -0.138 | 0.429 | 0.022 | 0.200 | -0.016 | 0.988 | G | Cumple |
| N37/N44 | 50.28 | 6.030 | -0.188 | 0.066 | 1.305 | 0.000 | -2.001 | -0.088 | GV | Cumple |
| N44/N40 | 43.67 | 0.000 | 0.966 | 0.024 | -1.351 | -0.003 | -1.421 | 0.074 | G | Cumple |
| N39/N48 | 64.28 | 6.030 | -0.247 | -0.066 | 1.344 | 0.000 | -2.051 | 0.089 | GV | Cumple |
| N48/N40 | 43.82 | 0.000 | 0.985 | -0.024 | -1.365 | 0.003 | -1.423 | -0.075 | G | Cumple |
| N43/N44 | 60.18 | 0.000 | -2.313 | 0.611 | -4.324 | 0.001 | -5.807 | 2.059 | GV | Cumple |
| N47/N48 | 60.27 | 0.000 | -2.362 | -0.625 | -4.311 | -0.001 | -5.729 | -2.102 | GV | Cumple |
| N63/N90 | 34.54 | 0.100 | -0.726 | -1.036 | -7.461 | 0.000 | -1.120 | -0.155 | G | Cumple |
| N90/N64 | 0.03 | 0.000 | 0.000 | 0.000 | -0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N67/N82 | 0.03 | 0.250 | 0.000 | 0.000 | 0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N82/N68 | 34.54 | 0.150 | -0.726 | -1.036 | 7.461 | 0.000 | -1.120 | 0.155 | G | Cumple |

Flechas

| Flechas | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grupo | Flecha máxima absoluta xy<br>Flecha máxima relativa xy | | Flecha máxima absoluta xz<br>Flecha máxima relativa xz | | Flecha activa absoluta xy<br>Flecha activa relativa xy | | Flecha activa absoluta xz<br>Flecha activa relativa xz | |
| | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) |
| N36/N37 | 3.025<br>3.850 | 5.91<br>L/752.9 | 2.200<br>2.200 | 3.99<br>L/(>1000) | 3.025<br>3.850 | 8.20<br>L/758.1 | 1.925<br>2.475 | 7.25<br>L/(>1000) |
| N38/N39 | 3.300<br>1.100 | 5.70<br>L/849.3 | 2.200<br>1.375 | 3.62<br>L/(>1000) | 3.850<br>1.100 | 8.22<br>L/853.0 | 1.925<br>1.375 | 6.79<br>L/(>1000) |
| N37/N40 | 2.508<br>2.508 | 9.68<br>L/595.7 | 2.223<br>0.799 | 5.23<br>L/473.3 | 2.508<br>2.508 | 15.36<br>L/598.0 | 2.223<br>0.799 | 8.90<br>L/473.4 |
| N39/N40 | 2.508<br>2.508 | 8.49<br>L/741.9 | 2.223<br>0.799 | 4.90<br>L/520.5 | 2.508<br>2.223 | 15.33<br>L/746.9 | 2.223<br>0.799 | 8.45<br>L/520.6 |
| N43/N44 | 1.630<br>1.304 | 2.74<br>L/(>1000) | 3.585<br>3.585 | 8.54<br>L/763.5 | 1.304<br>1.630 | 5.29<br>L/(>1000) | 3.911<br>3.585 | 12.90<br>L/763.7 |
| N47/N48 | 1.304<br>1.304 | 2.71<br>L/(>1000) | 3.585<br>3.585 | 8.93<br>L/729.9 | 1.630<br>1.304 | 5.34<br>L/(>1000) | 3.260<br>3.585 | 12.64<br>L/731.2 |
| N63/N64 | 0.075<br>0.075 | 0.01<br>L/(>1000) | 0.150<br>0.150 | 0.06<br>L/(>1000) | 0.075<br>0.075 | 0.01<br>L/(>1000) | 0.150<br>0.150 | 0.06<br>L/(>1000) |
| N67/N68 | 0.325<br>0.325 | 0.01<br>L/(>1000) | 0.250<br>0.250 | 0.06<br>L/(>1000) | 0.325<br>0.325 | 0.01<br>L/(>1000) | 0.250<br>0.250 | 0.06<br>L/(>1000) |

### 2.2.1 PÓRTICO HASTIAL CON ALMACÉN

Nudos

| Nudos | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Referencia | Coordenadas | | | Vinculación exterior | | | | | | Vinculación interior |
| | X (m) | Y (m) | Z (m) | $\Delta_x$ | $\Delta_y$ | $\Delta_z$ | $\theta_x$ | $\theta_y$ | $\theta_z$ | |
| N1 | 0.000 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N2 | 0.000 | 0.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N3 | 0.000 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N4 | 0.000 | 18.000 | 6.000 | - | - | - | - | - | - | Empotrado |
| N5 | 0.000 | 9.000 | 6.900 | - | - | - | - | - | - | Empotrado |
| N41 | 0.000 | 6.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N42 | 0.000 | 6.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N43 | 42.700 | 6.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N44 | 42.700 | 6.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N45 | 0.000 | 12.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N46 | 0.000 | 12.000 | 6.600 | - | - | - | - | - | - | Empotrado |
| N61 | 0.000 | 0.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N62 | 0.000 | 0.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N65 | 0.000 | 17.500 | 4.500 | - | - | - | - | - | - | Empotrado |
| N66 | 0.000 | 18.000 | 4.500 | - | - | - | - | - | - | Empotrado |
| N81 | 0.000 | 17.750 | 4.500 | - | - | - | - | - | - | Empotrado |
| N89 | 0.000 | 0.250 | 4.500 | - | - | - | - | - | - | Empotrado |
| N109 | 0.000 | 26.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N110 | 0.000 | 26.000 | 5.200 | - | - | - | - | - | - | Empotrado |

Descripción de barras

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| Acero laminado | S275 | N1/N61 | N1/N2 | HE 200 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.70 | 4.500 | 4.500 |
| | | N61/N2 | N1/N2 | HE 200 B (HEB) | 0.100 | 1.107 | 0.293 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N3/N66 | N3/N4 | HE 220 B (HEB) | - | 4.400 | 0.100 | 0.50 | 0.50 | 4.500 | 4.500 |
| | | N66/N4 | N3/N4 | HE 220 B (HEB) | 0.100 | 1.108 | 0.292 | 0.50 | 0.70 | 1.500 | 1.500 |
| | | N2/N42 | N2/N5 | IPE 200 (IPE) | 0.101 | 5.929 | - | 0.17 | 1.00 | 1.000 | 2.000 |
| | | N42/N5 | N2/N5 | IPE 200 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N4/N46 | N4/N5 | IPE 200 (IPE) | 0.111 | 5.919 | - | 0.17 | 1.00 | 1.000 | 3.000 |
| | | N46/N5 | N4/N5 | IPE 200 (IPE) | - | 3.015 | - | 0.33 | 1.00 | 1.000 | 3.000 |
| | | N41/N42 | N41/N42 | HE 200 B (HEB) | - | 6.499 | 0.101 | 0.50 | 0.70 | - | - |
| | | N45/N46 | N45/N46 | HE 200 B (HEB) | - | 6.499 | 0.101 | 0.50 | 0.70 | - | - |
| | | N61/N89 | N61/N62 | IPE 200 (IPE) | 0.100 | 0.150 | - | 1.00 | 1.00 | - | - |

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| | | N89/N62 | N61/N62 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N65/N81 | N65/N66 | IPE 200 (IPE) | - | 0.250 | - | 1.00 | 1.00 | - | - |
| | | N81/N66 | N65/N66 | IPE 200 (IPE) | - | 0.140 | 0.110 | 1.00 | 1.00 | - | - |
| | | N109/N110 | N109/N110 | HE 180 B (HEB) | - | 5.108 | 0.092 | 0.50 | 0.70 | 2.600 | 2.600 |
| | | N110/N4 | N110/N4 | IPE 200 (IPE) | 0.091 | 7.838 | 0.111 | 0.12 | 1.00 | 1.000 | 2.000 |

*Notación:*
*Ni: Nudo inicial*
*Nf: Nudo final*
*$\beta_{xy}$: Coeficiente de pandeo en el plano 'XY'*
*$\beta_{xz}$: Coeficiente de pandeo en el plano 'XZ'*
*$Lb_{Sup.}$: Separación entre arriostramientos del ala superior*
*$Lb_{Inf.}$: Separación entre arriostramientos del ala inferior*

## Cargas

A continuación se exponen las cargas sobre las barras y se indican las cargas sobre los nudos aplicadas. En estas cargas sobre nudos se consideran las cargas relativas al puente grúa y su viga carril, de igual forma a lo indicado en el primer subapartado de cargas.

| Cargas en nudos | | | | | |
|---|---|---|---|---|---|
| Referencia | Hipótesis | Cargas puntuales (t) | Dirección | | |
| | | | X | Y | Z |
| N81 | Peso propio | 0.140 | 0.000 | 0.000 | -1.000 |
| N81 | PUENTE1 | 0.220 | 1.000 | 0.000 | 0.000 |
| N81 | PUENTE1 | 0.154 | 0.000 | 1.000 | 0.000 |
| N81 | PUENTE1 | 1.540 | 0.000 | 0.000 | -1.000 |
| N81 | PUENTE2 | 0.484 | 0.000 | 1.000 | 0.000 |
| N81 | PUENTE2 | 0.691 | -1.000 | 0.000 | 0.000 |
| N81 | PUENTE2 | 4.840 | 0.000 | 0.000 | -1.000 |
| N89 | Peso propio | 0.140 | 0.000 | 0.000 | -1.000 |
| N89 | PUENTE1 | 0.691 | 1.000 | 0.000 | 0.000 |
| N89 | PUENTE1 | 0.484 | 0.000 | -1.000 | 0.000 |
| N89 | PUENTE1 | 4.840 | 0.000 | 0.000 | -1.000 |
| N89 | PUENTE2 | 0.154 | 0.000 | -1.000 | 0.000 |
| N89 | PUENTE2 | 0.220 | -1.000 | 0.000 | 0.000 |
| N89 | PUENTE2 | 1.540 | 0.000 | 0.000 | -1.000 |

| Cargas en barras | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N1/N61 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N1/N61 | V(0°) H1 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(0°) H1 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(0°) H1 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N1/N61 | V(0°) H2 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(0°) H2 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(0°) H2 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N1/N61 | V(90°) H1 | Uniforme | 0.351 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N1/N61 | V(90°) H1 | Uniforme | 0.288 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N1/N61 | V(90°) H1 | Uniforme | 0.100 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N1/N61 | V(180°) H1 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N1/N61 | V(180°) H1 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(180°) H1 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(180°) H2 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(180°) H2 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N1/N61 | V(180°) H2 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(270°) H1 | Uniforme | 0.123 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N1/N61 | V(270°) H1 | Uniforme | 0.209 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N61/N2 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N61/N2 | V(0°) H1 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(0°) H1 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(0°) H1 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N61/N2 | V(0°) H2 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(0°) H2 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(0°) H2 | Uniforme | 0.300 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N61/N2 | V(90°) H1 | Uniforme | 0.351 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N61/N2 | V(90°) H1 | Uniforme | 0.288 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N61/N2 | V(90°) H1 | Uniforme | 0.100 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N61/N2 | V(180°) H1 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N61/N2 | V(180°) H1 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(180°) H1 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(180°) H2 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(180°) H2 | Uniforme | 0.140 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N61/N2 | V(180°) H2 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(270°) H1 | Uniforme | 0.123 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N61/N2 | V(270°) H1 | Uniforme | 0.209 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |
| N3/N66 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N3/N66 | V(0°) H1 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(0°) H1 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N3/N66 | V(0°) H1 | Uniforme | 0.276 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N3/N66 | V(0°) H2 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(0°) H2 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(0°) H2 | Uniforme | 0.276 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N3/N66 | V(90°) H1 | Uniforme | 0.288 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N3/N66 | V(90°) H1 | Uniforme | 0.384 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N3/N66 | V(180°) H1 | Uniforme | 0.656 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(180°) H1 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | 0.000 |
| N3/N66 | V(180°) H1 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(180°) H2 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | 0.000 |
| N3/N66 | V(180°) H2 | Uniforme | 0.656 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N3/N66 | V(180°) H2 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(270°) H1 | Uniforme | 0.123 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N3/N66 | V(270°) H1 | Uniforme | 0.209 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N3/N66 | V(270°) H1 | Uniforme | 0.164 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | Peso propio | Uniforme | 0.071 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N66/N4 | V(0°) H1 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(0°) H1 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(0°) H1 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N66/N4 | V(0°) H1 | Triangular Izq. | 0.276 | - | 0.700 | 1.500 | Globales | -1.000 | 0.000 | 0.000 |
| N66/N4 | V(0°) H1 | Faja | 0.276 | - | 0.000 | 0.700 | Globales | -1.000 | 0.000 | 0.000 |
| N66/N4 | V(0°) H2 | Triangular Izq. | 0.276 | - | 0.700 | 1.500 | Globales | -1.000 | 0.000 | 0.000 |
| N66/N4 | V(0°) H2 | Faja | 0.276 | - | 0.000 | 0.700 | Globales | -1.000 | 0.000 | 0.000 |
| N66/N4 | V(0°) H2 | Uniforme | 0.187 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(0°) H2 | Uniforme | 0.030 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(90°) H1 | Faja | 0.384 | - | 0.000 | 0.700 | Globales | 1.000 | -0.000 | -0.000 |
| N66/N4 | V(90°) H1 | Uniforme | 0.288 | - | - | - | Globales | 1.000 | 0.000 | 0.000 |
| N66/N4 | V(90°) H1 | Triangular Izq. | 0.384 | - | 0.700 | 1.500 | Globales | 1.000 | -0.000 | -0.000 |
| N66/N4 | V(180°) H1 | Faja | 0.656 | - | 0.000 | 0.700 | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(180°) H1 | Triangular Izq. | 0.656 | - | 0.700 | 1.500 | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(180°) H1 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(180°) H1 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | 0.000 |
| N66/N4 | V(180°) H2 | Uniforme | 0.349 | - | - | - | Globales | -1.000 | -0.000 | 0.000 |
| N66/N4 | V(180°) H2 | Faja | 0.656 | - | 0.000 | 0.700 | Globales | -1.000 | 0.000 | 0.000 |
| N66/N4 | V(180°) H2 | Uniforme | 0.096 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(180°) H2 | Triangular Izq. | 0.656 | - | 0.700 | 1.500 | Globales | -1.000 | 0.000 | 0.000 |
| N66/N4 | V(270°) H1 | Uniforme | 0.209 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N66/N4 | V(270°) H1 | Uniforme | 0.123 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(270°) H1 | Faja | 0.164 | - | 0.000 | 0.700 | Globales | -1.000 | -0.000 | -0.000 |
| N66/N4 | V(270°) H1 | Triangular Izq. | 0.164 | - | 0.700 | 1.500 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | Peso propio | Trapezoidal | 0.037 | 0.029 | 0.000 | 0.800 | Globales | 0.000 | 0.000 | -1.000 |
| N2/N42 | Peso propio | Faja | 0.022 | - | 0.800 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N2/N42 | Peso propio | Uniforme | 0.048 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N2/N42 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N2/N42 | V(0°) H1 | Faja | 0.092 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(0°) H1 | Faja | 0.242 | - | 1.387 | 6.030 | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(0°) H1 | Faja | 0.557 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(0°) H1 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | -1.000 | -0.000 | -0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N2/N42 | V(0°) H1 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(0°) H1 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(0°) H2 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(0°) H2 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(0°) H2 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(0°) H2 | Faja | 0.005 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | -0.995 |
| N2/N42 | V(0°) H2 | Faja | 0.001 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | -0.995 |
| N2/N42 | V(0°) H2 | Faja | 0.006 | - | 1.387 | 6.030 | Globales | -0.000 | 0.100 | -0.995 |
| N2/N42 | V(90°) H1 | Faja | 0.265 | - | 0.000 | 3.467 | Globales | -0.000 | -0.100 | 0.995 |
| N2/N42 | V(90°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N2/N42 | V(90°) H1 | Faja | 0.218 | - | 3.467 | 6.030 | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(90°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(180°) H1 | Uniforme | 0.245 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(180°) H1 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(180°) H1 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(180°) H1 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(180°) H2 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(180°) H2 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(180°) H2 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | V(180°) H2 | Uniforme | 0.233 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(270°) H1 | Uniforme | 0.248 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N2/N42 | V(270°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N2/N42 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N2/N42 | N(R) 1 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N2/N42 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N42/N5 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N42/N5 | Peso propio | Uniforme | 0.048 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N42/N5 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N42/N5 | V(0°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N42/N5 | V(0°) H1 | Uniforme | 0.242 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | V(0°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N42/N5 | V(0°) H2 | Uniforme | 0.006 | - | - | - | Globales | -0.000 | 0.100 | -0.995 |
| N42/N5 | V(90°) H1 | Uniforme | 0.218 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | V(90°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N42/N5 | V(90°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | V(180°) H1 | Faja | 0.048 | - | 1.635 | 3.015 | Globales | -0.000 | 0.100 | -0.995 |
| N42/N5 | V(180°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N42/N5 | V(180°) H1 | Faja | 0.245 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | V(180°) H2 | Faja | 0.233 | - | 0.000 | 1.635 | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | V(180°) H2 | Faja | 0.233 | - | 1.635 | 3.015 | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | V(180°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N42/N5 | V(270°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N42/N5 | V(270°) H1 | Uniforme | 0.248 | - | - | - | Globales | 0.000 | -0.100 | 0.995 |
| N42/N5 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N42/N5 | N(R) 1 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N42/N5 | N(R) 2 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | Peso propio | Trapezoidal | 0.037 | 0.029 | 0.000 | 0.800 | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | Peso propio | Faja | 0.022 | - | 0.800 | 6.030 | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | Peso propio | Uniforme | 0.055 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | V(0°) H1 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(0°) H1 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(0°) H1 | Uniforme | 0.245 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N4/N46 | V(0°) H1 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(0°) H2 | Uniforme | 0.233 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N4/N46 | V(0°) H2 | Trapezoidal | 0.019 | 0.002 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(0°) H2 | Trapezoidal | 0.002 | 0.008 | 0.000 | 4.221 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(0°) H2 | Faja | 0.005 | - | 4.221 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(90°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N4/N46 | V(90°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 6.030 | Globales | 1.000 | 0.000 | 0.000 |
| N4/N46 | V(90°) H1 | Faja | 0.218 | - | 3.467 | 6.030 | Globales | 0.000 | 0.100 | 0.995 |
| N4/N46 | V(90°) H1 | Faja | 0.265 | - | 0.000 | 3.467 | Globales | -0.000 | 0.100 | 0.995 |
| N4/N46 | V(180°) H1 | Faja | 0.490 | - | 0.000 | 1.387 | Globales | -0.000 | 0.100 | 0.995 |
| N4/N46 | V(180°) H1 | Faja | 0.242 | - | 1.387 | 6.030 | Globales | 0.000 | 0.100 | 0.995 |
| N4/N46 | V(180°) H1 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | -1.000 | -0.000 | 0.000 |
| N4/N46 | V(180°) H1 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(180°) H1 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(180°) H2 | Faja | 0.019 | - | 0.000 | 2.774 | Globales | -1.000 | -0.000 | 0.000 |
| N4/N46 | V(180°) H2 | Faja | 0.001 | - | 0.000 | 1.387 | Globales | 0.000 | -0.100 | -0.995 |
| N4/N46 | V(180°) H2 | Triangular Izq. | 0.018 | - | 2.774 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(180°) H2 | Trapezoidal | 0.009 | 0.017 | 0.000 | 2.774 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(180°) H2 | Faja | 0.005 | - | 0.000 | 1.387 | Globales | -0.000 | -0.100 | -0.995 |
| N4/N46 | V(180°) H2 | Faja | 0.006 | - | 1.387 | 6.030 | Globales | -0.000 | -0.100 | -0.995 |
| N4/N46 | V(270°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 6.030 | Globales | -1.000 | -0.000 | -0.000 |
| N4/N46 | V(270°) H1 | Uniforme | 0.248 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N4/N46 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N4/N46 | N(R) 2 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N46/N5 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N46/N5 | Peso propio | Uniforme | 0.055 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N46/N5 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N46/N5 | V(0°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N46/N5 | V(0°) H1 | Faja | 0.048 | - | 1.635 | 3.015 | Globales | -0.000 | -0.100 | -0.995 |
| N46/N5 | V(0°) H1 | Faja | 0.245 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N46/N5 | V(0°) H2 | Faja | 0.233 | - | 1.635 | 3.015 | Globales | 0.000 | 0.100 | 0.995 |
| N46/N5 | V(0°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N46/N5 | V(0°) H2 | Faja | 0.233 | - | 0.000 | 1.635 | Globales | -0.000 | 0.100 | 0.995 |
| N46/N5 | V(90°) H1 | Uniforme | 0.173 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N46/N5 | V(90°) H1 | Uniforme | 0.218 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N46/N5 | V(90°) H1 | Triangular Izq. | 0.029 | - | 0.000 | 3.015 | Globales | 1.000 | 0.000 | 0.000 |
| N46/N5 | V(180°) H1 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N46/N5 | V(180°) H1 | Uniforme | 0.242 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N46/N5 | V(180°) H2 | Uniforme | 0.006 | - | - | - | Globales | -0.000 | -0.100 | -0.995 |
| N46/N5 | V(180°) H2 | Triangular Izq. | 0.033 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N46/N5 | V(270°) H1 | Triangular Izq. | 0.012 | - | 0.000 | 3.015 | Globales | -1.000 | -0.000 | -0.000 |
| N46/N5 | V(270°) H1 | Uniforme | 0.248 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N46/N5 | N(EI) | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N46/N5 | N(R) 1 | Uniforme | 0.184 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N46/N5 | N(R) 2 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N41/N42 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N41/N42 | V(0°) H1 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H1 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H1 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H1 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H1 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H2 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H2 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H2 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H2 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(0°) H2 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(90°) H1 | Faja | 0.575 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N41/N42 | V(90°) H1 | Trapezoidal | 0.575 | 0.288 | 6.000 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H1 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(180°) H2 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(270°) H1 | Faja | 0.247 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N41/N42 | V(270°) H1 | Trapezoidal | 0.247 | 0.123 | 6.000 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | Peso propio | Uniforme | 0.061 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N45/N46 | V(0°) H1 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N45/N46 | V(0°) H1 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H1 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H1 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H1 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H1 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H1 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H1 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.497 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.492 | - | 6.000 | 6.161 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.480 | - | 6.161 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.456 | - | 6.276 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.378 | - | 6.420 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.101 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.074 | - | 6.000 | 6.173 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(0°) H2 | Faja | 0.017 | - | 6.173 | 6.420 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(90°) H1 | Faja | 0.575 | - | 0.000 | 6.000 | Globales | 1.000 | 0.000 | 0.000 |
| N45/N46 | V(90°) H1 | Trapezoidal | 0.575 | 0.288 | 6.000 | 6.600 | Globales | 1.000 | 0.000 | 0.000 |
| N45/N46 | V(180°) H1 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | 0.000 |
| N45/N46 | V(180°) H1 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | -1.000 | -0.000 | 0.000 |
| N45/N46 | V(180°) H1 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(180°) H1 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(180°) H1 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(180°) H2 | Faja | 0.104 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | 0.000 |
| N45/N46 | V(180°) H2 | Faja | 0.034 | - | 6.000 | 6.276 | Globales | -1.000 | -0.000 | 0.000 |
| N45/N46 | V(180°) H2 | Faja | 0.588 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(180°) H2 | Trapezoidal | 0.597 | 0.517 | 6.000 | 6.276 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(180°) H2 | Trapezoidal | 0.506 | 0.329 | 6.276 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(270°) H1 | Faja | 0.247 | - | 0.000 | 6.000 | Globales | -1.000 | -0.000 | -0.000 |
| N45/N46 | V(270°) H1 | Trapezoidal | 0.247 | 0.123 | 6.000 | 6.600 | Globales | -1.000 | -0.000 | -0.000 |
| N61/N89 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N89/N62 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N65/N81 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N81/N66 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N109/N110 | Peso propio | Uniforme | 0.051 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N109/N110 | V(0°) H1 | Uniforme | 0.276 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N109/N110 | V(0°) H2 | Uniforme | 0.140 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N109/N110 | V(0°) H2 | Uniforme | 0.276 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N109/N110 | V(90°) H1 | Uniforme | 0.351 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N109/N110 | V(90°) H1 | Uniforme | 0.100 | - | - | - | Globales | -0.000 | 1.000 | -0.000 |
| N109/N110 | V(90°) H1 | Uniforme | 0.384 | - | - | - | Globales | 1.000 | -0.000 | -0.000 |
| N109/N110 | V(180°) H1 | Uniforme | 0.299 | - | - | - | Globales | -0.000 | -1.000 | -0.000 |
| N109/N110 | V(180°) H1 | Uniforme | 0.656 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N109/N110 | V(180°) H2 | Uniforme | 0.656 | - | - | - | Globales | -1.000 | 0.000 | 0.000 |
| N109/N110 | V(180°) H2 | Uniforme | 0.299 | - | - | - | Globales | 0.000 | -1.000 | 0.000 |

**Cargas en barras**

| Barra | Hipótesis | Tipo | Valores | | Posición | | Dirección | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | P1 | P2 | L1 (m) | L2 (m) | Ejes | X | Y | Z |
| N109/N110 | V(270°) H1 | Uniforme | 0.164 | - | - | - | Globales | -1.000 | -0.000 | -0.000 |
| N109/N110 | V(270°) H1 | Uniforme | 0.500 | - | - | - | Globales | 0.000 | 1.000 | 0.000 |
| N110/N4 | Peso propio | Uniforme | 0.022 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N110/N4 | Peso propio | Uniforme | 0.055 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N110/N4 | QCubierta | Uniforme | 0.122 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N110/N4 | V(0°) H1 | Uniforme | 0.244 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N110/N4 | V(0°) H1 | Triangular Izq. | 0.027 | - | 0.000 | 8.040 | Globales | -1.000 | 0.000 | 0.000 |
| N110/N4 | V(0°) H2 | Uniforme | 0.232 | - | - | - | Globales | 0.000 | 0.100 | 0.995 |
| N110/N4 | V(0°) H2 | Triangular Izq. | 0.027 | - | 0.000 | 8.040 | Globales | -1.000 | 0.000 | 0.000 |
| N110/N4 | V(90°) H1 | Trapezoidal | 0.174 | 0.173 | 0.000 | 8.040 | Globales | -0.000 | 0.100 | 0.995 |
| N110/N4 | V(90°) H1 | Triangular Izq. | 0.038 | - | 0.000 | 8.040 | Globales | 1.000 | -0.000 | -0.000 |
| N110/N4 | V(90°) H1 | Trapezoidal | 0.263 | 0.264 | 0.000 | 8.040 | Globales | -0.000 | 0.100 | 0.995 |
| N110/N4 | V(180°) H1 | Faja | 0.241 | - | 1.387 | 8.040 | Globales | 0.000 | 0.100 | 0.995 |
| N110/N4 | V(180°) H1 | Triangular Izq. | 0.065 | - | 0.000 | 8.040 | Globales | -1.000 | -0.000 | -0.000 |
| N110/N4 | V(180°) H1 | Faja | 0.687 | - | 0.000 | 1.387 | Globales | 0.000 | 0.100 | 0.995 |
| N110/N4 | V(180°) H2 | Uniforme | 0.006 | - | - | - | Globales | 0.000 | -0.100 | -0.995 |
| N110/N4 | V(180°) H2 | Triangular Izq. | 0.065 | - | 0.000 | 8.040 | Globales | -1.000 | 0.000 | 0.000 |
| N110/N4 | V(270°) H1 | Uniforme | 0.290 | - | - | - | Globales | -0.000 | 0.100 | 0.995 |
| N110/N4 | V(270°) H1 | Triangular Izq. | 0.016 | - | 0.000 | 8.040 | Globales | -1.000 | -0.000 | -0.000 |
| N110/N4 | N(EI) | Uniforme | 0.183 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N110/N4 | N(R) 1 | Uniforme | 0.183 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |
| N110/N4 | N(R) 2 | Uniforme | 0.092 | - | - | - | Globales | 0.000 | 0.000 | -1.000 |

## Tensiones

**Comprobación de resistencia**

| Barra | η (%) | Posición (m) | Esfuerzos pésimos | | | | | | Origen | Estado |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | N (t) | Vy (t) | Vz (t) | Mt (t·m) | My (t·m) | Mz (t·m) | | |
| N1/N61 | 68.87 | 0.000 | -1.020 | -2.396 | 2.291 | 0.004 | 4.955 | -2.789 | GV | Cumple |
| N61/N2 | 32.74 | 0.100 | -0.085 | -0.332 | -0.089 | 0.201 | 0.047 | -1.070 | G | Cumple |
| N3/N66 | 93.22 | 0.000 | -2.344 | -5.975 | -1.361 | 0.004 | -4.807 | -7.007 | GV | Cumple |
| N66/N4 | 36.05 | 0.100 | -1.696 | 1.624 | -1.361 | 0.004 | 1.504 | 3.001 | GV | Cumple |
| N2/N42 | 43.41 | 6.030 | -0.256 | -0.041 | 1.390 | 0.000 | -1.751 | 0.068 | GV | Cumple |
| N42/N5 | 44.00 | 0.000 | 1.198 | -0.021 | -1.390 | 0.003 | -1.460 | -0.069 | G | Cumple |
| N41/N42 | 52.57 | 0.000 | -2.096 | 0.451 | 4.296 | -0.001 | 5.678 | 1.507 | GV | Cumple |
| N45/N46 | 49.97 | 0.000 | -2.214 | -0.371 | 4.301 | 0.000 | 5.740 | -1.261 | GV | Cumple |
| N61/N89 | 34.54 | 0.100 | -0.726 | -1.036 | -7.461 | 0.000 | -1.120 | -0.155 | G | Cumple |
| N89/N62 | 0.03 | 0.000 | 0.000 | 0.000 | -0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N65/N81 | 0.03 | 0.250 | 0.000 | 0.000 | 0.008 | 0.000 | -0.001 | 0.000 | G | Cumple |
| N81/N66 | 34.53 | 0.140 | -0.726 | -1.036 | 7.461 | 0.000 | -1.045 | 0.145 | G | Cumple |
| N109/N110 | 80.07 | 0.000 | -0.003 | -2.967 | -2.101 | -0.010 | -3.965 | -2.869 | GV | Cumple |
| N110/N4 | 53.12 | 7.137 | -0.378 | 0.141 | 1.165 | 0.007 | -1.930 | -0.136 | GV | Cumple |

## Flechas

| Flechas | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grupo | Flecha máxima absoluta xy<br>Flecha máxima relativa xy | | Flecha máxima absoluta xz<br>Flecha máxima relativa xz | | Flecha activa absoluta xy<br>Flecha activa relativa xy | | Flecha activa absoluta xz<br>Flecha activa relativa xz | |
| | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) |
| N1/N2 | 2.750<br>1.100 | 6.26<br>L/861.6 | 3.025<br>3.025 | 3.47<br>L/(>1000) | 3.025<br>1.100 | 8.18<br>L/862.4 | 2.475<br>3.025 | 5.05<br>L/(>1000) |
| N3/N4 | 3.300<br>3.575 | 10.47<br>L/505.0 | 1.925<br>1.650 | 2.61<br>L/(>1000) | 3.300<br>3.575 | 14.59<br>L/505.4 | 1.925<br>1.650 | 5.13<br>L/(>1000) |
| N2/N5 | 2.508<br>2.508 | 8.49<br>L/751.5 | 5.924<br>0.799 | 4.05<br>L/619.9 | 2.508<br>2.223 | 15.44<br>L/752.1 | 2.508<br>0.799 | 6.73<br>L/620.9 |
| N4/N5 | 1.652<br>1.652 | 3.95<br>L/(>1000) | 5.914<br>0.801 | 4.09<br>L/600.4 | 1.368<br>1.652 | 6.96<br>L/(>1000) | 5.914<br>0.801 | 6.05<br>L/600.6 |
| N41/N42 | 1.630<br>5.215 | 1.97<br>L/(>1000) | 3.585<br>3.585 | 9.25<br>L/704.6 | 1.304<br>5.215 | 3.79<br>L/(>1000) | 3.911<br>3.585 | 12.72<br>L/708.3 |
| N45/N46 | 1.630<br>1.304 | 1.98<br>L/(>1000) | 3.585<br>3.585 | 8.47<br>L/769.4 | 1.630<br>1.304 | 3.87<br>L/(>1000) | 3.260<br>3.585 | 12.56<br>L/771.6 |
| N61/N62 | 0.075<br>0.075 | 0.01<br>L/(>1000) | 0.150<br>0.150 | 0.06<br>L/(>1000) | 0.075<br>0.075 | 0.01<br>L/(>1000) | 0.150<br>0.150 | 0.06<br>L/(>1000) |
| N65/N66 | 0.320<br>0.320 | 0.00<br>L/(>1000) | 0.250<br>0.250 | 0.06<br>L/(>1000) | 0.320<br>0.320 | 0.01<br>L/(>1000) | 0.250<br>0.250 | 0.05<br>L/(>1000) |
| N109/N110 | 2.925<br>2.925 | 8.01<br>L/649.0 | 1.625<br>1.300 | 2.44<br>L/(>1000) | 2.925<br>2.925 | 11.63<br>L/649.1 | 1.625<br>1.300 | 4.84<br>L/(>1000) |
| N110/N4 | 3.519<br>3.519 | 22.73<br>L/344.8 | 3.128<br>7.039 | 10.94<br>L/596.5 | 3.519<br>3.519 | 38.41<br>L/345.1 | 3.519<br>7.039 | 19.85<br>L/598.5 |

### 2.2.2 ARRIOSTRADOS

La estructura dispone de unos arriostrados entre los pórticos que componen la nave, disponiéndose de perfiles perpendiculares a los pórticos que unen unos con otros por la cabeza de pilares y en dinteles (ejecutado mediante perfiles IPE-160), y se dispone de arriostrados en forma de cruz de San Andrés (realizados mediante redondos de 14 mm de diametro).

## Descripción de barras

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| Acero laminado | S275 | N42/N97 | N42/N97 | IPE 160 (IPE) | 0.100 | 6.000 | - | 0.50 | 0.50 | - | - |
| | | N46/N103 | N46/N103 | IPE 160 (IPE) | 0.100 | 6.000 | - | 0.50 | 0.50 | - | - |
| | | N5/N10 | N5/N10 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N37/N102 | N37/N102 | R 14 (R) | - | 8.577 | - | 0.00 | 0.00 | - | - |
| | | N102/N40 | N102/N40 | R 14 (R) | - | 6.804 | - | 0.00 | 0.00 | - | - |
| | | N108/N40 | N108/N40 | R 14 (R) | - | 6.804 | - | 0.00 | 0.00 | - | - |
| | | N39/N108 | N39/N108 | R 14 (R) | - | 8.577 | - | 0.00 | 0.00 | - | - |
| | | N34/N48 | N34/N48 | R 14 (R) | - | 8.436 | 0.141 | 0.00 | 0.00 | - | - |
| | | N48/N35 | N48/N35 | R 14 (R) | 0.112 | 6.692 | - | 0.00 | 0.00 | - | - |
| | | N44/N35 | N44/N35 | R 14 (R) | 0.112 | 6.692 | - | 0.00 | 0.00 | - | - |
| | | N32/N44 | N32/N44 | R 14 (R) | - | 8.436 | 0.141 | 0.00 | 0.00 | - | - |
| | | N2/N97 | N2/N97 | R 14 (R) | - | 8.577 | - | 0.00 | 0.00 | - | - |
| | | N97/N5 | N97/N5 | R 14 (R) | - | 6.804 | - | 0.00 | 0.00 | - | - |
| | | N103/N5 | N103/N5 | R 14 (R) | - | 6.804 | - | 0.00 | 0.00 | - | - |
| | | N4/N103 | N4/N103 | R 14 (R) | - | 8.577 | - | 0.00 | 0.00 | - | - |
| | | N9/N46 | N9/N46 | R 14 (R) | - | 8.436 | 0.141 | 0.00 | 0.00 | - | - |
| | | N46/N10 | N46/N10 | R 14 (R) | 0.112 | 6.692 | - | 0.00 | 0.00 | - | - |
| | | N42/N10 | N42/N10 | R 14 (R) | 0.112 | 6.692 | - | 0.00 | 0.00 | - | - |
| | | N7/N42 | N7/N42 | R 14 (R) | - | 8.436 | 0.141 | 0.00 | 0.00 | - | - |
| | | N2/N7 | N2/N7 | IPE 160 (IPE) | 0.100 | 5.890 | 0.110 | 0.50 | 0.50 | - | - |
| | | N32/N37 | N32/N37 | IPE 160 (IPE) | 0.110 | 5.890 | 0.100 | 0.50 | 0.50 | - | - |
| | | N35/N40 | N35/N40 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N102/N44 | N102/N44 | IPE 160 (IPE) | - | 6.000 | 0.100 | 0.50 | 0.50 | - | - |
| | | N108/N48 | N108/N48 | IPE 160 (IPE) | - | 6.000 | 0.100 | 0.50 | 0.50 | - | - |
| | | N4/N9 | N4/N9 | IPE 160 (IPE) | 0.110 | 5.880 | 0.110 | 0.50 | 0.50 | - | - |
| | | N34/N39 | N34/N39 | IPE 160 (IPE) | 0.110 | 5.890 | 0.100 | 0.50 | 0.50 | - | - |
| | | N7/N12 | N7/N32 | IPE 160 (IPE) | 0.110 | 5.990 | - | 0.50 | 0.50 | - | - |
| | | N12/N17 | N7/N32 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N17/N22 | N7/N32 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N22/N27 | N7/N32 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N27/N32 | N7/N32 | IPE 160 (IPE) | - | 5.990 | 0.110 | 0.50 | 0.50 | - | - |
| | | N97/N98 | N97/N102 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N98/N99 | N97/N102 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N99/N100 | N97/N102 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N100/N101 | N97/N102 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N101/N102 | N97/N102 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N103/N104 | N103/N108 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N104/N105 | N103/N108 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N105/N106 | N103/N108 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N106/N107 | N103/N108 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N107/N108 | N103/N108 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N9/N14 | N9/N34 | IPE 160 (IPE) | 0.110 | 5.990 | - | 0.50 | 0.50 | - | - |
| | | N14/N19 | N9/N34 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |

| Descripción | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | | Barra (Ni/Nf) | Pieza (Ni/Nf) | Perfil(Serie) | Longitud (m) | | | $\beta_{xy}$ | $\beta_{xz}$ | $Lb_{Sup.}$ (m) | $Lb_{Inf.}$ (m) |
| Tipo | Designación | | | | Indeformable origen | Deformable | Indeformable extremo | | | | |
| | | N19/N24 | N9/N34 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N24/N29 | N9/N34 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N29/N34 | N9/N34 | IPE 160 (IPE) | - | 5.990 | 0.110 | 0.50 | 0.50 | - | - |
| | | N10/N15 | N10/N35 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N15/N20 | N10/N35 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N20/N25 | N10/N35 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N25/N30 | N10/N35 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N30/N35 | N10/N35 | IPE 160 (IPE) | - | 6.100 | - | 0.50 | 0.50 | - | - |
| | | N116/N14 | N116/N14 | R 14 (R) | 0.127 | 9.826 | 0.139 | 0.00 | 0.00 | - | - |
| | | N112/N14 | N112/N14 | R 14 (R) | 0.114 | 9.839 | 0.139 | 0.00 | 0.00 | - | - |
| | | N112/N4 | N112/N4 | R 14 (R) | 0.114 | 9.839 | 0.139 | 0.00 | 0.00 | - | - |
| | | N110/N9 | N110/N9 | R 14 (R) | 0.114 | 9.839 | 0.139 | 0.00 | 0.00 | - | - |
| | | N114/N9 | N114/N9 | R 14 (R) | 0.114 | 9.839 | 0.139 | 0.00 | 0.00 | - | - |
| | | N114/N19 | N114/N19 | R 14 (R) | 0.114 | 9.839 | 0.139 | 0.00 | 0.00 | - | - |
| | | N114/N19 | N114/N19 | R 14 (R) | 0.114 | 9.839 | 0.139 | 0.00 | 0.00 | - | - |

*Notación:*
*Ni: Nudo inicial*
*Nf: Nudo final*
*$\beta_{xy}$: Coeficiente de pandeo en el plano 'XY'*
*$\beta_{xz}$: Coeficiente de pandeo en el plano 'XZ'*
*$Lb_{Sup.}$: Separación entre arriostramientos del ala superior*
*$Lb_{Inf.}$: Separación entre arriostramientos del ala inferior*

## Tensiones

| Comprobación de resistencia | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | η (%) | Posición (m) | Esfuerzos pésimos | | | | | | Origen | Estado |
| | | | N (t) | Vy (t) | Vz (t) | Mt (t·m) | My (t·m) | Mz (t·m) | | |
| N42/N97 | 53.70 | 0.100 | -1.980 | -0.019 | -0.416 | -0.001 | -1.425 | -0.049 | G | Cumple |
| N46/N103 | 49.90 | 0.100 | -1.690 | 0.017 | -0.396 | 0.001 | -1.341 | 0.043 | G | Cumple |
| N5/N10 | 25.89 | 5.338 | -2.436 | -0.001 | 0.008 | 0.000 | 0.312 | 0.001 | G | Cumple |
| N37/N102 | 69.43 | 0.000 | 2.854 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N102/N40 | 34.70 | 0.000 | 1.426 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N108/N40 | 33.58 | 0.000 | 1.380 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N39/N108 | 64.85 | 0.000 | 2.665 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N34/N48 | 49.79 | 0.000 | 2.046 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N48/N35 | 32.34 | 0.112 | 1.329 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N44/N35 | 35.47 | 0.112 | 1.458 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N32/N44 | 51.08 | 0.000 | 2.099 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N2/N97 | 78.52 | 0.000 | 3.227 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N97/N5 | 41.03 | 0.000 | 1.686 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N103/N5 | 29.52 | 0.000 | 1.213 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |

| Comprobación de resistencia | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Barra | η (%) | Posición (m) | Esfuerzos pésimos | | | | | | Origen | Estado |
| | | | N (t) | Vy (t) | Vz (t) | Mt (t·m) | My (t·m) | Mz (t·m) | | |
| N4/N103 | 58.56 | 0.000 | 2.407 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N9/N46 | 46.81 | 0.000 | 1.924 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N46/N10 | 29.74 | 0.112 | 1.222 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N42/N10 | 38.09 | 0.112 | 1.566 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N7/N42 | 63.31 | 0.000 | 2.602 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N2/N7 | 42.55 | 5.990 | -3.078 | 0.012 | 0.206 | 0.000 | -0.629 | -0.030 | GV | Cumple |
| N32/N37 | 38.68 | 0.110 | -2.844 | -0.011 | -0.183 | 0.000 | -0.560 | -0.027 | GV | Cumple |
| N35/N40 | 26.34 | 1.144 | -2.468 | 0.000 | 0.004 | 0.000 | 0.335 | 0.000 | G | Cumple |
| N102/N44 | 55.60 | 6.000 | -1.434 | 0.013 | 0.436 | 0.000 | -1.606 | -0.031 | G | Cumple |
| N108/N48 | 55.85 | 6.000 | -1.833 | -0.019 | 0.436 | -0.001 | -1.508 | 0.048 | G | Cumple |
| N4/N9 | 43.53 | 0.110 | 3.357 | -0.009 | 0.232 | 0.000 | 1.067 | -0.035 | GV | Cumple |
| N34/N39 | 41.90 | 0.110 | -2.566 | 0.011 | -0.291 | 0.000 | -0.877 | 0.026 | GV | Cumple |
| N7/N12 | 37.32 | 6.100 | -2.525 | 0.005 | 0.278 | 0.000 | -0.743 | -0.016 | GV | Cumple |
| N12/N17 | 30.96 | 6.100 | -1.995 | 0.003 | 0.253 | 0.000 | -0.695 | -0.011 | GV | Cumple |
| N17/N22 | 30.41 | 0.000 | -1.408 | -0.014 | -0.234 | 0.000 | -0.634 | -0.044 | GV | Cumple |
| N22/N27 | 29.25 | 0.000 | -1.868 | -0.004 | -0.234 | 0.000 | -0.636 | -0.013 | GV | Cumple |
| N27/N32 | 35.40 | 0.000 | -2.346 | -0.006 | -0.257 | 0.000 | -0.680 | -0.020 | GV | Cumple |
| N97/N98 | 23.19 | 0.075 | 2.599 | 0.001 | -0.126 | 0.000 | -0.562 | 0.010 | GV | Cumple |
| N98/N99 | 9.52 | 6.100 | 2.368 | 0.008 | 0.074 | 0.000 | -0.116 | -0.011 | GV | Cumple |
| N99/N100 | 14.01 | 6.100 | 1.962 | -0.009 | 0.088 | 0.000 | -0.143 | 0.042 | GV | Cumple |
| N100/N101 | 9.89 | 0.000 | -0.476 | -0.011 | -0.095 | 0.000 | -0.170 | -0.019 | GV | Cumple |
| N101/N102 | 24.99 | 6.025 | 2.585 | -0.006 | 0.120 | 0.000 | -0.549 | 0.025 | GV | Cumple |
| N103/N104 | 22.87 | 0.075 | -0.558 | 0.010 | 0.053 | 0.000 | 0.642 | 0.017 | G | Cumple |
| N104/N105 | 10.95 | 6.100 | 2.188 | -0.009 | 0.078 | 0.000 | -0.152 | 0.016 | GV | Cumple |
| N105/N106 | 15.58 | 0.000 | 2.260 | -0.010 | -0.094 | 0.000 | -0.156 | -0.046 | GV | Cumple |
| N106/N107 | 9.66 | 0.000 | 2.115 | 0.007 | -0.081 | 0.000 | -0.152 | 0.008 | GV | Cumple |
| N107/N108 | 25.33 | 6.025 | 2.346 | -0.009 | 0.127 | 0.000 | -0.597 | 0.020 | GV | Cumple |
| N9/N14 | 37.05 | 6.100 | -2.423 | -0.001 | 0.329 | 0.000 | -0.893 | 0.004 | GV | Cumple |
| N14/N19 | 29.03 | 6.100 | -1.968 | 0.000 | 0.261 | 0.000 | -0.683 | -0.002 | GV | Cumple |
| N19/N24 | 30.44 | 6.100 | -1.922 | -0.001 | 0.262 | 0.000 | -0.759 | 0.005 | GV | Cumple |
| N24/N29 | 31.17 | 0.000 | -0.951 | 0.000 | -0.354 | 0.000 | -0.957 | 0.002 | GV | Cumple |
| N29/N34 | 33.63 | 0.000 | -1.663 | -0.001 | -0.377 | 0.000 | -0.984 | -0.002 | GV | Cumple |
| N10/N15 | 26.59 | 1.144 | -2.534 | 0.001 | -0.009 | 0.000 | 0.303 | 0.002 | G | Cumple |
| N15/N20 | 24.35 | 6.100 | -2.538 | 0.002 | 0.099 | 0.000 | -0.125 | -0.007 | G | Cumple |
| N20/N25 | 23.74 | 0.000 | -2.537 | -0.001 | -0.073 | 0.000 | -0.125 | -0.004 | G | Cumple |
| N25/N30 | 23.78 | 4.956 | -2.564 | 0.001 | 0.007 | 0.000 | 0.144 | -0.001 | G | Cumple |
| N30/N35 | 27.47 | 4.956 | -2.570 | 0.001 | 0.011 | 0.000 | 0.331 | -0.002 | G | Cumple |
| N116/N14 | 8.58 | 0.127 | 0.353 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N112/N14 | 17.67 | 0.114 | 0.726 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N112/N4 | 46.19 | 0.114 | 1.898 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |
| N110/N9 | 25.20 | 0.114 | 1.036 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N114/N9 | 12.17 | 0.114 | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | GV | Cumple |
| N114/N19 | 18.63 | 0.114 | 0.766 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | G | Cumple |

## Flecha

| Flechas | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grupo | Flecha máxima absoluta xy<br>Flecha máxima relativa xy | | Flecha máxima absoluta xz<br>Flecha máxima relativa xz | | Flecha activa absoluta xy<br>Flecha activa relativa xy | | Flecha activa absoluta xz<br>Flecha activa relativa xz | |
| | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) |
| N42/N97 | 1.481<br>1.481 | 2.59<br>L/(>1000) | 1.852<br>1.852 | 10.85<br>L/546.2 | 1.481<br>1.481 | 4.80<br>L/(>1000) | 2.222<br>1.852 | 19.36<br>L/549.7 |
| N46/N103 | 1.481<br>1.481 | 2.00<br>L/(>1000) | 1.852<br>1.852 | 10.71<br>L/553.3 | 1.481<br>1.481 | 3.59<br>L/(>1000) | 2.222<br>1.852 | 17.99<br>L/557.6 |
| N5/N10 | 1.525<br>1.525 | 0.52<br>L/(>1000) | 3.431<br>3.431 | 6.37<br>L/958.4 | 1.525<br>1.525 | 0.76<br>L/(>1000) | 3.431<br>3.431 | 8.23<br>L/960.1 |
| N37/N102 | 5.361<br>- | 0.00<br>L/(>1000) | 3.216<br>- | 0.00<br>L/(>1000) | 6.969<br>- | 0.00<br>L/(>1000) | 5.897<br>- | 0.00<br>L/(>1000) |
| N102/N40 | 5.103<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) |
| N108/N40 | 4.678<br>- | 0.00<br>L/(>1000) | 5.103<br>- | 0.00<br>L/(>1000) | 1.701<br>- | 0.00<br>L/(>1000) | 4.678<br>- | 0.00<br>L/(>1000) |
| N39/N108 | 4.289<br>- | 0.00<br>L/(>1000) | 5.897<br>- | 0.00<br>L/(>1000) | 5.361<br>- | 0.00<br>L/(>1000) | 7.505<br>- | 0.00<br>L/(>1000) |
| N34/N48 | 5.273<br>- | 0.00<br>L/(>1000) | 4.745<br>- | 0.00<br>L/(>1000) | 5.273<br>- | 0.00<br>L/(>1000) | 4.745<br>- | 0.00<br>L/(>1000) |
| N48/N35 | 5.019<br>- | 0.00<br>L/(>1000) | 4.183<br>- | 0.00<br>L/(>1000) | 4.183<br>- | 0.00<br>L/(>1000) | 4.183<br>- | 0.00<br>L/(>1000) |
| N44/N35 | 4.601<br>- | 0.00<br>L/(>1000) | 5.438<br>- | 0.00<br>L/(>1000) | 6.274<br>- | 0.00<br>L/(>1000) | 5.438<br>- | 0.00<br>L/(>1000) |
| N32/N44 | 6.327<br>- | 0.00<br>L/(>1000) | 6.854<br>- | 0.00<br>L/(>1000) | 2.109<br>- | 0.00<br>L/(>1000) | 4.745<br>- | 0.00<br>L/(>1000) |
| N2/N97 | 5.897<br>- | 0.00<br>L/(>1000) | 6.969<br>- | 0.00<br>L/(>1000) | 5.897<br>- | 0.00<br>L/(>1000) | 6.969<br>- | 0.00<br>L/(>1000) |
| N97/N5 | 0.851<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) | 4.253<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) |
| N103/N5 | 5.529<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) | 2.552<br>- | 0.00<br>L/(>1000) | 5.954<br>- | 0.00<br>L/(>1000) |
| N4/N103 | 5.361<br>- | 0.00<br>L/(>1000) | 6.433<br>- | 0.00<br>L/(>1000) | 5.361<br>- | 0.00<br>L/(>1000) | 6.433<br>- | 0.00<br>L/(>1000) |
| N9/N46 | 7.382<br>- | 0.00<br>L/(>1000) | 1.582<br>- | 0.00<br>L/(>1000) | 7.909<br>- | 0.00<br>L/(>1000) | 5.273<br>- | 0.00<br>L/(>1000) |
| N46/N10 | 5.856<br>- | 0.00<br>L/(>1000) | 5.019<br>- | 0.00<br>L/(>1000) | 5.856<br>- | 0.00<br>L/(>1000) | 5.019<br>- | 0.00<br>L/(>1000) |
| N42/N10 | 6.274<br>- | 0.00<br>L/(>1000) | 6.274<br>- | 0.00<br>L/(>1000) | 4.183<br>- | 0.00<br>L/(>1000) | 6.274<br>- | 0.00<br>L/(>1000) |
| N7/N42 | 5.800<br>- | 0.00<br>L/(>1000) | 5.273<br>- | 0.00<br>L/(>1000) | 5.273<br>- | 0.00<br>L/(>1000) | 6.327<br>- | 0.00<br>L/(>1000) |
| N2/N7 | 1.841<br>1.841 | 5.00<br>L/(>1000) | 1.841<br>1.841 | 4.12<br>L/(>1000) | 1.841<br>1.841 | 8.98<br>L/(>1000) | 4.417<br>1.472 | 5.59<br>L/(>1000) |
| N32/N37 | 4.049<br>4.049 | 5.86<br>L/901.1 | 4.049<br>1.473 | 3.64<br>L/(>1000) | 4.049<br>4.049 | 8.87<br>L/904.3 | 1.473<br>1.473 | 5.59<br>L/(>1000) |
| N35/N40 | 4.575<br>4.575 | 0.29<br>L/(>1000) | 2.669<br>2.669 | 6.88<br>L/886.1 | 4.575<br>4.575 | 0.52<br>L/(>1000) | 2.669<br>2.669 | 8.95<br>L/887.6 |
| N102/N44 | 4.073<br>4.444 | 2.39<br>L/(>1000) | 4.073<br>4.073 | 12.31<br>L/481.4 | 4.444<br>4.444 | 4.62<br>L/(>1000) | 3.703<br>4.073 | 20.06<br>L/485.2 |
| N108/N48 | 4.444 | 2.63 | 4.073 | 11.58 | 4.444 | 4.77 | 3.703 | 19.73 |

| Flechas | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Grupo | Flecha máxima absoluta xy<br>Flecha máxima relativa xy | | Flecha máxima absoluta xz<br>Flecha máxima relativa xz | | Flecha activa absoluta xy<br>Flecha activa relativa xy | | Flecha activa absoluta xz<br>Flecha activa relativa xz | |
| | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) | Pos. (m) | Flecha (mm) |
| | 4.444 | L/(>1000) | 4.073 | L/511.5 | 4.444 | L/(>1000) | 4.073 | L/514.5 |
| N4/N9 | 1.837<br>1.837 | 3.33<br>L/(>1000) | 1.837<br>1.837 | 6.27<br>L/938.1 | 1.837<br>1.837 | 6.05<br>L/(>1000) | 2.205<br>1.837 | 8.29<br>L/939.0 |
| N34/N39 | 4.049<br>4.049 | 4.99<br>L/(>1000) | 4.049<br>1.473 | 3.72<br>L/(>1000) | 4.049<br>4.049 | 8.95<br>L/(>1000) | 1.473<br>1.473 | 5.97<br>L/(>1000) |
| N112/N14 | 4.920<br>- | 0.00<br>L/(>1000) | 8.609<br>- | 0.00<br>L/(>1000) | 7.994<br>- | 0.00<br>L/(>1000) | 8.609<br>- | 0.00<br>L/(>1000) |
| N112/N4 | 7.379<br>- | 0.00<br>L/(>1000) | 9.224<br>- | 0.00<br>L/(>1000) | 7.994<br>- | 0.00<br>L/(>1000) | 9.224<br>- | 0.00<br>L/(>1000) |
| N110/N9 | 4.920<br>- | 0.00<br>L/(>1000) | 6.764<br>- | 0.00<br>L/(>1000) | 5.534<br>- | 0.00<br>L/(>1000) | 8.609<br>- | 0.00<br>L/(>1000) |
| N114/N9 | 7.994<br>- | 0.00<br>L/(>1000) | 8.609<br>- | 0.00<br>L/(>1000) | 8.609<br>- | 0.00<br>L/(>1000) | 8.609<br>- | 0.00<br>L/(>1000) |
| N114/N19 | 6.149<br>- | 0.00<br>L/(>1000) | 4.305<br>- | 0.00<br>L/(>1000) | 6.149<br>- | 0.00<br>L/(>1000) | 6.764<br>- | 0.00<br>L/(>1000) |

### 2.2.3 PLACAS BASE O DE ANCLAJE

Las placas base se dividen en tres grupos. Las placas se dividen en placas tipo centrales, placas tipo esquina junto a las hastiales, y por ultimo las placas de los pilares de almacén.

Placas centrales

Son las placas empleadas en los apoyos de los pilares de los pórticos centrales. Son los nudos de referencia N3, N6, N8, N11, N13, N16, N18, N21, N23, N26, N28, N31 y N33. Siendo placas base con unas dimensiones de 700x500x40 mm con 2 rigidizadores en cada eje principal, con un espesor de 10 y 6mm.

| Referencia: | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Separación mínima entre pernos:<br>*3 diámetros* | Mínimo: 96 mm<br>Calculado: 200 mm | Cumple |
| Separación mínima pernos-perfil:<br>*1.5 diámetros* | Mínimo: 48 mm<br>Calculado: 91 mm | Cumple |
| Separación mínima pernos-borde:<br>*1.5 diámetros* | Mínimo: 48 mm<br>Calculado: 50 mm | Cumple |
| Esbeltez de rigidizadores: | Máximo: 50 | |
| -Paralelos a X: | Calculado: 49 | Cumple |
| -Paralelos a Y: | Calculado: 44.4 | Cumple |
| Longitud mínima del perno:<br>*Se calcula la longitud de anclaje necesaria por adherencia.* | Mínimo: 46 cm<br>Calculado: 65 cm | Cumple |
| Anclaje perno en hormigón: | | |
| -Tracción: | Máximo: 18.124 t<br>Calculado: 15.443 t | Cumple |
| -Cortante: | Máximo: 12.686 t<br>Calculado: 1.085 t | Cumple |
| -Tracción + Cortante: | Máximo: 18.124 t<br>Calculado: 16.993 t | Cumple |
| Tracción en vástago de pernos: | Máximo: 26.064 t<br>Calculado: 14.757 t | Cumple |
| Tensión de Von Mises en vástago de pernos: | Máximo: 4854.13 kp/cm²<br>Calculado: 1852.14 kp/cm² | Cumple |
| Aplastamiento perno en placa:<br>*Límite del cortante en un perno actuando contra la placa* | Máximo: 68.346 t<br>Calculado: 1.035 t | Cumple |
| Tensión de Von Mises en secciones globales: | Máximo: 2669.77 kp/cm² | |
| -Derecha: | Calculado: 1185.4 kp/cm² | Cumple |
| -Izquierda: | Calculado: 1162.32 kp/cm² | Cumple |
| -Arriba: | Calculado: 2163.41 kp/cm² | Cumple |
| -Abajo: | Calculado: 2082.26 kp/cm² | Cumple |
| Flecha global equivalente:<br>*Limitación de la deformabilidad de los vuelos* | Mínimo: 250 | |
| -Derecha: | Calculado: 4159.36 | Cumple |
| -Izquierda: | Calculado: 4014.05 | Cumple |
| -Arriba: | Calculado: 4247.01 | Cumple |
| -Abajo: | Calculado: 4690.94 | Cumple |
| Tensión de Von Mises local:<br>*Tensión por tracción de pernos sobre placas en voladizo* | Máximo: 2669.77 kp/cm²<br>Calculado: 2096.39 kp/cm² | Cumple |
| Se cumplen todas las comprobaciones | | |

Placas esquina

Son las placas empleadas en los apoyos de los pilares que forman las esquinas de la edificación y de los pilares hastiales, es decir los pilares de los pórticos primero y último. Son los nudos de referencia N1, N36, N38, N41, N45, N43 y N47. Siendo placas base con unas dimensiones de 450x450x25 mm con 2 rigidizadores en cada eje principal, con un espesor de 6 y 9 mm.

| Referencia: | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Separación mínima entre pernos:<br>*3 diámetros* | Mínimo: 60 mm<br>Calculado: 185 mm | Cumple |
| Separación mínima pernos-perfil:<br>*1.5 diámetros* | Mínimo: 30 mm<br>Calculado: 76 mm | Cumple |
| Separación mínima pernos-borde:<br>*1.5 diámetros* | Mínimo: 30 mm<br>Calculado: 40 mm | Cumple |
| Esbeltez de rigidizadores: | Máximo: 50 | |
| -Paralelos a X: | Calculado: 46.2 | Cumple |
| -Paralelos a Y: | Calculado: 30.8 | Cumple |
| Longitud mínima del perno:<br>*Se calcula la longitud de anclaje necesaria por adherencia.* | Mínimo: 22 cm<br>Calculado: 45 cm | Cumple |
| Anclaje perno en hormigón: | | |
| -Tracción: | Máximo: 10.194 t<br>Calculado: 8.454 t | Cumple |
| -Cortante: | Máximo: 7.136 t<br>Calculado: 0.586 t | Cumple |
| -Tracción + Cortante: | Máximo: 10.194 t<br>Calculado: 9.291 t | Cumple |

| Referencia: | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Tracción en vástago de pernos: | Máximo: 10.179 t<br>Calculado: 7.988 t | Cumple |
| Tensión de Von Mises en vástago de pernos: | Máximo: 4854.13 kp/cm²<br>Calculado: 2566.13 kp/cm² | Cumple |
| Aplastamiento perno en placa:<br>*Límite del cortante en un perno actuando contra la placa* | Máximo: 26.698 t<br>Calculado: 0.55 t | Cumple |
| Tensión de Von Mises en secciones globales: | Máximo: 2669.77 kp/cm² | |
| -Derecha: | Calculado: 1691.07 kp/cm² | Cumple |
| -Izquierda: | Calculado: 1774.37 kp/cm² | Cumple |
| -Arriba: | Calculado: 2382 kp/cm² | Cumple |
| -Abajo: | Calculado: 2371.93 kp/cm² | Cumple |
| Flecha global equivalente:<br>*Limitación de la deformabilidad de los vuelos* | Mínimo: 250 | |
| -Derecha: | Calculado: 4192.5 | Cumple |
| -Izquierda: | Calculado: 3854.39 | Cumple |
| -Arriba: | Calculado: 2835.84 | Cumple |
| -Abajo: | Calculado: 2870.21 | Cumple |
| Tensión de Von Mises local:<br>*Tensión por tracción de pernos sobre placas en voladizo* | Máximo: 2669.77 kp/cm²<br>Calculado: 2418.61 kp/cm² | Cumple |
| Se cumplen todas las comprobaciones | | |

Placas almacén

Son las placas empleadas en los apoyos de los pilares de la edificación del almacén. Son los nudos de referencia N109, N111, N113 y N115. Siendo placas base con unas dimensiones de 450x450x25 mm con 2 rigidizadores en el eje principal del perfil, con un espesor de 6 y 8 mm.

| Referencia: | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Separación mínima entre pernos:<br>*3 diámetros* | Mínimo: 60 mm<br>Calculado: 185 mm | Cumple |
| Separación mínima pernos-perfil:<br>*1.5 diámetros* | Mínimo: 30 mm<br>Calculado: 84 mm | Cumple |
| Separación mínima pernos-borde:<br>*1.5 diámetros* | Mínimo: 30 mm<br>Calculado: 40 mm | Cumple |
| Esbeltez de rigidizadores: | Máximo: 50 | |
| -Paralelos a X: | Calculado: 48.5 | Cumple |
| -Paralelos a Y: | Calculado: 36.4 | Cumple |
| Longitud mínima del perno:<br>*Se calcula la longitud de anclaje necesaria por adherencia.* | Mínimo: 22 cm<br>Calculado: 35 cm | Cumple |

| Referencia: | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Anclaje perno en hormigón: | | |
| -Tracción: | Máximo: 7.929 t<br>Calculado: 6.693 t | Cumple |
| -Cortante: | Máximo: 5.55 t<br>Calculado: 0.664 t | Cumple |
| -Tracción + Cortante: | Máximo: 7.929 t<br>Calculado: 7.642 t | Cumple |
| Tracción en vástago de pernos: | Máximo: 10.179 t<br>Calculado: 6.234 t | Cumple |
| Tensión de Von Mises en vástago de pernos: | Máximo: 4854.13 kp/cm²<br>Calculado: 2021.21 kp/cm² | Cumple |
| Aplastamiento perno en placa:<br>*Límite del cortante en un perno actuando contra la placa* | Máximo: 26.698 t<br>Calculado: 0.619 t | Cumple |
| Tensión de Von Mises en secciones globales: | Máximo: 2669.77 kp/cm² | |
| -Derecha: | Calculado: 1512.23 kp/cm² | Cumple |
| -Izquierda: | Calculado: 1590.85 kp/cm² | Cumple |
| -Arriba: | Calculado: 2464.36 kp/cm² | Cumple |
| -Abajo: | Calculado: 2280.45 kp/cm² | Cumple |
| Flecha global equivalente:<br>*Limitación de la deformabilidad de los vuelos* | Mínimo: 250 | |
| -Derecha: | Calculado: 4243.52 | Cumple |
| -Izquierda: | Calculado: 3996.47 | Cumple |
| -Arriba: | Calculado: 2680.38 | Cumple |
| -Abajo: | Calculado: 2733.46 | Cumple |
| Tensión de Von Mises local:<br>*Tensión por tracción de pernos sobre placas en voladizo* | Máximo: 2669.77 kp/cm²<br>Calculado: 2079.46 kp/cm² | Cumple |
| Se cumplen todas las comprobaciones | | |

## 2.3 REACCIONES DE LOS PÓRTICOS EN LA CIMENTACIÓN

## Nudos

| Nudos | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Referencia | Coordenadas | | | Vinculación exterior | | | | | | Vinculación interior |
| | X (m) | Y (m) | Z (m) | $\Delta_x$ | $\Delta_y$ | $\Delta_z$ | $\theta_x$ | $\theta_y$ | $\theta_z$ | |
| N1 | 0.000 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N3 | 0.000 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N6 | 6.100 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N8 | 6.100 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N11 | 12.200 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N13 | 12.200 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N16 | 18.300 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N18 | 18.300 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N21 | 24.400 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N23 | 24.400 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N26 | 30.500 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N28 | 30.500 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N31 | 36.600 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N33 | 36.600 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N36 | 42.700 | 0.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N38 | 42.700 | 18.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N41 | 0.000 | 6.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N43 | 42.700 | 6.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N45 | 0.000 | 12.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N47 | 42.700 | 12.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N109 | 0.000 | 26.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N111 | 6.100 | 26.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N113 | 12.200 | 26.000 | 0.000 | X | X | X | X | X | X | Empotrado |
| N115 | 18.300 | 26.000 | 0.000 | X | X | X | X | X | X | Empotrado |

## Reacciones sobre el terreno

| Envolventes de las reacciones en nudos | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Referencia | Combinación | | Reacciones en ejes globales | | | | | |
| | Tipo | Descripción | Rx (t) | Ry (t) | Rz (t) | Mx (t·m) | My (t·m) | Mz (t·m) |
| N1 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -2.013 | -2.596 | -1.890 | -3.923 | -3.298 | -0.020 |
| | | Valor máximo de la envolvente | 2.560 | 2.168 | 9.355 | 5.360 | 2.989 | 0.063 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -1.730 | -1.604 | -0.891 | -3.823 | -3.446 | -0.016 |
| | | Valor máximo de la envolvente | 1.786 | 1.996 | 6.384 | 3.317 | 2.435 | 0.041 |
| N3 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -4.422 | -2.410 | -4.243 | -5.129 | -6.738 | -0.021 |
| | | Valor máximo de la envolvente | 6.382 | 1.455 | 11.319 | 5.856 | 7.507 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -2.947 | -1.954 | -2.192 | -3.772 | -4.810 | -0.016 |
| | | Valor máximo de la envolvente | 4.453 | 1.060 | 8.473 | 4.621 | 6.094 | 0.041 |
| N6 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -1.003 | -6.972 | -5.120 | -10.265 | -3.012 | -0.016 |
| | | Valor máximo de la envolvente | 0.553 | 4.581 | 14.170 | 13.042 | 1.934 | 0.050 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -1.009 | -4.036 | -2.420 | -10.176 | -3.224 | -0.011 |
| | | Valor máximo de la envolvente | 0.606 | 4.612 | 11.778 | 7.662 | 2.005 | 0.032 |

| Envolventes de las reacciones en nudos | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Referencia | Combinación | | Reacciones en ejes globales | | | | | |
| | Tipo | Descripción | Rx (t) | Ry (t) | Rz (t) | Mx (t·m) | My (t·m) | Mz (t·m) |
| N8 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.714 | -3.886 | -8.218 | -6.723 | -2.549 | -0.017 |
| | | Valor máximo de la envolvente | 0.828 | 2.150 | 17.188 | 8.941 | 2.766 | 0.050 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.663 | -4.079 | -4.069 | -3.672 | -2.254 | -0.011 |
| | | Valor máximo de la envolvente | 1.013 | 1.101 | 15.464 | 9.354 | 3.230 | 0.032 |
| N11 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.979 | -7.644 | -5.367 | -12.036 | -2.976 | -0.020 |
| | | Valor máximo de la envolvente | 0.527 | 5.220 | 14.835 | 14.952 | 1.889 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.975 | -4.401 | -2.511 | -11.736 | -3.162 | -0.013 |
| | | Valor máximo de la envolvente | 0.569 | 5.164 | 12.580 | 8.525 | 1.933 | 0.039 |
| N13 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.699 | -4.346 | -8.711 | -8.186 | -2.521 | -0.021 |
| | | Valor máximo de la envolvente | 0.805 | 2.744 | 18.125 | 10.697 | 2.665 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.645 | -4.436 | -4.301 | -4.456 | -2.221 | -0.013 |
| | | Valor máximo de la envolvente | 0.962 | 1.420 | 16.506 | 10.783 | 3.146 | 0.039 |
| N16 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.973 | -7.677 | -5.319 | -11.966 | -2.968 | -0.020 |
| | | Valor máximo de la envolvente | 0.519 | 5.198 | 14.754 | 15.111 | 1.875 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.962 | -4.431 | -2.486 | -11.606 | -3.132 | -0.013 |
| | | Valor máximo de la envolvente | 0.560 | 5.132 | 12.499 | 8.659 | 1.912 | 0.039 |
| N18 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -3.675 | -4.866 | -8.063 | -10.726 | -4.199 | -0.021 |
| | | Valor máximo de la envolvente | 2.900 | 5.078 | 16.818 | 12.261 | 5.154 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -2.507 | -4.828 | -3.993 | -5.959 | -3.277 | -0.014 |
| | | Valor máximo de la envolvente | 2.317 | 2.844 | 14.842 | 11.981 | 4.703 | 0.041 |
| N21 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.974 | -8.600 | -5.641 | -15.035 | -2.973 | -0.020 |
| | | Valor máximo de la envolvente | 0.522 | 6.031 | 14.899 | 18.566 | 1.882 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.960 | -4.988 | -2.679 | -14.995 | -3.124 | -0.013 |
| | | Valor máximo de la envolvente | 0.558 | 6.043 | 12.643 | 10.753 | 1.907 | 0.039 |
| N23 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.678 | -6.049 | -5.588 | -16.693 | -2.466 | -0.021 |
| | | Valor máximo de la envolvente | 0.806 | 8.124 | 14.990 | 15.025 | 2.659 | 0.063 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.638 | -6.055 | -2.620 | -9.595 | -2.205 | -0.013 |
| | | Valor máximo de la envolvente | 0.959 | 4.689 | 12.697 | 15.000 | 3.149 | 0.039 |
| N26 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.983 | -8.675 | -5.714 | -15.290 | -2.992 | -0.020 |
| | | Valor máximo de la envolvente | 0.533 | 6.123 | 14.975 | 18.780 | 1.911 | 0.062 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.969 | -5.026 | -2.715 | -15.268 | -3.139 | -0.014 |
| | | Valor máximo de la envolvente | 0.565 | 6.136 | 12.742 | 10.866 | 1.920 | 0.039 |
| N28 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.699 | -6.123 | -5.541 | -16.929 | -2.504 | -0.021 |
| | | Valor máximo de la envolvente | 0.812 | 8.220 | 15.103 | 15.208 | 2.752 | 0.063 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.654 | -6.119 | -2.581 | -9.727 | -2.239 | -0.013 |
| | | Valor máximo de la envolvente | 0.991 | 4.742 | 12.823 | 15.165 | 3.216 | 0.039 |
| N31 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -1.018 | -7.689 | -5.138 | -12.178 | -3.048 | -0.017 |
| | | Valor máximo de la envolvente | 0.550 | 5.135 | 14.231 | 15.618 | 1.942 | 0.049 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -1.005 | -4.473 | -2.423 | -12.577 | -3.194 | -0.011 |
| | | Valor máximo de la envolvente | 0.577 | 5.268 | 11.868 | 9.049 | 1.932 | 0.031 |
| N33 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.735 | -5.376 | -5.116 | -14.186 | -2.565 | -0.017 |
| | | Valor máximo de la envolvente | 0.829 | 7.322 | 14.384 | 12.292 | 2.819 | 0.050 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.694 | -5.408 | -2.382 | -8.462 | -2.312 | -0.011 |
| | | Valor máximo de la envolvente | 1.024 | 4.260 | 11.968 | 12.206 | 3.276 | 0.032 |
| N36 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -2.563 | -3.051 | -1.902 | -5.972 | -2.998 | -0.022 |
| | | Valor máximo de la envolvente | 1.979 | 2.196 | 9.664 | 6.855 | 3.174 | 0.061 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -2.081 | -1.882 | -0.894 | -4.618 | -3.276 | -0.016 |
| | | Valor máximo de la envolvente | 1.405 | 1.885 | 6.596 | 4.247 | 2.497 | 0.042 |
| N38 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -2.569 | -2.501 | -1.894 | -6.882 | -3.020 | -0.021 |
| | | Valor máximo de la envolvente | 2.130 | 2.915 | 9.452 | 5.881 | 3.738 | 0.064 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -1.776 | -2.180 | -0.883 | -4.264 | -2.398 | -0.016 |
| | | Valor máximo de la envolvente | 1.739 | 1.801 | 6.467 | 4.982 | 3.480 | 0.041 |
| N41 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -4.532 | -0.485 | -3.157 | -1.472 | -8.547 | -0.003 |
| | | Valor máximo de la envolvente | 4.617 | 0.450 | 3.954 | 1.615 | 6.134 | 0.002 |

| Envolventes de las reacciones en nudos | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Referencia | Combinación | | Reacciones en ejes globales | | | | | |
| | Tipo | Descripción | Rx (t) | Ry (t) | Rz (t) | Mx (t·m) | My (t·m) | Mz (t·m) |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -3.054 | -0.320 | -1.580 | -1.147 | -6.644 | -0.003 |
| | | Valor máximo de la envolvente | 3.233 | 0.354 | 3.507 | 1.072 | 5.134 | 0.001 |
| N43 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -4.646 | -0.658 | -3.107 | -2.296 | -6.260 | -0.002 |
| | | Valor máximo de la envolvente | 4.525 | 0.689 | 3.878 | 2.213 | 8.466 | 0.002 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -3.339 | -0.457 | -1.555 | -1.549 | -5.661 | -0.002 |
| | | Valor máximo de la envolvente | 2.962 | 0.470 | 3.471 | 1.529 | 6.128 | 0.002 |
| N45 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -4.556 | -0.476 | -3.078 | -1.381 | -8.693 | -0.001 |
| | | Valor máximo de la envolvente | 4.620 | 0.413 | 3.750 | 1.595 | 6.182 | 0.002 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -2.992 | -0.359 | -1.535 | -1.014 | -6.315 | -0.001 |
| | | Valor máximo de la envolvente | 3.258 | 0.300 | 3.319 | 1.177 | 5.325 | 0.002 |
| N47 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -4.636 | -0.675 | -3.124 | -2.246 | -6.200 | -0.003 |
| | | Valor máximo de la envolvente | 4.581 | 0.669 | 3.958 | 2.250 | 8.791 | 0.002 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -3.266 | -0.479 | -1.549 | -1.449 | -5.247 | -0.002 |
| | | Valor máximo de la envolvente | 3.035 | 0.430 | 3.426 | 1.587 | 6.550 | 0.001 |
| N109 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -2.367 | -2.921 | -2.429 | -4.200 | -3.491 | -0.005 |
| | | Valor máximo de la envolvente | 3.200 | 2.298 | 2.136 | 4.383 | 3.163 | 0.010 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -1.523 | -2.117 | -1.386 | -2.926 | -2.330 | -0.004 |
| | | Valor máximo de la envolvente | 2.197 | 1.510 | 1.913 | 3.362 | 2.620 | 0.006 |
| N111 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.630 | -5.274 | -3.435 | -6.240 | -1.857 | -0.001 |
| | | Valor máximo de la envolvente | 0.611 | 4.218 | 3.304 | 6.780 | 1.778 | 0.001 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.456 | -3.854 | -1.844 | -3.756 | -1.342 | -0.001 |
| | | Valor máximo de la envolvente | 0.647 | 2.577 | 2.900 | 5.596 | 1.873 | 0.001 |
| N113 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -0.663 | -5.192 | -3.490 | -6.904 | -1.912 | -0.001 |
| | | Valor máximo de la envolvente | 0.606 | 4.325 | 3.211 | 6.633 | 1.769 | 0.002 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -0.480 | -3.774 | -1.891 | -4.150 | -1.382 | -0.001 |
| | | Valor máximo de la envolvente | 0.644 | 2.641 | 2.846 | 5.506 | 1.866 | 0.001 |
| N115 | Hormigón en cimentaciones | Valor mínimo de la envolvente | -3.344 | -2.727 | -2.197 | -7.717 | -3.567 | -0.011 |
| | | Valor máximo de la envolvente | 2.494 | 3.186 | 1.833 | 7.426 | 3.998 | 0.007 |
| | Tensiones sobre el terreno | Valor mínimo de la envolvente | -2.157 | -2.193 | -1.302 | -4.743 | -2.452 | -0.007 |
| | | Valor máximo de la envolvente | 1.812 | 1.975 | 1.566 | 6.334 | 3.376 | 0.004 |

## 2.4 CIMENTACIÓN DE LA ESTRUCTURA

La nave dispondrá de una cimentación conformada por zapatas aisladas con unas vigas de atado entre zapatas, por el contorno de la edificación.

Todas las cimentaciones se diseñan considerando la unión entre el pilar y la zapata como una unión empotrada, es decir, se le transmiten todos los momentos generados en el pilar. De igual forma a como se indicaba en las placas de anclaje, se dividen en 5 grupos, centrales, esquina, hastiales, almacén, y pilar de fachada hastial anexo a almacén.

Las zapatas se unifican entre los 5 grupos en cuanto a profundidad de las mismas y tipología de armadura, empleándose en los cinco casos armaduras de 16 mm de diámetro cada 20 cm, en ambas direcciones y caras de la zapata.

<u>Zapata central</u>

Son las zapatas de los pilares centrales, es decir, de los pórticos centrales de la nave. Se dispone un total de 6 zapatas de esta tipología, siendo los nudos de referencia los nudos: N6, N8, N11, N13, N16, N18, N21, N23, N26, N28, N31 y N33. Siendo las dimensiones de las zapatas de 360x260x100 cm con armadura de 16 mm cada 20 cm en ambas caras y direcciones. Se indica a continuación la comprobación de una de ellas, la más limitante.

| Referencia: N28<br>Dimensiones: 260 x 360 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Tensiones sobre el terreno:<br>*Criterio de CYPE* | | |
| -Tensión media en situaciones persistentes: | Máximo: 3 kp/cm²<br>Calculado: 0.387 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes sin viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.729 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes con viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.781 kp/cm² | Cumple |
| Vuelco de la zapata:<br>*Si el % de reserva de seguridad es mayor que cero, quiere decir que los coeficientes de seguridad al vuelco son mayores que los valores estrictos exigidos para todas las combinaciones de equilibrio.* | | |
| -En dirección X: | Reserva seguridad: 581.0 % | Cumple |
| -En dirección Y: | Reserva seguridad: 27.8 % | Cumple |
| Deslizamiento de la zapata:<br>-Situaciones persistentes:<br>*CTE DB-SE C (Cimientos): Tabla 2.1* | Mínimo: 1.5<br>Calculado: 22 | Cumple |
| Flexión en la zapata: | | |
| -En dirección X: | Momento: 4.45 t·m | Cumple |
| -En dirección Y: | Momento: 13.40 t·m | Cumple |
| Cortante en la zapata: | | |
| -En dirección X: | Cortante: 1.15 t | Cumple |
| -En dirección Y: | Cortante: 10.31 t | Cumple |
| Compresión oblicua en la zapata:<br>-Situaciones persistentes:<br>*Criterio de CYPE* | Máximo: 713.55 t/m²<br>Calculado: 7.74 t/m² | Cumple |
| Canto mínimo:<br>*Artículo 58.8.1 de la norma EHE-08* | Mínimo: 25 cm<br>Calculado: 100 cm | Cumple |
| Espacio para anclar arranques en cimentación:<br>-N28: | Mínimo: 65 cm<br>Calculado: 92 cm | Cumple |
| Cuantía geométrica mínima:<br>*Artículo 42.3.5 de la norma EHE-08* | Mínimo: 0.0009 | |
| -Armado inferior dirección X: | Calculado: 0.001 | Cumple |

| Referencia: N28<br>Dimensiones: 260 x 360 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| -Armado superior dirección X: | Calculado: 0.001 | Cumple |
| -Armado inferior dirección Y: | Calculado: 0.001 | Cumple |
| -Armado superior dirección Y: | Calculado: 0.001 | Cumple |
| Cuantía mínima necesaria por flexión:<br>*Artículo 42.3.2 de la norma EHE-08* | Calculado: 0.0011 | |
| -Armado inferior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado inferior dirección Y: | Mínimo: 0.0003 | Cumple |
| -Armado superior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado superior dirección Y: | Mínimo: 0.0002 | Cumple |
| Diámetro mínimo de las barras:<br>*Recomendación del Artículo 58.8.2 (norma EHE-08)* | Mínimo: 12 mm | |
| -Parrilla inferior: | Calculado: 16 mm | Cumple |
| -Parrilla superior: | Calculado: 16 mm | Cumple |
| Separación máxima entre barras:<br>*Artículo 58.8.2 de la norma EHE-08* | Máximo: 30 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Separación mínima entre barras:<br>*Criterio de CYPE, basado en: J. Calavera. "Cálculo de Estructuras de Cimentación". Capítulo 3.16* | Mínimo: 10 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Longitud de anclaje:<br>*Criterio del libro "Cálculo de estructuras de cimentación", J. Calavera. Ed. INTEMAC, 1991* | | |
| -Armado inf. dirección X hacia der: | Mínimo: 16 cm<br>Calculado: 108 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Mínimo: 16 cm<br>Calculado: 108 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Mínimo: 16 cm<br>Calculado: 163 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Mínimo: 16 cm<br>Calculado: 163 cm | Cumple |
| -Armado sup. dirección X hacia der: | Mínimo: 34 cm<br>Calculado: 108 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Mínimo: 34 cm<br>Calculado: 108 cm | Cumple |

| Referencia: N28<br>Dimensiones: 260 x 360 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| -Armado sup. dirección Y hacia arriba: | Mínimo: 19 cm<br>Calculado: 163 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Mínimo: 19 cm<br>Calculado: 163 cm | Cumple |
| Longitud mínima de las patillas: | Mínimo: 16 cm | |
| -Armado inf. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| Abertura de fisuras: | Máximo: 0.3 mm | |
| -Armado inferior dirección X: | Calculado: 0 mm | Cumple |
| -Armado inferior dirección Y: | Calculado: 0.01 mm | Cumple |
| -Armado superior dirección X: | Calculado: 0 mm | Cumple |
| -Armado superior dirección Y: | Calculado: 0 mm | Cumple |
| Se cumplen todas las comprobaciones | | |

Zapata esquina

Son las zapatas de los pilares de esquina, es decir, de los pilares principales de los pórticos extremos. Se dispone un total de 3 zapatas de esta tipología, siendo los nudos de referencia los nudos: N1, N36 y N38. Siendo las dimensiones de las zapatas de 245x170x100 cm con armadura de 16 mm cada 20 cm en ambas caras y direcciones. Se indica a continuación la comprobación de las mismas.

Referencia: N38
Dimensiones: 170 x 245 x 100
Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20

| Comprobación | Valores | Estado |
|---|---|---|
| Tensiones sobre el terreno:<br>*Criterio de CYPE* | | |
| -Tensión media en situaciones persistentes: | Máximo: 3 kp/cm²<br>Calculado: 0.455 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes sin viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.654 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes con viento: | Máximo: 3.75 kp/cm²<br>Calculado: 1.205 kp/cm² | Cumple |
| Vuelco de la zapata:<br>*Si el % de reserva de seguridad es mayor que cero, quiere decir que los coeficientes de seguridad al vuelco son mayores que los valores estrictos exigidos para todas las combinaciones de equilibrio.* | | |
| -En dirección X: | Reserva seguridad: 23.4 % | Cumple |
| -En dirección Y: | Reserva seguridad: 28.7 % | Cumple |
| Deslizamiento de la zapata:<br>-Situaciones persistentes:<br>*CTE DB-SE C (Cimientos): Tabla 2.1* | Mínimo: 1.5<br>Calculado: 16.84 | Cumple |
| Flexión en la zapata: | | |
| -En dirección X: | Momento: 3.04 t·m | Cumple |
| -En dirección Y: | Momento: 5.69 t·m | Cumple |
| Cortante en la zapata: | | |
| -En dirección X: | Cortante: 0.00 t | Cumple |
| -En dirección Y: | Cortante: 2.56 t | Cumple |
| Compresión oblicua en la zapata:<br>-Situaciones persistentes:<br>*Criterio de CYPE* | Máximo: 713.55 t/m²<br>Calculado: 6.46 t/m² | Cumple |
| Canto mínimo:<br>*Artículo 58.8.1 de la norma EHE-08* | Mínimo: 25 cm<br>Calculado: 100 cm | Cumple |
| Espacio para anclar arranques en cimentación:<br>-N38: | Mínimo: 44 cm<br>Calculado: 92 cm | Cumple |
| Cuantía geométrica mínima:<br>*Artículo 42.3.5 de la norma EHE-08* | Mínimo: 0.0009 | |
| -Armado inferior dirección X: | Calculado: 0.001 | Cumple |
| -Armado superior dirección X: | Calculado: 0.001 | Cumple |
| -Armado inferior dirección Y: | Calculado: 0.001 | Cumple |
| -Armado superior dirección Y: | Calculado: 0.001 | Cumple |
| Cuantía mínima necesaria por flexión:<br>*Artículo 42.3.2 de la norma EHE-08* | Calculado: 0.0011 | |
| -Armado inferior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado inferior dirección Y: | Mínimo: 0.0002 | Cumple |

Referencia: N38
Dimensiones: 170 x 245 x 100
Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20

| Comprobación | Valores | Estado |
|---|---|---|
| -Armado superior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado superior dirección Y: | Mínimo: 0.0001 | Cumple |
| Diámetro mínimo de las barras:<br>*Recomendación del Artículo 58.8.2 (norma EHE-08)* | Mínimo: 12 mm | |
| -Parrilla inferior: | Calculado: 16 mm | Cumple |
| -Parrilla superior: | Calculado: 16 mm | Cumple |
| Separación máxima entre barras:<br>*Artículo 58.8.2 de la norma EHE-08* | Máximo: 30 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Separación mínima entre barras:<br>*Criterio de CYPE, basado en: J. Calavera. "Cálculo de Estructuras de Cimentación". Capítulo 3.16* | Mínimo: 10 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Longitud de anclaje:<br>*Criterio del libro "Cálculo de estructuras de cimentación", J. Calavera. Ed. INTEMAC, 1991* | | |
| -Armado inf. dirección X hacia der: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Mínimo: 16 cm<br>Calculado: 107 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Mínimo: 16 cm<br>Calculado: 107 cm | Cumple |
| -Armado sup. dirección X hacia der: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Mínimo: 33 cm<br>Calculado: 107 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Mínimo: 33 cm<br>Calculado: 107 cm | Cumple |
| Longitud mínima de las patillas: | Mínimo: 16 cm | |
| -Armado inf. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |

| Referencia: N38<br>Dimensiones: 170 x 245 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| -Armado inf. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| Abertura de fisuras: | Máximo: 0.3 mm | |
| -Armado inferior dirección X: | Calculado: 0 mm | Cumple |
| -Armado inferior dirección Y: | Calculado: 0 mm | Cumple |
| -Armado superior dirección X: | Calculado: 0 mm | Cumple |
| -Armado superior dirección Y: | Calculado: 0 mm | Cumple |
| Se cumplen todas las comprobaciones | | |

## Zapata hastial

Son las zapatas de los pilares hastiales, es decir, de los 2 pilares ubicados en la fachada hastial de ambos extremos de la nave. Se dispone un total de 4 zapatas de esta tipología, siendo los nudos de referencia los nudos: N43, N47, N41 y N45. Siendo las dimensiones de las zapatas de 280x185x100 cm con armadura de 16 mm cada 20 cm en ambas caras y direcciones. Se indica a continuación la comprobación de las mismas.

| Referencia: N43<br>Dimensiones: 185 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Tensiones sobre el terreno:<br>*Criterio de CYPE* | | |
| -Tensión media en situaciones persistentes: | Máximo: 3 kp/cm²<br>Calculado: 0.355 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes sin viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.433 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes con viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.833 kp/cm² | Cumple |
| Vuelco de la zapata:<br>*Si el % de reserva de seguridad es mayor que cero, quiere decir que los coeficientes de seguridad al vuelco son mayores que los valores estrictos exigidos para todas las combinaciones de equilibrio.* | | |

| Referencia: N43<br>Dimensiones: 185 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| -En dirección X: | Reserva seguridad: 264.1 % | Cumple |
| -En dirección Y: | Reserva seguridad: 6.1 % | Cumple |
| Deslizamiento de la zapata:<br>-Situaciones persistentes:<br>*CTE DB-SE C (Cimientos): Tabla 2.1* | Mínimo: 1.5<br>Calculado: 16.96 | Cumple |
| Flexión en la zapata:<br>-En dirección X: | Momento: 1.48 t·m | Cumple |
| -En dirección Y: | Momento: 7.85 t·m | Cumple |
| Cortante en la zapata:<br>-En dirección X: | Cortante: 0.00 t | Cumple |
| -En dirección Y: | Cortante: 8.44 t | Cumple |
| Compresión oblicua en la zapata:<br>-Situaciones persistentes:<br>*Criterio de CYPE* | Máximo: 713.55 t/m²<br>Calculado: 2.65 t/m² | Cumple |
| Canto mínimo:<br>*Artículo 58.8.1 de la norma EHE-08* | Mínimo: 25 cm<br>Calculado: 100 cm | Cumple |
| Espacio para anclar arranques en cimentación:<br>-N43: | Mínimo: 44 cm<br>Calculado: 92 cm | Cumple |
| Cuantía geométrica mínima:<br>*Artículo 42.3.5 de la norma EHE-08* | Mínimo: 0.0009 | |
| -Armado inferior dirección X: | Calculado: 0.001 | Cumple |
| -Armado superior dirección X: | Calculado: 0.001 | Cumple |
| -Armado inferior dirección Y: | Calculado: 0.001 | Cumple |
| -Armado superior dirección Y: | Calculado: 0.001 | Cumple |
| Cuantía mínima necesaria por flexión:<br>*Artículo 42.3.2 de la norma EHE-08* | Calculado: 0.0011 | |
| -Armado inferior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado inferior dirección Y: | Mínimo: 0.0002 | Cumple |
| -Armado superior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado superior dirección Y: | Mínimo: 0.0002 | Cumple |
| Diámetro mínimo de las barras:<br>*Recomendación del Artículo 58.8.2 (norma EHE-08)* | Mínimo: 12 mm | |
| -Parrilla inferior: | Calculado: 16 mm | Cumple |
| -Parrilla superior: | Calculado: 16 mm | Cumple |
| Separación máxima entre barras:<br>*Artículo 58.8.2 de la norma EHE-08* | Máximo: 30 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |

| Referencia: N43<br>Dimensiones: 185 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Separación mínima entre barras:<br>*Criterio de CYPE, basado en: J. Calavera. "Cálculo de Estructuras de Cimentación". Capítulo 3.16* | Mínimo: 10 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Longitud de anclaje:<br>*Criterio del libro "Cálculo de estructuras de cimentación", J. Calavera. Ed. INTEMAC, 1991* | | |
| -Armado inf. dirección X hacia der: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Mínimo: 16 cm<br>Calculado: 124 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Mínimo: 16 cm<br>Calculado: 124 cm | Cumple |
| -Armado sup. dirección X hacia der: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Mínimo: 19 cm<br>Calculado: 124 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Mínimo: 19 cm<br>Calculado: 124 cm | Cumple |
| Longitud mínima de las patillas: | Mínimo: 16 cm | |
| -Armado inf. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| Abertura de fisuras: | Máximo: 0.3 mm | |
| -Armado inferior dirección X: | Calculado: 0 mm | Cumple |
| -Armado inferior dirección Y: | Calculado: 0 mm | Cumple |
| -Armado superior dirección X: | Calculado: 0 mm | Cumple |
| -Armado superior dirección Y: | Calculado: 0 mm | Cumple |

| Referencia: N43<br>Dimensiones: 185 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Se cumplen todas las comprobaciones | | |

## Zapata almacén

Son las zapatas de los pilares de la fachada lateral del almacén. Se dispone un total de 4 zapatas de esta tipología, siendo los nudos de referencia los nudos: N109, N111, N113 y N115. Siendo las dimensiones de las zapatas de 275x170x100 cm con armadura de 16 mm cada 20 cm en ambas caras y direcciones. Se indica a continuación la comprobación de las mismas.

| Referencia: N111<br>Dimensiones: 170 x 275 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Tensiones sobre el terreno:<br>*Criterio de CYPE* | | |
| -Tensión media en situaciones persistentes: | Máximo: 3 kp/cm²<br>Calculado: 0.43 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes sin viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.545 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes con viento: | Máximo: 3.75 kp/cm²<br>Calculado: 1.13 kp/cm² | Cumple |
| Vuelco de la zapata:<br>*Si el % de reserva de seguridad es mayor que cero, quiere decir que los coeficientes de seguridad al vuelco son mayores que los valores estrictos exigidos para todas las combinaciones de equilibrio.* | | |
| -En dirección X: | Reserva seguridad: 205.5 % | Cumple |
| -En dirección Y: | Reserva seguridad: 10.6 % | Cumple |
| Deslizamiento de la zapata:<br>-Situaciones persistentes:<br>*CTE DB-SE C (Cimientos): Tabla 2.1* | Mínimo: 1.5<br>Calculado: 11.14 | Cumple |
| Flexión en la zapata: | | |
| -En dirección X: | Momento: -1.22 t·m | Cumple |
| -En dirección Y: | Momento: 6.98 t·m | Cumple |
| Cortante en la zapata: | | |
| -En dirección X: | Cortante: 0.00 t | Cumple |
| -En dirección Y: | Cortante: 6.39 t | Cumple |

Referencia: N111
Dimensiones: 170 x 275 x 100
Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20

| Comprobación | Valores | Estado |
|---|---|---|
| Compresión oblicua en la zapata: | | |
| -Situaciones persistentes: *Criterio de CYPE* | Máximo: 713.55 t/m²<br>Calculado: 2.34 t/m² | Cumple |
| Canto mínimo: *Artículo 58.8.1 de la norma EHE-08* | Mínimo: 25 cm<br>Calculado: 100 cm | Cumple |
| Espacio para anclar arranques en cimentación: | | |
| -N111: | Mínimo: 35 cm<br>Calculado: 92 cm | Cumple |
| Cuantía geométrica mínima: *Artículo 42.3.5 de la norma EHE-08* | Mínimo: 0.0009 | |
| -Armado inferior dirección X: | Calculado: 0.001 | Cumple |
| -Armado superior dirección X: | Calculado: 0.001 | Cumple |
| -Armado inferior dirección Y: | Calculado: 0.001 | Cumple |
| -Armado superior dirección Y: | Calculado: 0.001 | Cumple |
| Cuantía mínima necesaria por flexión: *Artículo 42.3.2 de la norma EHE-08* | Calculado: 0.0011 | |
| -Armado inferior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado inferior dirección Y: | Mínimo: 0.0002 | Cumple |
| -Armado superior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado superior dirección Y: | Mínimo: 0.0002 | Cumple |
| Diámetro mínimo de las barras: *Recomendación del Artículo 58.8.2 (norma EHE-08)* | Mínimo: 12 mm | |
| -Parrilla inferior: | Calculado: 16 mm | Cumple |
| -Parrilla superior: | Calculado: 16 mm | Cumple |
| Separación máxima entre barras: *Artículo 58.8.2 de la norma EHE-08* | Máximo: 30 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Separación mínima entre barras: *Criterio de CYPE, basado en: J. Calavera. "Cálculo de Estructuras de Cimentación". Capítulo 3.16* | Mínimo: 10 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Longitud de anclaje: *Criterio del libro "Cálculo de estructuras de cimentación", J. Calavera. Ed. INTEMAC, 1991* | | |
| -Armado inf. dirección X hacia der: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |

Referencia: N111
Dimensiones: 170 x 275 x 100
Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20

| Comprobación | Valores | Estado |
|---|---|---|
| -Armado inf. dirección X hacia izq: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Mínimo: 16 cm<br>Calculado: 122 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Mínimo: 16 cm<br>Calculado: 122 cm | Cumple |
| -Armado sup. dirección X hacia der: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Mínimo: 19 cm<br>Calculado: 122 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Mínimo: 19 cm<br>Calculado: 122 cm | Cumple |
| Longitud mínima de las patillas: | Mínimo: 16 cm | |
| -Armado inf. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| Abertura de fisuras: | Máximo: 0.3 mm | |
| -Armado inferior dirección X: | Calculado: 0 mm | Cumple |
| -Armado inferior dirección Y: | Calculado: 0 mm | Cumple |
| -Armado superior dirección X: | Calculado: 0 mm | Cumple |
| -Armado superior dirección Y: | Calculado: 0 mm | Cumple |
| Se cumplen todas las comprobaciones | | |

Zapata hastial anexa almacén

Es la zapata del pilar anexo al almacén en la fachada hastial. Es decir, sería un pilar en esquina, pero al anexionarse el almacén, este le afecta. Siendo el nudo de referencia el N3. Y con unas dimensiones de las zapatas de 280x230x100 cm con armadura de 16 mm cada 20 cm en ambas caras y direcciones. Se indica a continuación la comprobación de las mismas.

| Referencia: N3<br>Dimensiones: 230 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Tensiones sobre el terreno:<br>*Criterio de CYPE* | | |
| -Tensión media en situaciones persistentes: | Máximo: 3 kp/cm²<br>Calculado: 0.41 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes sin viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.494 kp/cm² | Cumple |
| -Tensión máxima en situaciones persistentes con viento: | Máximo: 3.75 kp/cm²<br>Calculado: 0.921 kp/cm² | Cumple |
| Vuelco de la zapata:<br>*Si el % de reserva de seguridad es mayor que cero, quiere decir que los coeficientes de seguridad al vuelco son mayores que los valores estrictos exigidos para todas las combinaciones de equilibrio.* | | |
| -En dirección X: | Reserva seguridad: 10.2 % | Cumple |
| -En dirección Y: | Reserva seguridad: 160.6 % | Cumple |
| Deslizamiento de la zapata:<br>-Situaciones persistentes:<br>*CTE DB-SE C (Cimientos): Tabla 2.1* | Mínimo: 1.5<br>Calculado: 17.41 | Cumple |
| Flexión en la zapata: | | |
| -En dirección X: | Momento: 7.86 t·m | Cumple |
| -En dirección Y: | Momento: 3.78 t·m | Cumple |
| Cortante en la zapata: | | |
| -En dirección X: | Cortante: 0.00 t | Cumple |
| -En dirección Y: | Cortante: 1.68 t | Cumple |
| Compresión oblicua en la zapata:<br>-Situaciones persistentes:<br>*Criterio de CYPE* | Máximo: 713.55 t/m²<br>Calculado: 5.8 t/m² | Cumple |
| Canto mínimo:<br>*Artículo 58.8.1 de la norma EHE-08* | Mínimo: 25 cm<br>Calculado: 100 cm | Cumple |
| Espacio para anclar arranques en cimentación:<br>-N3: | Mínimo: 65 cm<br>Calculado: 92 cm | Cumple |

| Referencia: N3<br>Dimensiones: 230 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Cuantía geométrica mínima:<br>*Artículo 42.3.5 de la norma EHE-08* | Mínimo: 0.0009 | |
| -Armado inferior dirección X: | Calculado: 0.001 | Cumple |
| -Armado superior dirección X: | Calculado: 0.001 | Cumple |
| -Armado inferior dirección Y: | Calculado: 0.001 | Cumple |
| -Armado superior dirección Y: | Calculado: 0.001 | Cumple |
| Cuantía mínima necesaria por flexión:<br>*Artículo 42.3.2 de la norma EHE-08* | Calculado: 0.0011 | |
| -Armado inferior dirección X: | Mínimo: 0.0002 | Cumple |
| -Armado inferior dirección Y: | Mínimo: 0.0001 | Cumple |
| -Armado superior dirección X: | Mínimo: 0.0001 | Cumple |
| -Armado superior dirección Y: | Mínimo: 0.0001 | Cumple |
| Diámetro mínimo de las barras:<br>*Recomendación del Artículo 58.8.2 (norma EHE-08)* | Mínimo: 12 mm | |
| -Parrilla inferior: | Calculado: 16 mm | Cumple |
| -Parrilla superior: | Calculado: 16 mm | Cumple |
| Separación máxima entre barras:<br>*Artículo 58.8.2 de la norma EHE-08* | Máximo: 30 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Separación mínima entre barras:<br>*Criterio de CYPE, basado en: J. Calavera. "Cálculo de Estructuras de Cimentación". Capítulo 3.16* | Mínimo: 10 cm | |
| -Armado inferior dirección X: | Calculado: 20 cm | Cumple |
| -Armado inferior dirección Y: | Calculado: 20 cm | Cumple |
| -Armado superior dirección X: | Calculado: 20 cm | Cumple |
| -Armado superior dirección Y: | Calculado: 20 cm | Cumple |
| Longitud de anclaje:<br>*Criterio del libro "Cálculo de estructuras de cimentación", J. Calavera. Ed. INTEMAC, 1991* | | |
| -Armado inf. dirección X hacia der: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Mínimo: 16 cm<br>Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Mínimo: 16 cm<br>Calculado: 123 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Mínimo: 16 cm<br>Calculado: 123 cm | Cumple |

| Referencia: N3<br>Dimensiones: 230 x 280 x 100<br>Armados: Xi:Ø16c/20 Yi:Ø16c/20 Xs:Ø16c/20 Ys:Ø16c/20 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| -Armado sup. dirección X hacia der: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Mínimo: 19 cm<br>Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Mínimo: 19 cm<br>Calculado: 123 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Mínimo: 19 cm<br>Calculado: 123 cm | Cumple |
| Longitud mínima de las patillas: | Mínimo: 16 cm | |
| -Armado inf. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado inf. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia der: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección X hacia izq: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia arriba: | Calculado: 90 cm | Cumple |
| -Armado sup. dirección Y hacia abajo: | Calculado: 90 cm | Cumple |
| Abertura de fisuras: | Máximo: 0.3 mm | |
| -Armado inferior dirección X: | Calculado: 0 mm | Cumple |
| -Armado inferior dirección Y: | Calculado: 0 mm | Cumple |
| -Armado superior dirección X: | Calculado: 0 mm | Cumple |
| -Armado superior dirección Y: | Calculado: 0 mm | Cumple |
| Se cumplen todas las comprobaciones | | |

Vigas de atado

Entre cada dos zapatas aisladas se realiza una viga de atado que conecta el centro de cada zapata con su adyacente. Las vigas de atado son de 40x40 cm con 4 barras de 12 mm de diámetro y estribos de 8 mm de diámetro cada 30 cm.

Se incluye la justificación de una de las vigas.

| Referencia: C.1 [N13-N18] (Viga de atado) -Dimensiones: 40.0 cm x 40.0 cm -Armadura superior: 2Ø12 -Armadura inferior: 2Ø12 -Estribos: 1xØ8c/30 | | |
|---|---|---|
| Comprobación | Valores | Estado |
| Diámetro mínimo estribos: | Mínimo: 6 mm<br>Calculado: 8 mm | Cumple |
| Separación mínima entre estribos:<br>*Artículo 69.4.1 de la norma EHE-08* | Mínimo: 2.5 cm<br>Calculado: 29.2 cm | Cumple |
| Separación mínima armadura longitudinal:<br>*Artículo 69.4.1 de la norma EHE-08* | Mínimo: 2.5 cm | |
| -Armadura superior: | Calculado: 26 cm | Cumple |
| -Armadura inferior: | Calculado: 26 cm | Cumple |
| Separación máxima estribos:<br>-Sin cortantes:<br>*Artículo 44.2.3.4.1 de la norma EHE-08* | Máximo: 30 cm<br>Calculado: 30 cm | Cumple |
| Separación máxima armadura longitudinal:<br>*Artículo 42.3.1 de la norma EHE-08* | Máximo: 30 cm | |
| -Armadura superior: | Calculado: 26 cm | Cumple |
| -Armadura inferior: | Calculado: 26 cm | Cumple |
| Se cumplen todas las comprobaciones | | |

## 2.5 EXPOSICIÓN AL RADÓN

El Real Decreto 732/2019 incluye en el documento básico DB-HS Salubridad del Código Técnico de Edificación la sección HS6: protección frente a la exposición al radón. En base a este documento, la zona de ubicación de la estación de bombeo se considera incluida dentro de la zona incluida en el listado de municipios expuestos al Radón.

Para la correcta protección frente a la exposición al radón se plantean varias opciones. En este caso se debe en primer lugar recalcar que la estación de bombeo es una zona de trabajo autónomo, que no requiere de la presencia de personal continua. Sino una revisión puntual, además de que los sistemas de telecontrol y automatización permiten que el sistema sea operable y vigilable desde el exterior. A ello se hace referencia porque no será la estación de bombeo y el almacén anexos zonas de permanencia de personas.

Para luchar con el radón se plantean dos metodologías, aprovechando las propias instalaciones del bombeo.

- Barrera: mediante la ejecución de una solera continua. La solera solo se atraviesa en dos puntos mediante las tuberías de impulsión. Estas tuberías metálicas se ejecutan embebidas en el hormigón de la solera. Quedando sellado así el punto de unión.
- Ventilación: ambas salas cuentan con ventilación natural mediante rejillas de chapa. Estas rejillas no pueden cerrarse como pudieran ser ventanas. Por ello, la ventilación natural es constante. Las rejillas de ventilación se disponen en las fachadas alternas facilitando la circulación del aire.

  Además de las rejillas la instalación cuenta con extractores de aire planteados para momentos de acumulación de calor, permitir la refrigeración de la sala. Estos mismos equipos permitirán la salida del aire, consiguiendo una constante renovación del aire.

De esta forma mediante la barrera que supone la solera, y mediante la renovación del aire continua, se consigue la protección frente al Radón. Ello además de que es una edificación con bajo uso por personal.

# 3 ARQUETA TOMA DE FONDO INFERIOR SUR

El cálculo de la arqueta se ha realizado con el programa CYPE 2020, concretamente con su aplicación Cypecad, especializada en el cálculo de estructuras con hormigón. Empleándose para ello el citado programa bajo la licencia nº 68665.

## 3.1 ACCIONES CONSIDERADAS

**Gravitatorias**

| Planta | S.C.U (t/m²) | Cargas muertas (t/m²) |
|---|---|---|
| Forjado 1 | 0.40 | 0.20 |
| Cimentación | 0.40 | 0.00 |

**Viento**

Sin acción de viento

**Sismo**

Sin acción de sismo

**Hipótesis de carga**

| | |
|---|---|
| Automáticas | Peso propio |
| | Cargas muertas |
| | Sobrecarga de uso |

**Empujes en muros**

Empuje de Defecto

Una situación de relleno

Carga:Cargas muertas

Con nivel freático: Cota -2.30 m

Con relleno: Cota 0.00 m

Ángulo de talud 0.00 Grados

Densidad aparente 2.00 t/m³

Densidad sumergida 1.20 t/m³

Ángulo rozamiento interno 28.00 Grados

Evacuación por drenaje 100.00 %

Carga 1:

Tipo: Uniforme

Valor: 1.00 t/m²

## 3.2 ESTADOS LÍMITE

| | |
|---|---|
| E.L.U. de rotura. Hormigón<br>E.L.U. de rotura. Hormigón en cimentaciones | CTE<br>Cota de nieve: Altitud inferior o igual a 1000 m |
| Tensiones sobre el terreno<br>Desplazamientos | Acciones características |

## 3.3 SITUACIONES DE PROYECTO

Para las distintas situaciones de proyecto, las combinaciones de acciones se definirán de acuerdo con los siguientes criterios:

- **Con coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\gamma_{Q1}\Psi_{p1}Q_{k1}+\sum_{i>1}\gamma_{Qi}\Psi_{ai}Q_{ki}$$

- **Sin coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\sum_{i\geq 1}\gamma_{Qi}Q_{ki}$$

- Donde:

$G_k$ Acción permanente

$P_k$ Acción de pretensado

$Q_k$ Acción variable

$g_G$ Coeficiente parcial de seguridad de las acciones permanentes

$g_P$ Coeficiente parcial de seguridad de la acción de pretensado

$g_{Q,1}$ Coeficiente parcial de seguridad de la acción variable principal

$g_{Q,i}$ Coeficiente parcial de seguridad de las acciones variables de acompañamiento

$y_{p,1}$ Coeficiente de combinación de la acción variable principal

$y_{a,i}$ Coeficiente de combinación de las acciones variables de acompañamiento

**Coeficientes parciales de seguridad (g) y coeficientes de combinación (y)**

Para cada situación de proyecto y estado límite los coeficientes a utilizar serán:

**E.L.U. de rotura. Hormigón: EHE-08**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.350 | - | - |
| Sobrecarga (Q) | 0.000 | 1.500 | 1.000 | 0.700 |

**E.L.U. de rotura. Hormigón en cimentaciones: EHE-08 / CTE DB-SE C**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.600 | - | - |
| Sobrecarga (Q) | 0.000 | 1.600 | 1.000 | 0.700 |

**Tensiones sobre el terreno**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Desplazamientos**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Combinaciones**

- **Nombres de las hipótesis**

PP Peso propio

CM Cargas muertas

Qa Sobrecarga de uso

- **E.L.U. de rotura. Hormigón**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.350 | 1.350 | |
| 3 | 1.000 | 1.000 | 1.500 |
| 4 | 1.350 | 1.350 | 1.500 |

- **E.L.U. de rotura. Hormigón en cimentaciones**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.600 | 1.600 | |
| 3 | 1.000 | 1.000 | 1.600 |
| 4 | 1.600 | 1.600 | 1.600 |

**Tensiones sobre el terreno**

- **Desplazamientos**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.000 | 1.000 | 1.000 |

## 3.4 DATOS GEOMÉTRICOS DE GRUPOS Y PLANTAS

| Grupo | Nombre del grupo | Planta | Nombre planta | Altura | Cota |
|---|---|---|---|---|---|
| 1 | Forjado 1 | 1 | Forjado 1 | 3.80 | 0.50 |
| 0 | Cimentación | | | | -3.30 |

## 3.5 DATOS GEOMÉTRICOS DE MUROS

- Las coordenadas de los vértices inicial y final son absolutas.
- Las dimensiones están expresadas en metros.

Datos geométricos del muro

| Ref. | Tipo muro | GI- GF | Vértices Inicial | Final | Planta | Dimensiones Izquierda+Derecha=Total |
|---|---|---|---|---|---|---|
| M1 | Muro de hormigón armado | 0-1 | ( 0.00, 5.90) | ( 6.20, 5.90) | 1 | 0.2+0.2=0.4 |
| M2 | Muro de hormigón armado | 0-1 | ( 6.20, 0.00) | ( 6.20, 5.90) | 1 | 0.2+0.2=0.4 |
| M3 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 6.20, 0.00) | 1 | 0.2+0.2=0.4 |
| M4 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 0.00, 5.90) | 1 | 0.2+0.2=0.4 |

Empujes y zapata del muro

| Referencia | Empujes | Zapata del muro |
|---|---|---|
| M1 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M2 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M3 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M4 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |

## 3.6 LOSAS Y ELEMENTOS DE CIMENTACIÓN

| Losas cimentación | Canto (cm) | Módulo balasto (t/m³) | Tensión admisible en situaciones persistentes (kp/cm²) | Tensión admisible en situaciones accidentales (kp/cm²) |
|---|---|---|---|---|
| Todas | 40 | 8000.00 | 1.60 | 2.50 |

## 3.7 LISTADO DE ARMADO DE MUROS

**Muro M1: Longitud: 620 cm [Nudo inicial: 0.00:5.90 -> Nudo final: 6.20:5.90]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M2: Longitud: 590 cm [Nudo inicial: 6.20:0.00 -> Nudo final: 6.20:5.90]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M3: Longitud: 620 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 6.20:0.00]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M4: Longitud: 590 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:5.90]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

F.C. = El factor de cumplimiento indica el porcentaje de área en el cual el armado y espesor de hormigón son suficientes.

## 3.8 PÉSIMOS DE MUROS

Referencias:

Aprovechamiento: Nivel de tensiones (relación entre la tensión máxima y la admisible). Equivale al inverso del coeficiente de seguridad.

Nx : Axil vertical.

Ny : Axil horizontal.

Nxy: Axil tangencial.

Mx : Momento vertical (alrededor del eje horizontal).

My : Momento horizontal (alrededor del eje vertical).

Mxy: Momento torsor.

Qx : Cortante transversal vertical.

Qy : Cortante transversal horizontal.

**Muro M1: Longitud: 620 cm [Nudo inicial: 0.00:5.90 -> Nudo final: 6.20:5.90]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 2.23 | -8.06 | -1.02 | 0.38 | -5.02 | -0.63 | -0.04 | --- | --- |
| | Arm. horz. der. | 1.47 | -1.88 | -5.27 | 0.04 | -0.71 | -3.57 | -0.07 | --- | --- |
| | Arm. vert. iza. | 0.69 | -4.07 | -2.85 | -0.30 | 1.32 | 1.39 | 0.13 | --- | --- |
| | Arm. horz. iza. | 0.74 | -1.88 | -3.41 | -0.09 | 1.05 | 1.69 | 0.19 | --- | --- |
| | Hormigón | 6.58 | -8.06 | -1.02 | 0.38 | -5.02 | -0.63 | -0.04 | --- | --- |
| | Arm. transve. | 2.97 | -5.95 | -1.93 | -0.76 | --- | --- | --- | 4.87 | 0.28 |

**Muro M2: Longitud: 590 cm [Nudo inicial: 6.20:0.00 -> Nudo final: 6.20:5.90]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 0.67 | -4.28 | -2.79 | -0.11 | -1.23 | -0.99 | 0.00 | --- | --- |
| | Arm. horz. der. | 0.76 | -1.39 | -3.92 | 0.00 | -0.82 | -1.65 | 0.10 | --- | --- |
| | Arm. vert. iza. | 2.19 | -8.00 | -1.01 | 0.02 | 4.93 | 0.62 | 0.11 | --- | --- |
| | Arm. horz. iza. | 1.28 | -1.66 | -4.88 | 0.39 | 0.52 | 3.08 | 0.05 | --- | --- |
| | Hormigón | 6.47 | -8.00 | -1.01 | 0.02 | 4.93 | 0.62 | 0.11 | --- | --- |
| | Arm. transve. | 3.05 | -5.96 | -1.83 | -0.08 | --- | --- | --- | -5.01 | 0.05 |

**Muro M3: Longitud: 620 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 6.20:0.00]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 0.70 | -3.91 | -2.90 | -0.08 | -1.37 | -1.45 | 0.03 | --- | --- |
| | Arm. horz. der. | 0.76 | -2.00 | -3.41 | 0.08 | -1.12 | -1.75 | 0.13 | --- | --- |
| | Arm. vert. iza. | 2.28 | -8.16 | -1.03 | -0.15 | 5.15 | 0.65 | 0.06 | --- | --- |
| | Arm. horz. iza. | 1.58 | -1.82 | -5.02 | 0.21 | 0.52 | 3.94 | -0.30 | --- | --- |
| | Hormigón | 6.73 | -8.16 | -1.03 | -0.15 | 5.15 | 0.65 | 0.06 | --- | --- |
| | Arm. transve. | 3.04 | -6.16 | -1.89 | -0.40 | --- | --- | --- | -5.00 | -0.15 |

**Muro M4: Longitud: 590 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:5.90]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 2.15 | -7.89 | -1.00 | 0.17 | -4.81 | -0.61 | -0.01 | --- | --- |
| | Arm. horz. der. | 1.42 | -1.78 | -5.10 | 0.14 | 0.04 | -3.45 | -0.03 | --- | --- |
| | Arm. vert. iza. | 0.68 | -3.70 | -3.21 | -0.47 | 1.34 | 1.30 | 0.25 | --- | --- |
| | Arm. horz. iza. | 0.75 | -1.00 | -4.00 | -0.05 | -0.02 | 1.61 | -0.06 | --- | --- |
| | Hormigón | 6.33 | -7.89 | -1.00 | 0.17 | -4.81 | -0.61 | -0.01 | --- | --- |
| | Arm. transve. | 2.91 | -5.84 | -1.91 | 0.25 | --- | --- | --- | 4.78 | 0.06 |

### 3.9 COMPROBACIÓN DE ACCIÓN HIDRAULICA PUNTUAL

Además de la comprobación de la arqueta en base a los empujes generados por las tierras, tal y como se recoge en los subapartados anteriores, se comprueba el armado y espesor del muro de la arqueta para la acción generada por el empuje hidráulico de la tubería en los momentos de accionamiento de la válvula de seccionamiento y situaciones de válvula cerrada. Situaciones en las que la tubería y la válvula transmiten el empuje hidráulico al muro de la misma.

# 4 ARQUETA TOMA DE FONDO BALSA INFERIOR NORTE

El cálculo de la arqueta se ha realizado con el programa CYPE 2020, concretamente con su aplicación Cypecad, especializada en el cálculo de estructuras con hormigón. Empleándose para ello el citado programa bajo la licencia nº 68665.

## 4.1 ACCIONES CONSIDERADAS

**Gravitatorias**

| Planta | S.C.U (t/m²) | Cargas muertas (t/m²) |
|---|---|---|
| Forjado 1 | 0.40 | 0.20 |
| Cimentación | 0.40 | 0.10 |

**Viento**

Sin acción de viento

**Sismo**

Sin acción de sismo

**Hipótesis de carga**

| | |
|---|---|
| Automáticas | Peso propio |
| | Cargas muertas |
| | Sobrecarga de uso |

**Empujes en muros**

Empuje de Defecto

Una situación de relleno
Carga:Cargas muertas
Con nivel freático: Cota -4.60 m
Con relleno: Cota 0.00 m
Ángulo de talud 0.00 Grados
Densidad aparente 2.00 t/m³
Densidad sumergida 1.50 t/m³
Ángulo rozamiento interno 28.00 Grados
Evacuación por drenaje 100.00 %
Carga 1:
Tipo: Uniforme
Valor: 1.00 t/m²

## 4.2 ESTADOS LÍMITE

| | |
|---|---|
| E.L.U. de rotura. Hormigón<br>E.L.U. de rotura. Hormigón en cimentaciones | CTE<br>Cota de nieve: Altitud inferior o igual a 1000 m |
| Tensiones sobre el terreno<br>Desplazamientos | Acciones características |

## 4.3 SITUACIONES DE PROYECTO

Para las distintas situaciones de proyecto, las combinaciones de acciones se definirán de acuerdo con los siguientes criterios:

- **Con coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\gamma_{Q1}\Psi_{p1}Q_{k1}+\sum_{i>1}\gamma_{Qi}\Psi_{ai}Q_{ki}$$

- **Sin coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\sum_{i\geq 1}\gamma_{Qi}Q_{ki}$$

- Donde:

$G_k$ Acción permanente

$P_k$ Acción de pretensado

$Q_k$ Acción variable

$g_G$ Coeficiente parcial de seguridad de las acciones permanentes

$g_P$ Coeficiente parcial de seguridad de la acción de pretensado

$g_{Q,1}$ Coeficiente parcial de seguridad de la acción variable principal

$g_{Q,i}$ Coeficiente parcial de seguridad de las acciones variables de acompañamiento

$y_{p,1}$ Coeficiente de combinación de la acción variable principal

$y_{a,i}$ Coeficiente de combinación de las acciones variables de acompañamiento

**Coeficientes parciales de seguridad (g) y coeficientes de combinación (y)**

Para cada situación de proyecto y estado límite los coeficientes a utilizar serán:

**E.L.U. de rotura. Hormigón: EHE-08**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.350 | - | - |
| Sobrecarga (Q) | 0.000 | 1.500 | 1.000 | 0.700 |

**E.L.U. de rotura. Hormigón en cimentaciones: EHE-08 / CTE DB-SE C**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.600 | - | - |
| Sobrecarga (Q) | 0.000 | 1.600 | 1.000 | 0.700 |

**Tensiones sobre el terreno**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Desplazamientos**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Combinaciones**

- **Nombres de las hipótesis**

PP Peso propio

CM Cargas muertas

Qa Sobrecarga de uso

- **E.L.U. de rotura. Hormigón**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.350 | 1.350 | |
| 3 | 1.000 | 1.000 | 1.500 |
| 4 | 1.350 | 1.350 | 1.500 |

- **E.L.U. de rotura. Hormigón en cimentaciones**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.600 | 1.600 | |
| 3 | 1.000 | 1.000 | 1.600 |
| 4 | 1.600 | 1.600 | 1.600 |

**Tensiones sobre el terreno**

- **Desplazamientos**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.000 | 1.000 | 1.000 |

## 4.4 DATOS GEOMÉTRICOS DE GRUPOS Y PLANTAS

| Grupo | Nombre del grupo | Planta | Nombre planta | Altura | Cota |
|---|---|---|---|---|---|
| 1 | Forjado 1 | 1 | Forjado 1 | 6.10 | 0.50 |
| 0 | Cimentación | | | | -5.60 |

## 4.5 DATOS GEOMÉTRICOS DE MUROS

- Las coordenadas de los vértices inicial y final son absolutas.
- Las dimensiones están expresadas en metros.

Datos geométricos del muro

| Ref. | Tipo muro | GI- GF | Vértices Inicial | Vértices Final | Planta | Dimensiones Izquierda+Derecha=Total |
|---|---|---|---|---|---|---|
| M1 | Muro de hormigón armado | 0-1 | ( 0.00, 4.90) | ( 4.70, 4.90) | 1 | 0.2+0.25=0.45 |
| M2 | Muro de hormigón armado | 0-1 | ( 4.70, 0.00) | ( 4.70, 4.90) | 1 | 0.2+0.25=0.45 |
| M3 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 4.70, 0.00) | 1 | 0.25+0.2=0.45 |
| M4 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 0.00, 4.90) | 1 | 0.2+0.25=0.45 |

Empujes y zapata del muro

| Referencia | Empujes | Zapata del muro |
|---|---|---|
| M1 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.450 x 0.450<br>Vuelos: izq.:0.00 der.:0.00 canto:0.45<br>Tensiones admisibles<br>-Situaciones persistentes: 3.00 kp/cm²<br>-Situaciones accidentales: 3.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M2 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.450 x 0.450<br>Vuelos: izq.:0.00 der.:0.00 canto:0.45<br>Tensiones admisibles<br>-Situaciones persistentes: 3.00 kp/cm²<br>-Situaciones accidentales: 3.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M3 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.450 x 0.450<br>Vuelos: izq.:0.00 der.:0.00 canto:0.45<br>Tensiones admisibles<br>-Situaciones persistentes: 3.00 kp/cm²<br>-Situaciones accidentales: 3.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M4 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.450 x 0.450<br>Vuelos: izq.:0.00 der.:0.00 canto:0.45<br>Tensiones admisibles<br>-Situaciones persistentes: 3.00 kp/cm²<br>-Situaciones accidentales: 3.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |

## 4.6 LOSAS Y ELEMENTOS DE CIMENTACIÓN

| Losas cimentación | Canto (cm) | Módulo balasto (t/m³) | Tensión admisible en situaciones persistentes (kp/cm²) | Tensión admisible en situaciones accidentales (kp/cm²) |
|---|---|---|---|---|
| Todas | 45 | 8000.00 | 1.60 | 2.50 |

## 4.7 LISTADO DE ARMADO DE MUROS

**Muro M1: Longitud: 470 cm [Nudo inicial: 0.00:4.90 -> Nudo final: 4.70:4.90]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 45.0 | Ø12c/25 cm | Ø12c/25 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M2: Longitud: 490 cm [Nudo inicial: 4.70:0.00 -> Nudo final: 4.70:4.90]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 45.0 | Ø12c/25 cm | Ø12c/25 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M3: Longitud: 470 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 4.70:0.00]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 45.0 | Ø12c/25 cm | Ø12c/25 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M4: Longitud: 490 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:4.90]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 45.0 | Ø12c/25 cm | Ø12c/25 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

F.C. = El factor de cumplimiento indica el porcentaje de área en el cual el armado y espesor de hormigón son suficientes.

## 4.8 PÉSIMOS DE MUROS

Referencias:

Aprovechamiento: Nivel de tensiones (relación entre la tensión máxima y la admisible). Equivale al inverso del coeficiente de seguridad.

Nx : Axil vertical.

Ny : Axil horizontal.

Nxy: Axil tangencial.

Mx : Momento vertical (alrededor del eje horizontal).

My : Momento horizontal (alrededor del eje vertical).

Mxy: Momento torsor.

Qx : Cortante transversal vertical.

Qy : Cortante transversal horizontal.

**Muro M1: Longitud: 470 cm [Nudo inicial: 0.00;4.90 -> Nudo final: 4.70;4.90]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=45.0 cm) | Arm. vert. der. | 2.76 | -14.33 | -1.81 | -0.48 | -7.42 | -0.94 | 0.00 | --- | --- |
| | Arm. horz. der. | 2.21 | -5.89 | -12.54 | 0.15 | 0.13 | -6.27 | 0.16 | --- | --- |
| | Arm. vert. izq. | 1.01 | -5.27 | -9.79 | -0.49 | 2.70 | 2.69 | 0.07 | --- | --- |
| | Arm. horz. izq. | 1.35 | -4.48 | -10.12 | 0.13 | 2.33 | 3.34 | -0.04 | --- | --- |
| | Hormigón | 8.12 | -14.33 | -1.81 | -0.48 | -7.42 | -0.94 | 0.00 | --- | --- |
| | Arm. transve. | 4.19 | -10.57 | -4.25 | -1.13 | --- | --- | --- | 7.84 | 0.36 |

**Muro M2: Longitud: 490 cm [Nudo inicial: 4.70;0.00 -> Nudo final: 4.70;4.90]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=45.0 cm) | Arm. vert. der. | 1.06 | -7.88 | -7.38 | -0.23 | -2.42 | -2.69 | -0.25 | --- | --- |
| | Arm. horz. der. | 1.40 | -3.88 | -9.59 | 0.04 | 0.09 | -3.67 | -0.05 | --- | --- |
| | Arm. vert. izq. | 2.90 | -14.87 | -1.88 | -0.49 | 7.85 | 0.99 | -0.01 | --- | --- |
| | Arm. horz. izq. | 2.16 | -5.56 | -12.16 | -0.28 | 0.95 | 6.12 | -0.01 | --- | --- |
| | Hormigón | 8.55 | -14.87 | -1.88 | -0.49 | 7.85 | 0.99 | -0.01 | --- | --- |
| | Arm. transve. | 4.37 | -11.09 | -4.20 | -1.16 | --- | --- | --- | -8.16 | -0.42 |

**Muro M3: Longitud: 470 cm [Nudo inicial: 0.00;0.00 -> Nudo final: 4.70;0.00]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=45.0 cm) | Arm. vert. der. | 1.00 | -5.26 | -9.86 | -0.47 | -2.68 | -2.67 | -0.06 | --- | --- |
| | Arm. horz. der. | 1.34 | -4.49 | -10.17 | 0.10 | 0.10 | -3.31 | 0.04 | --- | --- |
| | Arm. vert. izq. | 2.75 | -14.35 | -1.81 | -0.48 | 7.40 | 0.93 | -0.01 | --- | --- |
| | Arm. horz. izq. | 2.17 | -5.72 | -12.18 | -0.11 | 1.17 | 6.18 | -0.13 | --- | --- |
| | Hormigón | 8.11 | -14.35 | -1.81 | -0.48 | 7.40 | 0.93 | -0.01 | --- | --- |
| | Arm. transve. | 4.17 | -10.59 | -4.30 | -1.15 | --- | --- | --- | -7.80 | -0.35 |

**Muro M4: Longitud: 490 cm [Nudo inicial: 0.00;0.00 -> Nudo final: 0.00;4.90]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=45.0 cm) | Arm. vert. der. | 2.91 | -14.90 | -1.88 | -0.50 | -7.86 | -0.99 | 0.01 | --- | --- |
| | Arm. horz. der. | 2.13 | -5.41 | -11.79 | 0.09 | 0.12 | -6.08 | 0.08 | --- | --- |
| | Arm. vert. izq. | 1.05 | -7.86 | -7.45 | -0.23 | 2.40 | 2.70 | 0.25 | --- | --- |
| | Arm. horz. izq. | 1.40 | -3.97 | -9.45 | 0.03 | -0.09 | 3.68 | 0.05 | --- | --- |
| | Hormigón | 8.56 | -14.90 | -1.88 | -0.50 | -7.86 | -0.99 | 0.01 | --- | --- |
| | Arm. transve. | 4.37 | -11.09 | -4.26 | -1.19 | --- | --- | --- | 8.17 | 0.42 |

## 4.9 COMPROBACIÓN DE ACCIÓN HIDRAULICA PUNTUAL

Además de la comprobación de la arqueta en base a los empujes generados por las tierras, tal y como se recoge en los subapartados anteriores, se comprueba el armado y espesor del muro de la arqueta para la acción generada por el empuje hidráulico de la tubería en los momentos de accionamiento de la válvula de seccionamiento y situaciones de válvula cerrada. Situaciones en las que la tubería y la válvula transmiten el empuje hidráulico al muro de la misma.

# 5 ARQUETA TOMA DE FONDO BALSA INTERMEDIA

El cálculo de la arqueta se ha realizado con el programa CYPE 2020, concretamente con su aplicación Cypecad, especializada en el cálculo de estructuras con hormigón. Empleándose para ello el citado programa bajo la licencia nº 68665.

## 5.1 ACCIONES CONSIDERADAS

**Gravitatorias**

| Planta | S.C.U (t/m²) | Cargas muertas (t/m²) |
|---|---|---|
| Forjado 1 | 0.40 | 0.20 |
| Cimentación | 0.40 | 0.10 |

**Viento**

Sin acción de viento

**Sismo**

Sin acción de sismo

**Hipótesis de carga**

| | |
|---|---|
| Automáticas | Peso propio |
| | Cargas muertas |
| | Sobrecarga de uso |

**Empujes en muros**

Empuje de Defecto

Una situación de relleno

Carga:Cargas muertas
Con nivel freático: Cota -2.50 m
Con relleno: Cota 0.00 m
Ángulo de talud 0.00 Grados
Densidad aparente 2.00 t/m³
Densidad sumergida 1.50 t/m³
Ángulo rozamiento interno 28.00 Grados
Evacuación por drenaje 100.00 %
Carga 1:
Tipo: Uniforme
Valor: 1.00 t/m²

## 5.2 ESTADOS LÍMITE

| | |
|---|---|
| E.L.U. de rotura. Hormigón<br>E.L.U. de rotura. Hormigón en cimentaciones | CTE<br>Cota de nieve: Altitud inferior o igual a 1000 m |
| Tensiones sobre el terreno<br>Desplazamientos | Acciones características |

## 5.3 SITUACIONES DE PROYECTO

Para las distintas situaciones de proyecto, las combinaciones de acciones se definirán de acuerdo con los siguientes criterios:

- **Con coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\gamma_{Q1}\Psi_{p1}Q_{k1}+\sum_{i>1}\gamma_{Qi}\Psi_{ai}Q_{ki}$$

- **Sin coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\sum_{i\geq 1}\gamma_{Qi}Q_{ki}$$

- Donde:

$G_k$ Acción permanente

$P_k$ Acción de pretensado

$Q_k$ Acción variable

$g_G$ Coeficiente parcial de seguridad de las acciones permanentes

$g_P$ Coeficiente parcial de seguridad de la acción de pretensado

$g_{Q,1}$ Coeficiente parcial de seguridad de la acción variable principal

$g_{Q,i}$ Coeficiente parcial de seguridad de las acciones variables de acompañamiento

$y_{p,1}$ Coeficiente de combinación de la acción variable principal

$y_{a,i}$ Coeficiente de combinación de las acciones variables de acompañamiento

**Coeficientes parciales de seguridad (g) y coeficientes de combinación (y)**

Para cada situación de proyecto y estado límite los coeficientes a utilizar serán:

**E.L.U. de rotura. Hormigón: EHE-08**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.350 | - | - |
| Sobrecarga (Q) | 0.000 | 1.500 | 1.000 | 0.700 |

**E.L.U. de rotura. Hormigón en cimentaciones: EHE-08 / CTE DB-SE C**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.600 | - | - |
| Sobrecarga (Q) | 0.000 | 1.600 | 1.000 | 0.700 |

**Tensiones sobre el terreno**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Desplazamientos**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Combinaciones**

- **Nombres de las hipótesis**

PP Peso propio

CM Cargas muertas

Qa Sobrecarga de uso

- **E.L.U. de rotura. Hormigón**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.350 | 1.350 | |
| 3 | 1.000 | 1.000 | 1.500 |
| 4 | 1.350 | 1.350 | 1.500 |

- **E.L.U. de rotura. Hormigón en cimentaciones**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.600 | 1.600 | |
| 3 | 1.000 | 1.000 | 1.600 |
| 4 | 1.600 | 1.600 | 1.600 |

**Tensiones sobre el terreno**

- **Desplazamientos**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.000 | 1.000 | 1.000 |

## 5.4 DATOS GEOMÉTRICOS DE GRUPOS Y PLANTAS

| Grupo | Nombre del grupo | Planta | Nombre planta | Altura | Cota |
|---|---|---|---|---|---|
| 1 | Forjado 1 | 1 | Forjado 1 | 4.00 | 0.50 |
| 0 | Cimentación | | | | -3.50 |

## 5.5 DATOS GEOMÉTRICOS DE MUROS

- Las coordenadas de los vértices inicial y final son absolutas.
- Las dimensiones están expresadas en metros.

Datos geométricos del muro

| Ref. | Tipo muro | GI- GF | Vértices Inicial | Final | Planta | Dimensiones Izquierda+Derecha=Total |
|---|---|---|---|---|---|---|
| M1 | Muro de hormigón armado | 0-1 | ( 0.00, 4.80) | ( 4.00, 4.80) | 1 | 0.2+0.2=0.4 |
| M2 | Muro de hormigón armado | 0-1 | ( 4.00, 0.00) | ( 4.00, 4.80) | 1 | 0.2+0.2=0.4 |
| M3 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 4.00, 0.00) | 1 | 0.2+0.2=0.4 |
| M4 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 0.00, 4.80) | 1 | 0.2+0.2=0.4 |

Empujes y zapata del muro

| Referencia | Empujes | Zapata del muro |
|---|---|---|
| M1 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M2 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M3 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M4 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.400 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |

## 5.6 LOSAS Y ELEMENTOS DE CIMENTACIÓN

| Losas cimentación | Canto (cm) | Módulo balasto (t/m³) | Tensión admisible en situaciones persistentes (kp/cm²) | Tensión admisible en situaciones accidentales (kp/cm²) |
|---|---|---|---|---|
| Todas | 40 | 8000.00 | 1.60 | 2.50 |

## 5.7 LISTADO DE ARMADO DE MUROS

**Muro M1: Longitud: 400 cm [Nudo inicial: 0.00;4.80 -> Nudo final: 4.00;4.80]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M2: Longitud: 480 cm [Nudo inicial: 4.00;0.00 -> Nudo final: 4.00;4.80]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M3: Longitud: 400 cm [Nudo inicial: 0.00;0.00 -> Nudo final: 4.00;0.00]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

| Muro M4: Longitud: 480 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:4.80] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 40.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

F.C. = El factor de cumplimiento indica el porcentaje de área en el cual el armado y espesor de hormigón son suficientes.

## 5.8 PÉSIMOS DE MUROS

Referencias:

Aprovechamiento: Nivel de tensiones (relación entre la tensión máxima y la admisible). Equivale al inverso del coeficiente de seguridad.

Nx : Axil vertical.

Ny : Axil horizontal.

Nxy: Axil tangencial.

Mx : Momento vertical (alrededor del eje horizontal).

My : Momento horizontal (alrededor del eje vertical).

Mxy: Momento torsor.

Qx : Cortante transversal vertical.

Qy : Cortante transversal horizontal.

| Muro M1: Longitud: 400 cm [Nudo inicial: 0.00:4.80 -> Nudo final: 4.00:4.80] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | | |
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 1.56 | -7.94 | -1.00 | -0.01 | -3.16 | -0.40 | -0.06 | --- | --- |
| | Arm. horz. der. | 1.12 | -3.03 | -6.42 | -0.47 | 0.06 | -2.33 | -0.13 | --- | --- |
| | Arm. vert. izq. | 0.59 | -2.84 | -4.47 | -0.03 | 1.23 | 1.29 | -0.06 | --- | --- |
| | Arm. horz. izq. | 0.67 | -2.84 | -4.47 | -0.03 | 1.23 | 1.29 | -0.06 | --- | --- |
| | Hormigón | 4.60 | -7.94 | -1.00 | -0.01 | -3.16 | -0.40 | -0.06 | --- | --- |
| | Arm. transve. | 1.93 | -5.42 | -2.22 | -0.08 | --- | --- | --- | 3.18 | 0.01 |

| Muro M2: Longitud: 480 cm [Nudo inicial: 4.00:0.00 -> Nudo final: 4.00:4.80] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | | |
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 0.72 | -4.07 | -3.27 | -0.12 | -1.41 | -1.40 | -0.10 | --- | --- |
| | Arm. horz. der. | 0.72 | -1.79 | -3.06 | 0.00 | 0.04 | -1.68 | -0.09 | --- | --- |
| | Arm. vert. izq. | 2.04 | -9.13 | -1.15 | -0.28 | 4.31 | 0.54 | 0.01 | --- | --- |
| | Arm. horz. izq. | 1.02 | -1.80 | -3.97 | 0.00 | 0.34 | 2.44 | 0.07 | --- | --- |
| | Hormigón | 6.00 | -9.13 | -1.15 | -0.28 | 4.31 | 0.54 | 0.01 | --- | --- |
| | Arm. transve. | 2.67 | -6.48 | -2.14 | -0.70 | --- | --- | --- | -4.39 | -0.19 |

| Muro M3: Longitud: 400 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 4.00:0.00] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | | |
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 0.59 | -2.83 | -4.51 | -0.04 | -1.23 | -1.27 | 0.06 | --- | --- |
| | Arm. horz. der. | 0.67 | -2.83 | -4.51 | -0.04 | 0.06 | -1.27 | 0.06 | --- | --- |
| | Arm. vert. izq. | 1.57 | -7.96 | -1.01 | -0.01 | 3.17 | 0.40 | 0.06 | --- | --- |
| | Arm. horz. izq. | 1.10 | -2.05 | -4.51 | -0.17 | -0.04 | 2.59 | -0.33 | --- | --- |
| | Hormigón | 4.61 | -7.96 | -1.01 | -0.01 | 3.17 | 0.40 | 0.06 | --- | --- |
| | Arm. transve. | 1.94 | -5.46 | -2.22 | -0.07 | --- | --- | --- | -3.19 | -0.01 |

| Muro M4: Longitud: 480 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:4.80] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | | |
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=40.0 cm) | Arm. vert. der. | 2.03 | -9.13 | -1.15 | -0.28 | -4.30 | -0.54 | -0.01 | --- | --- |
| | Arm. horz. der. | 1.04 | -1.90 | -4.11 | 0.14 | 0.04 | -2.47 | -0.03 | --- | --- |
| | Arm. vert. izq. | 0.72 | -4.04 | -3.31 | -0.12 | 1.40 | 1.40 | 0.10 | --- | --- |
| | Arm. horz. izq. | 0.72 | -1.76 | -3.05 | -0.00 | -0.04 | 1.67 | 0.10 | --- | --- |
| | Hormigón | 5.99 | -9.13 | -1.15 | -0.28 | -4.30 | -0.54 | -0.01 | --- | --- |
| | Arm. transve. | 2.66 | -6.45 | -2.17 | -0.71 | --- | --- | --- | 4.36 | 0.19 |

## 5.9 COMPROBACIÓN DE ACCIÓN HIDRAULICA PUNTUAL

Además de la comprobación de la arqueta en base a los empujes generados por las tierras, tal y como se recoge en los subapartados anteriores, se comprueba el armado y espesor del muro de la arqueta para la acción generada por el empuje hidráulico de la tubería en los momentos de accionamiento de la válvula de seccionamiento y situaciones de válvula cerrada. Situaciones en las que la tubería y la válvula transmiten el empuje hidráulico al muro de la misma.

# 6 ARQUETA TOMA DE FONDO BALSA ELEVADA

El cálculo de la arqueta se ha realizado con el programa CYPE 2020, concretamente con su aplicación Cypecad, especializada en el cálculo de estructuras con hormigón. Empleándose para ello el citado programa bajo la licencia nº 68665.

## 6.1 ACCIONES CONSIDERADAS

**Gravitatorias**

| Planta | S.C.U (t/m²) | Cargas muertas (t/m²) |
|---|---|---|
| Forjado 1 | 0.40 | 0.20 |
| Cimentación | 0.40 | 0.10 |

**Viento**

Sin acción de viento

**Sismo**

Sin acción de sismo

**Hipótesis de carga**

| | |
|---|---|
| Automáticas | Peso propio |
| | Cargas muertas |
| | Sobrecarga de uso |

**Empujes en muros**

Empuje de Defecto

Una situación de relleno
Carga:Cargas muertas
Con nivel freático: Cota 1.00 m
Con relleno: Cota 1.80 m
Ángulo de talud 0.00 Grados
Densidad aparente 2.00 t/m³
Densidad sumergida 1.50 t/m³
Ángulo rozamiento interno 28.00 Grados
Evacuación por drenaje 100.00 %
Carga 1:
Tipo: Uniforme
Valor: 1.00 t/m²

## 6.2 ESTADOS LÍMITE

| | |
|---|---|
| E.L.U. de rotura. Hormigón<br>E.L.U. de rotura. Hormigón en cimentaciones | CTE<br>Cota de nieve: Altitud inferior o igual a 1000 m |
| Tensiones sobre el terreno<br>Desplazamientos | Acciones características |

## 6.3 SITUACIONES DE PROYECTO

Para las distintas situaciones de proyecto, las combinaciones de acciones se definirán de acuerdo con los siguientes criterios:

- **Con coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\gamma_{Q1}\Psi_{p1}Q_{k1}+\sum_{i>1}\gamma_{Qi}\Psi_{ai}Q_{ki}$$

- **Sin coeficientes de combinación**

$$\sum_{j\geq 1}\gamma_{Gj}G_{kj}+\gamma_P P_k+\sum_{i\geq 1}\gamma_{Qi}Q_{ki}$$

- Donde:

$G_k$ Acción permanente

$P_k$ Acción de pretensado

$Q_k$ Acción variable

$g_G$ Coeficiente parcial de seguridad de las acciones permanentes

$g_P$ Coeficiente parcial de seguridad de la acción de pretensado

$g_{Q,1}$ Coeficiente parcial de seguridad de la acción variable principal

$g_{Q,i}$ Coeficiente parcial de seguridad de las acciones variables de acompañamiento

$y_{p,1}$ Coeficiente de combinación de la acción variable principal

$y_{a,i}$ Coeficiente de combinación de las acciones variables de acompañamiento

**Coeficientes parciales de seguridad (g) y coeficientes de combinación (y)**

Para cada situación de proyecto y estado límite los coeficientes a utilizar serán:

**E.L.U. de rotura. Hormigón: EHE-08**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.350 | - | - |
| Sobrecarga (Q) | 0.000 | 1.500 | 1.000 | 0.700 |

**E.L.U. de rotura. Hormigón en cimentaciones: EHE-08 / CTE DB-SE C**

| **Persistente o transitoria** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.600 | - | - |
| Sobrecarga (Q) | 0.000 | 1.600 | 1.000 | 0.700 |

**Tensiones sobre el terreno**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Desplazamientos**

| **Característica** | | | | |
|---|---|---|---|---|
| | Coeficientes parciales de seguridad (g) | | Coeficientes de combinación (y) | |
| | Favorable | Desfavorable | Principal ($y_p$) | Acompañamiento ($y_a$) |
| Carga permanente (G) | 1.000 | 1.000 | - | - |
| Sobrecarga (Q) | 0.000 | 1.000 | 1.000 | 1.000 |

**Combinaciones**

- **Nombres de las hipótesis**

PP Peso propio

CM Cargas muertas

Qa Sobrecarga de uso

- **E.L.U. de rotura. Hormigón**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.350 | 1.350 | |
| 3 | 1.000 | 1.000 | 1.500 |
| 4 | 1.350 | 1.350 | 1.500 |

- **E.L.U. de rotura. Hormigón en cimentaciones**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.600 | 1.600 | |
| 3 | 1.000 | 1.000 | 1.600 |
| 4 | 1.600 | 1.600 | 1.600 |

**Tensiones sobre el terreno**

- **Desplazamientos**

| Comb. | PP | CM | Qa |
|---|---|---|---|
| 1 | 1.000 | 1.000 | |
| 2 | 1.000 | 1.000 | 1.000 |

## 6.4 DATOS GEOMÉTRICOS DE GRUPOS Y PLANTAS

| Grupo | Nombre del grupo | Planta | Nombre planta | Altura | Cota |
|---|---|---|---|---|---|
| 1 | Forjado 1 | 1 | Forjado 1 | 2.30 | 2.30 |
| 0 | Cimentación | | | | 0.00 |

## 6.5 DATOS GEOMÉTRICOS DE MUROS

- Las coordenadas de los vértices inicial y final son absolutas.
- Las dimensiones están expresadas en metros.

Datos geométricos del muro

| Ref. | Tipo muro | GI- GF | Vértices Inicial | Vértices Final | Planta | Dimensiones Izquierda+Derecha=Total |
|---|---|---|---|---|---|---|
| M1 | Muro de hormigón armado | 0-1 | ( 0.00, 3.80) | ( 4.20, 3.80) | 1 | 0.15+0.15=0.3 |
| M2 | Muro de hormigón armado | 0-1 | ( 4.20, 0.00) | ( 4.20, 3.80) | 1 | 0.15+0.15=0.3 |
| M3 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 4.20, 0.00) | 1 | 0.15+0.15=0.3 |
| M4 | Muro de hormigón armado | 0-1 | ( 0.00, 0.00) | ( 0.00, 3.80) | 1 | 0.15+0.15=0.3 |

Empujes y zapata del muro

| Referencia | Empujes | Zapata del muro |
|---|---|---|
| M1 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.300 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M2 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.300 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M3 | Empuje izquierdo:<br>Sin empujes<br>Empuje derecho:<br>Empuje de Defecto | Viga de cimentación: 0.300 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |
| M4 | Empuje izquierdo:<br>Empuje de Defecto<br>Empuje derecho:<br>Sin empujes | Viga de cimentación: 0.300 x 0.400<br>Vuelos: izq.:0.00 der.:0.00 canto:0.40<br>Tensiones admisibles<br>-Situaciones persistentes: 1.60 kp/cm²<br>-Situaciones accidentales: 2.50 kp/cm²<br>Módulo de balasto: 8000.00 t/m³ |

## 6.6 LOSAS Y ELEMENTOS DE CIMENTACIÓN

| Losas cimentación | Canto (cm) | Módulo balasto (t/m³) | Tensión admisible en situaciones persistentes (kp/cm²) | Tensión admisible en situaciones accidentales (kp/cm²) |
|---|---|---|---|---|
| Todas | 40 | 8000.00 | 1.60 | 2.50 |

## 6.7 LISTADO DE ARMADO DE MUROS

**Muro M1: Longitud: 420 cm [Nudo inicial: 0.00:3.80 -> Nudo final: 4.20:3.80]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 30.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M2: Longitud: 380 cm [Nudo inicial: 4.20:0.00 -> Nudo final: 4.20:3.80]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 30.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M3: Longitud: 420 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 4.20:0.00]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 30.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

**Muro M4: Longitud: 380 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:3.80]**

| Planta | Espesor (cm) | Armadura vertical | | Armadura horizontal | | Armadura transversal | | | | F.C. (%) | Estado |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Izquierda | Derecha | Izquierda | Derecha | Ramas | Diám. | Sep.ver (cm) | Sep.hor (cm) | | |
| Forjado 1 | 30.0 | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | Ø12c/15 cm | --- | --- | --- | --- | 100.0 | --- |

F.C. = El factor de cumplimiento indica el porcentaje de área en el cual el armado y espesor de hormigón son suficientes.

## 6.8 PÉSIMOS DE MUROS

Referencias:

Aprovechamiento: Nivel de tensiones (relación entre la tensión máxima y la admisible). Equivale al inverso del coeficiente de seguridad.

Nx : Axil vertical.

Ny : Axil horizontal.

Nxy: Axil tangencial.

Mx : Momento vertical (alrededor del eje horizontal).

My : Momento horizontal (alrededor del eje vertical).

Mxy: Momento torsor.

Qx : Cortante transversal vertical.

Qy : Cortante transversal horizontal.

**Muro M1: Longitud: 420 cm [Nudo inicial: 0.00:3.80 -> Nudo final: 4.20:3.80]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=30.0 cm) | Arm. vert. der. | 1.19 | -3.78 | -0.48 | -0.25 | -1.32 | -0.17 | 0.03 | --- | --- |
| | Arm. horz. der. | 0.46 | -0.78 | -1.77 | 0.05 | 0.02 | -0.54 | 0.06 | --- | --- |
| | Arm. vert. iza. | 0.32 | -3.79 | -0.38 | -0.01 | 0.08 | -0.31 | 0.03 | --- | --- |
| | Arm. horz. iza. | 0.33 | -1.15 | -0.97 | -0.12 | 0.27 | 0.41 | 0.04 | --- | --- |
| | Hormigón | 3.53 | -3.78 | -0.48 | -0.25 | -1.32 | -0.17 | 0.03 | --- | --- |
| | Arm. transve. | 0.94 | -2.37 | -0.73 | 0.31 | --- | --- | --- | 1.12 | -0.03 |

**Muro M2: Longitud: 380 cm [Nudo inicial: 4.20:0.00 -> Nudo final: 4.20:3.80]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=30.0 cm) | Arm. vert. der. | 0.31 | -3.66 | -0.46 | -0.01 | -0.07 | 0.16 | 0.01 | --- | --- |
| | Arm. horz. der. | 0.33 | -1.25 | -1.29 | -0.12 | 0.02 | -0.38 | -0.06 | --- | --- |
| | Arm. vert. iza. | 1.15 | -3.66 | -0.46 | -0.01 | 1.27 | 0.16 | 0.01 | --- | --- |
| | Arm. horz. iza. | 0.64 | -0.88 | -2.07 | -0.16 | 0.09 | 0.78 | -0.03 | --- | --- |
| | Hormigón | 3.41 | -3.66 | -0.46 | -0.01 | 1.27 | 0.16 | 0.01 | --- | --- |
| | Arm. transve. | 0.98 | -2.29 | -0.80 | -0.04 | --- | --- | --- | -1.16 | -0.02 |

**Muro M3: Longitud: 420 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 4.20:0.00]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=30.0 cm) | Arm. vert. der. | 0.34 | -3.98 | -0.50 | -0.13 | -0.08 | 0.18 | 0.02 | --- | --- |
| | Arm. horz. der. | 0.32 | -1.36 | -0.99 | 0.12 | 0.03 | -0.40 | 0.03 | --- | --- |
| | Arm. vert. iza. | 1.29 | -3.98 | -0.50 | -0.13 | 1.43 | 0.18 | 0.02 | --- | --- |
| | Arm. horz. iza. | 0.61 | -0.94 | -2.07 | -0.06 | 0.15 | 0.73 | 0.07 | --- | --- |
| | Hormigón | 3.80 | -3.98 | -0.50 | -0.13 | 1.43 | 0.18 | 0.02 | --- | --- |
| | Arm. transve. | 1.07 | -2.52 | -0.75 | -0.26 | --- | --- | --- | -1.26 | -0.06 |

**Muro M4: Longitud: 380 cm [Nudo inicial: 0.00:0.00 -> Nudo final: 0.00:3.80]**

| Planta | Comprobación | Aprovechamiento (%) | Pésimos | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nx (t/m) | Ny (t/m) | Nxy (t/m) | Mx (t·m/m) | My (t·m/m) | Mxy (t·m/m) | Qx (t/m) | Qy (t/m) |
| Forjado 1 (e=30.0 cm) | Arm. vert. der. | 1.11 | -3.57 | -0.45 | 0.09 | -1.22 | -0.15 | 0.00 | --- | --- |
| | Arm. horz. der. | 0.62 | -0.87 | -1.93 | -0.24 | -0.12 | -0.77 | 0.02 | --- | --- |
| | Arm. vert. iza. | 0.33 | -1.67 | -1.15 | 0.21 | 0.30 | 0.26 | -0.03 | --- | --- |
| | Arm. horz. iza. | 0.29 | -1.00 | -1.38 | -0.07 | 0.23 | 0.30 | 0.07 | --- | --- |
| | Hormigón | 3.28 | -3.57 | -0.45 | 0.09 | -1.22 | -0.15 | 0.00 | --- | --- |
| | Arm. transve. | 0.99 | -2.27 | -0.82 | 0.14 | --- | --- | --- | 1.18 | -0.02 |

## 6.9 COMPROBACIÓN DE ACCIÓN HIDRAULICA PUNTUAL

Además de la comprobación de la arqueta en base a los empujes generados por las tierras, tal y como se recoge en los subapartados anteriores, se comprueba el armado y espesor del muro de la arqueta para la acción generada por el empuje hidráulico de la tubería en los momentos de accionamiento de la válvula de seccionamiento y situaciones de válvula cerrada. Situaciones en las que la tubería y la válvula transmiten el empuje hidráulico al muro de la misma.

# ANEJO Nº 13.- INSTALACIÓN FOTOVOLTAICA

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# ANEJO 13.- INSTALACIÓN FOTOVOLTAICA

## 1 INTRODUCCIÓN Y OBJETO DEL ANEJO

Para la puesta en riego de las parcelas incluidas en el presente proyecto se prevé la implantación de un sistema de riego a la demanda, mediante redes de tuberías enterradas abastecidas desde balsas de regulación.

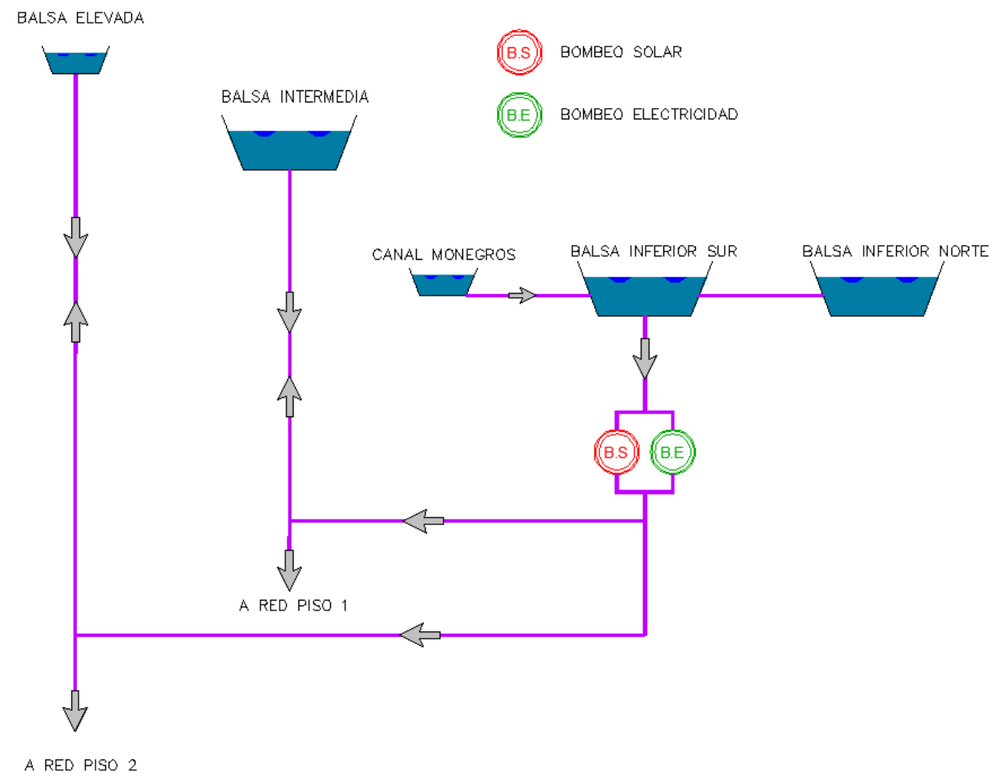
El total de la superficie regable asciende a 2.613,88 ha y se abastecerá desde dos pisos de riego, ambos abastecidos por presión natural, uno desde la balsa intermedia y el otro desde la balsa elevada.

- Red Baja (Red 1), alimentada desde la Balsa Intermedia:
  - Superficie: 2.268,90 ha:
- Red Alta (Red 2), alimentada desde la Balsa Elevada:
  - Superficie: 344,98 ha:

El sistema cuenta con los siguientes elementos:

- Obra de toma y compuerta de derivación y control, en el Canal de Monegros, aproximadamente en el P.K. 28+370.
- Tubería de llenado de Balsa Inferior Sur de 60 m de longitud, compuesta por tubería de PRFV DN 1600 PN6, y con inicio en la obra de toma anteriormente mencionada.
- 2 balsas a pie de canal comunicadas entre sí con las siguientes características:
  - Balsa Inferior Sur, con una capacidad de 68.451 $m^3$.
  - Balsa Inferior Norte, con una capacidad de 77.858 $m^3$.
- Balsa elevada, denominada Balsa Intermedia, con una capacidad de 180.793 $m^3$.
- Balsa elevada, denominada Balsa Elevada, con una capacidad de 28.540 $m^3$.
- Riego por gravedad desde ambas balsas elevadas a dos pisos de riego.
- Estación de bombeo con 2 bombeos independientes a cada una de las balsas elevadas, con 123 horas de funcionamiento por semana para suministro eléctrico y bombeo mediante instalación fotovoltaica en tantas horas como haya disponibilidad para esta zona.
- Edificio de nueva construcción para albergar los equipos de bombeo, realizado en estructura metálica y cerramientos de obra de fábrica.
- Tuberías de impulsión:
  - A balsa Intermedia, de 914 m, PRFV DN 1400 PN10.
  - A balsa Elevada, de 1.969 m, PRFV DN 700 PN10.
- Redes de riego por presión natural desde balsas intermedia y elevada.
- Red terciaria.
- Instalaciones eléctricas en Media Tensión
- Instalaciones eléctricas en Baja Tensión
- Instalación fotovoltaica de 1.694,56 kWp para reducir el coste energético de estos.
- Telecontrol en Red de riego y Automatización bombeo y balsas.

Esquema hidráulico y energético del proyecto en cada una de las zonas:



La actual situación del mercado energético conlleva el análisis de fuentes energéticas distintas a las convencionales. Tras el análisis de las diferentes alternativas se concluye que la alternativa a desarrollar contemplará el suministro energético para el bombeo a balsas elevadas basado en la energía solar fotovoltaica, combinada con la energía eléctrica convencional de la red eléctrica en los periodos donde la energía sea más barata, periodos P6 de la tarifa 6.1TD, evitando consumir energía de la red en el resto de periodos.

Se plantea que el volumen equivalente a P2, entorno al 30% del volumen del mes de máximas necesidades, julio, deberá ser elevado mediante energía solar fotovoltaica.

El resto de volumen a bombear se elevará con suministro eléctrico convencional pero solo coincidiendo con el periodo 6 de la tarifa 6.1TD.

En el presente anejo se exponen las características técnicas generales de la solución adoptada y el dimensionado de la instalación fotovoltaica necesaria.

## 2 RESUMENES INSTALACIONES

A continuación, se detallan las principales características de la instalación.

| ***Parámetro*** | ***Comentario*** | ***Unidades*** | ***Valor*** |
|---|---|---|---|
| *Localidad* | | | Torralba de Aragón (Huesca) |
| *Latitud* | | | 41° 93136”,<br>-0° 51632” |
| $E_D$ | Consumo máximo de la carga | kWh | 1.406,361 kWh |
| *Período diseño* | Regadío | Meses | Enero - Diciembre<br>Máximas necesidades: julio |
| $(\alpha_{opt}, \beta_{opt})$ | Hemisferio norte. Orientación SUR | Grados | (0º, 15º) |
| $(\alpha, \beta)$ | | Grados | (0º, 15º)<br>Instalación fija |
| *Gdm (0)* | Sistema de Información Geográfica Fotovoltaica (PVGIS) desarrollado por el Servicio de Ciencia y Conocimiento de la Comisión Europea | kWh/(m²/día) | Serie sintética<br>Datos cuartohorarios |
| *FI* | $FI = 1 - [1{,}2 \times 10^{-4} (\beta - \beta_{opt})^2 + 3{,}5 \times 10^{-5} \alpha^2]$ | | 1,00 |
| *FS* | Zona rural despejada. No hay sombras | | 0 |
| *PR* | Pérdidas por temperatura calculadas según datos temperatura. | | 0,78 |
| *Gdm (α, β)* | | kWh/(m²/día) | Calculadas según Anejo |
| *Pmp, min* | $P_{mp,min} = \frac{E_D\ G_{CEM}}{G_{dm}(\alpha,\beta)\ PR}$ | kWp | |

| ***Parámetro*** | ***Comentario*** | ***Unidades*** | ***Valor*** |
|---|---|---|---|
| *Pmp* | Potencia pico del generador | Wp | 1.694.560 |
| *Pmódulo* | Datos módulo tipo | Wp | 445 |
| *Tec.módulo* | | | Monocristalino PERC |
| *Umpp (V)* | | | 40,9 |
| *Impp (A)* | | | 10,89 |
| *Isc (A)* | | | 11,54 |
| *Uoc (V)* | | | 48,9 |
| *Rto. Módulo* | | | 20,10% |
| *Coef. Tª (V)* | | | -0,270% |
| *Coef. Tª (A)* | | | 0,050% |
| *Coef. Tª (P)* | | | -0,350% |
| *Ns* | Módulos en serie | Uds | 16 |
| *Np* | Cadenas o strings | Cadenas | 238 |
| *C20* | Capacidad nominal del acumulador | Ah | No se prevé |
| *PDmax* | Profundidad de descarga máx. permitida por | | No se prevé |
| *η inv* | Rendimiento energético del inversor | | 0,98 |
| $T_{máx.\ Inversor}$ | Datos variador tipo | V | 900 |
| $T_{mín.\ Inversor}$ | Datos variador tipo | V | 540 |
| *ηrb* | Rendimiento energético del regulador-acum | | No se prevé |
| $V_{NOM}$ | Tensión nominal del acumulador | V | No se prevé |
| *LD* | Consumo diario de la carga ($L_D = E_D / V_{NOM}$) | Ah | No se prevé |
| *A* | $A = \frac{C_{20}\ PD_{max}}{L_D} \eta_{inv}\ \eta_{rb}$ | Días | No se prevé |
| *C20 /Isc* | $C_{20} / I_{sc} < 25$ para el caso general | h | No se prevé |

## 3 CONDICIONANTES DE DISEÑO

A continuación, se enumeran los principales condicionantes de diseño de la instalación fotovoltaica.

- Bombeo a balsa intermedia y balsa elevada, ambos bombeos se abastecen de las balsas inferiores y reciben suministro de la misma instalación fotovoltaica.
- Necesidades:
  - Bombeo a balsa intermedia.

    Se plantea que el volumen equivalente a P2, entorno al 28% del volumen del mes de máximas necesidades, julio, deberá ser elevado mediante energía solar fotovoltaica.

    El resto de volumen a bombear se elevará con suministro eléctrico convencional pero solo coincidiendo con el periodo 6 de la tarifa 6.1TD. En el resto de periodos solo se bombeará con energía fotovoltaica. No obstante, lo anterior, la preferencia de bombeo será con suministro fotovoltaico, completándose con el suministro eléctrico convencional.

    Para ello se prevé el siguiente funcionamiento:

    SOLAR y RED:

| | Caudal TOTAL (l/s) | Bomba 1 110 kW | Bomba 2 200 kW | Bomba 3 315 kW | Bomba 4 315 kW | Bomba 5 315 kW |
|---|---|---|---|---|---|---|
| Paso 1 | 47-181 | Conexión | Desconectada | Desconectada | Desconectada | Desconectada |
| Paso 2 | 181-363 | Desconexión | Conexión | Desconectada | Desconectada | Desconectada |
| Paso 3 | 363-554 | Desconectada | Desconexión | Conexión | Desconectada | Desconectada |
| Paso 4 | 554-735 | Conexión | Desconectada | Conectada | Desconectada | Desconectada |
| Paso 5 | 735-917 | Desconexión | Conexión | Conectada | Desconectada | Desconectada |
| Paso 6 | 917-1098 | Conexión | Conectada | Conectada | Desconectada | Desconectada |
| Paso 7 | 1098-1278 | Conectada | Desconexión | Conectada | Conexión | Desconectada |
| Paso 8 | 1278-1460 | Desconexión | Conexión | Conectada | Conectada | Desconectada |
| Paso 9 | 1460-1641 | Conexión | Conectada | Conectada | Conectada | Desconectada |
| Paso 10 | 1641-1821 | Conectada | Desconexión | Conectada | Conectada | Conexión |
| Paso 11 | 1821-2003 | Desconexión | Conexión | Conectada | Conectada | Conectada |
| Paso 12 | 2003-2184 | Conexión | Conectada | Conectada | Conectada | Conectada |

  - Bombeo a balsa elevada.

    Se plantea que el volumen equivalente a P2, entorno al 28% del volumen del mes de máximas necesidades, julio, deberá ser elevado mediante energía solar fotovoltaica.

    El resto de volumen a bombear se elevará con suministro eléctrico convencional pero solo coincidiendo con el periodo 6 de la tarifa 6.1TD. En el resto de periodos solo se bombeará con energía fotovoltaica. No obstante, lo anterior, la preferencia de bombeo será con suministro fotovoltaico, completándose con el suministro eléctrico convencional.

    Para ello se prevé el siguiente funcionamiento:

    SOLAR y RED:

| | Caudal TOTAL (l/s) | Bomba 1 110 kW | Bomba 2 110 kW | Bomba 3 110 kW |
|---|---|---|---|---|
| Paso 1 | 42-117 | Conexión | Desconectada | Desconectada |
| Paso 2 | 117-234 | Conectada | Conexión | Desconectada |
| Paso 3 | 234-351 | Conectada | Conectada | Conexión |

- Los equipos de bombeo estarán accionados por variadores de frecuencia híbridos especiales para bombeo fotovoltaico, y permitirá el suministro mediante CC (fotovoltaica) y CA (red eléctrica).
- Dispondrá de un sistema automatizado de control de la instalación que los controlará para garantizar un óptimo funcionamiento.
- Sistema automatizado mediante PLC y SCADA para el control total de la instalación, y gestión de bombas según energía fotovoltaica disponible. Este incorporará el sistema de monitorización de la planta fotovoltaica tanto de los elementos de protección como de las diferentes variables que intervienen.

# 4 NORMATIVA

A continuación, se enumera la normativa de referencia que rige en este momento sobre las instalaciones fotovoltaicas en nuestro país.

**GENERALIDADES**

- Real Decreto 842/2002, de 2 de agosto, por el que se aprueba el Reglamento Electrotécnico para Baja Tensión e instrucciones técnicas complementarias (ITC), (B.O.E. de 18-9-2002).
- UNE 20406-5-523 (2004). Instalaciones eléctricas en edificios. Parte 5: selección e instalación de materiales eléctricos. Sección 523: Intensidades máximas admisibles en sistemas de conducción de cables.
- Real Decreto 314/2006, de 17 de marzo, por el que se aprueba el Código Técnico de la Edificación.
- Instrucción de Hormigón Estructural (EHE-08).
- UNE 20460-7-712. Instalaciones eléctricas en edificios. Reglas para las instalaciones y emplazamientos especiales. Sistemas de alimentación solar fotovoltaica (PV)
- UNE-HD 60364-7-712. Instalaciones eléctricas de baja tensión. Reglas para las instalaciones y emplazamientos especiales. Sistemas de alimentación solar fotovoltaica (PV)
- UNE 21302-826:2005 y IEC 60050-826. Vocabulario electrotécnico Internacional (VEI).
- UNE-EN 60439-1:2001 (1999) y A1:2005 (2004). Conjunto de aparamenta de baja tensión. Parte 1: Conjuntos en serie y conjuntos derivados de serie.
- IEC/TR 60755 (1983). Regalas generales para los dispositivos de protección con corriente diferencial residual. Modificación 2 (1992).
- UNE-EN 60904-3:1994 (1993) y IEC 60904-3 (1989). Dispositivos fotovoltaicos. Parte 3: fundamentos de medida de dispositivos solares fotovoltaicos (PV) de uso terrestre con datos de irradiancia espectral de referencia.
- Directivas Europeas de seguridad y compatibilidad electromagnética
- Especificaciones Técnicas para Sistemas de Riego Fotovoltaico editado por MASLOWATEN (MArket uptake of an innovative irrigation Solution based on LOW WATer-ENergy consumption)

**MERCADO ELÉCTRICO**

- Ley 54/1997, de 27 de noviembre, del Sector Eléctrico.
- Real Decreto 900/2015, de 9 de octubre, por el que se regulan las condiciones administrativas, técnicas y económicas de las modalidades de suministro de energía eléctrica con autoconsumo y de producción con autoconsumo.
- Real Decreto-ley 15/2018, de 5 de octubre, de medidas urgentes para la transición energética y la protección de los consumidores
- Real Decreto-Ley 244/2019, de 5 de abril, por el que se regulan las condiciones administrativas, técnicas y económicas del autoconsumo de energía.
- Real Decreto 661/2007, de 25 de mayo, por el que se regula la actividad de producción de energía eléctrica en régimen especial.
- Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento Unificado de puntos de medida del sistema eléctrico.
- Real Decreto 1578/2008, de 26 de septiembre, de retribución de la actividad de producción de energía eléctrica mediante tecnología solar fotovoltaica para instalaciones posteriores a la fecha límite de mantenimiento de la retribución del Real Decreto 661/2007, de 25 de mayo, para dicha tecnología.
- Norma UNE-EN 62466: Sistemas fotovoltaicos conectados a red. Requisitos mínimos de documentación, puesta en marcha e inspección de un sistema.
- Resolución de 31 de mayo de 2001 por la que se establecen modelo de contrato tipo y modelo de factura para las instalaciones solares fotovoltaicas conectadas a la red de baja tensión.
- Real Decreto 1663/2000, de 29 de septiembre, sobre conexión de instalaciones fotovoltaicas a la red de baja tensión.
- Real Decreto 1955/2000, de 1 de diciembre, por el que se regulan las actividades de transporte, distribución, comercialización, suministro y procedimientos de autorización de instalaciones de energía eléctrica.
- Real Decreto 1699/2011, de 18 de noviembre, por el que se regula la conexión a red de instalaciones de producción de energía eléctrica de pequeña potencia.

- Orden IET/931/2015, de 20 de mayo, por la que se modifica la Orden ITC/1522/2007, de 24 de mayo, por la que se establece la regulación de la garantía del origen de la electricidad procedente de fuentes de energía renovables y de cogeneración de alta eficiencia.
- Orden ETU/130/2017, de 17 de febrero, por la que se actualizan los parámetros retributivos de las instalaciones tipo aplicables a determinadas instalaciones de producción de energía eléctrica a partir de fuentes de energía renovables, cogeneración y residuos, a efectos de su aplicación al semiperiodo regulatorio que tiene su inicio el 1 de enero de 2017.

**MÓDULOS**

- UNE-EN 61730, armonizada para la Directiva 2006/95/CE, sobre cualificación de la seguridad de módulos fotovoltaicos
- UNE-EN 50380, sobre informaciones de las hojas de datos y de las placas de características para los módulos fotovoltaicos.
- UNE-EN 61215: Módulos fotovoltaicos (FV) de silicio cristalino para uso terrestre. Cualificación del diseño y homologación.
- UNE-EN 61646: Módulos fotovoltaicos (FV) de lámina delgada para aplicaciones terrestres. Cualificación del diseño y aprobación de tipo.
- UNE-EN 62108. Módulos y sistemas fotovoltaicos de concentración (CPV). Cualificación del diseño y homologación.
- Los módulos que se encuentren integrados en la edificación, aparte de que deben cumplir la normativa indicada anteriormente, además deberán cumplir con lo previsto en la Directiva 89/106/CEE del Consejo de 21 de diciembre de 1988 relativa a la aproximación de las disposiciones legales, reglamentarias y administrativas de los Estados miembros sobre los productos de construcción.

**ESTRUCTURA MÓDULOS**

- Si está construida con perfiles de acero laminado conformado en frío, cumplirán las normas UNE-EN 10219-1 y UNE-EN 10219-2 para garantizar todas sus características mecánicas y de composición química.
- Si es del tipo galvanizada en caliente, cumplirá las normas UNE-EN ISO 14713 (partes 1, 2 y 3) y UNE-EN ISO 10684 y los espesores cumplirán con los mínimos exigibles en la norma UNE-EN ISO 1461.
- En el caso de utilizarse seguidores solares, estos incorporarán el marcado CE y cumplirán lo previsto en la Directiva 98/37/CE del Parlamento Europeo y del Consejo, de 22 de junio de 1998, relativa a la aproximación de legislaciones de los Estados miembros sobre máquinas, y su normativa de desarrollo, así como la Directiva 2006/42/CE del Parlamento Europeo y del Consejo, de 17 de mayo de 2006 relativa a las máquinas.

**INVERSORES.**

- UNE-EN 62093: Componentes de acumulación, conversión y gestión de energía de sistemas fotovoltaicos. Cualificación del diseño y ensayos ambientales.
- UNE-EN 61683: Sistemas fotovoltaicos. Acondicionadores de potencia. Procedimiento para la medida del rendimiento.
- IEC 62116. Testing procedure of islanding prevention measures for utility interactive photovoltaic inverters.

# 5 NECESIDADES HÍDRICAS

Tal y como se justifica en el Anejo Nº3 "Estudio Agronómico" las necesidades brutas teóricas de riego para la alternativa estudiada son las siguientes:

| Alternativa | m³/mes | NRb (m³/Ha) | mm/día | Caudal (l/s y Ha) |
|---|---|---|---|---|
| Enero | 93.041,96 | 35,60 | 0,11 | 0,01 |
| Febrero | 290.808,92 | 111,26 | 0,36 | 0,04 |
| Marzo | 451.008,92 | 172,54 | 0,56 | 0,06 |
| Abril | 1.036.939,27 | 396,70 | 1,28 | 0,15 |
| Mayo | 2.262.704,56 | 865,65 | 2,79 | 0,32 |
| Junio | 3.337.582,60 | 1.276,87 | 4,12 | 0,48 |
| **Julio** | **4.693.421,72** | **1.795,58** | **5,79** | **0,67** |
| Agosto | 3.697.217,93 | 1.414,46 | 4,56 | 0,53 |
| Septiembre | 2.248.177,93 | 860,09 | 2,77 | 0,32 |
| Octubre | 326.662,91 | 124,97 | 0,40 | 0,05 |
| Noviembre | 5.710,12 | 2,18 | 0,01 | 0,00 |
| Diciembre | 83.972,30 | 32,13 | 0,10 | 0,01 |
| **TOTAL** | **18.527.249,14** | **7.088,02** | | |

De la tabla anterior se concluye que el consumo de agua para la alternativa elegida se da en todos los meses del año, y que el mes con mayores necesidades será el mes de julio.

# 6 CÁLCULOS DE LA ENERGÍA REQUERIDA POR EL BOMBEO

## 6.1 ENERGÍA REQUERIDA POR EL BOMBEO A BALSA INTERMEDIA

Tras el estudio de diferentes combinaciones, se plantea la instalación de un total de 5 bombas alimentadas mediante energía fotovoltaica y/o energía convencional para el periodo energético tarifario P6. En este caso el dimensionado del bombeo se establece para el funcionamiento de las 5 bombas, 2.172 l/s.

Para mejorar las condiciones de funcionamiento del conjunto ante las previsibles variaciones en la disponibilidad energética y de la demanda de la red se prevé un fraccionamiento del bombeo, planteándose la instalación de un total de 5 bombas (1 Tipo 1+1 Tipo 2 + 3 Tipo 3):

- 1 Bomba pequeña (Tipo 1) de 110 kW potencia motor funcionando a 181 l/s (652 $m^3$/h) a 44 m.c.a., accionada mediante variador de frecuencia para maximizar el aprovechamiento de la energía fotovoltaica disponible en las primeras y últimas horas del día.
- 1 Bomba intermedia (Tipo 2) de 200 kW potencia motor funcionando a 362 l/s (1305 $m^3$/h) a 44 m.c.a., accionada mediante variador de frecuencia para maximizar el aprovechamiento de la energía fotovoltaica disponible en las primeras y últimas horas del día.
- 3 Bombas grandes (Tipo 3) de 315 kW potencia motor funcionando a 543 l/s (1995 $m^3$/h) a 44 m.c.a. cada una. Todos los equipos estarán regulados mediante variador.

Al estar accionados por variadores de frecuencia serán capaces de trabajar correctamente en todos los rangos de funcionamiento posible, es decir entre los 43 m.c.a. de la situación más favorable y los 48 m.c.a. de la situación más desfavorable, y de garantizar estos puntos de funcionamiento para el caudal mínimo de cada equipo, garantizando así el solape entre ellos.

A continuación, se incluye la ecuación que relaciona la potencia disponible (x; en watios) con el caudal elevado (y; $m^3$/h):

| x2 | x | Cte |
|---|---|---|
| -1,53346E-10 | 0,00709788 | -44,353669 |

## 6.2 ENERGÍA REQUERIDA POR EL BOMBEO A BALSA ELEVADA

Tras el estudio de diferentes combinaciones, se plantea la instalación de un total de 3 bombas alimentadas mediante energía fotovoltaica y/o energía convencional para el periodo energético tarifario P6. En este caso el dimensionado del bombeo se establece para el funcionamiento de las 3 bombas, 351 l/s.

Para mejorar las condiciones de funcionamiento del conjunto ante las previsibles variaciones en la disponibilidad energética y de la demanda de la red se prevé un fraccionamiento del bombeo, planteándose la instalación de un total de 3 bombas de iguales características:

- 3 Bombas de 110 kW potencia motor funcionando a 117 l/s (652 $m^3$/h) a 62 m.c.a., accionada mediante variador de frecuencia para maximizar el aprovechamiento de la energía fotovoltaica disponible en las primeras y últimas horas del día.

Al estar accionados por variadores de frecuencia serán capaces de trabajar correctamente en todos los rangos de funcionamiento posible, es decir entre los 54 m.c.a. de la situación más favorable y los 64 m.c.a. de la situación más desfavorable, y de garantizar estos puntos de funcionamiento para el caudal mínimo de cada equipo, garantizando así el solape entre ellos.

A continuación, se incluye la ecuación que relaciona la potencia disponible (x; en watios) con el caudal elevado (y; $m^3$/h):

| x2 | x | Cte |
|---|---|---|
| 4,4714E-10 | 0,00470266 | -1,57813741 |

# 7 DIMENSIONADO DEL SISTEMA

## 7.1 DEFINICIONES

### 7.1.1 ÁNGULO DE INCLINACIÓN β

Ángulo que forma la superficie de los módulos con el plano horizontal (figura 1). Su valor es 0° para módulos horizontales y 90° para verticales.

### 7.1.2 ÁNGULO DE AZIMUT α

Ángulo entre la proyección sobre el plano horizontal de la normal a la superficie del módulo y el meridiano del lugar (figura 2). Valores típicos son 0° para módulos orientados al sur, - 90° para módulos orientados al este y + 90° para módulos orientados al oeste.

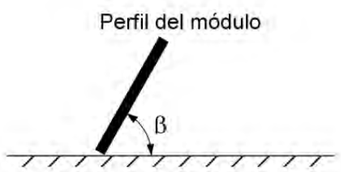



*Fig. 1*

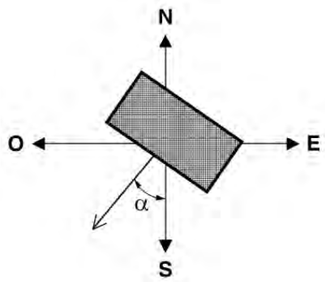



*Fig. 2*

### 7.1.3 $G_{dm}$ (0)

Valor medio mensual o anual de la irradiación diaria sobre superficie horizontal en kWh/(m²*día).

### 7.1.4 $G_{dm}$ ($\alpha_{opt}$, $\beta_{opt}$)

Valor medio mensual o anual de la irradiación diaria sobre el plano del generador orientado de forma óptima ($\alpha_{opt}$, $\beta_{opt}$), en kWh/(m²*día). Se considera orientación óptima aquella que hace que la energía colectada sea máxima en un período.

### 7.1.5 $G_{dm}$ ($\alpha$, $\beta$)

Valor medio mensual de la irradiación diaria sobre el plano del generador en kWh/(m²*día) y en el que se hayan descontado las pérdidas por sombreado.

### 7.1.6 FACTOR DE IRRADIACIÓN (FI)

Porcentaje de radiación incidente para un generador de orientación e inclinación ($\alpha$, $\beta$) respecto a la correspondiente para una orientación e inclinación óptimas ($\alpha_{opt}$, $\beta_{opt}$). Las pérdidas de radiación respecto a la orientación e inclinación óptimas vienen dadas por (1 - FI).

### 7.1.7 FACTOR DE SOMBREADO (FS)

Porcentaje de radiación incidente sobre el generador respecto al caso de ausencia total de sombras. Las pérdidas por sombreado vienen dadas por (1 - FS).

### 7.1.8 RENDIMIENTO ENERGÉTICO DE LA INSTALACIÓN O "PERFORMANCE RATIO", PR

Eficiencia de la instalación en condiciones reales de trabajo para el período de diseño, de acuerdo con la ecuación:

$$PR = \frac{E_D * G_{CEM}}{G_{dm}(\alpha, \beta) * P_{mp}}$$

- $G_{CEM}$ = 1 kW/m
- $P_{mp}$: Potencia pico del generador (kWp)
- $E_D$: Consumo expresado en kWh/día.

Este factor considera las pérdidas en la eficiencia energética debido a:

1. La temperatura.
2. El cableado.
3. Las pérdidas por dispersión de parámetros y suciedad.
4. Las pérdidas por errores en el seguimiento del punto de máxima potencia.
5. La eficiencia energética, $\eta_{rb}$, de otros elementos en operación como el regulador, batería, etc.
6. La eficiencia energética del inversor, $\eta_{inv}$.
7. Otros.

## 7.2 PROCEDIMIENTO

### 7.2.1 LOCALIZACIÓN Y TIPOLOGÍA INSTALACIÓN

La instalación objeto del presente proyecto se encuentra localizada en el término municipal de Torralba de Aragón.

Se plantea una **instalación fija orientada al sur**.

### 7.2.2 PERIODO DE DISEÑO

Se establecerá un período de diseño para calcular el dimensionado del generador en función de las necesidades de consumo y la radiación. Se indicará cuál es el período para el que se realiza el diseño y los motivos de la elección.

En nuestro caso, tal y como se expone en el punto 2 del presente documento el consumo de agua para la alternativa elegida se da en todos los meses del año, y el mes con mayores necesidades será el mes de julio.

### 7.2.3 ORIENTACIÓN E INCLINACIÓN ÓPTIMAS

Se determinará la orientación e inclinación óptimas ($\alpha$= 0º, $\beta_{opt}$) para el período de diseño elegido.

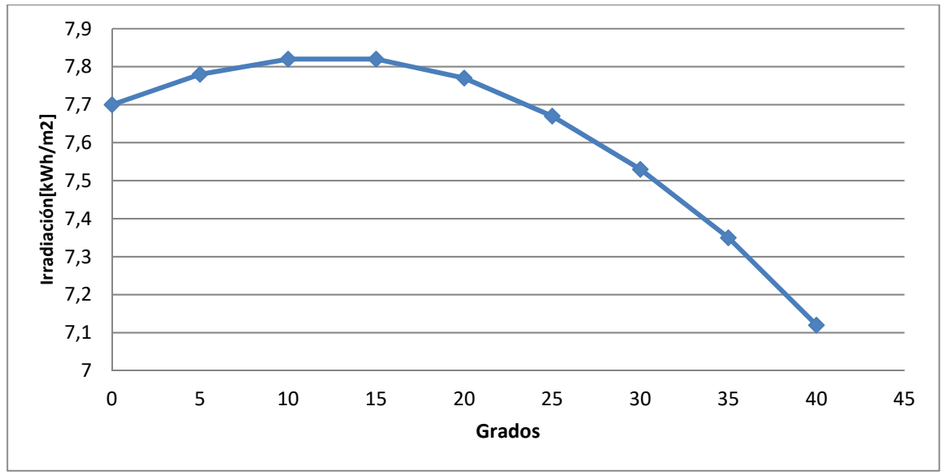
Al tratarse de una instalación fija a instalar en el hemisferio norte su orientación optima será con α= 0º, es decir orientación sur.

Por otro lado, para una instalación ubicada en el término municipal de Torralba de Aragón la irradiación según el mes del año y la inclinación ($\beta_{opt}$) de la instalación variará de forma considerable, siendo imprescindible conocer bien los meses de mayores consumos en la instalación. En este caso, tal y como se detalla en el apartado 2, los meses con mayores consumos serán los meses de verano. En esos meses, tal y como se detalla en la gráfica la inclinación óptima oscila entre los 5 y los 20 grados, siendo máxima en el mes de julio con inclinación entre 10 y 15º.

En este caso, como resulta obvio para una instalación de bombeo destinada al regadío y la latitud en la que nos encontramos, los peores meses son los de verano, en este caso el peor mes desde el punto de vista del factor energético es julio, coincidiendo con un periodo de grandes necesidades y menor energía.

Si analizamos este mes con mayor detalle vemos que el ángulo óptimo de instalación se dará entorno a los 10 grados. No obstante lo anterior, atendiendo a la escasa diferencia existente con respecto al factor de energía para estos meses de verano, en los que la inclinación óptima se encuentra entre los 10 y 15 grados, se establece una instalación fija orientada al sur con inclinación de 15º.

| Ángulo [º] | Irradiación[kWh/m$^2$] |
|---|---|
| 0 | 7,7 |
| 5 | 7,78 |
| 10 | 7,82 |
| 15 | 7,82 |
| 20 | 7,77 |
| 25 | 7,67 |
| 30 | 7,53 |
| 35 | 7,35 |
| 40 | 7,12 |




**Se determinará la orientación e inclinación óptimas ($\alpha$= 0º, $\beta$=15º)** para el período de diseño elegido.

### 7.2.4 IRRADIACIÓN SOBRE EL GENERADOR

Los datos de irradiancia e irradiación utilizados en el presente proyecto han sido obtenidos a partir del Sistema de Información Geográfica Fotovoltaica (PVGIS) desarrollado por el Servicio de Ciencia y Conocimiento de la Comisión Europea. Estos datos han sido obtenidos a partir de la herramienta SISIFO, desarrollada por la Universidad Politécnica de Madrid a través del programa europeo Maslowaten, la cual permite obtener series sintéticas de estos datos para una localización determinada.

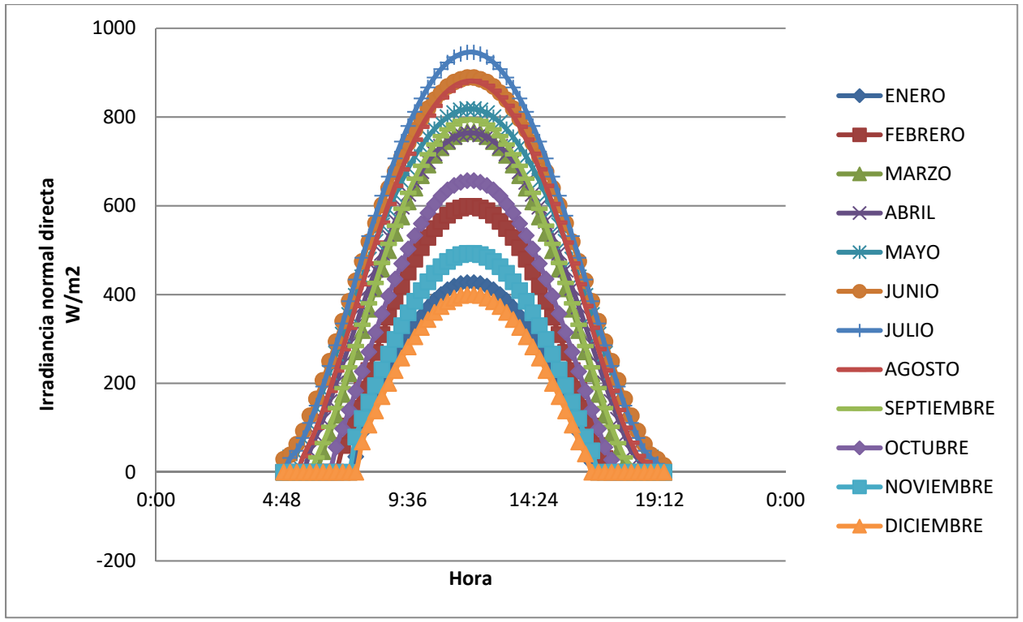
Dicho software ofrece información para el cálculo de instalaciones fotovoltaicas basados en lecturas efectuadas por satélite corregidas en base a procedimientos documentados científicamente.

El cálculo basado en satélite produce valores de irradiancia global y de haz en un plano horizontal, tanto en banda ancha como en valores de irradiancia de resolución espectral. Sin embargo, los módulos y los sistemas FV generalmente se instalan en un ángulo inclinado con respecto al plano horizontal o en los sistemas de seguimiento, para maximizar la irradiancia recibida en el plano. Por lo tanto, los valores de irradiancia recuperados del satélite no son representativos de la radiación solar disponible en la superficie del módulo, y es necesario estimar la irradiancia en el plano.

El modelo de estimación para la irradiación sobre superficie inclinada implementado en PVGIS es el desarrollado por Muneer T. (1990) que puede clasificarse como anisotrópico de dos componentes. Funciona de manera similar a otros modelos más complejos como los modelos anisotrópicos de tres componentes como los desarrollados por Pérez o Reindl. De hecho, el modelo de Muneer demostró el mejor desempeño en el estudio realizado por ESRA (2000). Distingue entre condiciones de cielo despejado y nublado y superficies iluminadas e iluminadas por el sol.

### 7.2.5 IRRADIANCIA GOLBAL

A continuación, se muestran los valores de irradiancia "G".




### 7.2.6 DIMENSIONADO DEL GENERADOR

El dimensionado mínimo del generador, en primera instancia, se realizará de acuerdo con los datos anteriores, el consumo previsto y la eficiencia de la instalación en condiciones reales de trabajo para el período de diseño.

Tal y como se ha expuesto con anterioridad la eficiencia de la instalación dependerá de:

1. La temperatura de los paneles. Pérdida de eficiencia calculada a partir de la Tª ambiente obtenida y la relación ofrecida por el fabricante de los módulos fotovoltaicos.
2. El cableado. (caída de tensión/pérdidas máximas admisibles en instalación según REBT y ASIF)
3. Las pérdidas por dispersión de parámetros y suciedad.
4. Las pérdidas por errores en el seguimiento del punto de máxima potencia.
5. La eficiencia energética, $\eta_{rb}$, de otros elementos en operación como el regulador, batería, etc.
6. La eficiencia energética del inversor, $\eta_{inv}$.
7. Otros.

### 7.2.6.1 MÓDULO FOTOVOLTAICO TIPO

En este caso se adopta para el diseño el siguiente panel:

| FABRICANTE/DISTRIBUIDOR | CERTIFICADO TIER1 |
|---|---|
| ORIGEN | - |
| MODELO | - |
| **TECNOLOGÍA** | **Monocristalino-PERC** |
| TIPO | CSW-445MS |
| **Células** | **144 half-cell (2x(12x6))** |
| Dimensiones | 2108x1048x40 |
| **Pmpp (Wp)** | **445** |
| Umpp (V) | 40,9 |
| Impp (A) | 10,89 |
| Isc (A) | 11,54 |
| Uoc (V) | 48,9 |
| Rto. Módulo | 20,10% |
| Coef. Tª (V) | -0,270% |
| Coef. Tª (A) | 0,050% |
| Coef. Tª (P) | -0,350% |
| NOCT ºC | 42±3 |
| Tensión (V) | 1000 |
| Corriente (A) | 20 |
| Tª max | 85 |
| Tª min | -40 |
| Diodos by-pass | 3 |

### 7.2.6.2 COEFICIENTE CORRECTOR POR Tª

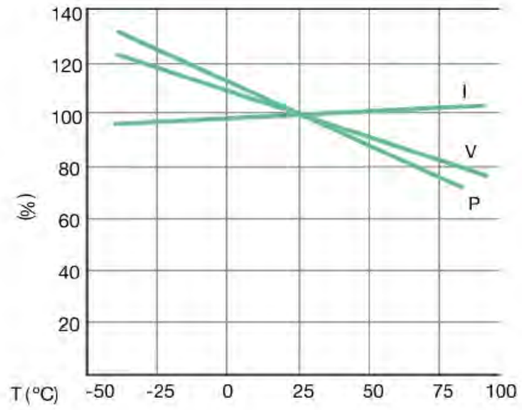
Los módulos fotovoltaicos disminuyen su rendimiento ante aumentos de temperatura de la célula. En la siguiente gráfica se muestra el comportamiento de la célula fotovoltaica ante la variación de temperatura siendo especialmente sensibles en parámetros como la tensión y la potencia, y en menor medida en la intensidad.

La siguiente expresión relaciona el efecto de la irradiancia sobre la temperatura de la célula, y en consecuencia sobre el rendimiento previsto en la célula fotovoltaica, habitualmente expresado por los fabricantes para una temperatura ambiente de 25 ºC.

$$\Delta T = 0{,}034 * I - 4$$

Siendo:

- I, irradiancia global sobre superficie, W/m$^2$
- ΔT, variación de temperatura de la célula por efecto de la irradiancia incidente. Aumento o disminución con respecto a la temperatura ambiente de referencia dada por el fabricante, habitualmente 25 ºC.




Es decir, cuando tengamos temperaturas superiores a la temperatura de referencia, existirá una mayor caída de tensión y por tanto una pérdida en la eficiencia, y una menor producción de los módulos, y por el contrario, cuando la temperatura se sitúe por debajo de la temperatura de referencia se reducirá la caída de tensión, y por tanto se incrementará la producción de la planta fotovoltaica.

Este aspecto es importante pues influirá sobre la tensión disponible en entrada de variador y por tanto en el rango de funcionamiento de la instalación.

#### 7.2.6.3 RENDIMIENTO ENERGÉTICO DE LA INSTALACIÓN O "PERFORMANCE RATIO", PR.

Así pues, y tal y como se ha expuesto al inicio del presente apartado, el dimensionado de la instalación fotovoltaica vendrá condicionado por el rendimiento energético de la misma, el cual está influenciado por diferentes factores como la temperatura, elementos de la instalación, o de funcionalidad o emplazamiento.

A continuación, se exponen los coeficientes considerados en la presente instalación.

| **Factores de pérdidas** | **Pérdidas** | **Factor** |
|---|---|---|
| Tª módulos FV máxima | 13,5% | 86,5% |
| Reflectancia angular espectrales | 3,0% | 97,0% |
| Cableado | 2,0% | 98,0% |
| Dispersión de parámetros en generador | 2,0% | 98,0% |
| Polvo y/o suciedad en los módulos | 3,0% | 97,0% |
| Errores en el seguimiento del PMP | 2,0% | 98,0% |
| Rendimiento inversor/variador | 3,0% | 97,0% |
| Coeficiente mayoración por limpieza | -5,0% | 105,0% |
| **Ratios considerando la pérdida por tª** | 23,5% | 78,0% |

| | | |
|---|---|---|
| **Ratios SIN contar la pérdida por tª** | 10,0% | **0,90** |

De la tabla anterior se concluye que el efecto de la temperatura es el mayor condicionante sobre el rendimiento de una instalación, en este caso genera unas pérdidas máximas de hasta el 13,5 %, sobre un total de 23,5% de pérdidas de la instalación, es decir, el 57% de las pérdidas las llegará a generar la temperatura ambiente.

**Para el dimensionado del campo fotovoltaico aplicaremos el coeficiente corrector por temperatura y pérdidas estimado en un 78%.**

## 7.3 RESULTADOS DEL DIMENSIONAMIENTO

### 7.3.1 INSTALACIÓN SOLAR BOMBEO A BALSA INTERMEDIA

En la siguiente tabla se detalla la potencia realmente producida por la instalación, potencia disponible, una vez deducidas las pérdidas por temperatura y por los demás conceptos

Se plantea una instalación de **1.359.560 Wp instalados**. A continuación, se indican los volúmenes elevados y los volúmenes que deben ser elevados con energía adicional.

**Superficie: 2.268,9 ha**

| | **Necesidades ($m^3$/ha y mes)** | **días/mes** | **Necesidades ($m^3$)** | **Suma de QREAL ($m^3$)** | **Vol. Pendiente ($m^3$)** | **% Satisfecho** |
|---|---|---|---|---|---|---|
| Enero | 35,60 | 31 | 80.772,84 | 821.747,61 | - | 100,0% |
| Febrero | 111,26 | 28 | 252.437,81 | 966.016,80 | - | 100,0% |
| Marzo | 172,54 | 31 | 391.476,01 | 1.338.891,28 | - | 100,0% |
| Abril | 396,70 | 30 | 900.072,63 | 1.516.517,27 | - | 100,0% |
| Mayo | 865,65 | 31 | 1.964.073,29 | 1.709.053,47 | 255.019,82 | 87,0% |
| Junio | 1.276,87 | 30 | 2.897.090,34 | 1.764.453,05 | 1.132.637,30 | 60,9% |
| Julio | 1.795,58 | 31 | 4.073.991,46 | 1.921.456,28 | 2.152.535,19 | 47,2% |
| Agosto | 1.414,46 | 31 | 3.209.268,29 | 1.782.947,50 | 1.426.320,79 | 55,6% |
| Septiembre | 860,09 | 30 | 1.951.458,20 | 1.479.561,75 | 471.896,45 | 75,8% |
| Octubre | 124,97 | 31 | 283.544,43 | 1.173.699,35 | - | 100,0% |
| Noviembre | 2,18 | 30 | 4.946,20 | 852.243,62 | - | 100,0% |
| Diciembre | 32,13 | 31 | 72.899,76 | 841.916,51 | - | 100,0% |
| **TOTAL** | **7.088,03** | | **16.082.031,27** | **16.168.504,49** | **5.438.409,54** | |
| | | | | | 34% | |

| | | | | | | Ratio KWh/kWp |
|---|---|---|---|---|---|---|
| Pabs. Max.: | 1.140.922,89 | W | FV. Pot. Real.: | 2.345.578.375 | Wh | 1.725,2 |
| Pfv inst.: | 1.359.560 | Wp | FV. Pot. Aprov.: | 2.340.297.588 | Wh | 1.721,4 |
| Ratio Wp/W: | 1,19 | | CE. Gasóleo: | | €/l | |
| Coef. Tª células: | 0,87 | | **CE. Vol. Grupo:** | | | €/$m^3$ |

Si analizamos la tabla de resultados, podemos observar que, en el mes de máximas necesidades, julio, se consigue bombear con energía solar un 52,80% del volumen necesario. Si analizamos el cómputo anual, la energía fotovoltaica consigue bombear el 66 % del volumen anual. El resto del volumen se ha de bombear con energía aportada de la red para la tarifa 6.1TD, en este caso solo en el periodo P6.

### 7.3.2 INSTALACIÓN SOLAR BOMBEO A BALSA ELEVADA

En la siguiente tabla se detalla la potencia realmente producida por la instalación, potencia disponible, una vez deducidas las pérdidas por temperatura y por los demás conceptos

Se plantea una instalación de **335.000 Wp instalados**. A continuación, se indican los volúmenes elevados y los volúmenes que deben ser elevados con energía adicional.

**Superficie: 344,98 ha**

| | Necesidades ($m^3$/ha y mes) | días/mes | Necesidades ($m^3$) | Suma de QREAL ($m^3$) | Vol. Pendiente ($m^3$) | % Satisfecho |
|---|---|---|---|---|---|---|
| Enero | 35,60 | 31 | 12.281,29 | 132.605,89 | - | 100,0% |
| Febrero | 111,26 | 28 | 38.382,47 | 158.309,29 | - | 100,0% |
| Marzo | 172,54 | 31 | 59.522,85 | 222.112,61 | - | 100,0% |
| Abril | 396,70 | 30 | 136.853,57 | 252.040,14 | - | 100,0% |
| Mayo | 865,65 | 31 | 298.631,94 | 282.777,75 | 15.854,19 | 94,7% |
| Junio | 1.276,87 | 30 | 440.494,61 | 298.140,57 | 142.354,04 | 67,7% |
| Julio | 1.795,58 | 31 | 619.439,19 | 323.724,18 | 295.715,01 | 52,3% |
| Agosto | 1.414,46 | 31 | 487.960,41 | 295.147,75 | 192.812,66 | 60,5% |
| Septiembre | 860,09 | 30 | 296.713,85 | 249.366,97 | 47.346,88 | 84,0% |
| Octubre | 124,97 | 31 | 43.112,15 | 193.109,82 | - | 100,0% |
| Noviembre | 2,18 | 30 | 752,06 | 139.738,35 | - | 100,0% |
| Diciembre | 32,13 | 31 | 11.084,21 | 136.709,08 | - | 100,0% |
| **TOTAL** | **7.088,03** | | **2.445.228,59** | **2.683.782,39** | **694.082,78** | |
| | | | | | 28% | |

| | | | | | | Ratio KWh/kWp |
|---|---|---|---|---|---|---|
| Pabs. Max.: | 265.437,63 | W | FV. Pot. Real.: | 577.958.130 | Wh | 1.725,2 |
| Pfv inst.: | 335.000 | Wp | FV. Pot. Aprov.: | 562.182.882 | Wh | 1.678,2 |
| Ratio Wp/W: | 1,26 | | CE. Gasóleo: | | €/l | |
| Coef. Tª células: | 0,87 | | **CE. Vol. Grupo:** | | | €/$m^3$ |

Si analizamos la tabla de resultados, podemos observar que, en el mes de máximas necesidades, julio, se consigue bombear con energía solar un 47,70% del volumen necesario. Si analizamos el cómputo anual, la energía fotovoltaica consigue bombear el 72 % del volumen anual. El resto del volumen se ha de bombear con energía aportada de la red para la tarifa 6.1TD, en este caso solo en el periodo P6.

## 7.4 DISTRIBUCIÓN CAMPO FOTOVOLTAICO

### 7.4.1 EQUIPOS PREVISTOS

A continuación, se detallan los parámetros más importantes de los equipos tipo considerados para el dimensionado de la instalación fotovoltaica. Las fichas de estos equipos se incluyen en el Apéndice 1.

**PARÁMETROS ELÉCTRICOS DEL MÓDULO TIPO SELECCIONADO**

| FABRICANTE/DISTRIBUIDOR | CERTIFICADO TIER1 |
|---|---|
| **ORIGEN** | - |
| **MODELO** | - |
| **TECNOLOGÍA** | Monocristalino-PERC |
| **TIPO** | CSW-445MS |
| **Células** | 144 half-cell (2x(12x6)) |
| **Dimensiones** | 2108x1048x40 |
| **Pmpp (Wp)** | 445 |
| **Umpp (V)** | 40,9 |
| **Impp (A)** | 10,89 |
| **Isc (A)** | 11,54 |
| **Uoc (V)** | 48,9 |
| **Rto. Módulo** | 20,10% |
| **Coef. Tª (V)** | -0,270% |
| **Coef. Tª (A)** | 0,050% |
| **Coef. Tª (P)** | -0,350% |
| **NOCT ºC** | 42±3 |
| **Tensión (V)** | 1000 |
| **Corriente (A)** | 20 |
| **Tª max** | 85 |
| **Tª min** | -40 |
| **Diodos by-pass** | 3 |
| **Longitud (mm)** | 2108 |
| **Ancho (mm)** | 1048 |

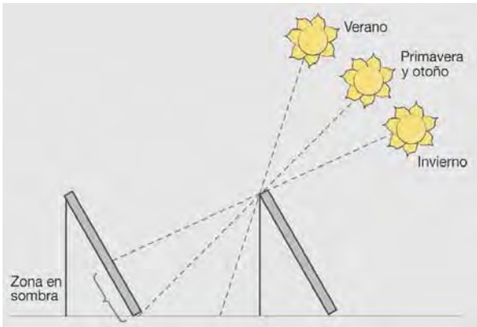
**PARÁMETROS ELÉCTRICOS DEL INVERSOR/VARIADOR TIPO SELECCIONADO**

| FABRICANTE/DISTRIBUIDOR | CERTIFICADO TIER1 | - |
|---|---|---|
| **Potencia:** | 37 | kW |
| **Input:** | | |
| **Vac máx:** | 500 | Vac |
| **Vac mín:** | 380 | Vac |
| **Vdc máx:** | 900 | Vdc |
| **Vdc mín:** | 540 | Vdc |
| **Frecuencia:** | 50 | Hz |
| **Factor de potencia:** | 0,98 | |
| **I DC (según potencia):** | Según potencia | A |
| **Output:** | | |
| **Frecuencia:** | 0-200 | Hz |

### 7.4.2 SEPARACIÓN LÍNEAS PANELES

Normalmente el espacio disponible suele ser limitado, es por ello que los módulos deben situarse en filas, unos detrás de otros, con el riesgo de que los situados delante proyecten sombras sobre los de atrás. Para evitar esto deberán plantearse las separaciones correspondientes entre las diferentes filas de modo que en el periodo de utilización la separación sea tal que la sombra de la arista superior del módulo anterior no se proyecte sobre el posterior.

En el siguiente gráfico se ilustra la influencia de la altura solar sobre la separación entre módulos y por tanto sobre la proyección de las sombras.




La separación entre filas de los módulos se hará de forma que durante el mediodía solar del día más desfavorable (altura solar mínima, $h_0$)) del periodo de utilización, la sombra de la arista superior de una fila se proyecte, como máximo, sobre la arista inferior de la fila siguiente.

La **altura solar mínima ($h_0$)** variará según el periodo de uso previsto para la instalación:

- Si la instalación **se usa durante todo el año**, el día más desfavorable será el 21 de diciembre (instalaciones en el hemisferio norte), ya que es cuando la altura solar es mínima durante el mediodía solar, y viene determinada por la siguiente expresión:

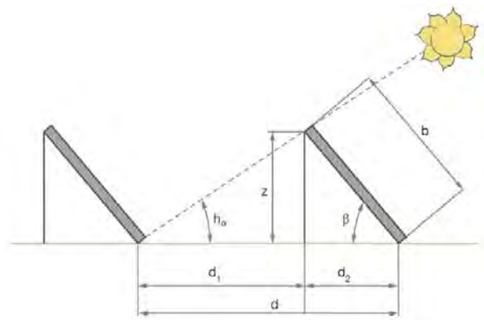
$$h_0 = (90° - \phi) - 23{,}5°$$

- Si el periodo de **uso es solo durante el verano**, el día más desfavorable corresponde a los equinoccios de otoño o de primavera (21 de marzo o 21 de septiembre), momento en el cual la altura solar durante el mediodía solar viene dada por:

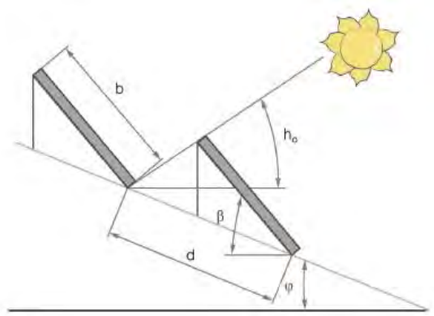
$$h_0 = (90° - \phi)$$

A continuación, se muestra la relación entre la distancia mínima, d, entre filas de módulos y otras dimensiones de los módulos:

- Superficies planas:




- Superficies inclinadas:



A partir de la localización, el periodo de diseño y la tipología e inclinación de la instalación definidos en apartados anteriores, y la pendiente de la parcela, se calcula la separación mínima entre líneas de paneles.

**Localización instalación**

| | |
|---|---|
| Ciudad: | Torralba de Aragón |
| Latitud (φ): | 41,93136º |

**Dimensiones panel**

| | |
|---|---|
| Longitud (b): | 4216 mm |
| Ancho: | 1048 mm |

**Instalación**

| | |
|---|---|
| Orientación: | SUR |
| Inclinación (β): | 15º |
| z: | 1092 mm |

**Instalación funcionando durante el verano**

| | |
|---|---|
| h0: | 48,06864 º |
| d: | 5053 mm |
| d1: | 981 mm |
| d2: | 4076 mm |

Atendiendo a los resultados la distancia mínima entre paneles para una instalación fija con paneles a 15º de inclinación con respecto a la horizontal, y una pendiente descendente despreciable en la parcela, deberá ser de 5053 mm, con una distancia entre paneles en la proyección vertical de 981 mm, es decir con un pasillo de 981 mm.

Por cuestiones de explotación y mantenimiento se adopta una separación en la proyección horizontal (d1), es decir un pasillo entre filas de módulos, de 4280 mm.

### 7.4.3 NÚMERO DE MÓDULOS. TOTAL, SERIE Y PARALELO

Para calcular el número de módulos deberemos tener en cuenta, la potencia total de la instalación y del módulo para determinar el número total de módulos, y los dos valores extremos del voltaje PMP (-10 ºC y 70 ºC), según se ajusten al rango de funcionamiento del inversor/variador.

### 7.4.4 INSTALACIÓN SOLAR

**POTENCIA NOMINAL DEL PARQUE FOTOVOLTAICO**

Potencia instalación FV: 1.694.560 Wp

**NÚMERO DE PANELES**

$$N\ (nº\ paneles) = \frac{P_{GVF,MSTC}}{P_{MOD,M,STC}} = \frac{1.694.560\ Wp}{445\ Wp} = 3.808\ paneles\ de\ 445\ Wp$$

$$N_{máx,s} = \frac{V_{INV,M}}{V_{MOD,OC(-10°c)}} = \frac{900\ V}{53{,}52\ V} = 16{,}82 = 16\ paneles\ en\ serie\ como\ máximo$$

$$N_{mín,s} = \frac{V_{INV,m,MPP}}{V_{MOD,PMP(70°c)}} = \frac{540\ V}{35{,}93\ V} = 15{,}03 = 16\ paneles\ en\ serie\ como\ mínimo$$

$$V_{MOD,OC(-10°c)} = U_{OC} \times \left(Coef.placa\ U_{OC}\ t^{a} \times (-35)\right) = 48{,}90 \times \left\{-0{,}270\frac{\%}{ºC} \times (-35)\right\} = 53{,}52\ V$$

$$V_{MOD,PMP(70°c)} = U_{MPP} \times \left(Coef.placa\ U_{OC}\ t^{a} \times (45)\right) = 40{,}90 \times \left\{-0{,}270\frac{\%}{ºC} \times (45)\right\} = 35{,}93\ V$$

Es decir, el número máximo de paneles por string o cadena de módulos será de 16 paneles y el mínimo de 16 para garantizar que en las condiciones de temperatura máximas y mínimas normalmente utilizadas como referencia (70 ºC y -10 ºC), se garantice que la tensión a la entrada del inversor/variador está dentro de los límites fijados por el fabricante.

**Se adopta como referencia $N_{máx,\,s}$ = 16 paneles en serie por string o cadena.**

A continuación, verificamos las cadenas o strings en paralelo en la instalación:

$$N_p(nº\ de\ strings\ en\ paralelo) = \frac{N}{N_s} = \frac{3.808}{16} = 238 = 238\ cadenas\ o\ strings$$

### 7.4.5 CÁLCULOS ELÉCTRICOS

A continuación, se justifica el dimensionado de los principales elementos de la instalación:

- Cableado entre módulos y caja de continua (agrupación de strings/cadenas; Cuadro Campo CC1-x).
- Cableado entre Caja de Campo nivel 1 (CC1-x) y cuadro de Campo nivel 2 (CC2) o acometida bombeo.
- Fusibles

- Seccionadores
- Descargadores de sobretensión
- Red de tierras
- Vigilantes de aislamiento
- Diodos de bloqueo

7.4.5.1 CABLEADO

En el dimensionado de la sección del conductor, básicamente, se tendrán en cuenta dos criterios:

- **Criterio de máxima intensidad** admisible por el conductor.

  De acuerdo con el estándar IEC 60364-7-712, a su temperatura de trabajo, el conductor de cada rama debe soportar 1,25 veces la intensidad de cortocircuito del módulo.

$$I_{máx.adm} = 1{,}25 \times I_{MOD,SC,STC}$$

  Selección de cable según Norma UNE 20460-5-523:2004:

  o En strings o cadenas. Tabla 52 - C11 (instalación aire libre tipo rejiban, cables unipolares). Instalación tipo E, 2 conductores cargados. Coef. Temperatura Tabla 52-D1, 30ºC; coef. Agrupamiento Tabla 52-E1, 1 circuito.

  o De caja de continua a Acometida CC. Tabla 52 – C4 (instalación en conductos enterrados). Instalación tipo D, 2 conductores cargados. Coef. Temperatura terreno Tabla 52-D2, 20ºC; coef. Agrupamiento Tabla 52-E3, máx. 2 circuitos.

- **Criterio de máxima caída de tensión** permisible en el cable.

  Atendiendo a las recomendaciones del informe de ASIF, "Caídas de tensión ASIF- Edición 3, marzo 2006", se fijará una caída de tensión máxima admisible entre el módulo y la Acometida de CC2 del 1,0%. Por otro lado, se fija una sección mínima de 4 mm$^2$.

$$S_{m,cadena}(monofásico) = \frac{2 \times L \times P}{K \times e \times V \times N_{ms}}$$

  Donde:

  - S, Sección en mm$^2$
  - L, longitud del conductor en metros
  - P, Potencia en vatios
  - K, conductividad, para CU 56 y Al 35
  - e, máxima caída de tensión permitida en vatios
  - V, tensión de utilización en voltios
  - Nms, número de módulos en serie

7.4.5.1.1 CABLEADO ENTRE MÓDULOS Y CAJA DE CONTINUA. TRAMO 1

A continuación, se detallan la justificación técnica para la elección del conductor entre la cadena módulos y caja de continua, punto en el que se unificará el cableado procedente de diferentes módulos.

Finalmente se optará por dos cables uno de 1 x 6 mm$^2$ tipo ZZ-F/H1Z2Z2-K 0,6/1kV y otro de 1 x 10 mm$^2$ tipo ZZ-F/H1Z2Z2-K 0,6/1kV por cadena, instalado al aire sobre superficie. Cable certificado TÜV y EN, conductor en cobre electrolítico estañado, clase 5 (flexible) según UNE-EN 60228 e IEC 60228, aislamiento a partir de goma libre de halógenos, y cubierta de goma libre de halógenos de color negro o rojo. Apto para instalaciones fotovoltaicas, tanto en servicio móvil como en instalación fija. Cable muy flexible especialmente indicado para la conexión entre paneles fotovoltaicos, y desde los paneles al inversor de corriente continua o alterna.

7.4.5.1.2 CABLEADO ENTRE CAJA DE CONTINUA Y ACOMETIDA CC. TRAMO 2

A continuación, se detalla la justificación técnica para la elección del conductor entre la caja de continua, punto en el que se unificará el cableado procedente de diferentes módulos (CC1-x), el cuadro de Campo de agrupación del campo fotovoltaico (CC2) y entre este y el cuadro de acometida de (corriente continua) del bombeo.

Tras el análisis de la distribución del campo fotovoltaico se determina agrupar entre 6 y 8 string/cadenas/ramas en una misma caja de continua, dependiendo de la morfología de parcela, dando lugar a 2 agrupamientos, es decir 2 cajas de continua. Desde cada una de estas cajas de continua se deberá tender cableado hasta la Caja de Capo de nivel 2 (CC2), y desde esta hasta la acometida CC del bombeo, debiéndose justificar la sección de cable por criterio de máxima intensidad y de máxima caída de tensión expuestos con anterioridad.

A continuación, se detalla la longitud de cableado de cada una de estas líneas de agrupación, añadiendo 5 metros adicionales para ajuste de conexión a cuadros eléctricos.

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | 1,74% |
| **TRAMO 0.** CABLE SOLAR | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tramo de conexión | 1 | 4 | Cu | 8,4 | 654,4 | 11,54 | 0,866 | 0,132% | | | | | | | | | | 10 | 400 | Al | 149 | 654,4 | **238** | 2746,52 | 14,747 | 0,893% | |
| Tramo directo | 1 | 10 | Cu | 15,5 | 654,4 | 11,54 | 0,639 | 0,098% | | | | | | | | | | | | | | | | 6000 A | CUMPLE A CORRIENTE | | |
| Tramo directo | 1 | 6 | Cu | 15,5 | 654,4 | 11,54 | 1,065 | 0,163% | | | | | | | | | | | | | | | | | | | |
| **Suma** | | **TRAMO 10** | | | | | **1,504** | **0,230%** | | | | | | | | | | | | | | | | | | | |
| **Suma** | | **TRAMO 6** | | | | | **1,930** | **0,295%** | | | | | | | | | | | | | | | | | | | |
| TRAMO 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (de fin de cadena a CN1) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C1 | | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 10 | 654,4 | 11,54 | 0,687 | 0,105% | 1 | **35** | Cu | 23,5 | 654,4 | 6 | 69,24 | 0,015 | 0,254% | | | | | | | | | | 1,55% |
| S2 | 1 | 6 | Cu | 8 | 654,4 | 11,54 | 0,550 | 0,084% | | | | | | | | | 0,65% | | | | | | | | | | 1,53% |
| S3 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | | | | | | | 185 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,45% |
| S4 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | | | | | | | | | | | 1,62% |
| S5 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,64% |
| S6 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,47% |
| C2 | | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **50** | Cu | 31,5 | 654,4 | 6 | 69,24 | 0,014 | 0,238% | | | | | | | | | | 1,44% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,65% | | | | | | | | | | 1,60% |
| S3 | 1 | 10 | Cu | 31,5 | 654,4 | 11,54 | 1,298 | 0,198% | | | | | | | 225 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,56% |
| S4 | 1 | 10 | Cu | 31,5 | 654,4 | 11,54 | 1,298 | 0,198% | | | | | | | | | | | | | | | | | | | 1,56% |
| S5 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,62% |
| S6 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,46% |
| C3 | | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **70** | Cu | 40 | 654,4 | 8 | 92,32 | 0,023 | 0,288% | | | | | | | | | | 1,49% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,78% | | | | | | | | | | 1,65% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 289 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,81% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,72% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,73% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,81% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,67% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,51% |
| C4 | | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **70** | Cu | 48 | 654,4 | 8 | 92,32 | 0,028 | 0,345% | | | | | | | | | | 1,54% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,84% | | | | | | | | | | 1,71% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 289 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,86% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,78% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | **1,74%** |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,79% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,86% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,73% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,57% |
| C5 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 56 | 654,4 | 8 | 92,32 | 0,024 | 0,297% | | | | | | | | | | 1,50% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,79% | | | | | | | | | | 1,66% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,82% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,73% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,74% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,82% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,68% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,52% |
| C6 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 65 | 654,4 | 8 | 92,32 | 0,028 | 0,345% | | | | | | | | | | 1,54% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,84% | | | | | | | | | | 1,71% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,86% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,78% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,79% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,86% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,73% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,56% |
| C7 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 73 | 654,4 | 8 | 92,32 | 0,031 | 0,387% | | | | | | | | | | 1,59% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,88% | | | | | | | | | | 1,75% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,91% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,82% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,83% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,91% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,77% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,61% |
| C8 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 81 | 654,4 | 8 | 92,32 | 0,034 | 0,430% | | | | | | | | | | 1,63% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,92% | | | | | | | | | | 1,79% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,95% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,86% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | **1,74%** |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,87% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,95% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,82% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,65% |
| C9 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 89 | 654,4 | 8 | 92,32 | 0,030 | 0,374% | | | | | | | | | | 1,57% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,87% | | | | | | | | | | 1,74% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,89% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,81% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,82% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,89% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,76% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,59% |
| C10 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 97,5 | 654,4 | 8 | 92,32 | 0,033 | 0,409% | | | | | | | | | | 1,61% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,90% | | | | | | | | | | 1,77% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,93% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,84% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,85% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,93% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,80% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,63% |
| C11 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 106 | 654,4 | 8 | 92,32 | 0,036 | 0,445% | | | | | | | | | | 1,64% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,94% | | | | | | | | | | 1,81% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,96% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,88% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,89% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,96% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,83% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,66% |
| C12 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 114 | 654,4 | 8 | 92,32 | 0,038 | 0,479% | | | | | | | | | | 1,68% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,97% | | | | | | | | | | 1,84% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 2,00% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,91% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | **1,74%** |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,92% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 2,00% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,86% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,70% |
| C13 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 122 | 654,4 | 8 | 92,32 | 0,041 | 0,512% | | | | | | | | | | 1,71% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 1,00% | | | | | | | | | | 1,88% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 2,03% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,94% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,96% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 2,03% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,90% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,73% |
| C14 | | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 130,5 | 654,4 | 8 | 92,32 | 0,044 | 0,548% | | | | | | | | | | 1,75% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 1,04% | | | | | | | | | | 1,91% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 2,07% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,98% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,99% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 2,07% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,93% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,77% |
| C15 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 20 | 654,4 | 11,54 | 1,374 | 0,210% | 1 | **70** | Cu | 43 | 654,4 | 7 | 80,78 | 0,019 | 0,271% | | | | | | | | | | 1,67% |
| S2 | 1 | 6 | Cu | 20 | 654,4 | 11,54 | 1,374 | 0,210% | | | | | | | | | 0,71% | | | | | | | | | | 1,67% |
| S3 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | | | | | | | 289 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,47% |
| S4 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | | | | | | | | | | | 1,64% |
| S5 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,66% |
| S6 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,49% |
| C16 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **35** | Cu | 25 | 654,4 | 7 | 80,78 | 0,022 | 0,315% | | | | | | | | | | 1,51% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,72% | | | | | | | | | | 1,68% |
| S3 | 1 | 10 | Cu | 31,5 | 654,4 | 11,54 | 1,298 | 0,198% | | | | | | | 185 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,64% |
| S4 | 1 | 10 | Cu | 31,5 | 654,4 | 11,54 | 1,298 | 0,198% | | | | | | | | | | | | | | | | | | | 1,64% |
| S5 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,70% |
| S6 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,53% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | **1,74%** |
| C17 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **25** | Cu | 10 | 654,4 | 8 | 92,32 | 0,016 | 0,202% | | | | | | | | | | 1,40% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,69% | | | | | | | | | | 1,57% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 149 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,72% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,63% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,65% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,72% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,59% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,42% |
| C18 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **25** | Cu | 14 | 654,4 | 8 | 92,32 | 0,023 | 0,282% | | | | | | | | | | 1,48% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,77% | | | | | | | | | | 1,65% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 149 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,80% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,71% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,73% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,80% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,67% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,50% |
| C19 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **35** | Cu | 22 | 654,4 | 8 | 92,32 | 0,025 | 0,317% | | | | | | | | | | 1,52% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,81% | | | | | | | | | | 1,68% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 185 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,84% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,75% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,76% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,84% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,70% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,54% |
| C20 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **50** | Cu | 30,5 | 654,4 | 8 | 92,32 | 0,025 | 0,307% | | | | | | | | | | 1,51% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,80% | | | | | | | | | | 1,67% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 225 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,83% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,74% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,75% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,83% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,69% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,53% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | 1,74% |
| C21 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **70** | Cu | 38,5 | 654,4 | 8 | 92,32 | 0,022 | 0,277% | | | | | | | | | | 1,48% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,77% | | | | | | | | | | 1,64% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 289 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,80% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,71% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,72% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,80% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,66% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,50% |
| C22 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **70** | Cu | 47 | 654,4 | 8 | 92,32 | 0,027 | 0,338% | | | | | | | | | | 1,54% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,83% | | | | | | | | | | 1,70% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 289 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,86% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,77% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,78% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,86% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,72% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,56% |
| C23 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 55 | 654,4 | 8 | 92,32 | 0,023 | 0,292% | | | | | | | | | | 1,49% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,78% | | | | | | | | | | 1,66% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,81% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,72% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,74% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,81% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,68% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,51% |
| C24 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 63,5 | 654,4 | 8 | 92,32 | 0,027 | 0,337% | | | | | | | | | | 1,54% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,83% | | | | | | | | | | 1,70% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,86% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,77% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,78% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,86% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,72% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,56% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | **1,74%** |
| C25 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 71,8 | 654,4 | 8 | 92,32 | 0,030 | 0,381% | | | | | | | | | | 1,58% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,87% | | | | | | | | | | 1,75% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,90% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,81% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,83% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,90% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,77% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,60% |
| C26 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **95** | Cu | 80 | 654,4 | 8 | 92,32 | 0,034 | 0,424% | | | | | | | | | | 1,62% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,92% | | | | | | | | | | 1,79% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 352 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,94% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,86% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,87% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,94% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,81% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,64% |
| C27 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 88 | 654,4 | 8 | 92,32 | 0,030 | 0,369% | | | | | | | | | | 1,57% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,86% | | | | | | | | | | 1,73% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,89% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,80% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,81% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,89% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,76% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,59% |
| C28 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 96 | 654,4 | 8 | 92,32 | 0,032 | 0,403% | | | | | | | | | | 1,60% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,90% | | | | | | | | | | 1,77% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,92% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,83% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,85% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,92% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,79% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,62% |

| | | TRAMO 1. EN CADENA | | | | | | | TRAMO 2: DE CAJA DE NIVEL 1 A CAJA DE NIVEL 2 | | | | | | | | | TRAMO 3: DE CAJA DE NIVEL 2 A BOMBEO | | | | | | | | | TOTAL CdT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | Material | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | Nº DE POLOS | CABLE (mm²) | | DISTANCIA (m) | V | Nº SERIES | Imp (A) | CdT (V) | CdT (%) | **1,74%** |
| C29 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 104,5 | 654,4 | 8 | 92,32 | 0,035 | 0,439% | | | | | | | | | | 1,64% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,93% | | | | | | | | | | 1,80% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,96% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,87% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,88% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,96% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,82% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,66% |
| C30 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 113 | 654,4 | 8 | 92,32 | 0,038 | 0,474% | | | | | | | | | | 1,67% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,97% | | | | | | | | | | 1,84% |
| S3 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,99% |
| S4 | 1 | 10 | Cu | 49 | 654,4 | 11,54 | 2,020 | 0,309% | | | | | | | | | | | | | | | | | | | 1,91% |
| S5 | 1 | 10 | Cu | 51 | 654,4 | 11,54 | 2,102 | 0,321% | | | | | | | | | | | | | | | | | | | 1,92% |
| S6 | 1 | 6 | Cu | 31,5 | 654,4 | 11,54 | 2,164 | 0,331% | | | | | | | | | | | | | | | | | | | 1,99% |
| S7 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,86% |
| S8 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,69% |
| C31 | 1 | | | | | 63 A | CUMPLE A CORRIENTE | | | | | | | | | | | | | | | | | | | | |
| S1 | 1 | 6 | Cu | 1 | 654,4 | 11,54 | 0,069 | 0,010% | 1 | **120** | Cu | 121 | 654,4 | 6 | 69,24 | 0,023 | 0,381% | | | | | | | | | | 1,58% |
| S2 | 1 | 6 | Cu | 16,8 | 654,4 | 11,54 | 1,154 | 0,176% | | | | | | | | | 0,79% | | | | | | | | | | 1,75% |
| S3 | 1 | 10 | Cu | 31,5 | 654,4 | 11,54 | 1,298 | 0,198% | | | | | | | 410 A | CUMPLE A CORRIENTE | | | | | | | | | | | 1,70% |
| S4 | 1 | 6 | Cu | 3 | 654,4 | 11,54 | 0,206 | 0,031% | | | | | | | | | | | | | | | | | | | 1,60% |
| S5 | 1 | 6 | Cu | 18,8 | 654,4 | 11,54 | 1,291 | 0,197% | | | | | | | | | | | | | | | | | | | 1,77% |
| S6 | 1 | 10 | Cu | 31,5 | 654,4 | 11,54 | 1,298 | 0,198% | | | | | | | | | | | | | | | | | | | 1,70% |

Los cables se instalarán bajo tubo enterrado en zanja, con un máximo de dos circuitos por zanja separados por al menos 0,25m. Cable certificado TÜV y EN, conductor en cobre electrolítico estañado, clase 5 (flexible) según UNE-EN 60228 e IEC 60228, aislamiento a partir de Polietileno reticulado (XLPE), y cubierta de PVC flexible, de color negro. Puede ser enterrado o instalado en un tubo, así como a la intemperie, sin requerir protección adicional. Soporta entornos húmedos incluyendo la total inmersión en agua.

7.4.5.2 FUSIBLES A INSTALAR

Los fusibles a instalar en serie en cada rama han de poseer una intensidad nominal, In, de acuerdo a la siguiente expresión:

$$1{,}5 \times I_{MOD,SC,STC} \leq I_n \leq 2 \times I_{MOD,SC,STC}$$

Del mismo modo, para la protección de los cables para cada cadena fotovoltaica, deberá considerarse lo siguiente:

- **Grupo FV con una cadena o dos cadenas en paralelo,** no se requiere dispositivo protector de sobreintensidad.

  La corriente permanente admisible $I_z$ del cable para cadena fotovoltaica debe ser superior o igual a la corriente máxima de corto circuito de la cadena:

  $$I_{SC,max} de\ la\ cadena \leq I_z$$

- **Grupo FV con cadenas $N_s$ en paralelo con $N_s$ superior a 2,** la corriente inversa que circula en el cable para cadena fotovoltaica es $(N_s - 1).\ I_{SC,\ MÁX.}$ Debe utilizarse una de las siguientes medidas:

  - Cuando no se requiere el dispositivo de protección de sobreintensidad de la cadena fotovoltaica, la corriente permanente admisible $I_z$ de los cables para cadena fotovoltaica deben ser superiores o iguales a la corriente máxima inversa:

    $$(N_s - 1) \times I_{SC,MÁX} \leq I_z$$

  - Cuando si se requiere de dispositivo de protección contra sobreintensidades de la cadena fotovoltaica la corriente permanente admisible $I_z$ de los cables para cadena fotovoltaica deben ser superiores o iguales a la corriente nominal del dispositivo de protección de la cadena In:

    $$I_n \leq I_z$$

**PROTECCIONES POR FUSIBLES EN CADENA/STRING:**

| **Fusibles (a instalar en serie en cada Rama o String; CC1-x):** | | |
|---|---|---|
| **Isc módulo** | 11,54 | A |
| **In mínima fusible:** | 17,31 | A |
| **In máxima fusible:** | 23,08 | A |
| **Elección de fusible cadenas/strings:** | 20 | A |
| **$N_{ramas\ paralelo}$ (agrupadas por caja conexión Grupo FV):** | 6 | Uds |
| **Isc (A), por cadena** | 11,54 | A |
| **Uoc (V)** | 48,90 | |
| **$N_{ms}$:** | 16 | Uds |
| **$I_z$, intensidad cable:** | 49,00 | A |
| **Régimen tensión fusible:** | 938,88 | V |
| **Elección de fusible cadenas:** | 20 A, y 1000 V | |

Atendiendo a la justificación anterior cada cadena de módulos se protegerá con seccionador de fusibles tipo E 92/32, y fusibles tipo 10,3x38 mm 1000 V c.c. 20 A.

Esta misma protección podría efectuarse mediante interruptor magnetotérmico atendiendo a la siguiente justificación:

| **Seccionador por cadena (a instalar en serie en cada Rama o String; CC1-x):** | | |
|---|---|---|
| **$V_{mod.\ OC\ (-10ºC)}$:** | 53,52 | V |
| **$N_{ms}$:** | 16 | Uds |
| **Umáx. a soportar, $N_s$*$V_{MOD,OC(-10ºC)}$:** | 856,34 | V |
| **$N_{ramas\ paralelo}$ (agrupadas por caja conexión Grupo FV):** | 1 | Uds |
| **Isc (A), por cadena** | 11,54 | A |
| **Intensidad a soportar en interruptor:** | 17,31 | A |
| **Interruptor elegido** | S803PV-S20 | |
| **Tensión máxima:** | 1200 | V |
| **Intensidad nominal:** | 20 | A |
| **Poder de Corte (kA):** | 5 | kA |

**PROTECCIONES POR FUSIBLES EN ACOMETIDA PARA AGRUPACIÓN CADENA/STRING:**

| Fusibles (a instalar en serie en agrupación Rama o String ; CC2): | | |
|---|---|---|
| **Isc módulo** | 11,54 | A |
| **In mínima fusible:** | 138,48 | A |
| **In máxima fusible:** | 184,64 | A |
| **Elección de fusible cadenas/strings:** | 160 | A |
| **$N_{ramas\ paralelo}$ (agrupadas por caja conexión Grupo FV):** | 8 | Uds |
| **Isc (A), por cadena** | 11,54 | A |
| **Uoc (V)** | 48,90 | |
| **$N_{ms}$:** | 16 | Uds |
| **$I_z$, intensidad cable:** | 49,00 | A |
| **Régimen tensión fusible:** | 938,88 | V |
| **Elección de fusible cadenas:** | 160 A, y 1000 V | |

7.4.5.3 SECCIONADORES

En cada una de las cajas de continua (agrupación de strings/cadenas; cuadro nivel 1, CC1-x), además de las correspondientes protecciones se colocará un seccionador acorde a la tensión y la intensidad del grupo de strings para facilitar el mantenimiento y la explotación.

Por otro lado, en el cuadro de Campo de nivel 2 (CC2), el cual agrupa todas las líneas procedentes de los cuadros de Campo de nivel 1 (CC1-x), y del cual parte la línea general hasta el cuadro de Acometida del Bombeo, además de las correspondientes protecciones se colocará un seccionador acorde a la tensión y la intensidad del grupo de strings para facilitar el mantenimiento y la explotación. En este cuadro también se unificarán las comunicaciones de la red Ethernet del campo fotovoltaico mediante Swich, la cual tendrá continuidad hasta el cuadro de control del bombeo mediante red Ethernet cuando la distancia lo permita o mediante red de Fibra Óptica cuando las distancias entre el CC1-x más alejado y el bombeo excedan de los 100 metros.

Por último, en el cuadro de acometida CC se colocará un interruptor General seccionador, para la gestión del aporte de la energía eléctrica por parte del campo fotovoltaico, interruptor conectado, o de los grupos electrogeneradores, interruptor desconectado.

A continuación, se justifica la elección del interruptor seccionador a instalar en cada caso:

**SECCIONADOR EN CAJA DE CONTINUA PARA AGRUPACIÓN CADENA/STRING. CUADRO NIVEL 1:**

| Seccionador por Grupo conexión (a instalar en serie en cada grupo): | | |
|---|---|---|
| **$V_{mod.\ OC\ (-10ºC)}$:** | 16 | Uds |
| **$N_{ms}$:** | 856,34 | V |
| **Umáx. a soportar, $N_s$*$V_{MOD,OC(-10ºC)}$:** | 8 | Uds |
| **$N_{ramas\ paralelo}$ (agrupadas por caja conexión Grupo FV):** | 11,54 | A |
| **Isc (A), por cadena** | 138,48 | A |
| **Intensidad a soportar en interruptor:** | T1D/PV-160 | |
| **Interruptor elegido** | 1000 | V |
| **Tensión máxima:** | 160 | A |
| **Intensidad nominal:** | 16 | Uds |

**SECCIONADOR GENERAL EN CC2 Y ACOMETIDA PARA CAMPO FOTOVOLTAICO:**

| | | |
|---|---|---|
| **$I_{máx.\ TOTAL\ a\ entrada\ inversores}$:** | 3.433,15 | A |
| **Interruptor elegido** | OT1250 | |
| **Tensión máxima:** | 1.000 | V |
| **Intensidad nominal:** | 1.250 | A |
| **Poder de Corte (kA):** | 8 | kA |
| **Unidades** | 3 | |

7.4.5.4 DESCARGADOR DE SOBRETENSIONES

En cada una de las cajas de continua (agrupación de strings/cadenas; cuadro nivel 1), en el cuadro de Campo de nivel 2 (CC2), y en el cuadro de acometida CC se colocarán los correspondientes descargadores de tensiones. A continuación se indican las principales características de los equipos a instalar.

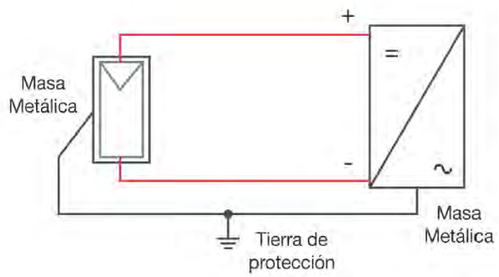
| Protección sobretensiones. En caja de continua y acometida | | |
|---|---|---|
| **MODELO** | OVR PV 40 | |
| **Tensión cont. máx. de funcionamiento Ucpv** | 1.000 | V |
| **Corriente nominal de descarga In (8/20 µs)** | 20 | kA |
| **Corriente de descarga máx. Imax (8/20 µs)** | 40 | kA |
| | | |
| **Fusible asociado a descargador** | Según I grupo y tensión sistema | |

#### 7.4.5.5 RED DE TIERRAS

En el campo fotovoltaico deberá existir un sistema de tierras de protección y otro de servicio.

La red de tierras del campo fotovoltaico deberá tener una configuración denominada "flotante". Este tipo de configuración consiste en el que ninguna de las partes activas eléctricamente esté puesta a tierra, mientras que los componentes metálicos de la instalación si estarán conectados a tierra (marcos, soportes, cajas de conexión DC, caja del interruptor principal e inversor).

En la imagen se muestra la configuración de generador flotante y masas a tierra.




En este tipo de configuración existe la tierra de protección a la cual se deben conectar todas las masas metálicas del sistema, así como los dispositivos de protección frente a sobretensiones. En este tipo de conexión toda la red de corriente continua del generador fotovoltaico se encuentra aislada de tierra.

#### 7.4.5.6 VIGILANTES DE AISLAMIENTO

Con la finalidad de proteger el lado de corriente continua de contactos indirectos se incorporará a la instalación vigilantes de aislamiento.

Estos dispositivos deberán tener en cuenta que la resistencia de aislamiento de la instalación debe estar por encima de unos valores mínimos que impidan que ante contactos directos de corriente por la persona se supere los 100 mA.

Habitualmente estos dispositivos inyectan una tensión en la red y la tierra, de la medida de la corriente que resulte se obtiene la resistencia real de aislamiento de la red y por tanto la existencia o no de una falta o fallo de aislamiento. Se realiza mediante una señal con una frecuencia baja para que las corrientes generadas se acoplen a las corrientes de fuga.

#### 7.4.5.7 DIODOS DE BLOQUEO

Se colocarán en el cableado de conexión al bus de continua de los variadores, evitando que pueda haber una fuga de corriente en la fase de arranque suave DC del variador y se puedan generar daños en las instalaciones.

# 8 RED DE COMUNICACIONES

Ver apartado 9.1.

# 9 SISTEMA DE MONITORIZACIÓN. CONTROL Y MANTENIMIENTO

## 9.1 MONITORIZACIÓN Y CONTROL DE INSTALACIONES

La experiencia en las instalaciones realizadas ha demostrado un funcionamiento sin apenas fallos y con un mantenimiento muy escaso. Siendo la fiabilidad una ventaja de estas instalaciones. Sin embargo, es adecuado dotar a la instalación de monitorización, por los siguientes motivos:

- Los propietarios de la instalación quieren conocer que la instalación funciona correctamente. Los sistemas de monitorización básicos de fácil manejo y compresión, informan al usuario de las principales variables del sistema.
- Los sistemas de monitorización permiten comprobar que el sistema está funcionando de acuerdo a lo previsto y actuar sobre algunos parámetros para corregir posibles deficiencias.

### 9.1.1 EVALUACIÓN DEL SISTEMA

Tiene como objeto aumentar el conocimiento de la tecnología con la finalidad de mejorar el rendimiento de la instalación. Este feedback, es aplicado posteriormente a nuevos desarrollos.

Como podemos ver, un buen sistema de monitorización es muy eficaz para el operador de la instalación, ya que va ayudar a desarrollar un mantenimiento adecuado de la instalación y además, garantizará confianza a los propietarios de la instalación.

Desde el punto de vista técnico, el objetivo de desarrollar la monitorización de una instalación solar fotovoltaica, es la evaluación de la eficiencia energética de la instalación, para ello es adecuado controlar el comportamiento de los inversores, módulos solares, controlando los parámetros de irradiancia y temperatura de los módulos.

La mayoría de los inversores fotovoltaicos integran sistemas electrónicos capaces de medir las magnitudes eléctricas tanto a su entrada como en la salida. Además, estas variables son acumuladas en memorias internas del propio inversor, o mediante equipos de almacenamiento que facilita el propio fabricante

### 9.1.2 PARÁMETROS MONITORIZABLES

Las variables a monitorizar en una instalación solar fotovoltaica son las siguientes:

- Variables meteorológicas
  - Irradiancia captada en el plano de los módulos ($W/m^2$):

    Esta variable permite conocer un correcto balance energético de la planta.

    Normalmente se mide mediante una célula de referencia de la misma tecnología que el generador fotovoltaico, calibrada por un laboratorio. En la salida de esta célula se coloca un shunt (resistencia calibrada) de manera que la señal de salida es proporcional a la irradiancia incidente. La ventaja de medir con una célula calibrada es su bajo precio si lo comparamos con el coste de un piranómetro y su mayor velocidad respuesta a cambios de irradiación bruscos, nubes rápidas. El principal inconveniente de estas instalaciones es que son menos precisas, a bajas irradiancia.
  - Irradiancia incidentes en el plano horizontal ($W/m^2$):

    Este parámetro es medido con la finalidad de comparar diferentes instalaciones, o realizar extrapolaciones en futuras instalaciones.
  - Temperatura de los módulos (ºC):

    El objeto de medir este parámetro, no es otro que conocer las pérdidas reales de los módulos, por el efecto de la temperatura, ya que va ser una de las mayores pérdidas de la instalación. En los primeros días de la instalación nos interesa verificar si los parámetros indicados por el fabricante de la instalación son correctos.

    La mejor forma de controlar este parámetro es con la medida directa de esta variable, mediante un sensor sobre el módulo, sin embargo, también podemos medir este parámetro, midiendo la irradiación y la temperatura ambiente de la instalación.

    Para medir la temperatura se suele emplear una RTD, son sensores que varían su resistencia interna con la temperatura, las más utilizadas son las Pt 1OO. Aunque existen diferentes tecnologías de conexionado, en distancias largas, es recomendable utilizar las de 4 hilos, ya que este método es más efectivo y preciso, ya que este tipo de sensores anula la resistencia adicional que introducen los conductores.
  - Temperatura ambiente (°C):

    Es útil conocer la temperatura ambiente, de la instalación, con el objeto de estimar el funcionamiento de los equipos, como puede ser los inversores y etc.
  - Velocidad y dirección del viento:

    Este parámetro es de vital importancia en las instalaciones con seguimiento de dos ejes, con la finalidad de proteger las estructuras ante vientos muy fuertes. También se suele medir dicho parámetro para realizar ajustes de la temperatura de los módulos, ya que dependiendo de la velocidad del viento puede existir diferencia entre la temperatura medida por el sensor o estimada, y la temperatura real de la célula.

    Estos sensores disponen de tres cazoletas, que giran en función de la velocidad del viento, y emitiendo una señal en alterna siendo la frecuencia proporcional a la velocidad el viento.

    Para la dirección del viento, se utiliza las veletas, estos dispositivos nos indican la dirección del viento, debido a que internamente tienen un potenciómetro, que nos da una señal de tensión proporcional a la resistencia media, en función de la dirección en la que se encuentra. Normalmente el Norte corresponde a O voltios.
- Variables de corriente continua.
  - Voltaje en DC (V).

    Asociación módulos serie.
  - Intensidad en DC (A).

    Asociación módulos paralelo.

    Ambas variables, son medias con ella finalidad de conocer y analizar si funciona correctamente la instalación generadora.
- Variables de corriente alterna
  - Tensión de cada una de las fases (V).
  - Intensidad de cada una de las fases (A).
  - Potencia de salida (W).
  - Factor de potencia (cos $\phi$).
  - Frecuencia de red (Hz).

- Energía total producida por el inversor (kWh).

Normalmente además de controlar los parámetros característicos de la instalación, se suelen generar alarmas, con la finalidad de vigilar o registrar las siguientes incidencias:

- Frecuencia de red fuera de límites.
- Tensión de red fuera de límites.
- Fallo de aislamiento.
- Temperatura de trabajo excesivo.
- Desviaciones en los seguidores solares.

### 9.1.3 ELEMENTOS DEL SISTEMA DE MONITORIZACIÓN

La mayoría de los inversores que podemos encontrar en el mercado, disponen de la electrónica adecuada, para medir los parámetros anteriormente introducidos. Además de incorporar los sistemas de almacenamiento temporal de las medidas del inversor, que a su vez permite la descarga de dicha información a un PC. Muchos fabricantes lo integran en el propio inversor, y otros ofrecen un data logger externo, conectado al inversor con ese propósito. El principal inconveniente de estos sistemas es que debido a la limitada capacidad de la memoria de dichos dispositivos se tiene que desarrollar descargas temporales, con la finalidad de poder guardar los datos recogidos.

La comunicación adecuada entre los usuarios y estos dispositivos utilizados en la monitorización de las instalaciones solares fotovoltaicas, se establece mediante protocolos de comunicación, estableciendo los flujos de información entre los distintos sistemas, estableciendo un protocolo entre las partes de la comunicación, sobre cómo se va a proceder al envío y recepción de datos. Para desarrollar este tipo de comunicación los protocolos más utilizados son los siguientes:

- Protocolo RS232.
- Protocolo RS485.
- Protocolo GSM.
- Protocolo Ethernet.
- Protocolo TCP/IP.
- Protocolo GPRS.

En este caso la comunicación entre el Autómata del bombeo y los variadores y el sistema de control se realizará a través de una red ModBUS y Ethernet, y se dotará al sistema de un PC de control en el que se almacenará todos los parámetros registrados y con el que se gestionará la comunicación con el Centro de Control de la CR.

En el campo solar fotovoltaico se establecerá una red de comunicaciones bajo tubo Ethernet entre cada una de las cajas de nivel 1 (CC1-x), donde se instalará un "Medidor de Cadenas de módulos", y la Caja de Campo de nivel 2 (CC2), en la que se instalará un Switch de comunicaciones que agrupará las comunicaciones de todo el campo fotovoltaico. Desde este punto se prologará la red hasta el autómata de control del bombeo, mediante red Ethernet cuando la longitud más desfavorable sea inferior a 100 m, o mediante Fibra Óptica cuando las longitudes sean mayores. Esta red de comunicaciones permitirá incluso la inclusión de las señales de los sensores del campo fotovoltaico o la instalación futura de una red de videovigilancia.

Los sensores que se instalarán con la finalidad de medir los parámetros anteriormente indicados, son los siguientes:

| Parámetro | Sensor | Precisión | Salida |
|---|---|---|---|
| Irradiancia | Célula de referencia | 2 W/m² | mV |
| | Piranometro | 1 W/m² | |
| Temperatura | PT100 | 0,5ºC | Ω |
| Velocidad viento | Anemómetro | | 0-1 Vdc |
| | | | 4-20mA |
| Dirección viento | Veleta | | 0-1 Vdc |
| | | | 4-20 mA |
| Intensidad DC | Shunt | 0,5 % | mV |

### 9.1.4 RED DE COMUNICACIONES

<u>COMUNICACIÓN ETHERNET TCP</u>

Se prevé la instalación de una red Ethernet con cable tipo UTP Exterior CAT6 bajo tubo, con conexiones RJ-45 y Switches de conexión, que comunicará:

- El PLC con el PC con el SCADA del edificio de Bombeo, y desde estos, y a través de una comunicación vía GPRS, comunicará con el Centro de Control, es decir con la Sede de la CR de Santa Ana.
- El sistema de monitorización de señales de tensión e intensidad de las cadenas de módulos, previsto en las diferentes Cajas de Campo nº 1 (CC1-x), y de los sensores de temperatura e irradiancia, con la Caja de Campo nº 2 (CC2). Desde este, y a través de una comunicación vía Fibra Óptica monomodo 9/125 enterrada bajo tubo, comunicará con el PLC y el PC del Bombeo. Usando convertidores de medios PoE 10/100 Base TX a 100 Base-FX para facilitar las conversiones y mantener una alta calidad en las comunicaciones.

Los Conversores de Medios PoE conectan de forma transparente cobre a fibra, al tiempo que proporcionan Power over Ethernet (PoE) a dispositivos que cumplan las normas PoE y PoE+. Este tipo de conversores permitirán incluso la futura conexión de cámaras IP.

Las características principales del conversor de medios son:

- Fibra 10/100/1000Base-T a 100/1000Base-X
- Alimentación IEEE 802.3 PoE & PoE+ PSE
- Compatible con dispositivos PoE antiguos anteriores a la norma
- Puertos de fibra fijos o ranura vacía para SFP Cisco y otro estándar
- Funciones avanzadas: PD Reset, Fiber redundancy, Smart Link Pass-Through, Fiber Fault Alert, Auto-MDIX y Loopback

#### 9.1.5 SISTEMAS DE MONITORIZACIÓN PREVISTO

El sistema de monitorización, además de todos los parámetros expuestos con anterioridad, proporcionará medidas de las siguientes variables:

- Tensión y corriente CC de las cadenas de módulos y del generador.
- Potencia CC consumida, incluyendo el inversor como carga CC.
- Potencia CA consumida si la hubiere, salvo para instalaciones cuya aplicación es exclusivamente el bombeo de agua.
- Contador volumétrico de agua para instalaciones de bombeo.
- Radiación solar en el plano de los módulos medida con un módulo o una célula de tecnología equivalente.
- Temperatura ambiente en la sombra.
- Estados fusibles strings/cadenas de módulos.

Los datos se presentarán en forma de medias horarias. Los tiempos de adquisición, la precisión de las medidas y el formato de presentación de las mismas se hará conforme al documento del JRC-Ispra "Guidelines for the Assessment of Photovoltaic Plants – Document A", Report EUR 16338 EN.

Se prevé un equipo de gestión y monitorización tipo Carlo Gavazzi o similar para el control de las cadenas de módulos

- Unidad de cuadro telemandable y gestionable desde PLC central.
- Monitorización de energía por cada pareja de string, Carlo Gavazzi o similar.
- Conexión con telecontrol y comunicación y visualización en tiempo real en centro de control CR

#### 9.1.6 SISTEMA DE CONTROL PREVISTO

En el Anejo 14 "Instalaciones eléctricas en Baja Tensión" se detalla la justificación de la configuración del equipo seleccionado.

## 9.2 ANÁLISIS DE PARÁMETROS

Los parámetros que debemos de controlar con la finalidad de analizar el correcto funcionamiento de la instalación son los siguientes:

#### 9.2.1 ENERGÍA SOLAR DIANA RECIBIDA POR EL GENERADOR FOTOVOLTAICO ($E_{solar}$)

Es el producto de la irradiación diaria $H_{\alpha,\beta}$ y el área del generador en $m^2$ y se mide en Wh. La irradiación diaria es energía diaria recibida sobre el plano del generador y se mide en $Wh/m^2$.

$$E_{solar} = H_{\alpha,\beta} x\ A$$

Donde:

- $E_{solar}$: Energía solar diaria recibida por el generador fotovoltaico.
- $H_{\alpha,\beta}$: Irradiación diaria.
- A: Superficie de captación

### 9.2.2 ENERGÍA DIARIA GENERADA EN CONTINUA $E_{DC}$

Es la energía diaria a la entrada del inversor, se mide en Wh o en kWh y la podemos calcular según la siguiente ecuación.

$$E_{DC} = \int P_{DC}\ x\ (dt) = \int I_{DC}\ x\ V_{DC}\ x\ (dt)$$

Donde:

- $E_{DC}$: Energía diaria generada en continua.
- $P_{DC}$: Potencia corriente continua (entrada inversor).
- Dt: Diferencia de tiempo.
- $I_{DC}$: Intensidad corriente continua.
- $V_{DC:}$ Tensión corriente continua.

### 9.2.3 ENERGÍA DIARIA GENERADA EN ALTEMA $E_{AC}$

Es la energía diaria a la salida del inversor, se mide en Wh o en kWh y se calcula la podemos calcular de acuerdo la siguiente ecuación:

$$E_{AC} = \int P_{AC}\ x\ (dt)$$

$$P_{AC} = I_{AC}\ x\ V_{AC}\ x\ cos\varphi$$

Las unidades de la energía $E_{AC}$ se expresa en kVAh.

Donde:

- $E_{AC}$: Energía diaria generada en alterna.
- $P_{AC}$: Potencia corriente alterna (salida inversor).
- dt: Diferencial de tiempo.
- $I_{AC}$: Intensidad corriente alterna.
- $V_{AC}$: Tensión corriente alterna.
- Cos ϕ, Factor de potencia.

### 9.2.4 RENDIMIENTO DEL GENERADOR $\eta_{GEN}$

Es el cociente entre la energía generada en la entrada del inversor y la energía solar recibida en el generador fotovoltaico. Se expresa en (%).

$$\eta_{gen} = \frac{E_{DC}}{E_{solar}} x100$$

Donde:

- $\eta_{gen}$: Rendimiento del generador.
- $E_{AC}$: Energía corriente continua (entrada inversor).
- $E_{solar}$: Energía solar.

### 9.2.5 RENDIMIENTO DEL INVERSOR $\eta_{INV}$

Es el cociente entre la energía a la salida del inversor $E_{AC}$ y su energía a la entrada $E_{DC}$. Se expresa en (%).

$$\eta_{inv} = \frac{E_{AC}}{E_{DC}} x100$$

Donde:

- $\eta_{inv}$: Rendimiento del inversor.
- $E_{AC}$: Energía corriente alterna (salida inversor).
- $E_{DC}$: Energía corriente continua (entrada inversor).

### 9.2.6 RENDIMIENTO DEL SISTEMA $\eta_{SISTEMA}$

Es el cociente entre la energía a la salida del inversor y la energía solar recibida por el sistema, expresado en (%).

$$\eta_{sistema} = \frac{E_{AC}}{E_{solar}} x100$$

Donde:

- $\eta_{sistema}$: Rendimiento del sistema.
- $E_{AC}$: Energía corriente alterna (salida inversor).
- $E_{solar}$: Energía solar.

### 9.2.7 RENDIMIENTO ENERGÉTICO DE LA INSTALACIÓN *PR*

También conocido como Performance Ratio, es el cociente entre la energía diaria generada por el sistema y la que generaría el sistema en condiciones ideales, es decir sin pérdidas expresado (%).

$$PR = \frac{E_{AC}}{E_{ideal}} x100$$

La energía diaria generada por el sistema es la energía generada media a la salida del inversor $E_{AC}$ La energía ideal es el producto de la energía solar recibida por el generador por su rendimiento en condiciones estándar de medida, como podemos ver en la siguiente ecuación:

$$E_{ideal} = E_{solar} x\, \eta_{STC}$$

Donde:

- *PR*: Rendimiento energético de la instalación.
- $E_{AC}$: Energía corriente alterna (salida inversor).
- $E_{ideal}$: Energía ideal.
- $E_{solar}$: Energía solar.
- $\eta_{STC}$: Rendimiento en condiciones estándar de medida.

### 9.2.8 HORAS EQUIVALENTES

Se define como el cociente entre la energía diaria producida y los vatios picos instalados, y por tanto sus unidades son (kWh/kWp).

$$H_{eq} = \frac{E_{AC}}{P_{nPV}}$$

Donde:

- $H_{eq}$: Horas equivalentes.
- $E_{AC}$: Energía corriente alterna (salida inversor).
- $P_{n.PV}$: La potencia nominal del generador fotovoltaico medida en condiciones STC.

Partiendo del $H_{eq}$, podemos llegar a calcular el PR, de acuerdo a la siguiente ecuación:

$$PR(\%) = \frac{H_{eq}}{H_{er,R}} = \frac{H_{eq}}{G_{\beta,\alpha}/1000} x100$$

Donde:

- *PR*: Rendimiento energético de la instalación.
- $H_{eq}$: Horas equivalentes.
- $H_{eq,R}$: horas equivalentes de referencia y se define como el cociente entre la radiación solar incidente en el plano del generador (Gα,β) y la irradiancia en condiciones estándar de medida (1000W/m$^2$).

## 9.3 MANTENIMIENTO INSTALACIONES

Aunque el mantenimiento en las instalaciones conectadas a red es sencillo, es muy recomendable, que las operaciones de mantenimiento lo realicen la empresa instaladora u otra empresa especializada en estos temas.

En los siguientes puntos, vamos a explicar las principales tareas de mantenimiento para este tipo de instalaciones.

### 9.3.1 MANTENIMIENTO DE LAS ESTRUCTURAS DE SOPORTE DE LOS MÓDULOS

Como ya hemos estudiado en las instalaciones solares fotovoltaicas, nos vamos a encontrar dos tipos de soporte; los fijos y los seguidores solares.

Las operaciones a desarrollar las intervenciones de mantenimiento sobre las estructuras fijas son las siguientes:

- Verificar qua toda la tornillería está correctamente apretada.
- Buscas posibles deterioros de la estructura. Hay que verificar que no hay ninguna corrosión sobre la estructura.
- Comprobar que no se mueve el ángulo de inclinación.

Las operaciones a desarrollar en las intervenciones de mantenimiento sobre los seguidores solares son las siguientes:

- Verificar que toda la tornillería está correctamente apretada.
- Lubricar las partes móviles del soporte para evitar fricciones que pueden provocar un malfuncionamiento del sistema.
- Verificar que todos los sensores están bien ajustados, y funcionan correctamente.
- Verificar que los equipos de seguridad como anemómetros, funcionan correctamente.

- Verificar el control del seguidor, comprobar que el autómata o la electrónica funciona correctamente.

### 9.3.2 MANTENIMIENTO DEL GENERADOR FOTOVOLTAICO

Aunque el mantenimiento de los módulos fotovoltaicos es similar a los generadores de las instalaciones aisladas. En las instalaciones conectadas a red, se tiene que conocer la configuración del generador, es decir cuántos módulos hay conectados en serie, y cuantos módulos hay conectados en paralelo. Es importante de contar con esquemas unifilares para conocer dichas configuraciones.

En este tipo de instalaciones, es recomendable desarrollar las siguientes tareas de mantenimiento:

- Proceder a la limpieza periódica de los módulos solares que forman el generador.
- Asegurarse de que no existen roturas en los vidrios de los módulos.
- Comprobar el cableado que llega desde los módulos a la caja de conexión.
- Asegurarse de la estanqueidad de las cajas de conexión.
- Comprobar el cableado de los módulos en el generador, así como las cajas de conexión.
- Verificar el estado mecánico de cables, terminales e interconexiones, presentado especial atención a que el aislamiento de los conductores permanezca intacto y sin síntomas de sobrecalentamientos, no existan terminales oxidados.
- Mediante un voltímetro verificar que no existen caídas de tensión que superen el límite establecido entre extremos de cables.
- Verificar el paso de corriente ayudándose de una pinza amperimétrica.
- Si se dispone de una cámara termográfica, comprobar que no existen puntos calientes.

### 9.3.3 MANTENIMIENTO DEL INVERSOR/VARIADOR

Los pasos que hay que seguir En el mantenimiento de los inversores conectados a red son las siguientes:

- Inspección visual, con el fin de poder detectar posibles anomalías y deterioros en ellas carcasas, elementos de medida y control del equipo.
- Comprobación del conexionado, comprobar e inspeccionar todas las conexiones, guardando las medidas de seguridad al respecto, con el fin de evitar cualquier posible riesgo de accidente eléctrico. Asegurarse de que los cables no están deteriorados por ella acción de roedores, la humedad, etc.
- Limpieza de las casetas donde están alojadas, con el fin de eliminar polvo otros elementos que puedan entorpecer el buen funcionamiento del equipo.
- Comprobación del sistema de refrigeración, si existe en la caseta, o en el propio equipo. Una mala refrigeración puede ocasionar graves deterioros en los equipos.

En las instalaciones conectadas a red, normalmente tienen equipos de monitorización por lo que es importante realizar seguimiento o generar alarmas, con la finalidad de verificar que la instalación funciona correctamente, o detectar el fallo o avería rápidamente.

En el punto de conexión a red, puede ser interesante medir los armónicos de la señal proporcionada por la instalación, en las labores de mantenimiento, con la finalidad de asegurarnos de que la señal que se está inyectando se encuentra dentro de los límites legales.

### 9.3.4 MANTENIMIENTO DE LOS SISTEMAS DE PROTECCIÓN Y MEDIDA

Para una instalación fotovoltaica conectada a red debemos tener en cuenta el mantenimiento de los elementos, de protección y medida. Los pasos a seguir son los siguientes:

- Inspección visual de todo el cableado, comprobando si existen deterioros en los aislantes.
- Comprobación del funcionamiento de los conductores, tanto de consumo como de inyección a red, verificando su correcta conexión.
- Verificación de fusibles, interruptores magnetotérmicos, interruptores diferenciales, etc., en los cuadros de protección de la instalación.
- Asegurarse de que no existen falso contactos, y proceder al reapriete de los bornes de conexión si fuese necesario.
- Comprobar que las lecturas de los contadores se incrementan con el paso del tiempo. Chequear que la producción de energía (kWh) coincide con la acumulada y aproximadamente con la suma de las potencias instantáneas proporcionadas por el inversor.

### 9.3.5 AVERÍAS FRECUENTES EN LAS INSTALACIONES SOLARES FOTOVOLTAICAS

Las instalaciones fotovoltaicas no suelen presentar muchas averías. La mayoría de las veces, las pocas averías que ocurren se deben a defectos producidos en las fases de diseño o instalación de los equipos. Entre las posibles causas de avería tenemos los siguientes:

- Proceso de instalación realizado de forma deficiente; cableado desordenado y sin marcar, falta de elementos de desconexión de la instalación.
- Ausencia e planos, esquemas y manuales de la instalación, así como de las características de los elementos utilizados en la misma.
- Aparatos sin indicadores de funcionamiento, falta de monitorización de la instalación.
- Falta de un registro de las acciones llevada a cabo en el plan de mantenimiento de la instalación, para poder analizar las intervenciones realizadas en la misma.

Es importante detectar y corregir una avería, pero también lo es corregir y detectar las causas de la misma y prevenir su aparición.

A continuación, detallamos algunas de las averías más típicas sobre los elementos de la instalación.

| Elemento | | Avería | Causa | Producida por | Efecto producido |
|---|---|---|---|---|---|
| GENERADOR FOTOVOLTAICO | Módulo solar | Deterioro en la superficie | Caída de un objeto | Golpe sufrido en el montaje de la instalación | Falta de producción de electricidad en el generador |
| | | | Golpe fortuito | Error en la instalación. Mal uso de usuario de la instalación | |
| | | | Vandalismo | Es aconsejable poner sistemas de seguridad (alarma, cámaras de vigilancia) | |
| | Célula solar | Penetración de agua | Rotura de la cubierta del módulo | Fallo montaje del módulo, o golpe sobre el módulo en las operaciones de mantenimiento o montaje | |
| | | Sobrecalentamiento | Sombreado parcial | Fallo en los diodos de paso | |
| | | Potencia disipada excesiva | Inexistencia o fallo de elementos de protección en el generador | Fallo en fusibles y diodos de paso | |
| | Diodos de bypass | Rotura | Caída de rayo o sobre tensión | Ausencia de pararrayos o equipos de protección de sobretensiones | |

| Elemento | Avería | Causa | Producida por | Efecto producido |
|---|---|---|---|---|
| ACUMULADOR | Deterioro de las placas | Sobrecargas excesivas y descarga demasiado profundas | Regulado mal ajustado | Disminución de la capacidad del acumulador y acortamiento de su vida útil |
| | | Sobrecarga excesivas y descarga demasiado profundas | Regulador mal ajustado | |
| | | Nivel de electrolito insuficiente | Falta de mantenimiento preventivo | |
| REGULADOR INVERSOR | Fallo interno | Inversión de la polaridad | Mala colocación de las tomas de corriente para consumo | Corte en el suministro eléctrico |
| | | Sobrecarga o cortocircuito | No existen medidas de protección | |
| INSTALACIÓN ELÉCTRICA | Puesta a tierra defectuosa | Montaje deficiente | Ausencia de la pica de puesta a tierra, mala continuidad de la instalación | Interrupción en el suministro eléctrico<br>Posibilidad de que ocurran accidentes eléctrico |
| | Problemas en las conexiones: corrosión, aflojamiento o cortocircuito | Montaje defectuoso | Mala estanqueidad de las cajas de conexión, fallos en las conexiones. | |
| | Aislante del cableado deteriorado | Montaje o canalizaciones inadecuadas | Elementos protegidos contra la intemperie, acción de roedores | |
| | Sobrecalentamiento del cableado | Dimensionado inadecuado | Cables de sección menor a la que sería necesaria | |

### 9.3.6 TERMOGRAFÍA EN LAS INSTALACIONES SOLARES FOTOVOLTAICAS

Es una de las técnicas más utilizadas en la actualidad en el mantenimiento, tal vez por la eficacia para predecir averías, y diagnosticar los puntos calientes sobre las células solares.

La termografía es una técnica predictiva que se realiza sin contacto físico, siendo esta una de las destacadas ventajas de este método, ya que como hemos indicado, los fallos electromagnéticos generalmente son manifestado por un aumento de intercambio de calor, dichos niveles de calor, podemos medirlos mediante niveles de radiación, que no la ayuda de las cámaras termográficas podemos controlar dentro del espectro infrarrojo, es decir en imágenes visibles, para el ojo humano.

Imagen. Cámaras termográficas.

En la realización de las termografías sobre las instalaciones solares fotovoltaicas, se deben tener en cuenta las siguientes consideraciones:

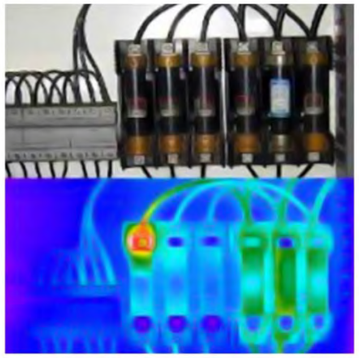
- Un correcto estudio termográfico del generador FV de un sistema tendría como alcance el 100 % de los módulos que ello compone.
- Debe de realizarse con una cámara termográfica calibrada y por un técnico con formación específica.
- El sistema fotovoltaico deberá estar en condiciones normales de operación y con todos los módulos conectados.
- El estudio termográfico se deberá realizar durante un día despejado, con irradiancia superiores a los 700 W/m2
- Es recomendable utilizar las dos hora anteriores y posteriores del mediodía solar.
- Se deben realizar y guardar fotos de todos los módulos que presente zonas con un gradiente de temperatura superior a 7°C. Esta acción permitirá realizar un estudio sobre la evolución del problema si persiste.

Se tendrá que realizar un análisis detallado con el siguiente alcance:

- La temperatura de operación del generador no se encuentre dentro del rango marcado fabricante del módulo fotovoltaico en función de la TONC del mismo (para ello se deberá considerar también la temperatura ambiente y el valor de la irradiancia incidente).
- Exista algún punto o célula caliente en un módulo fotovoltaicas entenderá por punto caliente toda aquella zona en la que exista un gradiente de temperatura mayor de 20 °C.
- Existen roturas o microrroturas, fisuras, zonas inactivas o cualquier otro tipo de daño en alguna célula fotovoltaica.

Aunque se han analizado las tareas de la termografía para los módulos solares fotovoltaicos, es recomendable desarrollar un análisis termográfico de la instalación fotovoltaica permitirá detectar puntos calientes en conexiones de los cuadros de DC y AC, así como en los inversores, y resto de equipos.

Los puntos calientes ocasionados en los cuadros eléctricos de las instalaciones solares fotovoltaicas, normalmente son ocasionados por un incorrecto diseño o una defectuosa ejecución en de la instalación o en su defecto por un incorrecto mantenimiento.



# ANEJO Nº 14.- INSTALACIONES ELÉCTRICAS EN BAJA TENSIÓN

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# ANEJO 14.- INSTALACIONES ELÉCTRICAS BAJA TENSIÓN

## 1 OBJETO DEL PROYECTO

El presente Anejo forma parte del "Proyecto de Modernización del Regadío de la Comunidad de Regantes Santa Ana (Huesca)", y tiene por objeto cumplir los requisitos establecidos en el Pliego de Bases para la Contratación de la Asistencia Técnica objeto del mencionado proyecto.

Las actuaciones planteadas consisten en la definición de las características de la Instalación Eléctrica de Baja Tensión que proveerá de suministro eléctrico a las instalaciones y equipos eléctricos de la proyectada en el TM de Torralba de Aragón (Huesca) y su automatización.

La red eléctrica de baja tensión consistirá en la instalación de la acometida subterránea desde el centro de transformación proyectado (detallado en el anejo de la línea de media tensión), a todos los puntos de consumo del bombeo.

En el presente proyecto se adjuntan los planos de la instalación eléctrica, situación y emplazamiento, esquemas unifilares y la planta de las instalaciones detallando la ubicación de los armarios, tomas de fuerza, puntos de alumbrado, luces de emergencia, extintores y salidas.

En el Apéndice 1 se incluyen los cálculos eléctricos y en el Apéndice 2 la justificación de la automatización definida.

## 2 LEGISLACIÓN APLICABLE

Esta memoria descriptiva, es justificativa ante el Organismo competente de las Medidas y Normas a tener en cuenta al efectuar las instalaciones, en virtud de los siguiente Reglamentos y Normativas:

**GENERALIDADES**

- Real Decreto 842/2002, de 2 de agosto, por el que se aprueba el Reglamento Electrotécnico para Baja Tensión e instrucciones técnicas complementarias (ITC), (B.O.E. de 18-9-2002).
- Normas particulares de la Compañía Suministradora de energía eléctrica. ERZ-Endesa.
- Real Decreto 1955/2000 de 1 de diciembre, por el que se regulan las Actividades de Transporte, Distribución, Comercialización, Suministro y Procedimientos de Autorización de Instalaciones de Energía Eléctrica.
- Reglamento de Instalaciones Térmicas en los Edificios.
- Normas Técnicas para la accesibilidad y la eliminación de barreras arquitectónicas, urbanísticas y en el transporte.
- UNE 20406-5-523 (2004). Instalaciones eléctricas en edificios. Parte 5: selección e instalación de materiales eléctricos. Sección 523: Intensidades máximas admisibles en sistemas de conducción de cables.
- Real Decreto 314/2006, de 17 de marzo, por el que se aprueba el Código Técnico de la Edificación.
- Instrucción de Hormigón Estructural (EHE-08).
- UNE 20460-7-712. Instalaciones eléctricas en edificios. Reglas para las instalaciones y emplazamientos especiales. Sistemas de alimentación solar fotovoltaica (PV)
- UNE-HD 60364-7-712. Instalaciones eléctricas de baja tensión. Reglas para las instalaciones y emplazamientos especiales. Sistemas de alimentación solar fotovoltaica (PV)
- UNE 21302-826:2005 y IEC 60050-826. Vocabulario electrotécnico Internacional (VEI).
- UNE-EN 60439-1:2001 (1999) y A1:2005 (2004). Conjunto de aparamenta de baja tensión. Parte 1: Conjuntos en serie y conjuntos derivados de serie.
- IEC/TR 60755 (1983). Regalas generales para los dispositivos de protección con corriente diferencial residual. Modificación 2 (1992).
- UNE-EN 60904-3:1994 (1993) y IEC 60904-3 (1989). Dispositivos fotovoltaicos. Parte 3: fundamentos de medida de dispositivos solares fotovoltaicos (PV) de uso terrestre con datos de irradiancia espectral de referencia.
- Directivas Europeas de seguridad y compatibilidad electromagnética
- Especificaciones Técnicas para Sistemas de Riego Fotovoltaico editado por MASLOWATEN (MArket uptake of an innovative irrigation Solution based on LOW WATer-ENergy consumption)
- Ley 31/1995, de 8 de noviembre, de Prevención de Riesgos Laborales.
- Real Decreto 1627/1997 de 24 de octubre de 1.997, sobre Disposiciones mínimas de seguridad y salud en las obras.
- Real Decreto 486/1997 de 14 de abril de 1997, sobre Disposiciones mínimas de seguridad y salud en los lugares de trabajo.
- Real Decreto 485/1997 de 14 de abril de 1997, sobre Disposiciones mínimas en materia de señalización de seguridad y salud en el trabajo.

- Real Decreto 1215/1997 de 18 de julio de 1997, sobre Disposiciones mínimas de seguridad y salud para la utilización por los trabajadores de los equipos de trabajo.
- Real Decreto 773/1997 de 30 de mayo de 1997, sobre Disposiciones mínimas de seguridad y salud relativas a la utilización por los trabajadores de equipos de protección individual.
- Real Decreto 1/1/2004 de 30 de enero. Desarrollo del artículo 24 de la ley 31/1995 sobre coordinación de actividades empresariales.

**MERCADO ELÉCTRICO**

- Ley 54/1997, de 27 de noviembre, del Sector Eléctrico.
- Real Decreto 900/2015, de 9 de octubre, por el que se regulan las condiciones administrativas, técnicas y económicas de las modalidades de suministro de energía eléctrica con autoconsumo y de producción con autoconsumo.
- Real Decreto-ley 15/2018, de 5 de octubre, de medidas urgentes para la transición energética y la protección de los consumidores
- Real Decreto 661/2007, de 25 de mayo, por el que se regula la actividad de producción de energía eléctrica en régimen especial.
- Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento Unificado de puntos de medida del sistema eléctrico.
- Real Decreto 1578/2008, de 26 de septiembre, de retribución de la actividad de producción de energía eléctrica mediante tecnología solar fotovoltaica para instalaciones posteriores a la fecha límite de mantenimiento de la retribución del Real Decreto 661/2007, de 25 de mayo, para dicha tecnología.
- Norma UNE-EN 62466: Sistemas fotovoltaicos conectados a red. Requisitos mínimos de documentación, puesta en marcha e inspección de un sistema.
- Resolución de 31 de mayo de 2001 por la que se establecen modelo de contrato tipo y modelo de factura para las instalaciones solares fotovoltaicas conectadas a la red de baja tensión.
- Real Decreto 1663/2000, de 29 de septiembre, sobre conexión de instalaciones fotovoltaicas a la red de baja tensión.
- Real Decreto 1955/2000, de 1 de diciembre, por el que se regulan las actividades de transporte, distribución, comercialización, suministro y procedimientos de autorización de instalaciones de energía eléctrica.
- Real Decreto 1699/2011, de 18 de noviembre, por el que se regula la conexión a red de instalaciones de producción de energía eléctrica de pequeña potencia.
- Orden IET/931/2015, de 20 de mayo, por la que se modifica la Orden ITC/1522/2007, de 24 de mayo, por la que se establece la regulación de la garantía del origen de la electricidad procedente de fuentes de energía renovables y de cogeneración de alta eficiencia.
- Orden ETU/130/2017, de 17 de febrero, por la que se actualizan los parámetros retributivos de las instalaciones tipo aplicables a determinadas instalaciones de producción de energía eléctrica a partir de fuentes de energía renovables, cogeneración y residuos, a efectos de su aplicación al semiperiodo regulatorio que tiene su inicio el 1 de enero de 2017.

**MÓDULOS**

- UNE-EN 61730, armonizada para la Directiva 2006/95/CE, sobre cualificación de la seguridad de módulos fotovoltaicos
- UNE-EN 50380, sobre informaciones de las hojas de datos y de las placas de características para los módulos fotovoltaicos.
- UNE-EN 61215: Módulos fotovoltaicos (FV) de silicio cristalino para uso terrestre. Cualificación del diseño y homologación.
- UNE-EN 61646: Módulos fotovoltaicos (FV) de lámina delgada para aplicaciones terrestres. Cualificación del diseño y aprobación de tipo.
- UNE-EN 62108. Módulos y sistemas fotovoltaicos de concentración (CPV). Cualificación del diseño y homologación.
- Los módulos que se encuentren integrados en la edificación, aparte de que deben cumplir la normativa indicada anteriormente, además deberán cumplir con lo previsto en la Directiva 89/106/CEE del Consejo de 21 de diciembre de 1988 relativa a la aproximación de las disposiciones legales, reglamentarias y administrativas de los Estados miembros sobre los productos de construcción.

**ESTRUCTURA MÓDULOS**

- Si está construida con perfiles de acero laminado conformado en frío, cumplirán las normas UNE-EN 10219-1 y UNE-EN 10219-2 para garantizar todas sus características mecánicas y de composición química.
- Si es del tipo galvanizada en caliente, cumplirá las normas UNE-EN ISO 14713 (partes 1, 2 y 3) y UNE-EN ISO 10684 y los espesores cumplirán con los mínimos exigibles en la norma UNE-EN ISO 1461.
- En el caso de utilizarse seguidores solares, estos incorporarán el marcado CE y cumplirán lo previsto en la Directiva 98/37/CE del Parlamento Europeo y del Consejo, de 22 de junio de 1998, relativa a la aproximación de legislaciones de los Estados miembros sobre máquinas, y su normativa de desarrollo, así como la Directiva 2006/42/CE del Parlamento Europeo y del Consejo, de 17 de mayo de 2006 relativa a las máquinas.

**INVERSORES**

- UNE-EN 62093: Componentes de acumulación, conversión y gestión de energía de sistemas fotovoltaicos. Cualificación del diseño y ensayos ambientales.
- UNE-EN 61683: Sistemas fotovoltaicos. Acondicionadores de potencia. Procedimiento para la medida del rendimiento.
- IEC 62116. Testing procedure of islanding prevention measures for utility interactive photovoltaic inverters.

En general, cuantas Reglamentaciones vigentes afecten a este tipo de Actividad.

## 3 EMPLAZAMIENTO

Las infraestructuras eléctricas proyectadas y documentadas en el presente anejo, se hallan en el T.M. de Torralba de Aragón (Huesca). Para mayor información, consultar el Plano Nº1 "Situación y Emplazamiento".

## 4 POTENCIA CONTRATADA

Dada la potencia necesaria para el suministro eléctrico previsto en la estación de bombeo, se prevé la construcción de un centro de recepción y medida, y un centro de transformación propio de la estación de bombeo, siendo la tensión de suministro normalizada de 15 kV a 50 Hz, propiedad de ERZ-ENDESA S.A.

La entrada al Centro de Seccionamiento y Transformación vendrá dada por la nueva derivación proyectada desde la línea de 15 kV existente. Esta derivación constará de una doble conversión aéreo-subterránea en el mismo apoyo de enganche, un tramo enterrado con doble circuito, hasta las celdas de entrada, salida, entrega del centro de seccionamiento, y un tramo enterrado de salida del centro de seccionamiento hasta las celdas de entrada al centro de transformación.

De modo que, en el apoyo de conexión al CTC Z61084 de la línea LEMT "Torralba" LA 78, se planteará una doble conversión A/S, y una doble línea entre este apoyo y las celdas de entrada y salida del centro de seccionamiento.

En el Centro de seccionamiento, de acceso exclusivo para la compañía en la zona de maniobras, se prevé la instalación de tres celdas de línea (entrada, salida y entrega a usuario), una celda de remonte y una celda de corte y protección por fusibles para el centro de trasformación existente (CTC Z61084), a partir de la cual comienza la instalación del usuario.

A continuación de estas celdas, se instalará una celda de corte y protección automática y una celda de medida. A continuación, se distribuirá en media tensión hasta el edificio en el que se encuentra el transformador, en el cual encontraremos una celda de línea y una celda de protección automática y el transformador de 2.000 kVA.

Las tensiones de alimentación de los receptores, se determinan acordes a su potencia, siendo para esta instalación 400 V para las bombas y 400/230 V para los servicios auxiliares.

La contratación de la acometida se hará en media tensión 15 kV a 50 Hz, y será de 1.600 kW.

## 5 JUSTIFICACIONES

La red eléctrica de baja tensión que da servicio a los diversos receptores del edificio de bombeo previsto en proyecto está constituida por una red trifásica con neutro. La tensión entre fases es de 400V para alimentación de bombas, mientras que el resto de receptores son monofásicos a 230V o trifásicos a 400V.

A la hora de la selección de los conductores se ha realizado una unificación de sus secciones, verificando que los factores de dimensionamiento (intensidad admisible y caída de tensión) cumplen lo establecido en el Reglamento Electrotécnico de Baja Tensión (R.E.B.T). Esto nos aportará en la fase de ejecución de la obra, una mayor agilidad en la realización del pedido de material.

## 6 POTENCIA A INSTALAR

En este proyecto contemplamos una instalación en baja tensión, concretamente la instalación de baja tensión de la estación de bombeo.

La demanda energética por parte de todos los equipos de bombeo es totalmente trifásica a 400V, mientras que el resto de receptores son monofásicos a 230V o trifásicos a 400V.

Se realizará reparto equitativo en cuanto a consumo, a la hora de conectar los receptores monofásicos, tratando de conseguir un reparto de cargas lo más equilibrado posible.

La potencia total instalada corresponde a los siguientes consumos:

CUADRO GENERAL DE MANDO Y PROTECCIÓN

BOMBA 1 ..... 110.000 W
BOMBA 2 ..... 110.000 W
BOMBA 3 ..... 110.000 W
BOMBA 4 ..... 110.000 W
BOMBA 5 ..... 200.000 W
BOMBA 6 ..... 315.000 W
BOMBA 7 ..... 315.000 W
BOMBA 8 ..... 315.000 W
SSAA ..... 37.222 W
**TOTAL ..... 1.622.222 W**

SUBCUADRO DE SERVICIOS AUXILIARES

AL.CUADROS ..... 8 W
BOMB PARED O ..... 470 W
BOMB PARED E ..... 329 W
BOMB CENTRAL ..... 470 W
BOMB SALAS ..... 141 W
AL EXT E ..... 520 W
AL EXT O ..... 520 W
ALMACÉN ..... 188 W
EM E ..... 32 W
EM O ..... 24 W
EXTRACCIÓN E ..... 1.850 W
EXTRACCION O ..... 740 W
EXTRACCIÓN CUADROS ..... 370 W
BASE III E ..... 5.000 W
BASE III O ..... 5.000 W
BASE II E ..... 3.000 W
BASE II O ..... 3.000 W
BASE II CUADROS ..... 3.000 W
RB1 ..... 150 W
RB2 ..... 150 W
RB3 ..... 150 W
RB4 ..... 150 W
RB5 ..... 150 W
RB6 ..... 150 W
RB7 ..... 150 W
RB8 ..... 150 W
P. GRUA ..... 5.000 W
CAUDALIMETRO 1 ..... 150 W
CAUDALIMETRO 2 ..... 150 W
FILTRO W ..... 4.300 W
LINEA AUTOMATISMOS ..... 1.760 W
**TOTAL ..... 37.222 W**

- Potencia Instalada Alumbrado (W): 2.702
- Potencia Instalada Fuerza (W): 1.619.520
- Potencia Máxima Admisible (kVA): 2.000

Todo esto conduce a una potencia instalada de 1.622,22 kW repartida entre los distintos usos como se refleja en el siguiente cuadro:

| USO | POTENCIA |
|---|---|
| Fuerza Bombeo | 34,52 kW |
| Alumbrado Bombeo | 2,70 kW |
| Bombeo | 1.585,00 kW |
| **TOTAL** | **1.622,22 kW** |

En el caso de la instalación de la estación de bombeo, se considera un factor de simultaneidad de 1 para el alumbrado y 0,8 para fuerza, todas las bombas podrán funcionar a la vez, y se añade un 25% de la potencia de la bomba mayor.

Con estas consideraciones, la potencia transportada es la siguiente: 1.377,07 kW. En caso de considerar el 100% de la potencia instalada, 1.622,22 kW.

Tomando un factor de potencia de 0,9 (razonable en estas instalaciones), para la potencia transportada indicada con anterioridad, se obtiene la siguiente potencia aparente: 1.530,07 kVA. En caso del 100% de la potencia, este valor se incrementa hasta los 1.802,47 kVA.

Para ello se dispondrá de un trafo de 2.000 kVA/400 V.

# 7 MATERIALES

## 7.1 NORMAS BÁSICAS

En todos los casos se han tenido en cuenta las especificaciones contenidas en el vigente R.E.B.T.

Como medida primera y primordial todos los elementos metálicos de la instalación que no deban hallarse bajo tensión, estarán conectados a tierra.

Todos los materiales serán de marcas acreditadas y debidamente homologadas, de modo que aseguren su buen funcionamiento dentro de lo marcado por el R.E.B.T. y las prescripciones de la compañía suministradora.

## 7.2 CONDUCTORES

Serán unipolares de Cobre, aislados, para una tensión de aislamiento de 1000 V. Serán de colores diferentes según lo establecido en el reglamento de tal forma que los haga fácilmente identificables.

En previsión de la existencia de cierto grado de humedad ocasionado por alguna fuga, todos los conductores por motivos de seguridad deben de cumplir la designación de RZ1 0'6/1 KV (Tensión soportable) y RV-K 0'6/1KV para la acometida.

## 7.3 CANALIZACIONES

Las cajas de derivación serán de un diámetro mínimo de 80 mm, no ocupando nunca los conductores y piezas de unión de los mismos una superficie superior al 60% en el interior de la caja.

En caso de proximidad de canalizaciones eléctricas con otras no eléctricas, se dispondrán de forma que entre las superficies exteriores de ambas se mantenga una distancia de, por lo menos, 5 cm. En caso de proximidad con conductos de calefacción, de aire caliente, o de humo, las canalizaciones eléctricas se establecerán de forma que no puedan alcanzar una temperatura peligrosa y, por consiguiente, se mantendrán separadas por una distancia conveniente o por medio de pantallas calorífugas.

Las canalizaciones eléctricas no se situarán paralelamente por debajo de otras canalizaciones que puedan dar lugar a condensaciones, tales como las destinadas a conducción de vapor, agua, etc., a menos que se tomen las disposiciones necesarias para proteger las canalizaciones eléctricas contra los efectos de estas condensaciones.

Las canalizaciones eléctricas y las no eléctricas sólo podrán ir dentro de un mismo canal o hueco en la construcción, cuando se cumplan simultáneamente las siguientes condiciones:

a) La protección contra contactos indirectos estará asegurada por alguno de los sistemas señalados en el apartado 4.1.2 en la ITC-BT-24 del R.E.B.T., considerando a las conducciones no eléctricas, cuando sean metálicas, como elementos conductores.
b) Las canalizaciones eléctricas estarán convenientemente protegidas contra los posibles peligros que pueda presentar su proximidad a canalizaciones.

## 7.4 INTERRUPTORES

Se instalarán interruptores de corte omnipolar y deberán soportar las 10.000 maniobras de vida útil.

## 7.5 FUSIBLES

Los fusibles serán en todo caso de tipo calibrado e irán acompañando a todas las tomas de corriente.

## 8 EQUIPOS DE MEDIDA

Debido a que el contrato de suministro está en media tensión no será necesario instalar caja general de protección, ni equipo de medida en baja, ya que la medida se realizará en media tensión (el equipo de medida en media tensión deberá de cumplir las normas de la Compañía).

A modo de verificación de consumos y para el equilibrado de las fases, se prevé la instalación de una central de medida y analizador de redes en baja tensión. Este equipo de medida en baja irá alojado en el armario de protección general de la instalación.

## 9 DESCRIPCIÓN DEL MÓDULO DE PROTECCIÓN Y CONTROLES

En el interior de la estación de bombeo, en la zona en que se refleja en el plano Nº 07.05 "Cuadros Eléctricos", se situará el módulo de protección y control, capaz de albergar los siguientes equipos:

PROTECCIÓN GENERAL

- 1 Interruptor Automático. IV, In= 3.000A, Ireg= 3.000A, P. de C: 50kA.
- Limitador de sobretensión, Up: 1,2 kV, Imáx.= 40 kA, I.A.= 20 A, C, P. de C.= 50 kA.
- 1 Contactor 3.000A, con inductancia y temporizador para el control de la batería de condensadores de vacío del trafo.
- 1 Batería de condensadores automática 100 kVAr
- 1 analizador de redes, 3.000/5 A

4 PROTECCIONES PARA MOTOBOMBA DE 110 kW CON VARIADOR

- 1 Interruptor Automático. III, In= 250A, Ireg= 250A, P. de C: 50kA.
- 1 Relé y transf. Diferencial de sensibilidad 300mA, Clase AC
- 1 Variador de 110kW híbrido fotovoltaico, incluido inductancia de línea. Incluye radiador de alta eficiencia, instalación completa para carga suave de condensadores previa a alimentación por bus continua.

1 PROTECCIÓN PARA MOTOBOMBA DE 200 KW CON VARIADOR

- 1 Interruptor Automático. III, In= 400A, Ireg= 400A, P. de C: 50kA.
- 1 Relé y transf. Diferencial de sensibilidad 300mA, Clase AC
- 1 Variador de 200kW híbrido fotovoltaico, incluido inductancia de línea. Incluye radiador de alta eficiencia, instalación completa para carga suave de condensadores previa a alimentación por bus continua.

3 PROTECCIONES PARA MOTOBOMBA DE 315 kW CON VARIADOR

- 1 Interruptor Automático. III, In= 630A, Ireg= 630A, P. de C: 50kA.
- 1 Relé y transf. Diferencial de sensibilidad 300mA, Clase AC
- 1 Variador de 315kW híbrido fotovoltaico, incluido inductancia de línea. Incluye radiador de alta eficiencia, instalación completa para carga suave de condensadores previa a alimentación por bus continua.

1 PROTECCIÓN GENERAL SERVICIOS AUXILIARES

- 1 Interruptor Automático. III, In= 80A, Ireg= 78A, P. de C: 50kA.
- 1 Relé y transf. Diferencial de sensibilidad 30mA, Clase AC

1 PROTECCIÓN GENERAL ALUMBRADO

- 1 Diferencial IV, 25 A, sensibilidad 30 mA.

1 PROTECCIÓN ALUMBRADO BOMBEO: FASE R

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 25 kA. Curva C

1 PROTECCIÓN ALUMBRADO EXTERIOR: FASE S

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 25 kA. Curva C

1 PROTECCIÓN ALMACÉN

- 1 Diferencial II, 25 A, sensibilidad 30 mA.
- 1 Interruptor Magnetotérmico. II, 10 A, P. de C: 35 kA. Curva C

1 PROTECCIÓN ALUMBRADO DE EMERGENCIA

- 1 Interruptor Magnetotérmico. II, 10 A, P. de C: 35 kA. Curva C
- 1 Diferencial II, 25 A, sensibilidad 30 mA.

1 PROTECCIÓN GENERAL EXTRACCIÓN

- 1 Diferencial IV, 63 A, sensibilidad 300 mA.

3 PROTECCIONES EXTRACCIÓN

- 1 Interruptor Magnetotérmico. III, 16 A, P. de C: 50 kA. Curva C
- 1 Contactor III 16 A.

1 PROTECCIÓN GENERAL BASES III

- 1 Diferencial IV, 40 A, sensibilidad 300 mA.

2 PROTECCIONES BASES III

- 1 Interruptor Magnetotérmico. III, 16 A, P. de C: 35 kA. Curva C

1 PROTECCIÓN GENERAL BASES MONO

- 1 Diferencial IV, 40 A, sensibilidad 300 mA.

3 PROTECCIONES BASES MONO

- 1 Interruptor Magnetotérmico. II, 20 A, P. de C: 25 kA. Curva C

1 PROTECCIÓN GENERAL RESISTENCIA CALDEO

- 1 Interruptor Magnetotérmico. IV, 16 A, P. de C: 50 kA. Curva C
- 1 Diferencial IV, 25 A, sensibilidad 30 mA.

8 PROTECCIONES RESISTENCIA CALDEO

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 25 kA. Curva C
- 1 Contactor III 16 A.

1 PROTECCIÓN PUENTE GRÚA

- 1 Interruptor Magnetotérmico. III, 16 A, P. de C: 50 kA. Curva C
- 1 Diferencial IV, 25 A, sensibilidad 300 mA.

2 PROTECCIONES CAUDALÍMETROS

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 35 kA. Curva C
- 1 Diferencial II, 25 A, sensibilidad 30 mA.

1 PROTECCIÓN FILTRO W

- 1 Interruptor Magnetotérmico. IV, 16 A, P. de C: 50 kA. Curva C
- 1 Diferencial IV, 25 A, sensibilidad 300 mA.

1 PROTECCIÓN PARA LINEA AUTOMATISMOS

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 35 kA. Curva C
- 1 Diferencial II, 25 A, sensibilidad 30 mA.
- 1 SAI Interactivo 2,2 kVA

1 PROTECCIÓN PARA AUTOMATISMOS

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 10 kA. Curva C

1 PROTECCIÓN PARA FA 24VCC

- 1 Interruptor Magnetotérmico. II, 16 A, P. de C: 10 kA. Curva C

## 10 DESCRIPCIÓN DE LA INSTALACIÓN DE ALUMBRADO

El alumbrado en las Estaciones de Bombeo va a contar de luminarias Led estancas de 47 W instalados en la sala de bombeo, y focos Led de 104 W instaladas en el exterior.

La alimentación de las luminarias led se hará a 230V, tensión que obtendremos entre Fase y Neutro. Las luminarias de led cumplen el grado de protección IP65.

En el plano "Instalaciones", se detallan los puntos de iluminación de las estaciones de bombeo.

Los conductores a emplear se detallan en los esquemas unifilares. El nivel de aislamiento del conductor deberá tener la designación RV-K 0'6/1KV, ya que se prevé la existencia de humedad.

## 11 DESCRIPCIÓN DE LA INSTALACIÓN ELÉCTRICA CANALIZADA INTERIOR

Se prevé que los conductores que dan suministro a las bombas vayan alojados bajo tubo corrugado de PVC. En la zona de cuadros irán por zócalo de hormigón y una atarjea entre los cuadros, y al salir de ésta irán bajo tubo trazado bajo la solera de la sala de bombeo. Al salir del tubo para dar conexión a cada motor de las bombas se coloca una bandeja metálica, instalada en apoyos por encima del nivel de la solera, con tapa, y con un cajón de chapa galvanizada de 3 mm de espesor, en forma de prisma rectangular hueco de 0,20x0,20 m y 1,5 m de altura, con sellado con material plástico o caucho entre la base y el suelo, y racor de acero con tubo galvanizado en curvatura, en la parte superior hasta conexión.

Los conductores que dan suministro al resto de los receptores de fuerza de la estación de bombeo irán canalizados en bandejas no perforadas de PVC con tapa, sobre solera. A los receptores que se encuentren a una distancia de esta, se dará suministro desde la bandeja mediante bandeja metálica tipo Rejiban con tapa de PVC y tubo de PVC.

Los conductores que den suministro a los Extractores, Bases Trifásicas y Alumbrado, irán canalizados por bandeja no perforada de PVC con tapa fijada a la pared a una altura de unos 3,5m sobre el suelo.

Los conductores que dan suministro al resto de los receptores de la estación de bombeo irán protegidos con un tubo rígido de PVC, colocados superficialmente mediante abrazaderas.

## 12 DESCRIPCIÓN DE LA INSTALACIÓN CANALIZADA EXTERIOR

Los conductores destinados para dar servicio a los receptores exteriores irán canalizados interiormente, siendo su interconexión a través de la fachada, previa colocación de un tubo de PVC de dimensiones apropiadas, según marca el Reglamento Electrotécnico de Baja Tensión.

## 13 DESCRIPCIÓN DE LA INSTALACIÓN DE ACOMETIDA

La acometida estará formada por 12 líneas de 3x240/120 $mm^2$ Al enterradas bajo tubo de D= 225 mm, a un mínimo de 0,60 m de la superficie hasta la parte inferior del cable, que reposarán sobre un lecho de arena de río lavada de 5 cm de espesor mínimo, serán recubiertos los cables por arena hasta 10 cm de su parte superior. Ambas capas cubrirán la anchura total de la zanja, la cual será suficiente para mantener 0,05 m entre los tubos y las paredes laterales. Por encima de la arena todos los cables tendrán una protección mecánica de PVC a un mínimo de 0,25 m desde la parte superior del tubo y 0,10 m de la superficie del terreno, que además servirá de señalización. El resto del relleno podrá ser de material procedente de la propia excavación o de zahorras compactadas. Se instalará un tubo de reserva y un tubo para señales de trafo.

## 14 DESCRIPCIÓN DE LAS PUESTAS A TIERRA

Las puestas a tierra se establecerán con objeto de limitar la tensión que con respecto a tierra pueden presentar en un momento dado las masas metálicas y así asegurar la actuación de las protecciones y eliminar o disminuir el riesgo que supone una avería en el material utilizado.

Emplearemos un mínimo de 4 picas en hilera, unidas entre sí por un conductor de cobre desnudo de 50 $mm^2$ de sección. Las dimensiones de las picas serán 14 mm de diámetro y longitud no inferior a 2 metros. La profundidad mínima a la que deberá alojarse el electrodo es de 0,50 metros. Deberemos seguir añadiendo tantas picas sean necesarias hasta garantizar que cualquier masa no pueda dar lugar a tensiones de contacto superiores a 24V. Estas mediciones se deberán realizar a continuación de la caja de seccionamiento.

La toma de tierra será la mínima que el terreno permita, pero no superando los 14 ohmios, y si fuera necesario se irán colocando más picas hasta conseguir los ohmios indicados.

Todas las partes metálicas de la instalación estarán conectadas a tierra, la sección del conductor de tierra dependerá de la sección del conductor que protege, tal y como indica la tabla 2 de la ITC BT -18.

Para la instalación de toma de tierra se tendrán en cuenta las fórmulas dadas por la tabla 5, de la ITC-BT-18 y en lo que a picas verticales se refiere son las siguientes:

$$R = \rho/L$$

Siendo:

- R: Resistencia de la toma de tierra
- $\rho$: Resistencia del terreno
- L: Longitud de la pica

## 15 ALUMBRADO DE EMERGENCIA Y SEÑALIZACIÓN

Con objeto de conseguir una fácil y segura evacuación del personal, en la estación de bombeo, en caso de fallo en el suministro habitual de alumbrado, se ha dispuesto de un sistema de iluminación autónoma capaz de abastecer, al menos durante una hora una intensidad luminosa de 1 lux que se deberán encender cuando exista un fallo en el suministro energético (ITC-BT-28).

A tal efecto, se situarán los diferentes elementos de emergencia indicados en los Planos adjuntos, compuestos cada uno de ellos por una batería recargable de níquel-cadmio.

Se ha distribuido de tal forma, que en todo momento señalicen de una manera permanente, las puertas del local y la ubicación de los extintores.

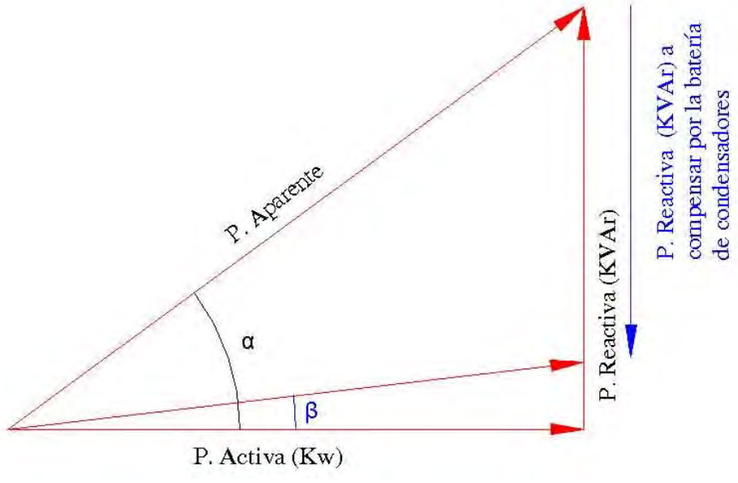
Las lámparas de emergencia a instalar son tipo fluorescente de 8W, batería estanca a baja temperatura (IP-4. IK04) y cada lámpara cubrirá una superficie de 59,20 $m^2$ (según normativa UNE 20-392-93, EN 60 598-2-22).

La salida quedará reflejada de forma serigrafiada junto a las luces de emergencias instaladas.

## 16 COMPENSACIÓN DE ENERGÍA REACTIVA

En la estación de bombeo, con el fin de obtener una compensación de energía reactiva y obtener una bonificación de la compañía suministradora, se instalarán equipos de compensación de energía reactiva.

La compensación se realizará mediante batería automática. Se estima que factor de potencia de cada motor es 0,86, tratando de mejorarlo incrementándolo hasta valores comprendidos entre 0,98 y 1.




En el caso de las bombas no se prevé la instalación de una batería de condensadores ya que el variador compensa la energía reactiva que genere el motor de la motobomba.

En el caso de los trafos la compensación de reactiva vendrá dada para su funcionamiento en vacío, siendo de 100 kVAr/400V.

Las características de los equipos son:

- Contactor
- Inductancia
- Temporizador en el caso de la compensación de vacío de los trafo
- Regulador digital
- Ventilación forzada por ventilador y termostato.
- Alojado todo ello en armario
- Grado de protección: IP30.
- Protección contra contactos indirectos.

Todos estos valores son de tipo orientativo ya que a la hora de realizar los cálculos se ha empleado un factor de potencia teórico ($\cos\varphi$= 0,9). La elección de los condensadores fijos para realizar la compensación de energía reactiva, se realizará una vez este montada la instalación, verificándose posteriormente a la instalación del equipo rectificador de energía reactiva, que la compensación realizada es la deseada (factor de potencia deseado 0,98).

## 17 DESCRIPCIÓN DE LA VENTILACIÓN Y CLIMATIZACIÓN

La elección de los equipos de la instalación de ventilación se ha realizado basándose en los criterios establecidos por la norma DIN1946. Según esta norma se ha considerado a la estación de bombeo como una sala de máquinas en donde la renovación de aire recomendada está establecida entre 10 y 40 veces.

Se instalarán dos equipos extractores en los lugares indicados en el plano Nº 07.05, cuyas características son:

| Nº Ventiladores | Caudal Máximo ($m^3/h$) | Voltaje (V) | Consumo Eléctrico (W) | Volumen Edificio ($m^3$) | Renovación (Nº/h) |
|---|---|---|---|---|---|
| 8 Unidades | 6.300 | 400 (Trifásica) | 370 | 4.611 | 10,93 |

La distribución de las NUEVE unidades se refleja en el plano correspondiente.

<u>Rejillas de ventilación</u>

Para favorecer la entrada de aire y poder generar una corriente de renovación adecuada se dispondrán de rejillas de ventilación en las fachadas de los edificios.

<u>Accesorios de los ventiladores</u>

Los accesorios que llevarán los ventiladores son los siguientes:

- Base soporte HCT para cubiertas inclinadas.
- Base atenuadora acústica: los ventiladores instalados son de gran capacidad, lo que conlleva a que generan un elevado nivel de presión sonora, por lo que se añade este accesorio.

<u>Motores Sala de Bombeo:</u>

- Velocidad: 900 (rev/min)
- Potencia absorbida: 370 W
- Caudal máximo: 6.300 $m^3/h$
- Nivel sonoro: 69 dB

Ventilador:

- Marco soporte en chapa de acero.
- Soporte motor con rejilla de protección contra contactos, según normas UNE 100250.
- Hélice en poliamida 6 reforzada con fibra de vidrio.
- Acabado anticorrosión en resina de poliéster polimerizada a 190ºC, previo desengrase, fosfatación y pasivado.

Motor:

- Motores asíncronos con rotor de jaula de ardilla.
- Tensión motor: 380 - 415 V 50 Hz.
- Aislamiento clase F y protección IP-65.

Protección térmica:

- Protección térmica para proteger el motor contra sobrecalentamientos producidos por cualquier anomalía.

## 18 CÁLCULOS ELÉCTRICOS

Los cálculos efectuados para el dimensionamiento de las instalaciones proyectadas se encuentran recogidos en el apéndice 1 presente Anejo.

## 19 AUTOMATIZACIÓN

En el apéndice 2 se incluye la definición detallada de los equipos a automatizar y las señales a integrar en el autómata y el SCADA. Del mismo modo en los planos de instalaciones eléctricas de detalla el recorrido del cableado y la disposición de los equipos y cuadros.

## 20 MEDIDAS PREVENTIVAS EN MATERIA DE SEGURIDAD Y SALUD

Los riesgos para la salud de los trabajadores durante la fase de ejecución de las obras objeto del presente Anejo, así como la posterior valoración presupuestaria de las correspondientes medidas preventivas, han sido incluidos en un estudio independiente en el Proyecto de Modernización Integral del Regadío de la C.R. de Santa Ana, TT.MM. de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta (Huesca)".

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# APÉNDICE 1. CÁLCULOS ELÉCTRICOS

## 1 FORMULAS

### 1.1 FORMULAS GENERALES

Emplearemos las siguientes:

Sistema trifásico

$$I = \frac{Pc}{\sqrt{3} \times U \times Cos\varphi}$$

$$e = \frac{P \times L}{k \times S \times U \times n}$$

Sistema monofásico

$$I = \frac{Pc}{U \times Cos\varphi}$$

$$e = \frac{2 \times P \times L}{k \times S \times U \times n}$$

En donde:

- Pc = Potencia de cálculo (W).
- L = Longitud de cálculo en (m).
- e = Caída de tensión en (V).
- K = Conductividad.
- I = Intensidad en (A).
- U = Tensión de servicio, trifásica ó monofásica, (V).
- S = Sección del conductor en (mm2).
- Cos $\varphi$ = Coseno de fi, factor de potencia.
- n = Nº de conductores por fase.

### 1.2 FORMULA CONDUCTIVIDAD ELÉCTRICA

$$k = \frac{1}{\rho}$$

$$\rho = \rho_{20}\left[1 + \alpha\left(T - 20\right)\right]$$

$$T = T_0 + \left[\left(T_{\max} - T_0\right)\left(\frac{I}{I_{\max}}\right)^2\right]$$

Siendo:

- K = Conductividad del conductor a la temperatura T.
- $\rho$ = Resistividad del conductor a la temperatura T.
- $\rho$20 = Resistividad del conductor a 20ºC.
  - Cu = 0,018
  - Al = 0,029
- $\alpha$ = Coeficiente de temperatura:
  - Cu = 0,00392
  - Al = 0,00403
- T = Temperatura del conductor (ºC).
- T0 = Temperatura ambiente, condiciones normales (ºC):
  - Cables enterrados = 25ºC (ITC-BT-07 3.1.2.1.)
  - Cables al aire = 40ºC (ITC-BT-06 4.2.1.)
- Tmax = Temperatura máxima admisible del conductor (ºC): (ITC-BT-07 Tabla 2)
  - XLPE, EPR = 90ºC
  - PVC = 70ºC
- I = Intensidad prevista por el conductor (A).
- Imax = Intensidad máxima admisible del conductor (A).

## 1.3 FÓRMULAS SOBRECARGAS

$$Ib \leq In \leq Iz$$

$$I2 \leq 1{,}45\ Iz$$

Donde:

- Ib: intensidad utilizada en el circuito.
- Iz: intensidad admisible de la canalización según la norma UNE 20-460/5-523.
- In: intensidad nominal del dispositivo de protección. Para los dispositivos de protección regulables, In es la intensidad de regulación escogida.
- I2: intensidad que asegura efectivamente el funcionamiento del dispositivo de protección. En la práctica I2 se toma igual:
  - a la intensidad de funcionamiento en el tiempo convencional, para los interruptores automáticos (1,45 In como máximo).
  - a la intensidad de fusión en el tiempo convencional, para los fusibles (1,6 In).

## 1.4 FÓRMULAS COMPENSACIÓN ENERGÍA REACTIVA

$$\cos\varphi = \frac{P}{\sqrt{P^2 + Q^2}}$$

$$tg\varphi = \frac{Q}{P}$$

$$Q_c = P \times \left(tg\varphi_1 - tg\varphi_2\right)$$

$$C = \frac{Q_c \times 1000}{U^2 \times \omega}$$ (Monofásico – Trifásico conexión estrella)

$$C = \frac{Q_c \times 1000}{3 \times U^2 \times \omega}$$ (Trifásico conexión triángulo)

Siendo:

- P = Potencia activa instalación (kW).
- Q = Potencia reactiva instalación (kVAr).
- Qc = Potencia reactiva a compensar (kVAr).
- $\varphi 1$ = Angulo de desfase de la instalación sin compensar.
- $\varphi 2$ = Angulo de desfase que se quiere conseguir.
- U = Tensión compuesta (V).
- $\omega = 2x\pi xf$ ; f = 50 Hz.
- C = Capacidad condensadores (F)

## 1.5 FÓRMULAS CORTOCIRCUITO

$$IpccI = Ct\ U / \sqrt{3}\ Zt$$

Siendo:

- IpccI: intensidad permanente de c.c. en inicio de línea en kA.
- Ct: Coeficiente de tensión.
- U: Tensión trifásica en V.
- Zt: Impedancia total en mohm, aguas arriba del punto de c.c. (sin incluir la línea o circuito en estudio).

$$IpccF = Ct\ UF / 2\ Zt$$

Siendo:

- IpccF: Intensidad permanente de c.c. en fin de línea en kA.
- Ct: Coeficiente de tensión.
- UF: Tensión monofásica en V.
- Zt: Impedancia total en mohm, incluyendo la propia de la línea o circuito (por tanto es igual a la impedancia en origen más la propia del conductor o línea).

La impedancia total hasta el punto de cortocircuito será:

$$Zt = (Rt^2 + Xt^2)^{1/2}$$

Siendo:

- Rt: R1 + R2 + .....+ Rn (suma de las resistencias de las líneas aguas arriba hasta el punto de c.c.)
- Xt: X1 + X2 + ..... + Xn (suma de las reactancias de las líneas aguas arriba hasta el punto de c.c.)
- R = L · 1000 · CR / K · S · n (mohm)
- X = Xu · L / n (mohm)
- R: Resistencia de la línea en mohm.
- X: Reactancia de la línea en mohm.
- L: Longitud de la línea en m.
- CR: Coeficiente de resistividad.
- K: Conductividad del metal.
- S: Sección de la línea en mm².
- Xu: Reactancia de la línea, en mohm por metro.
- n: nº de conductores por fase.

$$tmcicc = Cc \cdot S^2 / IpccF^2$$

Siendo:

- tmcicc: Tiempo máximo en sg que un conductor soporta una Ipcc.
- Cc= Constante que depende de la naturaleza del conductor y de su aislamiento.
- S: Sección de la línea en mm².
- IpccF: Intensidad permanente de c.c. en fin de línea en A.

$$tficc = cte.\ fusible / IpccF^2$$

Siendo:

- tficc: tiempo de fusión de un fusible para una determinada intensidad de cortocircuito.
- IpccF: Intensidad permanente de c.c. en fin de línea en A.

$$Lmax = 0{,}8\ UF / \quad 2 \cdot IF5 \cdot \sqrt{(1{,}5 / K \cdot S \cdot n)^2 + (Xu / n \cdot 1000)^2}$$

Siendo:

- Lmax: Longitud máxima de conductor protegido a c.c. (m) (para protección por fusibles)
- UF: Tensión de fase (V)
- K: Conductividad
- S: Sección del conductor (mm²)
- Xu: Reactancia por unidad de longitud (mohm/m). En conductores aislados suele ser 0,1.
- n: nº de conductores por fase
- Ct= 0,8: Es el coeficiente de tensión.
- CR = 1,5: Es el coeficiente de resistencia.
- IF5 = Intensidad de fusión en amperios de fusibles en 5 sg.

Curvas válidas. (Para protección de Interruptores automáticos dotados de Relé electromagnético).

CURVA B ..... IMAG = 5 In

CURVA C ..... IMAG = 10 In

CURVA D Y MA..... IMAG = 20 In

## 1.6 FÓRMULAS EMBARRADOS

Cálculo electrodinámico

$$\sigma max = Ipcc^2 \cdot L^2 / (60 \cdot d \cdot Wy \cdot n)$$

Siendo:

- σmax: Tensión máxima en las pletinas (kg/cm²)
- Ipcc: Intensidad permanente de c.c. (kA)
- L: Separación entre apoyos (cm)
- d: Separación entre pletinas (cm)
- n: nº de pletinas por fase
- Wy: Módulo resistente por pletina eje y-y (cm³)
- σadm: Tensión admisible material (kg/cm²)

Comprobación por solicitación térmica en cortocircuito

$$Icccs = Kc \cdot S / (1000 \cdot \sqrt{tcc})$$

Siendo:

- Ipcc: Intensidad permanente de c.c. (kA)
- Icccs: Intensidad de c.c. soportada por el conductor durante el tiempo de duración del c.c. (kA)
- S: Sección total de las pletinas (mm²)
- tcc: Tiempo de duración del cortocircuito (s)
- Kc: Constante del conductor: Cu = 164, Al = 107

### 1.7 FÓRMULAS RESISTENCIA TIERRA

Placa enterrada

$$Rt = 0,8 \cdot r / P$$

Siendo:

- Rt: Resistencia de tierra (Ohm)
- r: Resistividad del terreno (Ohm·m)
- P: Perímetro de la placa (m)

Pica vertical

$$Rt = r / L$$

Siendo:

- Rt: Resistencia de tierra (Ohm)
- r: Resistividad del terreno (Ohm·m)
- L: Longitud de la pica (m)

Conductor enterrado horizontalmente

$$Rt = 2 \cdot r / L$$

Siendo:

- Rt: Resistencia de tierra (Ohm)
- r: Resistividad del terreno (Ohm·m)
- L: Longitud del conductor (m)

Asociación en paralelo de varios electrodos

$$Rt = 1 / (Lc/2r + Lp/r + P/0,8r)$$

Siendo:

- Rt: Resistencia de tierra (Ohm)
- r: Resistividad del terreno (Ohm·m)
- Lc: Longitud total del conductor (m)
- Lp: Longitud total de las picas (m)
- P: Perímetro de las placas (m)

## 2 DEMANDA DE POTENCIAS

En este proyecto contemplamos una instalación en baja tensión, concretamente la instalación de baja tensión de la estación de bombeo.

La demanda energética por parte de todos los equipos de bombeo es totalmente trifásica a 400V, mientras que el resto de receptores son monofásicos a 230V o trifásicos a 400V.

Se realizará reparto equitativo en cuanto a consumo, a la hora de conectar los receptores monofásicos, tratando de conseguir un reparto de cargas lo más equilibrado posible.

La potencia total instalada corresponde a los siguientes consumos:

CUADRO GENERAL DE MANDO Y PROTECCIÓN

| | |
|---|---|
| BOMBA 1 | 110.000 W |
| BOMBA 2 | 110.000 W |
| BOMBA 3 | 110.000 W |
| BOMBA 4 | 110.000 W |
| BOMBA 5 | 200.000 W |
| BOMBA 6 | 315.000 W |
| BOMBA 7 | 315.000 W |
| BOMBA 8 | 315.000 W |
| SSAA | 37.222 W |
| **TOTAL** | **1.622.222 W** |

SUBCUADRO DE SERVICIOS AUXILIARES

AL.CUADROS ..... 8 W
BOMB PARED O ..... 470 W
BOMB PARED E ..... 329 W
BOMB CENTRAL ..... 470 W
BOMB SALAS ..... 141 W
AL EXT E ..... 520 W
AL EXT O ..... 520 W
ALMACÉN ..... 188 W
EM E ..... 32 W
EM O ..... 24 W
EXTRACCIÓN E .....1.850 W
EXTRACCION O ..... 740 W
EXTRACCIÓN CUADROS ..... 370 W
BASE III E .....5.000 W
BASE III O .....5.000 W
BASE II E.....3.000 W
BASE II O .....3.000 W
BASE II CUADROS.....3.000 W
RB1 ..... 150 W
RB2 ..... 150 W
RB3 ..... 150 W
RB4 ..... 150 W
RB5 ..... 150 W
RB6 ..... 150 W
RB7 ..... 150 W
RB8 ..... 150 W
P. GRUA .....5.000 W
CAUDALIMETRO 1 ..... 150 W
CAUDALIMETRO 2 ..... 150 W
FILTRO W.....4.300 W
LINEA AUTOMATISMOS.....1.760 W
**TOTAL.....37.222 W**

- Potencia Instalada Alumbrado (W): 2.702
- Potencia Instalada Fuerza (W): 1.619.520
- Potencia Máxima Admisible (kVA): 2.000

Todo esto conduce a una potencia instalada de 1.622,22 kW repartida entre los distintos usos como se refleja en el siguiente cuadro:

| USO | POTENCIA |
|---|---|
| Fuerza Bombeo | 34,52 kW |
| Alumbrado Bombeo | 2,70 kW |
| Bombeo | 1.585,00 kW |
| **TOTAL** | **1.622,22 kW** |

En el caso de la instalación de la estación de bombeo, se considera un factor de simultaneidad de 1 para el alumbrado y 0,8 para fuerza, todas las bombas podrán funcionar a la vez, y se añade un 25% de la potencia de la bomba mayor.

Con estas consideraciones, la potencia transportada es la siguiente: 1.377,07 kW. En caso de considerar el 100% de la potencia instalada, 1.622,22 kW.

Tomando un factor de potencia de 0,9 (razonable en estas instalaciones), para la potencia transportada indicada con anterioridad, se obtiene la siguiente potencia aparente: 1.530,07 kVA. En caso del 100% de la potencia, este valor se incrementa hasta los 1.802,47 kVA.

Para ello se dispondrá de un trafo de 2.000 kVA/400 V.

## 3 CÁLCULOS ELÉCTRICOS

Para los cálculos eléctricos se tomarán como base las condiciones más desfavorables, las cuales provocarán mayores caídas de tensión, obviándose el resto de los cálculos por entender que si cumplen unas, las demás también se ajustan a los criterios de funcionalidad establecidos.

De acuerdo con la ITC-BT-19 del R.E.B.T., en su apartado 2.2.2., la sección de los conductores a utilizar se determinará de forma que la caída de tensión entre el origen de la instalación y cualquier punto de utilización, sea menor del 4,5% de la tensión nominal en el origen de la instalación para alumbrado (siendo 1,5% la caída de tensión permitida por la acometida y un 3% la de la instalación interior), y del 6,5% para los demás usos (siendo 1,5% la caída de tensión permitida por la acometida y un 5% la de la instalación interior). Esta caída de tensión se calculará considerando alimentados todos los aparatos de utilización susceptibles de funcionar simultáneamente.

### 3.1 CÁLCULO DE LA LÍNEA: TRAFO

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 20 m; Cos φ: 0.8; Xu(mΩ/m): 0.1;
- Potencia aparente trafo: 2000 kVA.
- Indice carga c: 0.96.

I= Ct x St x 1000 / (1.732 x U) = 1x2000x1000/(1,732x400) =2886.84 A.

Se eligen conductores Unipolares 12(3x240/120) mm²Al

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-Al Eca

I.ad. a 25°C (Fc=1) 3132 A. según ITC-BT-19

Diámetro exterior tubo: 12(225) mm.

- Caída de tensión:

  Temperatura cable (ºC): 80.22

  e(parcial)=(20x1600000.02/28.47x400x12x240)+(20x1600000.02x0.1x0.6/1000x400x12x0.8) =1.48 V.=0.37 %

  e(total)=0.37% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tet. In.: 3000 A. Térmico reg. Int.Reg.: 3000 A.

### 3.2 CÁLCULO DE LA LÍNEA: VARIADOR B1

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 6 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 110 kW.
- Potencia aparente red: 133 kVA.

I= Sv x 1000 / (1.732 x U) = 133x1000/(1,732x00) =191.97 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 455 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 48.9

  e(parcial)=6x133000/52.09x400x240=0.16 V.=0.04 %

  e(total)=0.41% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 250 A. Térmico reg. Int.Reg.: 250 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.3 CÁLCULO DE LA LÍNEA: BOMBA 1

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 26.5 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 110000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 110000x1.25=137500 W.

I=137500/1,732x400x0.85x1=233.49 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.7) 235.2 A. según ITC-BT-19

Diámetro exterior tubo: 225 mm.

- Caída de tensión:

  Temperatura cable (ºC): 89.06

  e(parcial)=26.5x137500/45.62x400x240x1=0.83 V.=0.21 %

  e(total)=0.62% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.4 CÁLCULO DE LA LÍNEA: VARIADOR B2

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 9 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 110 kW.
- Potencia aparente red: 133 kVA.

I= Sv x 1000 / (1.732 x U) = 133x1000/(1,732x00)=191.97 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 455 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 48.9

  e(parcial)=9x133000/52.09x400x240=0.24 V.=0.06 %

  e(total)=0.43% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 250 A. Térmico reg. Int.Reg.: 250 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.5 CÁLCULO DE LA LÍNEA: BOMBA 2

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 29.5 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 110000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 110000x1.25=137500 W.

I=137500/1,732x400x0.85x1=233.49 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.7) 235.2 A. según ITC-BT-19

Diámetro exterior tubo: 225 mm.

- Caída de tensión:

  Temperatura cable (ºC): 89.06

  e(parcial)=29.5x137500/45.62x400x240x1=0.93 V.=0.23 %

  e(total)=0.66% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.6 CÁLCULO DE LA LÍNEA: VARIADOR B3

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 10 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 110 kW.
- Potencia aparente red: 133 kVA.

I= Sv x 1000 / (1.732 x U) = 133x1000/(1,732x00)=191.97 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 455 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 48.9

  e(parcial)=10x133000/52.09x400x240=0.27 V.=0.07 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 250 A. Térmico reg. Int.Reg.: 250 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.7 CÁLCULO DE LA LÍNEA: BOMBA 3

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 32 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 110000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 110000x1.25=137500 W.

I=137500/1,732x400x0.85x1=233.49 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.7) 235.2 A. según ITC-BT-19

Diámetro exterior tubo: 225 mm.

- Caída de tensión:

  Temperatura cable (ºC): 89.06

  e(parcial)=32x137500/45.62x400x240x1=1 V.=0.25 %

  e(total)=0.69% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.8 CÁLCULO DE LA LÍNEA: VARIADOR B4

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 10 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 110 kW.
- Potencia aparente red: 133 kVA.

I= Sv x 1000 / (1.732 x U) = 133x1000/(1,732x00)=191.97 A.

Se eligen conductores Unipolares 3x240+TTx120mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 455 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 48.9

  e(parcial)=10x133000/52.09x400x240=0.27 V.=0.07 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 250 A. Térmico reg. Int.Reg.: 250 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.9 CÁLCULO DE LA LÍNEA: BOMBA 4

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 17.5 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 110000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 110000x1.25=137500 W.

I=137500/1,732x400x0.85x1=233.49 A.

Se eligen conductores Unipolares 2(3x95+TTx50)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 242.4 A. según ITC-BT-19

Diámetro exterior tubo: 2(140) mm.

- Caída de tensión:

  Temperatura cable (ºC): 85.31

  e(parcial)=17.5x137500/46.16x400x2x95x1=0.69 V.=0.17 %

  e(total)=0.61% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.10 CÁLCULO DE LA LÍNEA: VARIADOR B5

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 10 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 200 kW.
- Potencia aparente red: 235 kVA.

I= Sv x 1000 / (1.732 x U) = 235x1000/(1,732x00)=339.2 A.

Se eligen conductores Unipolares 2(3x240+TTx120)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 910 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 46.95

  e(parcial)=10x235000/52.45x400x2x240=0.23 V.=0.06 %

  e(total)=0.43% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 400 A. Térmico reg. Int.Reg.: 400 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.11 CÁLCULO DE LA LÍNEA: BOMBA 5

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 23 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 200000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 200000x1.25=250000 W.

I=250000/1,732x400x0.85x1=424.53 A.

Se eligen conductores Unipolares 3(3x150+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 468 A. según ITC-BT-19

Diámetro exterior tubo: 3(180) mm.

- Caída de tensión:

  Temperatura cable (ºC): 78.49

  e(parcial)=23x250000/47.16x400x3x150x1=0.68 V.=0.17 %

  e(total)=0.6% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.12 CÁLCULO DE LA LÍNEA: VARIADOR B6

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 10 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 315 kW.
- Potencia aparente red: 365.3 kVA.

I= Sv x 1000 / (1.732 x U) = 365.3x1000/(1,732x00)=527.28 A.

Se eligen conductores Unipolares 4(3x185+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 1540 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 45.86

  e(parcial)=10x365299.99/52.65x400x4x185=0.23 V.=0.06 %

  e(total)=0.43% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 630 A. Térmico reg. Int.Reg.: 630 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.13 CÁLCULO DE LA LÍNEA: BOMBA 6

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 30.5 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 315000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 315000x1.25=393750 W.

I=393750/1,732x400x0.85x1=668.64 A.

Se eligen conductores Unipolares 4(3x185+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 698.4 A. según ITC-BT-19

Diámetro exterior tubo: 4(180) mm.

- Caída de tensión:

  Temperatura cable (ºC): 84.58

  e(parcial)=30.5x393750/46.26x400x4x185x1=0.88 V.=0.22 %

  e(total)=0.65% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.14 CÁLCULO DE LA LÍNEA: VARIADOR B7

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 10 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 315 kW.
- Potencia aparente red: 365.3 kVA.

I= Sv x 1000 / (1.732 x U) = 365.3x1000/(1,732x00)=527.28 A.

Se eligen conductores Unipolares 4(3x185+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 1540 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 45.86

  e(parcial)=10x365299.99/52.65x400x4x185=0.23 V.=0.06 %

  e(total)=0.43% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 630 A. Térmico reg. Int.Reg.: 630 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.15 CÁLCULO DE LA LÍNEA: BOMBA 7

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 38.5 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 315000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 315000x1.25=393750 W.

I=393750/1,732x400x0.85x1=668.64 A.

Se eligen conductores Unipolares 4(3x185+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 698.4 A. según ITC-BT-19

Diámetro exterior tubo: 4(180) mm.

- Caída de tensión:

  Temperatura cable (ºC): 84.58

  e(parcial)=38.5x393750/46.26x400x4x185x1=1.11 V.=0.28 %

  e(total)=0.7% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.16 CÁLCULO DE LA LÍNEA: VARIADOR B8

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 10 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia activa: 315 kW.
- Potencia aparente red: 365.3 kVA.

I= Sv x 1000 / (1.732 x U) = 365.3x1000/(1,732x00)=527.28 A.

Se eligen conductores Unipolares 4(3x185+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 1540 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 45.86

  e(parcial)=10x365299.99/52.65x400x4x185=0.23 V.=0.06 %

  e(total)=0.43% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Aut./Tri. In.: 630 A. Térmico reg. Int.Reg.: 630 A.

- Protección diferencial:

  Relé y Transfor. Diferencial Sens.: 300 mA. Clase AC.

### 3.17 CÁLCULO DE LA LÍNEA: BOMBA 8

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 47 m; Cos φ: 0.85; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 315000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 315000x1.25=393750 W.

I=393750/1,732x400x0.85x1=668.64 A.

Se eligen conductores Unipolares 4(3x185+TTx95)mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 698.4 A. según ITC-BT-19

Diámetro exterior tubo: 4(180) mm.

- Caída de tensión:

  Temperatura cable (ºC): 84.58

  e(parcial)=47x393750/46.26x400x4x185x1=1.35 V.=0.34 %

  e(total)=0.77% ADMIS (6.5% MAX.)

- Protecciones a sobrecargas y c.c. integradas en variador

### 3.18 CÁLCULO DE LA LÍNEA: SSAA

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 2 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 37222 W.
- Potencia de cálculo: (Según ITC-BT-47 y ITC-BT-44):
- 5000x1.25+33551.6=39801.6 W.(Coef. de Simult.: 1 )

I=39801.6/1,732x400x0.8=71.81 A.

Se eligen conductores Unipolares 4x16+TTx16mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 85 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm. Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 75.69

  e(parcial)=2x39801.6/47.59x400x16=0.26 V.=0.07 %

  e(total)=0.43% ADMIS (4.5% MAX.)

- Protección Termica en Principio de Línea

  I. Aut./Tet. In.: 80 A. Térmico reg. Int.Reg.: 78 A.

- Protección Térmica en Final de Línea

  I. Aut./Tet. In.: 80 A. Térmico reg. Int.Reg.: 78 A.

- Protección diferencial en Principio de Línea

  Relé y Transfor. Diferencial Sens.: 30 mA. Clase AC.

## 3.19 CÁLCULO DE LA LÍNEA: ALUMBRADO

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos j: 0.8; Xu(mW/m): 0;
- Potencia a instalar: 2458 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 3592.4 W.(Coef. de Simult.: 1 )

I=3592.4/1,732x400x0.8=6.48 A.

Se eligen conductores Unipolares 4x2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 27 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 42.88

  e(parcial)=0.3x3592.4/53.22x400x2.5=0.02 V.=0.01 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

### 3.19.1 CÁLCULO DE LA LÍNEA: AL BOMBEO

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos j: 0.8; Xu(mW/m): 0;
- Potencia a instalar: 1418 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 2552.4 W.(Coef. de Simult.: 1 )

I=2552.4/230.94x0.8=13.82 A.

Se eligen conductores Unipolares 2x2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 30 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 50.6

  e(parcial)=2x0.3x2552.4/51.78x230.94x2.5=0.05 V.=0.02 %

  e(total)=0.46% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

#### *3.19.1.1 CÁLCULO DE LA LÍNEA: AL.CUADROS*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 17 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 8 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 8x1.8=14.4 W.

I=14.4/230.94x1=0.06 A.

Se eligen conductores Unipolares 2x1.5+TTx1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 21 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: FUERZA SSAA). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 40

  e(parcial)=2x17x14.4/53.78x230.94x1.5=0.03 V.=0.01 %

  e(total)=0.47% ADMIS (4.5% MAX.)

*3.19.1.2 CÁLCULO DE LA LÍNEA: BOMB PARED O*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 60.5 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 470 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 470x1.8=846 W.

I=846/230.94x1=3.66 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.7) 21 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 41.52

  e(parcial)=2x60.5x846/53.48x230.94x2.5=3.32 V.=1.44 %

  e(total)=1.9% ADMIS (4.5% MAX.)

*3.19.1.3 CÁLCULO DE LA LÍNEA: BOMB PARED E*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 62 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 329 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 329x1.8=592.2 W.

I=592.2/230.94x1=2.56 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 18 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Oeste). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 41.01

  e(parcial)=2x62x592.2/53.58x230.94x2.5=2.37 V.=1.03 %

  e(total)=1.49% ADMIS (4.5% MAX.)

*3.19.1.4 CÁLCULO DE LA LÍNEA: BOMB CENTRAL*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 55 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 470 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 470x1.8=846 W.

I=846/230.94x1=3.66 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 18 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 42.07

  e(parcial)=2x55x846/53.37x230.94x2.5=3.02 V.=1.31 %

  e(total)=1.77% ADMIS (4.5% MAX.)

*3.19.1.5 CÁLCULO DE LA LÍNEA: BOMB SALAS*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 21 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 141 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 141x1.8=253.8 W.

I=253.8/230.94x1=1.1 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 18 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 40.19

  e(parcial)=2x21x253.8/53.74x230.94x2.5=0.34 V.=0.15 %

  e(total)=0.61% ADMIS (4.5% MAX.)

3.19.2 CÁLCULO DE LA LÍNEA: AL EXTERIOR

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos j: 0.8; Xu(mW/m): 0;
- Potencia a instalar: 1040 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 1040 W.(Coef. de Simult.: 1 )

I=1040/230.94x0.8=5.63 A.

Se eligen conductores Unipolares 2x1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 21 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 43.59

  e(parcial)=2x0.3x1040/53.08x230.94x1.5=0.03 V.=0.01 %

  e(total)=0.45% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 10 A.

*3.19.2.1 CÁLCULO DE LA LÍNEA: AL EXT E*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 84 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 520 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 520 W.

I=520/230.94x1=2.25 A.

Se eligen conductores Unipolares 2x1.5+TTx1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 12.6 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Oeste). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 41.6

  e(parcial)=2x84x520/53.46x230.94x1.5=4.72 V.=2.04 %

  e(total)=2.5% ADMIS (4.5% MAX.)

*3.19.2.2 CÁLCULO DE LA LÍNEA: AL EXT O*

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 58.6 m; Cos j: 1; Xu(mW/m): 0;
- Potencia a instalar: 520 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 520 W.

I=520/230.94x1=2.25 A.

Se eligen conductores Unipolares 2x1.5+TTx1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.7) 14.7 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 41.17

  e(parcial)=2x58.6x520/53.55x230.94x1.5=3.29 V.=1.42 %

  e(total)=1.88% ADMIS (4.5% MAX.)

## 3.20 CÁLCULO DE LA LÍNEA: ALMACÉN

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 50 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia a instalar: 188 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 188x1.8=338.4 W.

I=338.4/230.94x1=1.47 A.

Se eligen conductores Unipolares 2x1.5+TTx1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=1) 24 A. según ITC-BT-19

Diámetro exterior tubo: 25 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.24

  e(parcial)=2x50x338.4/56.83x230.94x1.5=1.72 V.=0.74 %

  e(total)=1.18% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 10 A.

  Protección diferencial:

  Inter. Dif. Bipolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

## 3.21 CÁLCULO DE LA LÍNEA: AL EMERGENCIA

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 56 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 100.8 W.(Coef. de Simult.: 1 )

I=100.8/230.94x0.8=0.55 A.

Se eligen conductores Unipolares 2x1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 21 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 40.03

  e(parcial)=2x0.3x100.8/53.77x230.94x1.5=0 V.=0 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 10 A.

- Protección diferencial:

  Inter. Dif. Bipolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

### 3.21.1 CÁLCULO DE LA LÍNEA: EM E

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 69 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia a instalar: 32 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 32x1.8=57.6 W.

I=57.6/230.94x1=0.25 A.

Se eligen conductores Unipolares 2x1.5+TTx1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 21 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 40.01

  e(parcial)=2x69x57.6/53.77x230.94x1.5=0.43 V.=0.18 %

  e(total)=0.62% ADMIS (4.5% MAX.)

3.21.2 CÁLCULO DE LA LÍNEA: EM O

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 53 m; Cos φ: 1; Xu(mΩ/m): 0;
- Potencia a instalar: 24 W.
- Potencia de cálculo: (Según ITC-BT-44):
- 24x1.8=43.2 W.

I=43.2/230.94x1=0.19 A.

Se eligen conductores Unipolares 2x1.5+TTx1.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 21 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Oeste). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 40

  e(parcial)=2x53x43.2/53.77x230.94x1.5=0.25 V.=0.11 %

  e(total)=0.54% ADMIS (4.5% MAX.)

## 3.22 CÁLCULO DE LA LÍNEA: EXTRACCIÓN

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 2960 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 1850x1.25+1110=3422.5 W.(Coef. de Simult.: 1 )

I=3422.5/1,732x400x0.8=6.18 A.

Se eligen conductores Unipolares 4x10mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 63 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 40.48

  e(parcial)=0.3x3422.5/53.68x400x10=0 V.=0 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 63 A. Sens. Int.: 300 mA. Clase AC.

3.22.1 CÁLCULO DE LA LÍNEA: EXTRACCIÓN E

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 41 m; Cos φ: 0.8; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 1850 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 1850x1.25=2312.5 W.

I=2312.5/1,732x400x0.8x1=4.17 A.

Se eligen conductores Unipolares 3x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 16.2 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 43.32

  e(parcial)=41x2312.5/53.13x400x2.5x1=1.78 V.=0.45 %

  e(total)=0.88% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tripolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Tripolar In: 16 A.

3.22.2 CÁLCULO DE LA LÍNEA: EXTRACCION O

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 64 m; Cos φ: 0.8; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 740 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 740x1.25=925 W.

I=925/1,732x400x0.8x1=1.67 A.

Se eligen conductores Unipolares 3x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.7) 18.9 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Oeste). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 40.39

  e(parcial)=64x925/53.7x400x2.5x1=1.1 V.=0.28 %

  e(total)=0.71% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tripolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Tripolar In: 16 A.

3.22.3 CÁLCULO DE LA LÍNEA: EXTRACCIÓN CUADROS

- Tensión de servicio: 400 V.
- Canalización: B1-Unip.Tubos Superf.o Emp.Obra
- Longitud: 9 m; Cos φ: 0.8; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 370 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 370x1.25=462.5 W.

I=462.5/1,732x400x0.8x1=0.83 A.

Se eligen conductores Unipolares 3x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 24 A. según ITC-BT-19

Diámetro exterior tubo: 20 mm.

- Caída de tensión:

  Temperatura cable (ºC): 40.06

  e(parcial)=9x462.5/53.76x400x2.5x1=0.08 V.=0.02 %

  e(total)=0.45% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tripolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Tripolar In: 16 A.

**3.23 CÁLCULO DE LA LÍNEA: BASES III**

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 10000 W.
- Potencia de cálculo:
- 10000 W.(Coef. de Simult.: 1 )

I=10000/1,732x400x0.8=18.04 A.

Se eligen conductores Unipolares 4x4+TTx4mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 36 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 52.56

  e(parcial)=0.3x10000/51.42x400x4=0.04 V.=0.01 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 40 A. Sens. Int.: 300 mA. Clase AC.

3.23.1 CÁLCULO DE LA LÍNEA: BASE III E

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 64 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 5000 W.
- Potencia de cálculo: 5000 W.

I=5000/1,732x400x0.8=9.02 A.

Se eligen conductores Unipolares 3x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 16.2 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 55.51

  e(parcial)=64x5000/50.9x400x2.5=6.29 V.=1.57 %

  e(total)=2.02% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tripolar Int. 16 A.

3.23.2 CÁLCULO DE LA LÍNEA: BASE III O

- Tensión de servicio: 400 V.
- Canalización: B1-Unip.Tubos Superf.o Emp.Obra
- Longitud: 22 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 5000 W.
- Potencia de cálculo: 5000 W.

I=5000/1,732x400x0.8=9.02 A.

Se eligen conductores Unipolares 3x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.8) 19.2 A. según ITC-BT-19

Diámetro exterior tubo: 25 mm. (Tubo compartido: TUBO1)

- Caída de tensión:

  Temperatura cable (ºC): 51.04

  e(parcial)=22x5000/51.7x400x2.5=2.13 V.=0.53 %

  e(total)=0.98% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tripolar Int. 16 A.

## 3.24 CÁLCULO DE LA LÍNEA: BASES MONO

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 9000 W.
- Potencia de cálculo:
- 9000 W.(Coef. de Simult.: 1 )

I=9000/1,732x400x0.8=16.24 A.

Se eligen conductores Unipolares 4x4mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 36 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 50.17

  e(parcial)=0.3x9000/51.85x400x4=0.03 V.=0.01 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 40 A. Sens. Int.: 300 mA. Clase AC.

### 3.24.1 CÁLCULO DE LA LÍNEA: BASE II E

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 63 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 3000 W.
- Potencia de cálculo: 3000 W.

I=3000/230.94x0.8=16.24 A.

Se eligen conductores Unipolares 2x4+TTx4mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.6) 24 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 62.89

  e(parcial)=2x63x3000/49.64x230.94x4=8.24 V.=3.57 %

  e(total)=4.01% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 20 A.

### 3.24.2 CÁLCULO DE LA LÍNEA: BASE II O

- Tensión de servicio: 230.94 V.
- Canalización: B1-Unip.Tubos Superf.o Emp.Obra
- Longitud: 21 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 3000 W.
- Potencia de cálculo: 3000 W.

I=3000/230.94x0.8=16.24 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=0.8) 22.4 A. según ITC-BT-19

Diámetro exterior tubo: 25 mm. (Tubo compartido: TUBO1)

- Caída de tensión:

  Temperatura cable (ºC): 66.27

  e(parcial)=2x21x3000/49.08x230.94x2.5=4.45 V.=1.93 %

  e(total)=2.37% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 20 A.

### 3.24.3 CÁLCULO DE LA LÍNEA: BASE II CUADROS

- Tensión de servicio: 230.94 V.
- Canalización: B1-Unip.Tubos Superf.o Emp.Obra
- Longitud: 9 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 3000 W.
- Potencia de cálculo: 3000 W.

I=3000/230.94x0.8=16.24 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 28 A. según ITC-BT-19

Diámetro exterior tubo: 20 mm.

- Caída de tensión:

  Temperatura cable (ºC): 56.82

  e(parcial)=2x9x3000/50.67x230.94x2.5=1.85 V.=0.8 %

  e(total)=1.24% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 20 A.

## 3.25 CÁLCULO DE LA LÍNEA: RESIST CALDEO

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 0.3 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 1200 W.
- Potencia de cálculo:
- 1200 W.(Coef. de Simult.: 1 )

I=1200/1,732x400x0.8=2.17 A.

Se eligen conductores Unipolares 4x2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 27 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 40.32

  e(parcial)=0.3x1200/53.71x400x2.5=0.01 V.=0 %

  e(total)=0.44% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Mag. Tetrapolar Int. 16 A.

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

### 3.25.1 CÁLCULO DE LA LÍNEA: RB1

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 30.7 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.65) 20.8 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.1

  e(parcial)=2x30.7x150/56.86x230.94x2.5=0.28 V.=0.12 %

  e(total)=0.56% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

### 3.25.2 CÁLCULO DE LA LÍNEA: RB2

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 34.2 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.65) 20.8 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.1

  e(parcial)=2x34.2x150/56.86x230.94x2.5=0.31 V.=0.14 %

  e(total)=0.57% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

### 3.25.3 CÁLCULO DE LA LÍNEA: RB3

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 38.2 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.65) 20.8 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.1

  e(parcial)=2x38.2x150/56.86x230.94x2.5=0.35 V.=0.15 %

  e(total)=0.59% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

### 3.25.4 CÁLCULO DE LA LÍNEA: RB4

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 20.5 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 19.2 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.12

  e(parcial)=2x20.5x150/56.86x230.94x2.5=0.19 V.=0.08 %

  e(total)=0.52% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

### 3.25.5 CÁLCULO DE LA LÍNEA: RB5

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 25.5 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 19.2 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.12

  e(parcial)=2x25.5x150/56.86x230.94x2.5=0.23 V.=0.1 %

  e(total)=0.54% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

3.25.6 CÁLCULO DE LA LÍNEA: RB6

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 30 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 19.2 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.12

  e(parcial)=2x30x150/56.86x230.94x2.5=0.27 V.=0.12 %

  e(total)=0.55% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

3.25.7 CÁLCULO DE LA LÍNEA: RB7

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 35.5 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 19.2 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.12

  e(parcial)=2x35.5x150/56.86x230.94x2.5=0.32 V.=0.14 %

  e(total)=0.58% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

3.25.8 CÁLCULO DE LA LÍNEA: RB8

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 41 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.6) 19.2 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.12

  e(parcial)=2x41x150/56.86x230.94x2.5=0.37 V.=0.16 %

  e(total)=0.6% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Elemento de Maniobra:

  Contactor Bipolar In: 16 A.

### 3.26 CÁLCULO DE LA LÍNEA: P. GRUA

- Tensión de servicio: 400 V.
- Canalización: C-Unip.o Mult.Bandeja no Perfor
- Longitud: 22.5 m; Cos φ: 0.8; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 5000 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 5000x1.25=6250 W.

I=6250/1,732x400x0.8x1=11.28 A.

Se eligen conductores Unipolares 3x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 27 A. según ITC-BT-19

Dimensiones bandeja: 75x60 mm (Bandeja compartida: SSAA Este). Sección útil: 2910 mm².

- Caída de tensión:

  Temperatura cable (ºC): 48.72

  e(parcial)=22.5x6250/52.12x400x2.5x1=2.7 V.=0.67 %

  e(total)=1.11% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tripolar Int. 16 A.

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 25 A. Sens. Int.: 300 mA. Clase AC.

### 3.27 CÁLCULO DE LA LÍNEA: CAUDALIMETRO 1

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 25 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.8) 25.6 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.07

  e(parcial)=2x25x150/56.87x230.94x2.5=0.23 V.=0.1 %

  e(total)=0.53% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Protección diferencial:

  Inter. Dif. Bipolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

### 3.28 CÁLCULO DE LA LÍNEA: CAUDALIMETRO 2

- Tensión de servicio: 230.94 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 25 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 150 W.
- Potencia de cálculo: 150 W.

I=150/230.94x0.8=0.81 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.8) 25.6 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 25.07

  e(parcial)=2x25x150/56.87x230.94x2.5=0.23 V.=0.1 %

  e(total)=0.53% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Protección diferencial:

  Inter. Dif. Bipolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

### 3.29 CÁLCULO DE LA LÍNEA: FILTRO W

- Tensión de servicio: 400 V.
- Canalización: D1-Unip.o Mult.Conduct.enterrad.
- Longitud: 43.2 m; Cos φ: 0.8; Xu(mΩ/m): 0; R: 1
- Potencia a instalar: 4300 W.
- Potencia de cálculo: (Según ITC-BT-47):
- 4300x1.25=5375 W.

I=5375/1,732x400x0.8x1=9.7 A.

Se eligen conductores Unipolares 4x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 25°C (Fc=0.65) 17.55 A. según ITC-BT-19

Diámetro exterior tubo: 32 mm.

- Caída de tensión:

  Temperatura cable (ºC): 44.85

  e(parcial)=43.2x5375/52.84x400x2.5x1=4.39 V.=1.1 %

  e(total)=1.53% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Tetrapolar Int. 16 A.

- Protección diferencial:

  Inter. Dif. Tetrapolar Int.: 25 A. Sens. Int.: 300 mA. Clase AC.

### 3.30 CÁLCULO DE LA LÍNEA: LINEA AUTOMATISMOS

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 2 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia aparente: 2.2 kVA.
- Indice carga c: 0.966.

I= Cs x Ss x 1000 / U = 1.25x2.2x1000/230.94=11.91 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 30 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 47.88

  e(parcial)=2x2x2200/52.28x230.94x2.5=0.29 V.=0.13 %

  e(total)=0.56% ADMIS (4.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

- Protección diferencial:

  Inter. Dif. Bipolar Int.: 25 A. Sens. Int.: 30 mA. Clase AC.

SISTEMA ALIMENTACION ININTERRUMPIDALINEA AUTOMATISMOS DEMANDA DE POTENCIAS

Potencia total instalada:

FA 24VCC ..... 200 W

AUTÓMATA..... 1500 W

TOTAL..... 1700 W

Potencia Instalada Fuerza (W): 1700

#### 3.30.1 CÁLCULO DE LA LÍNEA: FA 24VCC

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 30 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 200 W.
- Potencia de cálculo: 200 W.

I=200/230.94x0.8=1.08 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 30 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 40.07

  e(parcial)=2x30x200/53.76x230.94x2.5=0.39 V.=0.17 %

  e(total)=0.73% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

3.30.2 CÁLCULO DE LA LÍNEA: AUTÓMATA

- Tensión de servicio: 230.94 V.
- Canalización: C-Unip.o Mult.sobre Pared
- Longitud: 2 m; Cos φ: 0.8; Xu(mΩ/m): 0;
- Potencia a instalar: 1500 W.
- Potencia de cálculo: 1500 W.

I=1500/230.94x0.8=8.12 A.

Se eligen conductores Unipolares 2x2.5+TTx2.5mm²Cu

Nivel Aislamiento, Aislamiento: 0.6/1 kV, XLPE. Desig. UNE: RV-K Eca

I.ad. a 40°C (Fc=1) 30 A. según ITC-BT-19

- Caída de tensión:

  Temperatura cable (ºC): 43.66

  e(parcial)=2x2x1500/53.07x230.94x2.5=0.2 V.=0.08 %

  e(total)=0.65% ADMIS (6.5% MAX.)

- Prot. Térmica:

  I. Mag. Bipolar Int. 16 A.

# 4 CALCULO DE EMBARRADO

## 4.1 CALCULO DE EMBARRADO DESCARGA DIRECTA TRAFOS

Datos

- Metal: Cu
- Estado pletinas: desnudas
- nº pletinas por fase: 1
- Separación entre pletinas, d(cm): 10
- Separación entre apoyos, L(cm): 25
- Tiempo duración c.c. (s): 0.5

Pletina adoptada

- Sección (mm²): 45
- Ancho (mm): 15
- Espesor (mm): 3
- Wx, Ix, Wy, Iy ($cm^3$, $cm^4$): 0.112, 0.084, 0.022, 0.003
- I. admisible del embarrado (A): 170

a) Cálculo electrodinámico

- $\sigma max = Ipcc^2 \cdot L^2 / (60 \cdot d \cdot Wy \cdot n) = 3.34^2 \cdot 25^2 / (60 \cdot 10 \cdot 0.022 \cdot 1) = 527.718 <=$ 1200 kg/cm² Cu

b) Cálculo térmico, por intensidad admisible

- Ical = 144.34 A
- Iadm = 170 A

c) Comprobación por solicitación térmica en cortocircuito

- Ipcc = 3.34 kA
- $Icccs = Kc \cdot S / (1000 \cdot \sqrt{tcc}) = 164 \cdot 45 \cdot 1 / (1000 \cdot \sqrt{0.5}) = 10.44$ kA

## 4.2 CALCULO DE EMBARRADO SSAA

Datos

- Metal: Cu
- Estado pletinas: desnudas
- nº pletinas por fase: 1
- Separación entre pletinas, d(cm): 10

- Separación entre apoyos, L(cm): 25
- Tiempo duración c.c. (s): 0.5

Pletina adoptada

- Sección (mm²): 800
- Ancho (mm): 80
- Espesor (mm): 10
- Wx, Ix, Wy, Iy ($cm^3$,$cm^4$) : 10.66, 42.6, 1.333, 0.666
- I. admisible del embarrado (A): 1400

a) Cálculo electrodinámico

- $\sigma$max = Ipcc² · L² / ( 60 · d · Wy · n) =39.07² · 25² /(60 · 10 · 1.333 · 1) = 1193.082 <= 1200 kg/cm² Cu

b) Cálculo térmico, por intensidad admisible

- Ical = 71.81 A
- Iadm = 1400 A

c) Comprobación por solicitación térmica en cortocircuito

- Ipcc = 39.07 kA
- Icccs = Kc · S / ( 1000 · √tcc) = 164 · 800 · 1 / (1000 · √0.5) = 185.54 kA

## 5 TABLAS DE RESULTADOS

### CUADRO GENERAL DE MANDO Y PROTECCIÓN

| Denominación | P.Cálculo (W) | Dist.Cálc. (m) | Sección (mm²) | I.Cálculo (A) | I.Adm. (A) | C.T.Parc. (%) | C.T.Total (%) | Dimensiones(mm) Tubo,Canal,Band. |
|---|---|---|---|---|---|---|---|---|
| TRAFO | 1600000 | 20 | 12(3x240/120)Al | 2886.84 | 3132 | 0.37 | 0.37 | 12(225) |
| VARIADOR B1 | 133000 | 6 | 3x240+TTx120Cu | 191.97 | 455 | 0.04 | 0.41 | |
| BOMBA 1 | 137500 | 26.5 | 3x240+TTx120Cu | 233.49 | 235.2 | 0.21 | 0.62 | 225 |
| VARIADOR B2 | 133000 | 9 | 3x240+TTx120Cu | 191.97 | 455 | 0.06 | 0.43 | |
| BOMBA 2 | 137500 | 29.5 | 3x240+TTx120Cu | 233.49 | 235.2 | 0.23 | 0.66 | 225 |
| VARIADOR B3 | 133000 | 10 | 3x240+TTx120Cu | 191.97 | 455 | 0.07 | 0.44 | |
| BOMBA 3 | 137500 | 32 | 3x240+TTx120Cu | 233.49 | 235.2 | 0.25 | 0.69 | 225 |
| VARIADOR B4 | 133000 | 10 | 3x240+TTx120Cu | 191.97 | 455 | 0.07 | 0.44 | |
| BOMBA 4 | 137500 | 17.5 | 2(3x95+TTx50)Cu | 233.49 | 242.4 | 0.17 | 0.61 | 2(140) |
| VARIADOR B5 | 235000 | 10 | 2(3x240+TTx120)Cu | 339.2 | 910 | 0.06 | 0.43 | |
| BOMBA 5 | 250000 | 23 | 3(3x150+TTx95)Cu | 424.53 | 468 | 0.17 | 0.6 | 3(180) |
| VARIADOR B6 | 365299.99 | 10 | 4(3x185+TTx95)Cu | 527.28 | 1540 | 0.06 | 0.43 | |
| BOMBA 6 | 393750 | 30.5 | 4(3x185+TTx95)Cu | 668.64 | 698.4 | 0.22 | 0.65 | 4(180) |
| VARIADOR B7 | 365299.99 | 10 | 4(3x185+TTx95)Cu | 527.28 | 1540 | 0.06 | 0.43 | |
| BOMBA 7 | 393750 | 38.5 | 4(3x185+TTx95)Cu | 668.64 | 698.4 | 0.28 | 0.7 | 4(180) |
| VARIADOR B8 | 365299.99 | 10 | 4(3x185+TTx95)Cu | 527.28 | 1540 | 0.06 | 0.43 | |
| BOMBA 8 | 393750 | 47 | 4(3x185+TTx95)Cu | 668.64 | 698.4 | 0.34 | 0.77 | 4(180) |
| SSAA | 39801.6 | 2 | 4x16+TTx16Cu | 71.81 | 85 | 0.07 | 0.43 | 75x60 |

### CORTOCIRCUITO

| Denominación | Longitud (m) | Sección (mm²) | Ikmaxi (kA) | P de C (kA) | Ikmaxf (kA) | Ikminf (A) | Curva válida, xln | Lmáxima (m) | Fase |
|---|---|---|---|---|---|---|---|---|---|
| TRAFO | 20 | 12(3x240/120)Al | | 50 | 45.76 | 35828.89 | 3000;10 In | | |
| VARIADOR B1 | 6 | 3x240+TTx120Cu | 45.76 | 50 | 41.391 | 31732.16 | 250;10 In | | |
| BOMBA 1(2.1) | 26.5 | 3x240+TTx120Cu | 41.391 | | 28.61 | 19850.88 | | | |
| VARIADOR B2 | 9 | 3x240+TTx120Cu | 45.76 | 50 | 39.465 | 29894.67 | 250;10 In | | |
| BOMBA 2(2.2) | 29.5 | 3x240+TTx120Cu | 39.465 | | 26.683 | 18187.8 | | | |
| VARIADOR B3 | 10 | 3x240+TTx120Cu | 45.76 | 50 | 38.857 | 29314.53 | 250;10 In | | |
| BOMBA 3(2.3) | 32 | 3x240+TTx120Cu | 38.857 | | 25.669 | 17331.18 | | | |
| VARIADOR B4 | 10 | 3x240+TTx120Cu | 45.76 | 50 | 38.857 | 29314.53 | 250;10 In | | |

| Denominación | Longitud (m) | Sección (mm²) | Ikmaxi (kA) | P de C (kA) | Ikmaxf (kA) | Ikminf (A) | Curva válida, xln | Lmáxima (m) | Fase |
|---|---|---|---|---|---|---|---|---|---|
| BOMBA 4(1.1) | 17.5 | 2(3x95+TTx50)Cu | 38.857 | | 32.499 | 21924.27 | | | |
| VARIADOR B5 | 10 | 2(3x240+TTx120)Cu | 45.76 | 50 | 42.07 | 32376.99 | 400;10 In | | |
| BOMBA 5(1.2) | 23 | 3(3x150+TTx95)Cu | 42.07 | | 36.737 | 26722.14 | | | |
| VARIADOR B6 | 10 | 4(3x185+TTx95)Cu | 45.76 | 50 | 43.762 | 33889.67 | 630;10 In | | |
| BOMBA 6(1.3) | 30.5 | 4(3x185+TTx95)Cu | 43.762 | | 38.405 | 28497.31 | | | |
| VARIADOR B7 | 10 | 4(3x185+TTx95)Cu | 45.76 | 50 | 43.762 | 33889.67 | 630;10 In | | |
| BOMBA 7(1.4) | 38.5 | 4(3x185+TTx95)Cu | 43.762 | | 37.17 | 27255.11 | | | |
| VARIADOR B8 | 10 | 4(3x185+TTx95)Cu | 45.76 | 50 | 43.762 | 33889.67 | 630;10 In | | |
| BOMBA 8(1.5) | 47 | 4(3x185+TTx95)Cu | 43.762 | | 35.928 | 26016.99 | | | |
| SSAA | 2 | 4x16+TTx16Cu | 45.76 | 50\|50 | 39.074 | 19078.47 | 80;10 In\|80;10 In | | |

## SUBCUADRO SSAA

| Denominación | P.Cálculo (W) | Dist.Cálc. (m) | Sección (mm²) | I.Cálculo (A) | I.Adm. (A) | .T.Parc. (%) | C.T.Total (%) | Dimensiones(mm) Tubo,Canal,Band. |
|---|---|---|---|---|---|---|---|---|
| ALUMBRADO | 3592.4 | 0.3 | 4x2.5Cu | 6.48 | 27 | 0.01 | 0.44 | |
| AL BOMBEO | 2552.4 | 0.3 | 2x2.5Cu | 13.82 | 30 | 0.02 | 0.46 | |
| AL.CUADROS | 14.4 | 17 | 2x1.5+TTx1.5Cu | 0.06 | 21 | 0.01 | 0.47 | 75x60 |
| BOMB PARED O | 846 | 60.5 | 2x2.5+TTx2.5Cu | 3.66 | 21 | 1.44 | 1.9 | 75x60 |
| BOMB PARED E | 592.2 | 62 | 2x2.5+TTx2.5Cu | 2.56 | 18 | 1.03 | 1.49 | 75x60 |
| BOMB CENTRAL | 846 | 55 | 2x2.5+TTx2.5Cu | 3.66 | 18 | 1.31 | 1.77 | 75x60 |
| BOMB SALAS | 253.8 | 21 | 2x2.5+TTx2.5Cu | 1.1 | 18 | 0.15 | 0.61 | 75x60 |
| AL EXTERIOR | 1040 | 0.3 | 2x1.5Cu | 5.63 | 21 | 0.01 | 0.45 | |
| AL EXT E | 520 | 84 | 2x1.5+TTx1.5Cu | 2.25 | 12.6 | 2.04 | 2.5 | 75x60 |
| AL EXT O | 520 | 58.6 | 2x1.5+TTx1.5Cu | 2.25 | 14.7 | 1.42 | 1.88 | 75x60 |

| Denominación | P.Cálculo (W) | Dist.Cálc. (m) | Sección (mm²) | I.Cálculo (A) | I.Adm. (A) | .T.Parc. (%) | C.T.Total (%) | Dimensiones(mm) Tubo,Canal,Band. |
|---|---|---|---|---|---|---|---|---|
| ALMACÉN | 338.4 | 50 | 2x1.5+TTx1.5Cu | 1.47 | 24 | 0.74 | 1.18 | 25 |
| AL EMERGENCIA | 100.8 | 0.3 | 2x1.5Cu | 0.55 | 21 | 0 | 0.44 | |
| EM E | 57.6 | 69 | 2x1.5+TTx1.5Cu | 0.25 | 21 | 0.18 | 0.62 | 75x60 |
| EM O | 43.2 | 53 | 2x1.5+TTx1.5Cu | 0.19 | 21 | 0.11 | 0.54 | 75x60 |
| EXTRACCIÓN | 3422.5 | 0.3 | 4x10Cu | 6.18 | 63 | 0 | 0.44 | |
| EXTRACCIÓN E | 2312.5 | 41 | 3x2.5+TTx2.5Cu | 4.17 | 16.2 | 0.45 | 0.88 | 75x60 |
| EXTRACCION O | 925 | 64 | 3x2.5+TTx2.5Cu | 1.67 | 18.9 | 0.28 | 0.71 | 75x60 |
| EXTRACCIÓN CUADROS | 462.5 | 9 | 3x2.5+TTx2.5Cu | 0.83 | 24 | 0.02 | 0.45 | 20 |
| BASES III | 10000 | 0.3 | 4x4+TTx4Cu | 18.04 | 36 | 0.01 | 0.44 | |
| BASE III E | 5000 | 64 | 3x2.5+TTx2.5Cu | 9.02 | 16.2 | 1.57 | 2.02 | 75x60 |
| BASE III O | 5000 | 22 | 3x2.5+TTx2.5Cu | 9.02 | 19.2 | 0.53 | 0.98 | 25 |
| BASES MONO | 9000 | 0.3 | 4x4Cu | 16.24 | 36 | 0.01 | 0.44 | |
| BASE II E | 3000 | 63 | 2x4+TTx4Cu | 16.24 | 24 | 3.57 | 4.01 | 75x60 |
| BASE II O | 3000 | 21 | 2x2.5+TTx2.5Cu | 16.24 | 22.4 | 1.93 | 2.37 | 25 |
| BASE II CUADROS | 3000 | 9 | 2x2.5+TTx2.5Cu | 16.24 | 28 | 0.8 | 1.24 | 20 |
| RESIST CALDEO | 1200 | 0.3 | 4x2.5Cu | 2.17 | 27 | 0 | 0.44 | |
| RB1 | 150 | 30.7 | 2x2.5+TTx2.5Cu | 0.81 | 20.8 | 0.12 | 0.56 | 32 |
| RB2 | 150 | 34.2 | 2x2.5+TTx2.5Cu | 0.81 | 20.8 | 0.14 | 0.57 | 32 |
| RB3 | 150 | 38.2 | 2x2.5+TTx2.5Cu | 0.81 | 20.8 | 0.15 | 0.59 | 32 |
| RB4 | 150 | 20.5 | 2x2.5+TTx2.5Cu | 0.81 | 19.2 | 0.08 | 0.52 | 32 |
| RB5 | 150 | 25.5 | 2x2.5+TTx2.5Cu | 0.81 | 19.2 | 0.1 | 0.54 | 32 |
| RB6 | 150 | 30 | 2x2.5+TTx2.5Cu | 0.81 | 19.2 | 0.12 | 0.55 | 32 |

| Denominación | P.Cálculo (W) | Dist.Cálc. (m) | Sección (mm²) | I.Cálculo (A) | I.Adm. (A) | ..T.Parc. (%) | C.T.Total (%) | Dimensiones(mm) Tubo,Canal,Band. |
|---|---|---|---|---|---|---|---|---|
| RB7 | 150 | 35.5 | 2x2.5+TTx2.5Cu | 0.81 | 19.2 | 0.14 | 0.58 | 32 |
| RB8 | 150 | 41 | 2x2.5+TTx2.5Cu | 0.81 | 19.2 | 0.16 | 0.6 | 32 |
| P. GRUA | 6250 | 22.5 | 3x2.5+TTx2.5Cu | 11.28 | 27 | 0.67 | 1.11 | 75x60 |
| CAUDALIMETRO 1 | 150 | 25 | 2x2.5+TTx2.5Cu | 0.81 | 25.6 | 0.1 | 0.53 | 32 |
| CAUDALIMETRO 2 | 150 | 25 | 2x2.5+TTx2.5Cu | 0.81 | 25.6 | 0.1 | 0.53 | 32 |
| FILTRO W | 5375 | 43.2 | 4x2.5+TTx2.5Cu | 9.7 | 17.55 | 1.1 | 1.53 | 32 |
| LINEA AUTOMATISMOS | 2200 | 2 | 2x2.5+TTx2.5Cu | 11.91 | 30 | 0.13 | 0.56 | |
| FA 24VCC | 200 | 30 | 2x2.5+TTx2.5Cu | 1.08 | 30 | 0.17 | 0.73 | |
| AUTÓMATA | 1500 | 2 | 2x2.5+TTx2.5Cu | 8.12 | 30 | 0.08 | 0.65 | |

**CORTOCIRCUITO**

| Denominación | Longitud (m) | Sección (mm²) | Ikmaxi (kA) | P de C (kA) | Ikmaxf (kA) | Ikminf (A) | Curva válida, xIn | Lmáxima (m) | Fase |
|---|---|---|---|---|---|---|---|---|---|
| ALUMBRADO | 0.3 | 4x2.5Cu | 39.074 | | 32.433 | 11666.74 | | | |
| AL BOMBEO | 0.3 | 2x2.5Cu | 21.515 | 25 | 16.144 | 8297.5 | 16;C | | R |
| AL.CUADROS | 17 | 2x1.5+TTx1.5Cu | 16.144 | | 0.599 | 284.99 | | | R |
| BOMB PARED O | 60.5 | 2x2.5+TTx2.5Cu | 16.144 | | 0.286 | 135.89 | | | R |
| BOMB PARED E | 62 | 2x2.5+TTx2.5Cu | 16.144 | | 0.279 | 132.66 | | | R |
| BOMB CENTRAL | 55 | 2x2.5+TTx2.5Cu | 16.144 | | 0.314 | 149.24 | | | R |
| BOMB SALAS | 21 | 2x2.5+TTx2.5Cu | 16.144 | | 0.798 | 380.03 | | | R |
| AL EXTERIOR | 0.3 | 2x1.5Cu | 21.515 | 25 | 13.772 | 6944.66 | 10;C | | S |
| AL EXT E | 84 | 2x1.5+TTx1.5Cu | 13.772 | | 0.124 | 59.18 | | | S |
| AL EXT O | 58.6 | 2x1.5+TTx1.5Cu | 13.772 | | 0.178 | 84.53 | | | S |
| ALMACÉN | 50 | 2x1.5+TTx1.5Cu | 30.627 | 35 | 0.21 | 99.81 | 10;C | | T |

| Denominación | Longitud (m) | Sección (mm²) | Ikmaxi (kA) | P de C (kA) | Ikmaxf (kA) | Ikminf (A) | Curva válida, xIn | Lmáxima (m) | Fase |
|---|---|---|---|---|---|---|---|---|---|
| AL EMERGENCIA | 0.3 | 2x1.5Cu | 30.627 | 35 | 17.657 | 9190.91 | 10;C | | T |
| EM E | 69 | 2x1.5+TTx1.5Cu | 17.657 | | 0.152 | 72.1 | | | T |
| EM O | 53 | 2x1.5+TTx1.5Cu | 17.657 | | 0.197 | 93.65 | | | T |
| EXTRACCIÓN | 0.3 | 4x10Cu | 39.074 | | 37.305 | 16520.85 | | | |
| EXTRACCIÓN E | 41 | 3x2.5+TTx2.5Cu | 37.305 | 50 | 0.846 | 348.91 | 16;C | | |
| EXTRACCION O | 64 | 3x2.5+TTx2.5Cu | 37.305 | 50 | 0.545 | 224.45 | 16;C | | |
| EXTRACCIÓN CUADROS | 9 | 3x2.5+TTx2.5Cu | 37.305 | 50 | 3.676 | 1525.85 | 16;C | | |
| BASES III | 0.3 | 4x4+TTx4Cu | 39.074 | | 34.829 | 13704.99 | | | |
| BASE III E | 64 | 3x2.5+TTx2.5Cu | 34.829 | 35 | 0.544 | 224.06 | 16;C | | |
| BASE III O | 22 | 3x2.5+TTx2.5Cu | 34.829 | 35 | 1.552 | 640.58 | 16;C | | |
| BASES MONO | 0.3 | 4x4Cu | 39.074 | | 34.829 | 13704.99 | | | |
| BASE II E | 63 | 2x4+TTx4Cu | 24.36 | 25 | 0.44 | 209.15 | 20;C | | T |
| BASE II O | 21 | 2x2.5+TTx2.5Cu | 24.36 | 25 | 0.814 | 387.3 | 20;C | | S |
| BASE II CUADROS | 9 | 2x2.5+TTx2.5Cu | 24.36 | 25 | 1.829 | 872.64 | 20;C | | R |
| RESIST CALDEO | 0.3 | 4x2.5Cu | 39.074 | 50 | 32.433 | 11666.74 | 16;C | | |
| RB1 | 30.7 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.56 | 266.22 | 16;C | | T |
| RB2 | 34.2 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.503 | 239.51 | 16;C | | T |
| RB3 | 38.2 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.452 | 214.87 | 16;C | | T |
| RB4 | 20.5 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.829 | 394.38 | 16;C | | T |
| RB5 | 25.5 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.671 | 319.08 | 16;C | | T |
| RB6 | 30 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.572 | 272.29 | 16;C | | T |
| RB7 | 35.5 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.485 | 230.9 | 16;C | | S |

| Denominación | Longitud (m) | Sección (mm²) | Ikmaxi (kA) | P de C (kA) | Ikmaxf (kA) | Ikminf (A) | Curva válida, xIn | Lmáxima (m) | Fase |
|---|---|---|---|---|---|---|---|---|---|
| RB8 | 41 | 2x2.5+TTx2.5Cu | 21.515 | 25 | 0.421 | 200.44 | 16;C | | T |
| P. GRUA | 22.5 | 3x2.5+TTx2.5Cu | 39.074 | 50 | 1.531 | 631.85 | 16;C | | |
| CAUDALIMETRO 1 | 25 | 2x2.5+TTx2.5Cu | 30.627 | 35 | 0.692 | 329.14 | 16;C | | S |
| CAUDALIMETRO 2 | 25 | 2x2.5+TTx2.5Cu | 30.627 | 35 | 0.692 | 329.14 | 16;C | | T |
| FILTRO W | 43.2 | 4x2.5+TTx2.5Cu | 39.074 | 50 | 0.805 | 191.7 | 16;C | | |
| LINEA AUTOMATISMOS | 2 | 2x2.5+TTx2.5Cu | 30.627 | 35 | 7.186 | 3489.78 | 16;C | | S |
| FA 24VCC | 30 | 2x2.5+TTx2.5Cu | 7.186 | 10 | 0.542 | 258 | 16;C | | S |
| AUTÓMATA | 2 | 2x2.5+TTx2.5Cu | 7.186 | 10 | 3.967 | 1903.24 | 16;C | | S |

## 6 CÁLCULO DE LA PUESTA A TIERRA

La resistividad del terreno es 300 ohmios por metro.

El electrodo en la puesta a tierra del edificio, se constituye con los siguientes elementos:

- M. conductor de Cu desnudo: 35 mm² 30 m.
- M. conductor de Acero galvanizado: 95 mm²
- Picas verticales de Cobre: 14 mm
- de Acero recubierto Cu: 14 mm 4 picas de 2m.
- de Acero galvanizado: 25 mm

Con lo que se obtendrá una Resistencia de tierra de 13.04 ohmios.

Los conductores de protección, se calcularon adecuadamente y según la ITC-BT-18, en el apartado del cálculo de circuitos.

Así mismo cabe señalar que la línea principal de tierra no será inferior a 16 mm² en Cu, y la línea de enlace con tierra, no será inferior a 25 mm² en Cu.

## 7 CÁLCULO ILUMINACIÓN

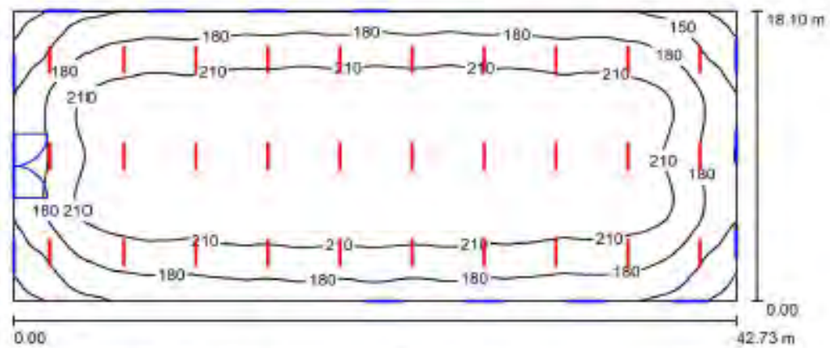
### SALA BOMBEO

CR Santa Ana

DIALux 23.08.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

Estación Bombeo / Resumen




Altura del local: 6.000 m, Altura de montaje: 6.000 m, Factor mantenimiento: 0.80

Valores en Lux, Escala 1:306

| Superficie | ρ [%] | $E_m$ [lx] | $E_{min}$ [lx] | $E_{max}$ [lx] | $E_{min}$ / $E_m$ |
|---|---|---|---|---|---|
| Plano útil | / | 201 | 105 | 239 | 0.524 |
| Suelo | 27 | 194 | 108 | 233 | 0.559 |
| Techo | 85 | 55 | 35 | 333 | 0.632 |
| Paredes (4) | 50 | 95 | 48 | 171 | / |

**Plano útil:**
Altura: 0.850 m
Trama: 128 x 64 Puntos
Zona marginal: 0.000 m

| UGR | Longi- | Tran | al eje de luminaria |
|---|---|---|---|
| Pared izq | 20 | 20 | |
| Pared inferior | 20 | 20 | |

(CIE, SHR = 0.25.)

**Lista de piezas - Luminarias**

| N° | Pieza | Designación (Factor de corrección) | Φ (Luminaria) [lm] | Φ (Lámparas) [lm] | P [W] |
|---|---|---|---|---|---|
| 1 | 30 | WT470C L1600 1 xLED64S/840 WB (1.000) | 6400 | 6400 | 46.5 |
| | | | Total: 192000 | Total: 192000 | 1395.0 |

Valor de eficiencia energética: 1.80 W/m² = 0.90 W/m²/100 lx (Base: 773.39 m²)

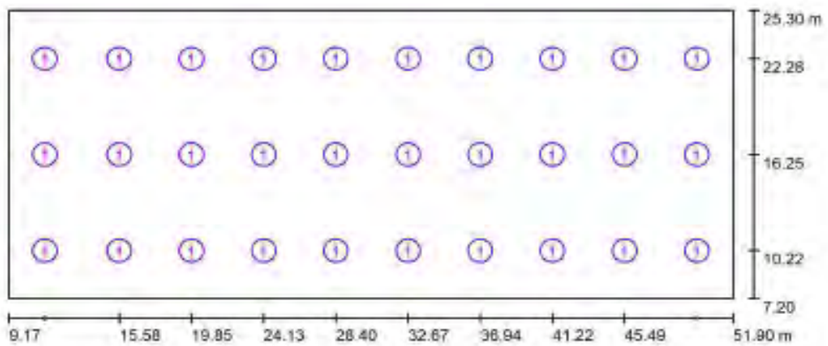
## UBICACIÓN LUMINARIAS

CR Santa Ana

DIALux
23.06.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

### Estación Bombeo / Luminarias (ubicación)




Escala 1 : 306

**Lista de piezas - Luminarias**

| N° | Pieza | Designación |
|---|---|---|
| 1 | 30 | WT470C L1600 1 xLED64S/840 WB |

## RESULTADOS LUMINOTÉCNICOS

CR Santa Ana

DIALux
23.06.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

### Estación Bombeo / Resultados luminotécnicos

Flujo luminoso total: 192000 lm
Potencia total: 1395.0 W
Factor mantenimiento: 0.80
Zona marginal: 0.000 m

| Superficie | Intensidades lumínicas medias [lx] | | | Grado de reflexión [%] | Densidad lumínica media [cd/m²] |
|---|---|---|---|---|---|
| | directo | indirecto | total | | |
| Plano útil | 154 | 47 | 201 | / | / |
| Suelo | 146 | 48 | 194 | 27 | 17 |
| Techo | 6.37 | 49 | 55 | 85 | 15 |
| Pared 1 | 48 | 49 | 97 | 50 | 15 |
| Pared 2 | 49 | 47 | 96 | 50 | 15 |
| Pared 3 | 48 | 46 | 95 | 50 | 15 |
| Pared 4 | 46 | 44 | 90 | 50 | 14 |

Simetrías en el plano útil
$E_{min}$ / $E_m$: 0.524 (1:2)
$E_{min}$ / $E_{max}$: 0.441 (1:2)

| UGR | Longi- | Tran | al eje de luminaria |
|---|---|---|---|
| Pared izq | 20 | 20 | |
| Pared inferior (CIE, SHR = 0.25.) | 20 | 20 | |

Valor de eficiencia energética: 1.80 W/m² = 0.90 W/m²/100 lx (Base: 773.39 m²)

**RENDERING PROCESADO 3D**

CR Santa Ana

DIALux
23.06.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

Estación Bombeo / **Rendering (procesado) en 3D**

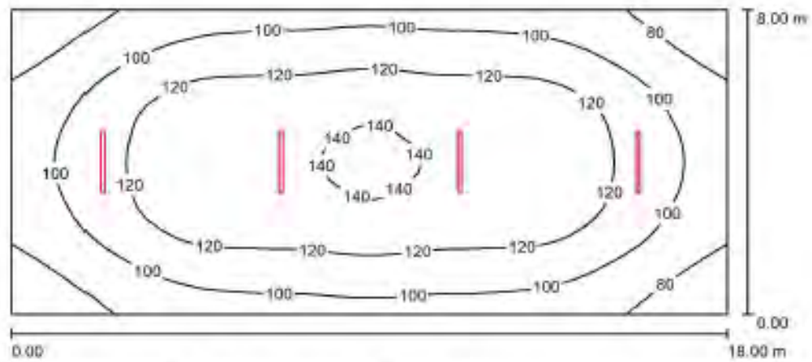
**ALMACEN**

CR Santa Ana

DIALux
23.06.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

Almacén / **Resumen**




Altura del local: 6.000 m, Altura de montaje: 6.000 m, Factor mantenimiento: 0.80

Valores en Lux, Escala 1:129

| Superficie | ρ [%] | $E_m$ [lx] | $E_{min}$ [lx] | $E_{max}$ [lx] | $E_{min}$ / $E_m$ |
|---|---|---|---|---|---|
| Plano útil | / | 110 | 61 | 143 | 0.556 |
| Suelo | 20 | 100 | 64 | 124 | 0.635 |
| Techo | 70 | 27 | 15 | 340 | 0.549 |
| Paredes (4) | 50 | 49 | 20 | 129 | / |

**Plano útil:**
Altura: 0.850 m
Trama: 64 x 32 Puntos
Zona marginal: 0.000 m

**Lista de piezas - Luminarias**

| N° | Pieza | Designación (Factor de corrección) | Φ (Luminaria) [lm] | Φ (Lámparas) [lm] | P [W] |
|---|---|---|---|---|---|
| 1 | 4 | WT470C L1600 1 xLED64S/840 WB (1.000) | 6400 | 6400 | 46.5 |
| | | | Total: 25600 | Total: 25600 | 186.0 |

Valor de eficiencia energética: 1.29 W/m² = 1.17 W/m²/100 lx (Base: 144.00 m²)

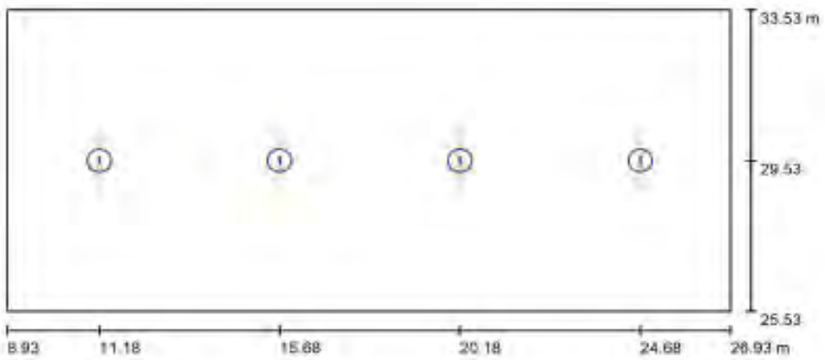
## UBICACIÓN LUMINARIAS

CR Santa Ana

DIALux
23.06.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

### Almacén / Luminarias (ubicación)




Escala 1 : 129

**Lista de piezas - Luminarias**

| Nº | Pieza | Designación |
|---|---|---|
| 1 | 4 | WT470C L1600 1 xLED64S/840 WB |

## RESULTADOS LUMINOTÉCNICOS

CR Santa Ana

DIALux
23.06.2021

Proyecto elaborado por
Teléfono
Fax
e-Mail

### Almacén / Resultados luminotécnicos

Flujo luminoso total: 25600 lm
Potencia total: 186.0 W
Factor mantenimiento: 0.80
Zona marginal: 0.000 m

| Superficie | Intensidades lumínicas medias [lx] | | | Grado de reflexión [%] | Densidad lumínica media [cd/m²] |
|---|---|---|---|---|---|
| | directo | indirecto | total | | |
| Plano útil | 87 | 23 | 110 | / | / |
| Suelo | 76 | 24 | 100 | 20 | 6.38 |
| Techo | 5.01 | 22 | 27 | 70 | 5.94 |
| Pared 1 | 26 | 21 | 48 | 50 | 7.62 |
| Pared 2 | 32 | 21 | 53 | 50 | 8.43 |
| Pared 3 | 26 | 21 | 48 | 50 | 7.62 |
| Pared 4 | 32 | 21 | 53 | 50 | 8.45 |

Simetrías en el plano útil
$E_{min}$ / $E_{m}$: 0.556 (1:2)
$E_{min}$ / $E_{max}$: 0.428 (1:2)

Valor de eficiencia energética: 1.29 W/m² = 1.17 W/m²/100 lx (Base: 144.00 m²)

**RENDERING PROCESADO 3D**

CR Santa Ana

DIALux
23.06.2021

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# APÉNDICE 2. AUTOMATIZACIÓN

## 1 GENERALIDADES

El presente documento forma parte del "Proyecto de Modernización del Regadío de la Comunidad de Regantes Santa Ana, TT.MM. (Huesca)", y tiene por objeto cumplir los requisitos establecidos en el Pliego de Bases para la Contratación de la Asistencia Técnica objeto del mencionado proyecto.

Las actuaciones planteadas consisten en la definición de las características de la Automatización que controlará la red de riego del regadío de la CR Santa Ana (Huesca).

El sistema cuenta con los siguientes elementos:

- Estación de Bombeo
- Balsa Inferior Norte
- Balsa Inferior Sur
- Balsa Intermedia
- Balsa Elevada
- Centro de Control. Situado en el núcleo urbano de Valfonda de Santa Ana.

## 2 ESTACIÓN DE BOMBEO

### 2.1 EQUIPOS INSTALADOS

Los equipos instalados en la estación de bombeo serán los siguientes:

- 4 Motobombas de 110 kW.
- 1 Motobomba de 200 kW.
- 3 Motobombas de 315 kW.
- 8 Variadores de frecuencia con inductancia de línea y filtro dV/dt incluido.
- 2 Caudalímetros, uno en cada colector de salida.
- 3 Transductores de presión, en admisión e impulsiones.
- 1 Filtro W autolimpiable.
- 15 Finales de carrera NC, válvula mariposa Abierta
- 2 Finales de carrera NC, válvula alivio activa
- 2 Sensores de nivel por presión hidrostático uno en cada balsa inferior.
- 2 Boyas indicadora de nivel de máximo uno en cada balsa inferior.
- 2 Sensores de intrusismo uno en cada puerta acceso.
- 1 Sensor de termostato para temperatura ambiente edificio.
- 1 Control trafo.
- 1 Control batería condensadores, batería Trafo vacío
- PC con SCADA para control de la estación de bombeo y módulos remotos.
- Conexión modbus entre equipos variadores y el autómata.
- Red comunicaciones fotovoltaica.
  - En Caja Campo 1 (CC1-x). Dispositivos de medición de corriente para las series fotovoltaicas de hasta 8 entradas.
  - En Caja Campo 2 (CC2). Swich comunicaciones con todas las CC1-x y los sensores (2 sondas de radiación, 2 sondas de temperatura en placa y 2 sondas de temperatura ambiente; en instalaciones fijas), en instalaciones con seguidor, además, anemómetro y monitorización de los Suntrackers.
  - Red Ethernet tipo UTP exterior CAT6 con conexión RJ-45 entre CC1-x, sensores y la CC2, y PC bombeo.
  - Suministro eléctrico a equipos de medición.
  - Además, en bombeo se medirán: tensión CC y AC, intensidad CC y AC, potencias, etc…

### 2.2 ELEMENTOS A CONTROLAR

Los parámetros a controlar en la Estación de bombeo y las entradas y salidas necesarias para cada elemento serán:

GENERAL

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Parada de Emergencia General | 1 | 0 | 0 | 0 |
| Rearme de Bombeo | 0 | 1 | 0 | 0 |
| Sensores de lámina (Anti-intrusión) | 2 | 0 | 0 | 0 |
| Interruptor general | 1 | 0 | 0 | 0 |
| **TOTAL** | 4 | 1 | 0 | 0 |

CENTRO DE TRANSFORMACIÓN

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Seccionador General | 1 | 0 | 0 | 0 |
| Contador | 1 | 0 | 0 | 0 |
| Interruptor Transformador | 1 | 0 | 0 | 0 |
| Sensores de lámina (Anti-intrusión) | 2 | 0 | 0 | 0 |
| Alarma Tª transformador | 1 | 0 | 0 | 0 |
| **TOTAL** | 6 | 0 | 0 | 0 |

CONDENSADOR REACTIVA. TRAFO (vacío)

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Equipo activo | 0 | 1 | 0 | 0 |
| Equipo paro | 0 | 1 | 0 | 0 |
| **TOTAL** | 0 | 2 | 0 | 0 |

MOTOBOMBAS

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda Tª Devanados | 0 | 0 | 3 | 0 |
| Sonda Tª Rodamientos | 0 | 0 | 2 | 0 |
| Interruptor Automático | 1 | 0 | 0 | 0 |
| Automático/Manual | 1 | 0 | 0 | 0 |
| Marcha/Paro | 0 | 1 | 0 | 0 |
| Resistencia de Caldeo | 0 | 1 | 0 | 0 |
| Pulsador Emergencia | 1 | 0 | 0 | 0 |
| **TOTAL** | 3 | 2 | 5 | 0 |

VARIADOR

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Consigna velocidad | 0 | 0 | 0 | 1 |
| Fin de Arranque | 1 | 0 | 0 | 0 |
| Fallo en variador | 1 | 0 | 0 | 0 |
| **TOTAL** | 2 | 0 | 0 | 1 |

CAUDALÍMETRO

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Caudal | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

TRANSDUCTOR DE PRESIÓN

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Presión | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

FILTRO AUTOMÁTICO AUTOLIMPIABLE

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Marcha | 0 | 1 | 0 | 0 |
| Paro | 0 | 1 | 0 | 0 |
| Filtro activo | 1 | 0 | 0 | 0 |
| Filtro detenido | 1 | 0 | 0 | 0 |
| Función Automático/manual | 1 | 0 | 0 | 0 |
| Confirmación Marcha Filtro | 1 | 0 | 0 | 0 |
| Confirmación Paro Filtro | 1 | 0 | 0 | 0 |
| Limitador Par corona | 1 | 0 | 0 | 0 |
| Filtro en fallo | 1 | 0 | 0 | 0 |
| Diferencial presión existente | 0 | 0 | 1 | 0 |
| **TOTAL** | 7 | 2 | 1 | 0 |

VALVULA/COMPUERTA

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Válvula Mariposa abierta | 1 | 0 | 0 | 0 |
| **TOTAL** | 1 | 0 | 0 | 0 |

VÁLVULA HIDRÁULICA ALIVIO/ANTICIPADORA

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Válvula Hidráulica Abierta | 1 | 0 | 0 | 0 |
| Válvula Hidráulica Cerrada | 1 | 0 | 0 | 0 |
| Válvula Hidráulica Control | 1 | 0 | 0 | 0 |
| **TOTAL** | 3 | 0 | 0 | 0 |

SENSOR INTRUSISMO

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sensores de lámina (Anti-intrusión) | 1 | 0 | 0 | 0 |
| **TOTAL** | 1 | 0 | 0 | 0 |

SENSOR TEMPERATURA CASETA CUADROS

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda temperatura | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

SENSOR DE NIVEL

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Nivel de balsa | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

BOYA DE MÁXMO

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Alarma nivel máximo balsa | 1 | 0 | 0 | 0 |
| **TOTAL** | 1 | 0 | 0 | 0 |

SENSOR IRRADIANCIA

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda temperatura | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

SENSOR TEMPERATURA PLACAS

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda temperatura | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

SENSOR TEMPERATURA AMBIENTE

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda temperatura | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

SENSOR TENSIÓN CC

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda temperatura | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

SENSOR INTENSIDAD CC

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sonda temperatura | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

## 2.3 CONFIGURACIÓN NECESARIA

La configuración mínima de Entradas/Salidas que tendrá el PLC será:

| Elemento a controlar | Entradas/Salidas Necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| General | 4 | 1 | 0 | 0 |
| Centro Transformación Y Reactiva | 6 | 2 | 0 | 0 |
| Motobomba 1 110 Kw (x4) | 3 | 2 | 5 | 0 |
| Motobomba 3 200 Kw | 3 | 2 | 5 | 0 |
| Motobomba 4 315 Kw (x3) | 3 | 2 | 5 | 0 |
| Variador (x8) | 2 | 0 | 0 | 1 |
| Caudalímetro (x2) | 0 | 0 | 1 | 0 |
| Transductor De Presión (x3) | 0 | 0 | 1 | 0 |
| Filtro Autolimpiable | 7 | 2 | 1 | 0 |

| Elemento a controlar | Entradas/Salidas Necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Válvula Mariposa Manual (x15) | 1 | 0 | 0 | 0 |
| Válvula Alivio (x2) | 3 | 0 | 0 | 0 |
| Sensor De Nivel (x2) | 0 | 0 | 1 | 0 |
| Boya De Nivel Máximo (x2) | 1 | 0 | 0 | 0 |
| Sensor Intrusismo (x2) | 1 | 0 | 0 | 0 |
| Sensor Termostato | 0 | 0 | 1 | 0 |
| **Instalación Fotovoltaica** | | | | |
| Sensor Irradiancia (x2) | 0 | 0 | 1 | 0 |
| Sensor Temperatura Placas (x2) | 0 | 0 | 1 | 0 |
| Sensor Temperatura Ambiente (x2) | 0 | 0 | 1 | 0 |
| Tensión CC | 0 | 0 | 1 | 0 |
| Intensidad CC | 0 | 0 | 1 | 0 |
| **TOTAL** | 82 | 21 | 57 | 8 |
| **NOTA.** Las señales de strings/cadenas FV se remiten directamente como información al PC | | | | |

Para la conexión de las señales procedentes de la instrumentación de la estación de bombeo como para el envío de órdenes a los elementos de maniobra, se utiliza un equipo de control basado en un autómata programable que realiza las siguientes funciones:

- Adquisición, tratamiento, supervisión y maniobra de señalización procedente de la instrumentación y equipos a controlar que componen la estación de bombeo, a través de módulos de entradas/salidas digitales, analógicas y bus de campo.
- Comunicación mediante bus de campo, con protocolo Modbus, con el analizador de redes, variadores, control de transformador y modem para comunicación con las estaciones remotas ubicadas en la balsa intermedia y la balsa elevada.
- Comunicación mediante cable se señala apantallado bajo tubo entre elementos y autómata para control de bombeo en función del estado de la instalación fotovoltaica y de la balsa intermedia y la balsa elevada.
- Posibilidad de implementar señales de estado de la red mediante transductores de presión ubicados en diferentes puntos de la red, comunicados vía Radio/GPRS con las remotas previstas para el control de la balsa intermedia y la balsa elevada.
- Instalación fotovoltaica. Monitorización, control y gestión de la instalación y bombeo. Comunicación mediante Red de Fibra Óptica y Ethernet para monitorización de señales de tensión e intensidad en cadenas de módulos y de los sensores de temperatura e irradiancia.
- Comunicación con Centro de Control de la CR, situado en el núcleo urbano de Valfonda de Santa Ana, vía VPN, y envío de alarmas vías GSM.

Los módulos mínimos necesarios para esta instalación son:

- CPU de 4.096 Kb de memoria de usuario interna, 3.584 Kb de memoria interna para el programa, puerto de programación USB, Puerto RS485/RS232 tipo RJ45, con protocolo MODBUS/ integrado para bus de datos y puerto Ethernet TCP, posibilidad de tarjeta de memoria de 8Mb para ampliación de memoria para registros del programa.
- 2 módulos de 32 Entradas Digitales
- 1 módulo de 32 Salidas Digitales
- 6 módulos de 8 Entradas Analógicas tipo ETemp.
- 3 módulo de 8 Entradas analógicas
- 3 módulo de 4 salidas analógicas
- 1 Rack de 12 Emplazamientos
- 1 Fuente de Alimentación de 36W

Se prevé también la necesidad de:

- SAI de 2.2 KVAs
- 3 Switch Industrial de 8 Puertos RJ45
- 2 Fuente de alimentación 230/24Vcc
- Modulo redundante para fuentes de alimentación.
- Panel de PC táctil tipo resistivo análogo, con Windows 7 a 64 bits y procesador Core 3rd generación, 827E, cache 3 MB, para pantalla de 12” y 17 millones de colores, resolución 1024x768 XGA, LCD de color TFT con retroiluminación LED, con luminancia 375 cd/m2, tarjeta gráfica Intel HD Graphics 3000, montada sobre soporte de aluminio. Disco duro mayor de 60 GB Flash Disck SSD MLC para 2000000 horas, y memoria interna de hasta 16 GB RAM DDR3. Conexiones (DVI, Ethernet, COM 1 y COM2, USB 2.0 y USB 3.0, Minijack) y puerto Ethernet
- Protecciones galvánicas
- Relés de mando
- 4 Interruptores magnéticos 1P de corriente continua con tensión 24Vcc y 6A de corriente.

- 2 Interruptores Bipolares 16 A PdeC de 35 kA. 230V
- Convertidor 24/12 Vcc para alimentación Unida maestra.
- Unidad Maestra adaptada para sistema radio UHF, WiMax o GRPS.
- Modem GPRS 3G/GSM con comunicación por Ethernet y tarjeta SIM
- Antena Onmidireccional Colineal UHF, 3dB de ganancia, N Hembra, 405-455 MHz o con sistema WiMax
- Protección de sobretensiones Nivel D.

# 3 BALSA INTERMEDIA Y BALSA ELEVADA

## 3.1 EQUIPOS INSTALADOS

Los equipos instalados en cada uno de los puntos serán los siguientes:

- 1 Sensor de nivel por presión hidrostático.
- 1 Boya indicadora de nivel de máximo.
- 1 Sensor de intrusismo en puerta acceso
- 1 Transductor de presión.
- 1 Válvula motorizada

## 3.2 ELEMENTOS A CONTROLAR

Los parámetros a controlar en la balsa intermedia y en la balsa elevada, y las entradas y salidas necesarias para cada elemento serán:

SENSOR DE NIVEL

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Nivel de balsa | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

BOYA DE MÁXMO

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Alarma nivel máximo balsa | 1 | 0 | 0 | 0 |
| **TOTAL** | 1 | 0 | 0 | 0 |

SENSOR LÁMINA PUERTA

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Puerta Arqueta Abierta | 1 | 0 | 0 | 0 |
| **TOTAL** | 1 | 0 | 0 | 0 |

VÁLVULA MARIPOSA MOTORIZADA

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Apertura válvula | 0 | 1 | 0 | 0 |
| Cierre válvula | 0 | 1 | 0 | 0 |
| Válvula Mariposa abierta | 1 | 0 | 0 | 0 |
| Válvula Mariposa cerrada | 1 | 0 | 0 | 0 |
| Selector Automático Válvula | 1 | 0 | 0 | 0 |
| Confirmación Abrir Válvula | 1 | 0 | 0 | 0 |
| Confirmación Cerrar Válvula | 1 | 0 | 0 | 0 |
| Limitador Par Abrir | 1 | 0 | 0 | 0 |
| Limitador Par Cerrar | 1 | 0 | 0 | 0 |
| Defecto Válvula | 1 | 0 | 0 | 0 |
| **TOTAL** | 8 | 2 | 0 | 0 |

TRANSDUCTOR DE PRESIÓN

| Elemento a controlar | Entradas/Salidas necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Presión | 0 | 0 | 1 | 0 |
| **TOTAL** | 0 | 0 | 1 | 0 |

## 3.3 CONFIGURACIÓN NECESARIA

La configuración mínima de Entradas/Salidas que tendrá la unidad Remota para estos puntos será:

| Elemento a controlar | Entradas/Salidas Necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Sensor De Nivel | 0 | 0 | 1 | 0 |
| Boya De Nivel Máximo | 1 | 0 | 0 | 0 |
| Sensor Lámina Puerta | 1 | 0 | 0 | 0 |
| Transductor De Presión | 0 | 0 | 1 | 0 |

| Elemento a controlar | Entradas/Salidas Necesarias | | | |
|---|---|---|---|---|
| | ED | SD | EA | SA |
| Válvula Mariposa Motorizada | 8 | 2 | 0 | 0 |
| **TOTAL** | 10 | 2 | 2 | 0 |

Para la conexión de las señales procedentes de la instrumentación de la balsa intermedia y balsa elevada, como para el envío de órdenes a los elementos de maniobra, se utiliza un autómata de control basado en un pequeño módulo remoto que realiza las siguientes funciones:

- Adquisición, tratamiento, supervisión y maniobra de señalización procedente de la instrumentación y equipos a controlar que componen la balsa, a través de módulos de entradas/salidas digitales, analógicas integradas en el propio módulo.
- Comunicación con la estación de bombeo vía modem Radio y con el centro de control vía modem GPRS.

Los módulos mínimos necesarios para esta instalación para la a balsa intermedia y balsa elevada son:

- Unidad Remota Radio con 10 entradas digitales, 2 salidas digitales y 2 entradas analógicas y con comunicación vía GPRS con protocolo Modbus RTU con la Balsa de San Asensio y centro de control.

Los Equipos al ser estancos con IP66, se montarán directamente en el interior de las arquetas sin necesidad de montaje en el interior de un cuadro.

## 4 COMUNICACIÓN

Habrá diferentes sistemas de comunicaciones:

**COMUNICACIÓN RADIO/GPRS**

El sistema de comunicación de los equipos remotos con la estación de bombeo se realizará mediante el envío y recepción de señales de RADIO de frecuencia libre. En los equipos remotos el módulo propuesto lleva integrada la comunicación vía RADIO. Toda la información y señales de la instalación se concentrarán en el Bombeo desde donde se visualizará y gestionará toda la instalación. Del mismo modo, entre el Bombeo y el Centro de Control ubicado en la Sede de la CR existirá conexión vía GPRS o VPN, desde donde se visualizará y gestionará telemáticamente toda la instalación (bombeo, balsas, tomas, red de riego, etc…), almacenando toda la información de las variables de funcionamiento de todas las infraestructuras, siendo para ello imprescindible que estas señales puedan ser visualizadas en tiempo real desde dicha sede y se almacenen adecuadamente para conservar los históricos de funcionamiento de todas ellas para su análisis.

Las comunicaciones con la unidad maestra (Concentradora) de la estación de Bombeo, se realizarán mediante comunicación Modbus, y se unirán a una red Modbus interior y se comunicarán con el PLC que procesará y gestionará las señales que le llegan de estos módulos remotos vía Unidad Maestra.

Este sistema es escalable, ya que la unidad maestra soporta hasta 128 módulos remotos, para futuras ampliaciones, con la condición que los módulos remotos deberán comunicar mediante el mismo protocolo Modbus.

Dentro de este sistema la unidad maestra actuará como Maestra de las unidades Remotas, y a su vez como esclava del PLC de la estación de bombeo.

**COMUNICACIÓN BUS DE CAMPO**

En el caso del bombeo para la comunicación del analizador de redes, variadores y centro de transformación, y el PLC, se prevé una red Modbus. En este caso el PLC será el maestro de la red, siendo los demás equipos esclavos suyos. Para ello se prevén 3 switches de 8 bocas RJ45 para la intercomunicación.

**COMUNICACIÓN ETHERNET TCP**

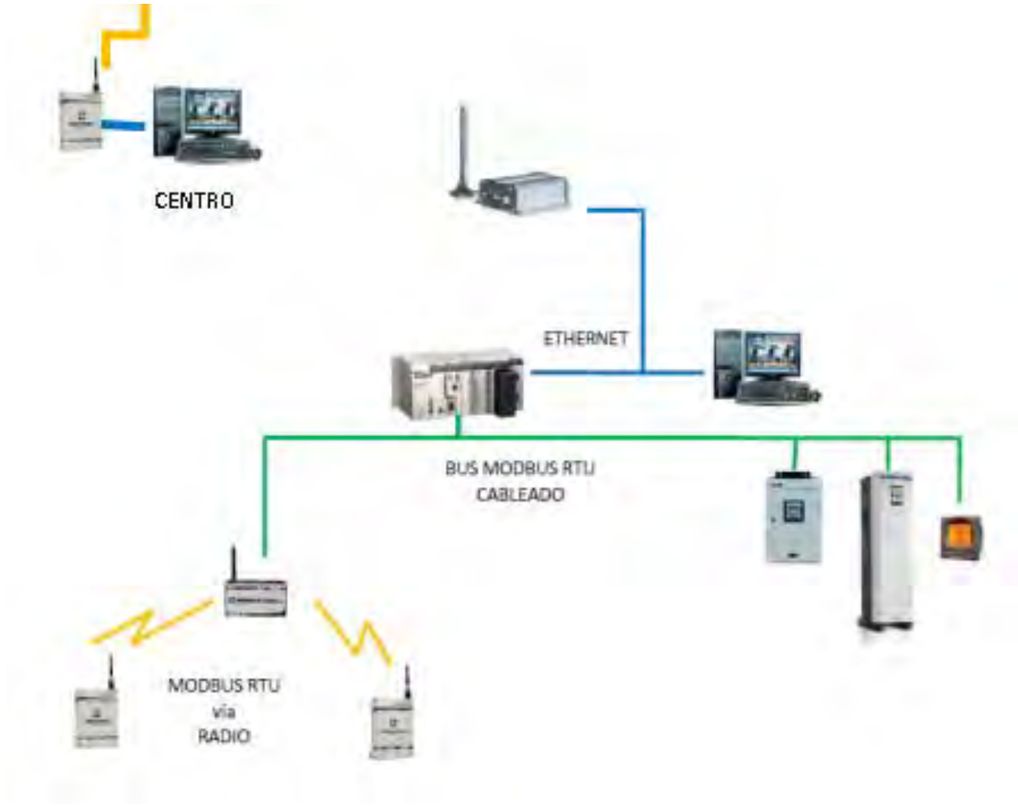
Se prevé la instalación de una red Ethernet con cable tipo UTP Exterior CAT6, con conexiones RJ-45 y Switches de conexión, que comunicará:

- El PLC con el PC con el SCADA del edificio de bombeo, y desde estos, y a través de una comunicación vía GPRS, comunicará con el Centro de Control, es decir con la sede de la CR.
- El sistema de monitorización de señales de tensión e intensidad de las cadenas de módulos, previsto en las diferentes Cajas de Campo nº 1 (CC1-x), y de los sensores de temperatura e irradiancia, con la Caja de Campo nº 2 (CC2). Desde este, y a través de una comunicación vía Fibra Óptica monomodo 9/125 enterrada bajo tubo, comunicará con el PLC y el PC del Bombeo. Usando convertidores de medios PoE 10/100 Base TX a 100 Base-FX para facilitar las conversiones y mantener una alta calidad en las comunicaciones.

Los Conversores de Medios PoE conectan de forma transparente cobre a fibra, al tiempo que proporcionan Power over Ethernet (PoE) a dispositivos que cumplan las normas PoE y PoE+. Este tipo de conversores permitirán incluso la futura conexión de cámaras IP.

Las características principales del conversor de medios son:

- Fibra 10/100/1000Base-T a 100/1000Base-X
- Alimentación IEEE 802.3 PoE & PoE+ PSE
- Compatible con dispositivos PoE antiguos anteriores a la norma
- Puertos de fibra fijos o ranura vacía para SFP Cisco y otros estándar
- Funciones avanzadas: PD Reset, Fiber redundancy, Smart Link Pass-Through, Fiber Fault Alert, Auto-MDIX y Loopback




Las comunicaciones entre sensores y elementos de control con el autómata se realizarán vía cable de comunicaciones apantallado.

# 5 FUNCIONAMIENTO

## 5.1 VÁLVULAS MARIPOSA MANUAL

Se colocarán válvulas manuales de tipo mariposa a la entrada y salida de cada una de las bombas. Estas válvulas serán del tipo todo/nada, y en el caso de las válvulas de admisión se conocerá su estado, mediante un único final de carrera en cada una de las válvulas, el cual será del tipo NC, el cual indicará mediante falta de señal que la válvula está cerrada. En el momento que se manipule dicha válvula y no se encuentre abierta, el PLC tendrá conocimiento mediante dicho Final de Carrera. También se señalizará luminosamente en el armario y saltará una advertencia en el SCADA.

En el by-pass y en la válvula de alivio también se dispondrá de dispositivo final de carrera.

## 5.2 FILTRO AUTOMÁTICO AUTOLIMPIABLE

Estará situado en el colector de admisión del bombeo, justo al inicio de la tubería. Este equipo permitirá tener agua filtrada tanto en la balsa intermedia y en la balsa elevada, y a su vez en las redes de riego. Desde el SCADA se controlará el funcionamiento del mismo, diferencial de presión y tiempo para su activación, estado, y funcionamiento manual o automático, pudiendo ponerlo en marcha o no desde el SCADA.

## 5.3 FUNCIONAMIENTO DEL BOMBEO

El funcionamiento general de la instalación se resume de la siguiente manera. Hay un colector de aspiración y dos colectores de impulsión. El colector de impulsión conecta con las balsas inferiores. Los colectores de impulsión son bidireccionales, de modo que se utilizará para llenar la balsa intermedia y la balsa elevada y a su vez para distribuir el agua en la zona regable dominada desde cada balsa.

Las balsas inferiores se llenarán por presión natural, atreves de la red de acequias, y desde esta se abastecerá al bombeo. A través del bombeo, las balsas inferiores se suministrará agua a la estación de bombeo para la impulsión hasta la balsa intermedia y la balsa elevada. Estas tuberías servirán como elemento de impulsión y distribución a la red de riego dominada desde cada balsa.

Para que esto suceda, será condición indispensable, que exista un nivel mínimo en las balsas inferiores, o que las válvulas de mariposa de entrada a las bombas estén completamente abiertas, y las balsas a las que se eleven tengan capacidad de almacenamiento o exista demanda de agua en la red. Además de esto, las protecciones y los demás equipos de los que dependen deberán estar correctos. Si alguna de estas condiciones no se produjera, no se pondrían en marcha las bombas cuyas protecciones y válvulas no estuviesen en la posición correcta, y ninguna de ellas si la válvula del colector de admisión estuviese cerrada.

## 5.4 FUNCIONAMIENTO DEL SISTEMA DE CONTROL

El sistema estará centralizado y permitirá la supervisión de la instalación, recogida y almacenamiento de datos y gestión del telecontrol de la zona regable en la estación de bombeo. A su vez estas remitirán de forma remota al centro de control de la CR toda la información del estado de las diferentes instalaciones, permitiendo la supervisión de todas las instalaciones, y la recogida y almacenamiento de datos y gestión del telecontrol.

El Centro de control, estará basado en una arquitectura compuesta por un PC, en el cual estará instalado el software de supervisión, control y adquisición de datos (SCADA). También habrá un modem GSM para el envío de SMS de alarmas.

## 5.5 FUNCIONAMIENTO DE LAS VÁLVULAS MOTORIZADAS Y TRANSDUCTORES DE PRESIÓN EN LAS TOMAS DE FONDO DE LA BALSA INTERMEDIA Y LA BALSA ELEVADA

En el caso de las balsas se ha previsto la instalación de válvulas motorizadas, gobernadas por un autómata, el cual, en función de la lectura del transductor de presión y del valor del nivel de balsa pueda accionar el mecanismo de cierre de las válvulas. Este mecanismo se plantea para evitar daños por inundaciones en caso de roturas en las tuberías de la red de riego.

Para ello se motorizará la válvula prevista en la tubería de fondo, ubicada en la arqueta de fondo. Esta válvula quedará gobernada por un autómata que, en función de las lecturas del transductor de presión y el nivel de la balsa, cerrará la válvula, evitando que se vacíe la balsa.

El estado de la válvula y de la presión y nivel será remitido al centro de control a través de la remota existente en la balsa.

En estos casos, al no existir suministro eléctrico convencional, se prevé la instalación de un sistema autónomo de alimentación con placas solares y baterías, que dotará de suministro en corriente continua tanto a la válvula motorizada como al caudalímetro y al autómata. El autómata además incorporará la apertura y cierre manual para la realización de pruebas y puesta a punto.

# ANEJO Nº 15.- TELECONTROL Y TELEGESTIÓN DEL RIEGO

# ANEJO 15. TELECONTROL Y GESTIÓN RIEGO

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# ANEJO 15. TELECONTROL Y GESTIÓN RIEGO

## 1 GENERALIDADES

El presente documento forma parte del "PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA)" y define las características del Telecontrol previsto para el control de la red de riego proyectada, así como la centralización y gestión del riego y de las infraestructuras principales en la sede de la CR, situada en el T.M. de Torralba de Aragón.

El sistema controlará los siguientes elementos:

- 4 balsas:
  - Balsa Inferior Norte
  - Balsa Inferior Sur
  - Balsa Intermedia
  - Balsa Elevada
- 2 redes de riego:
  - Red Piso 1. Abastecido por gravedad desde la balsa Intermedia.
  - Red Piso 2. Abastecido por gravedad desde la balsa Elevada
- 1 estación de Bombeo que bombeará agua a las Balsas Intermedia y Elevada
- 1 Centro de Control, situado en el municipio de Torralba de Aragón

Se deberá gestionar la apertura y cierre de las electroválvulas de los hidrantes, es decir, de la válvula principal y de las tomas en el caso de los hidrantes compartidos, la lectura de sus contadores, y el control de intrusismo en las arquetas. Además, se controlará el riego de forma centralizada, bien por la CR o bien por el usuario a través del acceso web habilitado, por lo que las remotas controlarán las válvulas de sector de cada usuario.

El Telecontrol también tendrá que gestionar la supervisión de los datos de las infraestructuras principales, valvulería control llenado balsas, y nivel de las balsas, así como el control de apertura y cierre de las válvulas motorizadas y lectura de los caudalímetros.

Para la memoria que se presenta se ha elegido un esquema con una arquitectura distribuida con comunicación vía radiofrecuencia libre 433 MHz debido a la orografía, distancias y especificaciones de proyecto y a criterios de ahorro en los costes de explotación e independencia de terceros para mantener las comunicaciones.

En la red de riego se pretende la gestión de 194 hidrantes de tipo único y compartidos desde 1 hasta 10 tomas por hidrante para el control de la válvula general de hidrantes, válvula de toma de parcela y contador y el control de electroválvulas para la sectorización del riego dentro de las parcelas.

## 2 DESCRIPCIÓN GENERAL DEL SISTEMA

### 2.1 PRINCIPALES CARACTERÍSTICAS

Las principales características son:

- Comunicaciones por sistema vía Radio, con banda libre.
- Remotas alimentadas por batería y placa solar fijada en mástil de al menos 4,5 metros de altura.
- Todos los equipos de campo serán IP66.
- Centro de control ubicado en la sede de la CR en el núcleo de Torralba de Aragón.
- Comunicación bidireccional entre elementos de control a balsas, obra de toma y redes de riego para el control de averías o anomalías en el funcionamiento.
- Gestión del riego a nivel de sector de parcela. La gestión del riego podrá ser realizada por la CR o por el usuario a través del acceso web habilitado, en este caso deberá las nuevas programaciones deberán ser validadas por la CR.
- Acceso Web para usuarios para gestión de hidrantes

Comunicaciones centralizadas en el centro de control. Desde este se visualizará el estado de las principales infraestructuras. Además, deberá recopilarse y almacenarse toda la información procedente de la automatización del bombeo, pudiéndose visualizar en tiempo real todos los parámetros de los equipos e infraestructuras que dependen de ella (balsas, etc.), y pudiendo actuar sobre la distribución horaria y programación del bombeo.

Desde el Centro de Control deberá poder analizarse el funcionamiento actual y pasado de las instalaciones, en las diferentes variables, de forma unificada o combinada.

Del mismo modo, el programa de gestión ofrecerá una total gestión de la red de riego, con consultas del estado de todos los hidrantes mediante sinópticos con visualización y tratamiento de GIS y catastral, planificación riegos, gráficos, avisos a móviles de alarmas del sistema y exportar de la base de datos los consumos de cada agricultor para su facturación, generación de facturas y ficheros bancarios.

Para ello se instalará todo el equipamiento completo para la adecuada gestión (PC, impresora, software y licencias, servidor, SAI, etc.

La visualización del SCADA estará adaptado a la obra ejecutada, siendo realista, tanto en el número y tipo de equipos, distribución, colectores, etc. Dispondrá de una pantalla de gran formato (85”) para visualización en la oficina de la CR en el que poder visualizar el estado de la instalación a tiempo real, complementaria al monitor del PC de control, o, si se precisa en un momento dado, actuar como escritorio remoto del PC de gestión.

## 2.2 ESTRUCTURA BÁSICA DEL SISTEMA

El sistema que aquí se describe se encargará del telecontrol y telegestión de la red de distribución en hidrantes de campo, llevando el control sobre las válvulas hidráulicas y contadores para cada arqueta de riego con las llamadas Unidades de Control Remoto (UCR) en adelante Módulos Radio (MR).

En los hidrantes únicos se pretende el control de la apertura y cierre de la válvula general de hidrante, la lectura de su contador y la apertura y cierre de todas las válvulas de sector, y en los hidrantes compartidos, además de lo anterior, se llevará el control sobre la apertura y cierre de cada una de las tomas de riego y lectura de sus contadores.

Además, el sistema de Telegestión permitirá el control sobre lecturas de transductores de presión en la red hidráulica, niveles de las balsas de regulación, caudalímetros principales de red, ordenes de apertura y cierre de válvulas motorizadas y de regulación según niveles de balsa y condiciones en la red hidráulica, y visualización de los datos más relevantes, en el software de gestión, referente al estado de los elementos principales de la red (válvulas motorizadas, presiones, caudalímetros, etc.), y pormenorizadamente de los sectores de parcela y su estado referente al riego.

Para la gestión de los elementos integrantes de la red de riego (194 hidrantes, las 4 balsas y obra de toma), se ha escogido un sistema vía Radio 433 MHz con la propuesta de:

- 8 unidades Módulos Radio 4-42 para la gestión de hasta 4 electroválvulas de 2 hilos ó salidas digitales, 4 contadores ó entradas digitales y 2 sensores ó entradas analógicas.
- 60 unidad Módulo Radio 10-102 para la gestión de hasta 10 electroválvulas de 2 hilos ó salidas digitales, 10 contadores ó entradas digitales y 2 sensores ó entradas analógicas.
- 132 unidad Módulo Radio 16-162 para la gestión de hasta 16 electroválvulas de 2 hilos ó salidas digitales, 16 contadores ó entradas digitales y 2 sensores ó entradas analógicas.
- 3 unidades concentradoras con radiomódem y protocolo ModBus.

La estructura del sistema por cantidad de módulos y distribución de los mismos requerirá de los siguientes equipos:

| DESCRIPCION EQUIPOS | UD. SISTEMA RADIO |
|---|---|
| ORDENADOR CENTRAL COMPLETO + IMPRESORA + PANTALLA AUXILIAR 85” LED TECNOLOGY, 4K UHD, EF.ENERG. “E” | **1** |
| SERVIDOR + SAI | **1** |
| PROGRAMA AGRÓNIC NET II/PC | **1** |
| MODEM GSM/GPRS para gestión alarmas | **1** |
| RADIO MODEM 1 W para comunicaciones PC/ Concentradora | **1** |
| CONCENTRADORA (ER+RADIOMÓDEM) en Hidrantes | **3** |
| MÓDULO RADIO 433 Mhz 4-42 PS | **2** |
| MÓDULO RADIO 433 Mhz 10-102 PS | **60** |
| MÓDULO RADIO 433 Mhz 16-162 PS | **132** |

| DESCRIPCION EQUIPOS | UD. SISTEMA RADIO |
|---|---|
| MÓDULO RADIO 433 Mhz 4-42 PS- en balas | **4** |
| MÓDULO A RADIO 433 Mhz 4-42 PS- en válv. seccionamiento | **2** |
| LECTOR RADIO | **1** |
| TRANSDUCTOR DE PRESION 4-20 mA | **8** |
| Acceso Web para usuarios para gestión de hidrantes | **1** |

## 2.3 TOPOLOGÍA DE LA RED DE COMUNICACIONES

Usando radiofrecuencia libre 433 MHz se traspasará toda la información de los Módulos Radio (MR) a los Enlaces Radio (ERs) y mediante puerto serie RS-485 ó Radio módems 1W 446 MHz se traspasará esta misma información al Centro de Control.

Las Concentradoras (ER) se ubicarán estratégicamente en la red, como resultado del estudio radioeléctrico sobre el terreno, según condicionantes del tipo:

- Distancia de alcance de las emisoras 433 MHz
- Orografía para visibilidad de las antenas.
- Capacidad máxima del Enlace Radio: cada Enlace Radio 433 MHz puede llevar hasta 60 módulos Radio).
- Fuentes de alimentación.

Debido a las distancias y la orografía se habilitarán el número necesario de módulos MODULO RADIO como repetidores para garantizar la total cobertura de la red a determinar en la prueba de cobertura.

Las concentradora ubicadas en la red de riego se enlazarán con el Centro de Control mediante radiomódems de 1W.

En las oficinas de la comunidad de Regantes se ubicará un servidor con el programa de gestión que de una forma muy dinámica y personalizada ofrecerá una total gestión de la red de riego, con consultas del estado de todos los hidrantes mediante sinópticos con visualización y tratamiento de GIS, gestión catastral del parcelario, planificación riegos a nivel de sector de parcela, gráficos, avisos a móviles de alarmas del sistema y exportar de la base de datos los consumos de cada agricultor para su facturación, generación de facturas y archivos de facturación bancarios.

## 2.4 ELEMENTOS A CONTROLAR POR CADA PARCELA

Desde el Centro de Control para cada hidrante se podrá visualizar y actuar sobre:

- Electroválvulas, sobre las cuales actuará para su apertura y cierre controlando el paso del agua y gestionando su estado de la manera más eficiente, realizando la apertura y cierre de las válvulas por demanda manual o programa de riego, pudiendo también, si se quisiera, hacerlo por condicionantes con la instalación de sensores. Tanto generales, de toma y de sector de parcela, permitiendo el riego desde la CR o a través del acceso web de los usuarios.

- Contadores, para la lectura de los volúmenes de agua consumidos por hidrante y así poder facturar a cada parcela la cantidad total consumida. Las entradas digitales tienen una frecuencia de contaje inferior a 2 pulsos por segundo y con totalizador para acumulados integrado en la misma placa electrónica de hasta 65.535 pulsos.

- Entradas digitales, para alarmas de intrusión, presostatos de mínima o máxima y otros sensores de todo/nada.

- Sensores analógicos, lectura de transductores de presión, sondas con transmisor de humedad del suelo, radiación, temperatura, etc. con salida de señal de 4-20 mA que se pudieran tener instalados Esto posibilita el tener una lectura en todo momento de los parámetros ambientales y del suelo que más puedan afectar al cultivo.

### 2.5 ELEMENTOS A CONTROLAR POR CADA MÓDULO RADIO

Tanto desde el Centro de Control como desde el propio Módulo Radio se podrá visualizar:

- El nivel de carga de la batería: se pueden gestionar avisos en el Centro de control si los niveles de carga de baterías son inferiores a 3,6 V, indicando su sustitución o verificación por nivel bajo.
- El nivel de cobertura radioeléctrica, señal RSSI, cuyo rango es de -35 dbm hasta 110 dbm: se pueden gestionar avisos de fallos de comunicación si los niveles de RSSI son inferiores a valores de 40 dbm.
- Alarma de intrusismo por activación de entrada digital en la UCR habilitada al efecto.

## 3 COMUNICACIONES

Las comunicaciones se realizarán mediante el envío y recepción de señales de radio con tecnología de radiofrecuencia bidireccional de muy bajo consumo usando una banda del espectro radioeléctrico de frecuencia 433 MHz.

Se trata de una arquitectura con dos eslabones bien diferenciados:

- Las Concentradoras (ER) comunican con el Centro de Control utilizando un protocolo de comunicación ModBus con una velocidad de transmisión de 19.200 bps. mediante Radiomódems 446 MHz UHF 1W con necesidad de legalización.
- Las Unidades Maestras (Concentradoras) comunica periódicamente vía radiofrecuencia con el resto de los Módulos Radio utilizando un "polling" de comunicación para un máximo de 1 minuto. Es decir, cada Concentradora comunica cada segundo con uno de los 60 posibles Módulos de radio que soporta la aplicación.
- Los módulos podrán trabajar también como repetidores y enlazar con unidades que no tienen visibilidad desde su Concentradora y, así, adaptarse con mayor facilidad a las dificultades orográficas del medio rural.

## 4 ALIMENTACIÓN

La tecnología será de muy bajo consumo y la alimentación de cada uno de los equipos estará en función de la disponibilidad de energía, pudiendo ser con pilas de litio, a través de panel solar o con transformadores 220/12 Vdc.

### 4.1 ALIMENTACIÓN UCR

Las fuentes utilizadas se resumen en el cuadro adjunto según consumo del equipo Módulo Radio 433 MHz

| | | |
|---|---|---|
| Fuente de alimentación: | Solar: 7,5V \ 2W --> 3,6V | Pack batería de Ni-MH (2,4 Amp / 7,2 W) de alta temperatura. |
| | Solar: 12V \ 5W --> 3,6V | |
| | Pila: 3,6 Vcc | Pack de Litio alta descarga |

Se puede alimentar con panel solar y baterías recargables de Níquel-Metalhidruro, según las nuevas normativas ROHS de medioambiente para este tipo de materiales.

Los paneles solares son de 2 vatios, montados sobre una base de acero inoxidable y con una cubierta de 4 mm de metacrilato, que los protege de impactos externos. Sus dimensiones son: 31,2 cm de longitud por 16 cm de anchura integrándose de forma fácil y sencilla en el medio y siendo poco vulnerables a vandalismos por su dimensión y pequeña capacidad de carga (solamente la necesaria para los módulos y los elementos sobre los que actúa).

La duración estimada de las baterías será de:

| TIPO | En un MR no repetidor de primer nivel | En un MR repetidor de 10 MRs |
|---|---|---|
| Con batería 2,4 Amp NiMh para panel solar | 3 meses | 15 días |
| Con batería 4,0 Amp NiMh para panel solar | 15 meses | 25 días |

Se puede optar por la utilización de baterías de Ni-Mh que se cargan a través de panel solar de 5 W para todos los módulos aun siendo repetidores, cuya duración estimada es de 10 años.

O por la alimentación con pack de pilas de litio de alta descarga. La duración estimada de las pilas es:

| TIPO | En un MR no repetidor de primer nivel | En un MR repetidor de 10 MRs |
|---|---|---|
| Pack de 4 pilas de Litio 56 A | > 5 años | > 10 meses |

### 4.2 ALIMENTACIÓN CONCENTRADORA ER

Las concentradoras ER ubicadas en los hidrantes se alimentan mediante placas solares 12 Vca, que dependerá del consumo del conjunto ER con radiomódem 0,5W-4W.

El equipo debe instalarse en un lugar donde esté protegido de la luz solar y de la lluvia. El equipo va alojado en una caja hermética con tapa frontal opaca. Para mantener la estanqueidad es necesario dejar la tapa siempre cerrada y los prensaestopas por los que salen cables bien ajustados. Los prensaestopas que no se utilizan dejarlos siempre con el tapón original.

La sujeción mural se hace por las cuatro piezas agujereadas de las cuatro esquinas de la caja.

Es necesario incluir en la instalación un interruptor magnetotérmico de 6 amperios que, marcado como dispositivo de desconexión, esté próximo al equipo y accesible por el usuario.

| | | |
|---|---|---|
| Alimentación ER | 12 / 24 Vcc / 12Vca, -10% +25% | |
| | Fuente de alimentación sin protección contra sobreintensidades en la salida de la fuente | VOC ≤ 30 V<br>ISC ≤ 8 A<br>S ≤ 100 VA |
| | Fuente de alimentación con protección contra sobreintensidades en la salida de la fuente (5 A) | VOC ≤ 20 V<br>ISC ≤ 1000 / VOC<br>S ≤ 250 VA |
| Consumos medios | 120 mA. | |
| Fusible | 0,9 Amp., automático con auto rearme. | |

## 5 INSTALACIÓN

La instalación de los equipos precisa de personal cualificado para tener garantía de una correcta instalación y verificación. Tan importante como las propias prestaciones de los equipos es su correcto montaje para asegurar un buen funcionamiento del sistema.

Es necesario aplicar los protocolos de instalación y puesta en marcha para asegurar su correcta instalación.

### 5.1 INSTALACIÓN UNIDAD CONTROL REMOTO UCR

Todos los Módulos Radio (MR) cumplen con todas las normativas exigibles y el diseño de los equipos facilita su instalación y ampliación.

Ofrece facilidades como son: montar las placas electrónicas en cajas para carril DIN, ampliar sin necesidad de desmontar el equipo, utilizar bornes extraíbles para una mejor conexión y disponer de los prensaestopas necesarios según el modelo de módulo.

Condiciones ambientales para su instalación:

| | |
|---|---|
| Temperatura | -10 °C a 70 °C |
| Humedad | < 85% |
| Altitud | 2000 m |
| Polución | Grado II |

Peso:

| | |
|---|---|
| Peso (aproximado) | 1,0 kg. (batería incluida) |

Dimensiones:

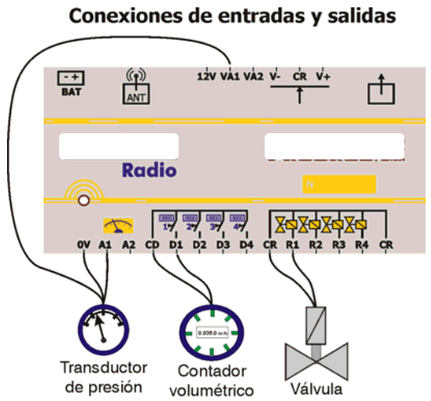
| | Caja estándar | Caja con ampliación |
|---|---|---|
| Alto | 180 mm | 180 mm |
| Ancho | 182 mm | 254 mm |
| Profundo | 90 mm | 90 mm |

Instalación en caseta

Las cajas se deben anclar en la arqueta del hidrante con tacos reforzados de sujeción y con los cableados alojados dentro de canaletas o tubos corrugados para su protección. (Ver fotos)

Cableado de señales

Se deberán conectar las diferentes salidas y entradas digitales y entradas analógicas a los elementos sobre los que actúan, asegurando la estanqueidad de los empalmes utilizando conectores tipo 3M. Una vez hechas las conexiones para mantener la estanqueidad de las cajas, que son de protección IP 66, es necesario dejar la tapa siempre cerrada y los prensaestopas por los que salen cables bien ajustados, dejando los prensaestopas que no se utilizan siempre con el tapón original.




- **Consumo volumétrico:** Conectar los dos hilos del emisor de pulsos de cada contador del Hidrómetro en las entradas digitales habilitadas a tal efecto del Módulo Radio (MR), conexionando un hilo en la borna CD y el otro hilo al Dx.

- **Estado de la válvula Apertura/Cierre:** Conectar los dos hilos o tres hilos de cada solenoide instalado en las salidas digitales habilitadas a tal efecto del MR, conexionando un hilo en la borna CR y el otro hilo al Rx.

- **Alarma intrusión:** Conectar los dos hilos del imán en contacto NC a una entrada digital libre del MR, conexionando un hilo en la borna CD y el otro hilo al D nºX.

- **Entrada analógica:** Alimentar el sensor con una conexión a la borna VA1 y la masa a la borna 0V, mientras la lectura de señal se conecta a la borna entrada A1. En el momento de lectura, el MR da alimentación sobre el sensor.

Instalación de antenas

Para el sistema radio ofertado 433 MHz utilizamos antenas según alcances y radios de cobertura:

Para el sistema radio 433 MHz utilizamos antenas Yagi de 1 elemento y 4,3 dBi de ganancia para los módulos no repetidores y para los módulos repetidores utilizamos la misma antena en una disposición diferente. En el primer caso las antenas funcionan como antenas directivas y en el segundo como omnidireccionales. (Ver esquemas).

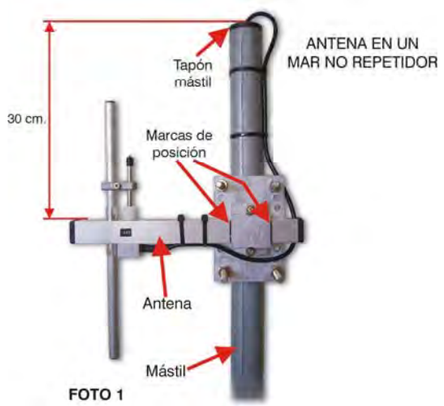


FOTO 1

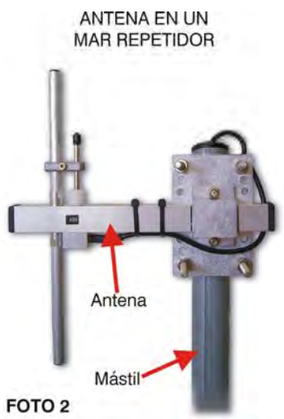
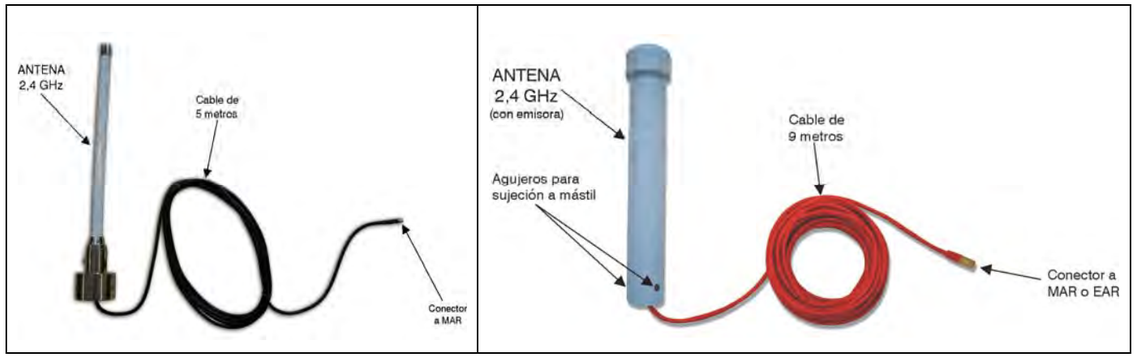


FOTO 2

Antenas módulos repetidores

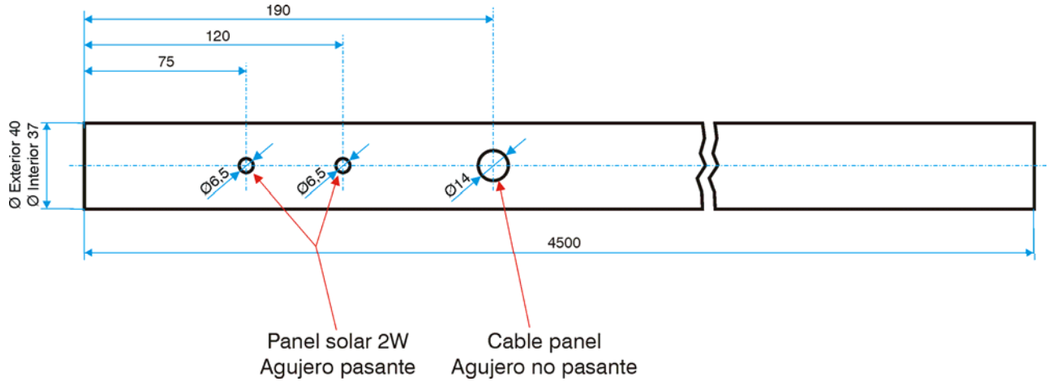



Ambas antenas van alojadas sobre mástil de hierro galvanizado mediante un soporte metálico o a un acoplador. Se colocan en el mástil y mediante cable de 5/6 m de longitud alojado en el interior del mástil, se rosca a un conector del módulo.

Las antenas se deben orientar o con plantillas o con brújulas sobre el plano donde se ubican los Enlaces Radio. En primer lugar, se conectan las antenas de los Enlaces Radio para después orientar las antenas de los módulos receptores para asegurar comunicaciones.

Instalación del Mástil

El mástil para los Módulos Radio es de 4,5 metros de longitud y 40 mm de diámetro mecanizado para la sujeción del soporte del panel solar y del cable de alimentación.

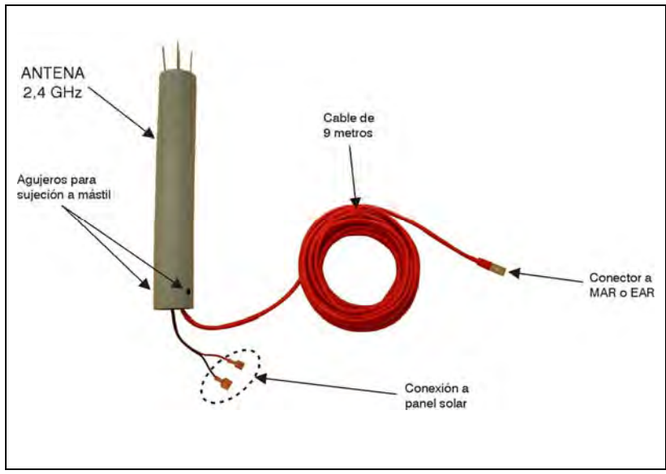



Para su instalación se fija a la arqueta con grapas y ángulos de fijación. Se puede instalar por la parte interior de la arqueta, haciendo un agujero tipo "corona" en la parte superior de la tapa o bien en la pared exterior de la arqueta y pasar cable antena y alimentación del panel solar.

## 5.2 INSTALACIÓN CONCENTRADORA ER

La antena omnidireccional 3 dbi en los Enlaces Radio (ER) va alojada sobre mástil de hierro galvanizado de 6 m o superior y mediante cable de 9 m de longitud alojado en el interior del mástil con conector RJ-45 en el otro extremo para conectar a la ER.

Además, se deberán instalar las antenas directivas de 5 elementos de los Radio Módem 1W de 11dbi con mástil de 6m.



Condiciones ambientales para su instalación:

| Ambiente | |
|---|---|
| Temperatura | -10 °C a 70 °C |
| Humedad | < 85% |
| Altitud | 2000 m |
| Polución | Grado II |

Peso y dimensiones:

| Peso y dimensiones (aproximado) | |
|---|---|
| Peso | 1,0 Kg. |
| Alto | 180 mm. |
| Ancho | 254 mm. |
| Profundo | 90 mm. |

### 5.2.1 ALIMENTACIÓN

Se alimenta 12 Vca mediante placas solares, que dependerá del consumo del conjunto ER con radiomódem 0,5W-4W que para tres de los casos se necesitará un de 75W con baterías de gel sílice de 120 A/h y regulador y en para el caso del ER configurado como repetidor se necesitará un panel solar de 230 con baterías de gel sílice de 385 A/h y regulador.

El equipo debe instalarse en un lugar donde esté protegido de la luz solar y de la lluvia. El equipo va alojado en una caja hermética con tapa frontal opaca. Para mantener la estanqueidad es necesario dejar la tapa siempre cerrada y los prensaestopas por los que salen cables bien ajustados. Los prensaestopas que no se utilizan dejarlos siempre con el tapón original.

La sujeción mural se hace por las cuatro piezas agujereadas de las cuatro esquinas de la caja.

Es necesario incluir en la instalación un interruptor magnetotérmico de 6 amperios que, marcado como dispositivo de desconexión, esté próximo al equipo y accesible por el usuario.

# 6 ESPECIFICACIONES TÉCNICAS DE LOS EQUIPOS

## 6.1 UNIDAD CONTROL REMOTA (UCR)

Los módulos externos vía radio que se presentan en esta propuesta y que gestiona el sistema son los Módulos Radio 433 MHZ

| ***Salidas digitales tipo Latch*** | ***Entradas*** | ***Digitales /Analógicas*** |
|---|---|---|
| Número: 4 / 10 / 16 | Número | 4 / 10 / 16 |
| 12 Vcc ó 16 Vcc configurable | Tipo | contacto libre de potencial |
| Tiempo de disparo: 80 ms | Número | 2 (10 bits) |
| Carga de condensador: 3300 µF | Tipo | analógicas 4 – 20 mA |

Siendo la comunicación vía radio, la fuente de energía para alimentar a los módulos debe de ser autónoma y su estado conocido en todo momento en la central. Como fuente de alimentación se proponen dos alternativas:

- La utilización de panel solar, ofrece un menor coste de mantenimiento pues las baterías tienen una vida útil de al menos 10 años.
- La utilización de pilas de litio, ofrece un menor coste de implantación para las unidades remotas mantenimiento y mantienen una vida útil de al menos 3 años.

Las prestaciones principales de los módulos son las siguientes:

Disponen de microcontrolador de 16 bits de bajo consumo con Watchdog y reloj calendario en tiempo real, memoria Flash, Ram y EEprom con registro de acumulados. Permiten en todo momento, la lectura y control de los elementos conectados al sistema, que pueden ser principalmente:

a) Solenoides tipo latch de 2 hilos, sobre los cuales se actuará para su apertura y cierre controlando el paso del agua en la válvula y gestionando este bien de la manera más eficiente.

b) Contadores, para la lectura de los volúmenes de agua consumidos por hidrante y así poder facturar a cada parcela la cantidad total consumida. Cuando se trabaje con bombeo se puede discriminar por horario en función del coste de la electricidad dependiendo de las horas punta y demás. Las entradas digitales tienen una frecuencia configurable de hasta 5 pulsos por segundo y con totalizador para acumulados integrado en la misma placa electrónica.

c) Entradas digitales, para alarmas, presostatos de máxima o mínima y otros sensores de este tipo.

d) Sensores analógicos, para todo tipo de sensores 4-20 mA y tensiones de 0-2,5 V, pudiendo ser de humedad del suelo, radiación, temperatura, etc. Esto posibilita el tener una lectura en todo momento de los parámetros ambientales que más puedan afectar al cultivo.

Los Módulos Radio 433 MHz tienen capacidad para ejecutar programas de forma directa y con autonomía respecto del centro de control en caso de pérdida de la comunicación. De esta forma, pueden trabajar de forma independiente y dan una mayor seguridad de funcionamiento a la comunidad.

Los módulos pueden ser también repetidores y enlazar con unidades que no tienen visibilidad desde el ER, y así adaptarse con mayor facilidad a las dificultades orográficas del medio rural. Un solo Enlace Radio puede conectarse a distintos módulos, aunque sean de distintas salidas, lo que permite llegar a distancias con un radio de acción de hasta 2,5 Km. Los módulos que se utilicen como repetidores de nivel 1 debido a su bajo consumo se pueden alimentar incluso con pilas de litio asegurando una autonomía de al menos 1 campaña de riego.

Cualidades de los equipos:

**Fiabilidad.** Al ser un sistema de comunicación vía radio, permite evitar los problemas que comúnmente puede generar el cable en algunas instalaciones. Resuelve de forma clara la seguridad en las instalaciones al tener un control constante y libre.

**Seguridad** en los datos transmitidos**.** El envío de los datos siempre se realiza de forma codificada y con un código de seguridad que evita actuaciones involuntarias. Por lo tanto, aunque haya interferencias, el módulo sólo actuará cuando reciba la información completa del controlador.

**Robustez.** El módulo va alojado en una caja IP67 y con protección contra cortocircuitos integrada en el módulo.

**Adaptabilidad** a las necesidades del usuario. Debido a los diferentes modelos disponibles, se puede encontrar siempre la unidad más conveniente según los requerimientos del usuario, el medio en el que se encuentra y las necesidades energéticas que se tengan. Además de ser integrables con otros sistemas.

**Escalabilidad.** Estos módulos MR 4-42 son ampliables incorporando los elementos que añaden 4 entradas y salidas al mismo, y 16, que añaden 12 salidas y entradas. Una sola caja de enlace puede controlar de 60 a 120 módulos vía radio en función de la configuración según frecuencia utilizadas 433 MHz ó 2,4 GHz, aunque sean de distintas salidas, lo que permite llegar a distancias con un diámetro de acción de 10 Km. Se podría afirmar que no hay instalación, comunidad o área regable que no pueda ser controlada por este sistema.

**Independencia.** Poder hacer redes de módulos vía radio que cubran las extensiones que convengan, pudiendo trabajar de forma independiente, si es la voluntad del usuario, de una forma descentralizada mediante un enlace a la página web con el password de acceso adecuado a cada usuario.

**Programación.** Los Módulos Radio 433 MHz y 2,4 GHz tienen capacidad para ejecutar hasta 20 programas de forma directa y con autonomía respecto del centro de control en caso de pérdida de la comunicación. De esta forma, pueden trabajar de forma independiente y dan una mayor seguridad de funcionamiento a la comunidad.

## 6.2 CONFIGURACIÓN ENLACE RADIO (ER) PARA CONEXIÓN A MÓDULOS RADIO

La configuración del ER se realiza desde cualquier equipo que tenga comunicación mediante el protocolo ModBus Cliente. Por ejemplo, se puede hacer desde un PC que disponga de un programa de comunicación ModBus.

Los parámetros de configuración se guardan en registros de salida ("holding registers"). Los parámetros son los siguientes:

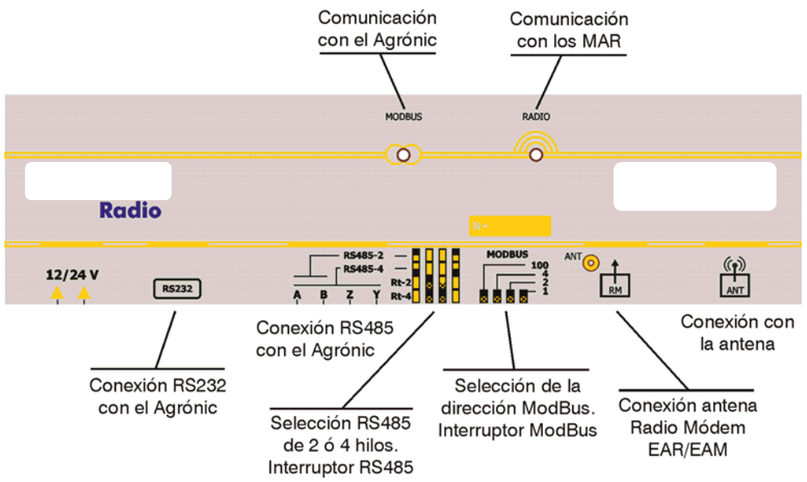
- Velocidad de transmisión del ModBus: registro 6. 0=1200 bps, 1=2400 bps, 2=4800 bps, 3=9600 bps, 4=19200 bps, 5=38400 bps. Esta velocidad debe coincidir con la configurada para el ModBus del Enlace. Por defecto sale de fábrica a 19200 bps.
- Paridad usada en el ModBus: registro 7. 0=ninguna, 1=par, 2=impar. Esta paridad debe coincidir con la del ModBus del Enlace. Por defecto sale de fábrica como paridad par.
- Canal: registro 8. De 1 a 99. El canal radio usado para la comunicación debe coincidir con el configurado en los MR. Las frecuencias que utilizan los 99 diferentes canales van de los 433,200 a los 434,425 MHz.
- Código de red: registro 11. De 0 a 99. Número identificativo que se envía a los MR para evitar interpretar datos de otros Enlaces cercanos. En los MR se debe configurar el mismo código de red.
- Intentos MR: registro 10. De 5 a 60. Número de veces que debe fallar la comunicación con un MR antes de marcar anomalía.
- Suspender Enlace Radio: registro 12. 0 = funcionamiento normal, 1 = MRs suspendidos. Para ahorrar pila en los periodos en que no se vaya a regar pueden suspenderse los MRs. En este estado el consumo baja y se alarga la duración de las baterías. En modo suspendido los MRs no pueden activar salidas ni contar pulsos de contadores.

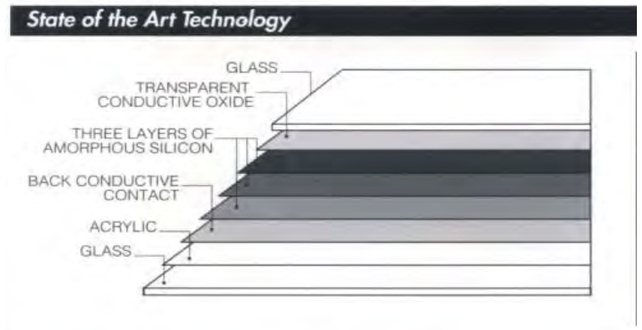
Otro parámetro de configuración del ModBus es la dirección del ER, pero este parámetro no se configura en ningún registro, se configura mediante los interruptores que hay en la parte inferior del ER. La dirección configurada debe coincidir con la programada en él Enlace.

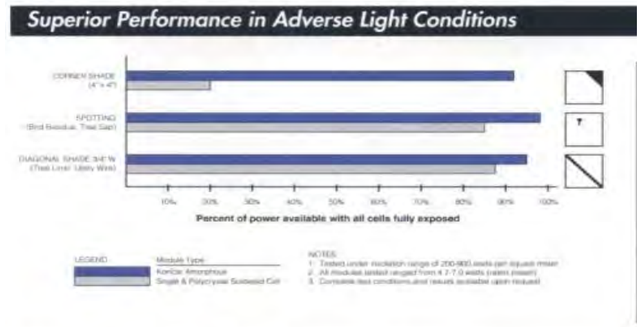
Las posibles direcciones pueden ser:

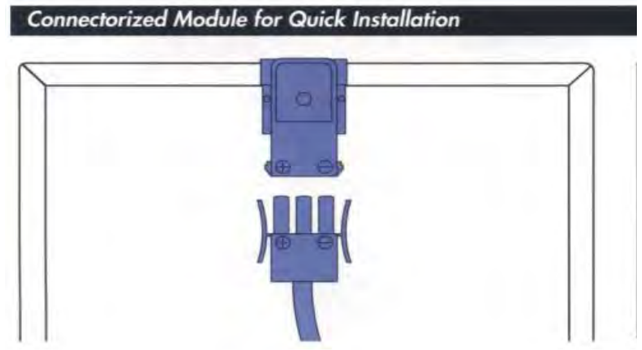
| Interruptor *MODBUS* | | | | Dirección |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | |
| off | off | off | off | no válido |
| off | off | off | on | 1 |
| off | off | on | off | 2 |
| off | off | on | on | 3 |
| off | on | off | off | 4 |
| off | on | off | on | 5 |
| off | on | on | off | 6 |
| off | on | on | on | 7 |

| Interruptor *MODBUS* | | | | Dirección |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | |
| on | off | off | off | 100 |
| on | off | off | on | 101 |
| on | off | on | off | 102 |
| on | off | on | on | 103 |
| on | on | off | off | 104 |
| on | on | off | on | 105 |
| on | on | on | off | 106 |
| on | on | on | on | 107 |




Configuración Módulos Radio (MR)

La configuración del MR se realiza con el suministro de los equipos, pero mediante el Lector Módulos se pueden configurar de nuevo los parámetros de su funcionamiento.

### 6.3 PANEL SOLAR Y PILAS

Los Módulos Radio (MR) propuestos para este estudio se alimentarán con un pack de 3 baterías de Ni-Mh que se alimentan mediante panel solar de 2W ó 5W en caso de módulos repetidores.

# Technical data

## DEFINITIONS

- [illegible] plate shall be defined as a [illegible] photovoltalc device on a glass substrate protected with a roler coated film medium (SP Series).
- [illegible] module shall be defined as a [illegible] photovoltaic device on a glass substrate protected with a glass to glass, edge seal and frame encapsulating system (SM Series).
- [illegible] modules SM series framed with aluminium frame over the polymer (SM Al Series).
- The short circuit current, Isc is defined as the current when there is no voltage across the load at STC.
- The open circuit voltage, Voc is defined as the voltage when no current is being drawn at STC.
- The specified voltage, Vspec is the voltage at which the circuit is designed to draw current from the PV device.
- The peak wattage is defined as the product of current and voltage at the peak power point; that is, Wpeak = Ipeak x Vpeak at STC.
- The Standard Test Conditions (STC) shall be defined as Insolation = 1000 W/m². Module Temperature = 25°C Air Mass = 1,5.
- The NOMT (Nominal Operating Module Temperature) is 45°C under test conditions with an ambient temperature of 25°C The relative temperature coefficient for a typical device are voltage (Voc): - 0,33%/°C; Curent (ISC): + 0,09%/°C; Power: - 0,23%/°C.

## QUALITY CONTROL

- Thermal cycling and shock test
- Thermal / Freezing and high humidity cycling test
- Electrical insulation test
- Hail impact test
- Mechanical, wind and twist loading test
- Salt mist test
- Light and water-exposure test
- Field exposure test
- Environmertally friendly packing materials

Amorphous
Thin - Film Tehnology
Stabilized/artificially aged
Low Cost, Many Standard Sizes, Modular
Effective in sun obstructed positions/shades/clouds
5-year warranty

can be made in sizes to suit requirements

| MODEL | SIZE EU (mm) | Vspec (V) | I at Vspec (mA) | Wpeak MAX (W) | Wpeak STABILE (W) | Voc Typical (V) | Isc Typical (mA) |
|---|---|---|---|---|---|---|---|
| SP 112 | 305x305 | 14,5 | 276 | 5 | 4 | 22,5 | 330 |
| SP 106 | 153x305 | 14,5 | 138 | 2,5 | 2 | 22,5 | 165 |
| SP 061 | 153x305 | 7,5 | 240 | 2,5 | 2 | 11 | 330 |
| SP 0606 | 153x153 | 7,5 | 133 | 1,2 | 1 | 11 | 165 |
| Glass thickness 2 mm or 3 mm | | | | | | | |

S_____M

| MODEL | SIZE EU (mm) | Vspec (V) | I at Vspec (mA) | Wpek MAX (W) | Wpeak STABILE (W) | Voc Typical (V) | Isc Typical (mA) |
|---|---|---|---|---|---|---|---|
| SM 136 | 308x920x8 | 14,5 | 828 | 14 | 12 | 22,5 | 990 |
| SM 118 | 308x463x8 | 14,5 | 414 | 7 | 6 | 22,5 | 495 |
| SM 112 | 308x310x8 | 14,5 | 276 | 5 | 4 | 22,5 | 330 |
| SM 106 | 308x157x8 | 14,5 | 138 | 2,5 | 2 | 22,5 | 165 |
| SM 061 | 157x308x8 | 7,5 | 266 | 2,5 | 2 | 11 | 330 |

easy mounting on support structures

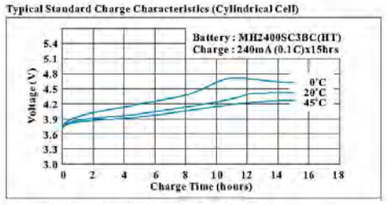
| MODEL | SIZE EU (mm) | Vspec (V) | I at Vspec (mA) | Wpek MAX (W) | Wpeak STABILE (W) | Voc Typical (V) | Isc Typical (mA) |
|---|---|---|---|---|---|---|---|
| SM Al 136 | 312x923x25 | 14,5 | 828 | 14 | 12 | 22,5 | 990 |
| SM Al 118 | 312x465x25 | 14,5 | 414 | 7 | 6 | 22,5 | 495 |
| SM Al 112 | 312x312x25 | 14,5 | 276 | 5 | 4 | 22,5 | 330 |
| SM Al 106 | 312x160x25 | 14,5 | 138 | 2,5 | 2 | 22,5 | 165 |

# NIMH RECHARGEABLE CYLINDRICAL BATTERY

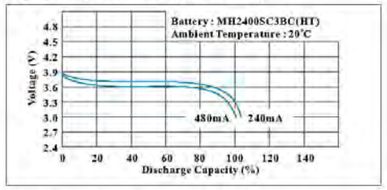
## *SPECIFICATIONS*

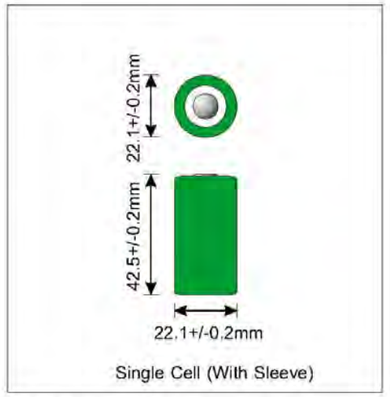
| | | |
|---|---|---|
| Model | : | MH2400SC3BC(HT) |
| Description | : | NiMH rechargeable battery, 'SC' size, flat cap, high temperature |
| Nominal Capacity | : | 2400 mAh at 480mA rate discharge |
| Nominal Voltage | : | 3.6 Volt |
| Cut-Off Voltage | : | 3.0 Volt |
| End of Charge Voltage | : | <= 4.8 Volt |
| End of Discharge Voltage | : | >= 2.7 Volt |
| Weight | : | 165 gram |
| Internal Impedance | : | <=15mOhm per unit cell (1KHz AC test upon full charge) |
| Life Duration | : | >= 50 cycles (Comply to IEC 61951-2 2nd Ed. 2003-04) |
| Charge | : | Trickle - 120-240 mA<br>Standard - 240 mA x 14-16 hours |
| Recharge | : | Every 3-6 months recommended |
| Temperature Environment | : | Standard and Trickle charge - 0 degC to 70 degC<br>Discharge - -20 degC to 70 degC<br>Storage - -20 degC to 30 degC |
| Permanent Charge | : | Comply to IEC 61951-2 2nd Ed. 2003-04 Section 7.4.2.3 |
| Charge Retention | : | >60% for 28 days storage after standard charge |
| Leakage | : | No leakage, No explosion under standard operating condition |
| Vibration | : | Battery remain normal after vibration at Amp: 4mm;<br>Freq.: 1000/min for 60 min. |
| Shock | : | Battery remain normal after dropping from 450mm to an Oak board for 3 times |

Typical Standard Charge Characteristics (Cylindrical Cell)

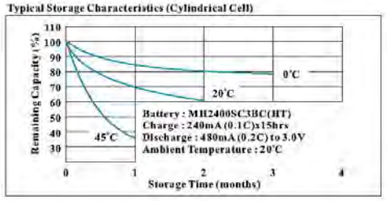



Typical Discharge Characteristics (Cylindrical Cell)

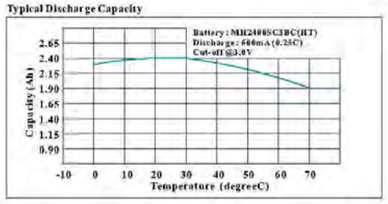



Typical Storage Characteristics (Cylindrical Cell)

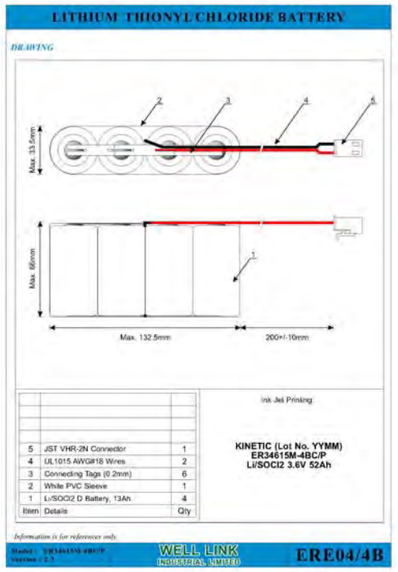



Typical Discharge Capacity



Los Módulos Radio MR También se pueden alimentar con pack de 4 pilas de litio de 3,6V de alta descarga.

Modelos homologados según fabricante: Kinetic Lisoci2-2, Able ER34615M, EEMB ER 3456M-N




## 6.4 PROGRAMADOR MULTIFUNCIONAL EN AUTOMATIZACIÓN

Se propone la utilización de un equipo de control para la realización de las siguientes funciones:

- Adquisición y tratamiento de la señalización procedente de la instrumentación y equipos a controlar en la estación de bombeo a través de entrada/salida digitales y analógicos.
- Comunicación con el Centro de Control mediante radiomódem 44 MHz 1W
- Almacenamiento de datos en local en caso de fallo de comunicación y envío de los mismos al restaurarse las comunicaciones.

La Estación Remota planteada estará formada por:

- 1 Armario eléctrico con placa de montaje y kit de sujeción mural
- 1 controlador con alimentación a 12Vdc y el siguiente equipamiento: 14SD,8ED relé, 7 EA (4-20mA), con regulador de carga integrado. Dispone de 14 Salidas Digitales, 8 Entradas Digitales y 7 Entradas Analógicas,

## 6.5 PROGRAMA DE PC

Es un programa completamente configurable, para que cada comunidad pueda personalizarlo según sus necesidades y así trabajar solamente aquellas opciones que precise, de la forma más sencilla y amena posible.

El programa de PC para la telegestión trabaja bajo soporte Windows y está diseñado para optimizar las prestaciones de los elementos de campo que controla.

El sistema consta de tres módulos de ejecución en PC, cada uno de ellos especializado en la realización de una tarea específica dentro del telecontrol de la comunidad o comunidades.

- **Módulo de control:** es el responsable de reaccionar y responder a la información que recibe tanto de los diferentes elementos del sistema de riego como de las solicitudes y programación realizadas por los usuarios, proporcionando a la red hidráulica el estado en el que deben estar cada uno de sus elementos.

- Sólo puede existir uno de estos módulos en todo el sistema de telegestión.

- **Módulo de comunicaciones:** es el responsable de realizar la comunicación con las concentradoras instaladas, obteniendo la información recogida por cada concentradora para que pueda ser procesada por el módulo de control y enviando la información perteneciente a cada concentradora según lo indicado por el módulo de control.

El sistema de telegestión permite la utilización de más de uno de estos módulos, siempre que éstos sean instalados en diferentes ordenadores y que los ordenadores en los que se instale tengan acceso a la base de datos del sistema de telegestión.

El módulo es versátil y abierto, de manera que no está limitado a la comunicación únicamente a concentradoras, sino que permite también la inclusión de otros equipos, como puede ser programadores GPRS, por ejemplo, o incluso con otros PCs.

El módulo de comunicaciones permite prácticamente cualquier tipo de comunicación existente: RS-232, RS-485, Ethernet, radio-módem, módem convencional, GSM, GPRS, etc., aparte de estar preparado para adaptarse a los nuevos avances tecnológicos que puedan aparecer.

- **Módulo de gestión**: es el encargado de la interfaz entre el sistema de telegestión y los usuarios.

El sistema permite la utilización de más de uno de estos módulos, siempre que éstos sean instalados en diferentes ordenadores y que los ordenadores donde se instale tengan acceso a la base de datos del sistema de telegestión.

La información se presenta y se solicita al usuario mediante ventanas y cuadros de diálogo que permiten el acceso a los datos deseados de forma rápida e intuitiva. Además, cada usuario puede molde

Para la ventana principal de consulta para que siempre aparezca la información más relevante para él.

Las principales características de este módulo son:

- Posibilidad de gestionar un número ilimitado de concentradoras, integrándolas todas como si fuese uno de solo.
- Posibilidad de gestionar otros equipos diferentes a las concentradoras Distintas posibilidades de conexión: cable directo (RS-232, RS-485, Ethernet), módem (convencional o GSM), radio-módem, GPRS, etc.
- Importación de dibujos y planos para la monitorización de la comunidad, pudiéndose incorporar iconos para una mejor visualización.
- Consulta mediante sinópticos totalmente configurables por el usuario.
- Exportación a ficheros ASCII de toda información relativa a la configuración, programación o funcionamiento del sistema, tanto si son datos de facturación, como de consumos, como de registros de sensores, pudiéndose tratar posteriormente con hojas de cálculo o bases de datos.
- Listados con la planificación de riegos.
- Gráficos de sensores, entre ellos, del consumo de los contadores de riego y también de la activación de las válvulas.
- Gestión de eventos y anomalías.
- Esquema hidráulico de la red de riego, con todos los elementos visibles y acceso a su programación y configuración in situ.
- Posibilidad de conexión de un panel sinóptico externo.
- Limitar la disponibilidad de agua a previo pago.
- Avisos y aceptación de órdenes a través de SMS (mensajes de móvil).
- Diferentes tarifas según el momento en que se produzca el consumo de agua.

El sistema ofrece una gran adaptabilidad a las comunidades a través de las múltiples opciones de programa y módulos de campo de que dispone, que lo convierten en un sistema dinámico y versátil, además de permitir la personalización según las particulares necesidades de cada comunidad.

El programa ofrece la monitorización completa de todos los elementos conectados al sistema, y gestiona de forma integrada las concentradoras como los terminales remotos que se conectan directamente a él.

La programación del riego puede ser secuencial, independiente, por demanda, por seguridad, etc. Estas distintas funciones se pueden visualizar en planos, en gráficas, imprimir su evolución, o ser exportadas a otros programas.

A nivel de registro, permite tener permanentemente actualizada la base de datos en función de la periodicidad de comunicación con los elementos de campo, visualizarlos por individual o totalizados, exportarlos a otros programas, así como un largo etc. de posibilidades que se explican en el manual del equipo.

## 6.6 INSTALACIÓN, CONFIGURACIÓN Y PROGRAMACIÓN PROGRAMA PC

### 6.6.1 INSTALACIÓN

El primer paso a realizar para la instalación del sistema I es decidir la ubicación de la base de datos del sistema, del frontal de comunicaciones, del módulo de control y del módulo de gestión. Todos ellos pueden residir en un único ordenador PC, pero puede ser conveniente distribuirlos en diversos ordenadores. En este caso, todo ordenador que vaya a utilizar alguno de los módulos del sistema debe tener acceso al ordenador donde se haya ubicado la base de datos.

Una vez se haya instalado el servidor de la base de datos, el módulo de control y los módulos de comunicación (en caso de existir más de uno) no precisan de ningún requisito en especial, puesto que el propio sistema se encarga de asegurar que todos estos módulos se hallen siempre en funcionamiento.

Hecho esto, desde cualquier ordenador donde se haya instalado el módulo de gestión se procede a la configuración y programación del sistema.

### 6.6.2 CONFIGURACIÓN

Toda la configuración del sistema se realiza desde el módulo de gestión y puede separarse en tres niveles según el módulo al que afecte:

- configuración de comunicación: se trata de definir todos los elementos que forman parte de la red hidráulica y de cómo acceder a ellos. Por lo tanto, se definirán las concentradoras, las válvulas, los sensores, los contadores, etc. y se indicarán los parámetros necesarios para que las concentradoras puedan comunicarse con sus módulos de campo y también los parámetros para que el módulo de comunicaciones pueda acceder a las concentradoras.
- configuración de control: se describe la manera en que se quiere que trabaje la red hidráulica, introduciendo los grupos de sectores, las limitaciones de caudal y presión, las limpiezas de filtros, los bombeos, etc.
- configuración de gestión: se definen todos aquellos parámetros necesarios para tener en cuenta las necesidades de los usuarios de la comunidad, como es la definición del parcelario, de los usuarios, las tarifas de riego, etc.

Estas configuraciones se realizan la primera vez de puesta en marcha del sistema y normalmente ya no se modificarán si no hay ampliaciones o modificaciones de la instalación que lo requieran, aunque siempre puede adaptarse.

## 6.7 PROGRAMACIÓN

Según las necesidades de la comunidad, ésta puede utilizar distintas formas de realizar la programación del riego: en función de sus disponibilidades de caudal o de presión, instalaciones, turnos, etc.

El sistema permite una gran flexibilidad a la hora de definir posibilidades de riego, desde la más sencilla hasta la más compleja, sin que el uso de una forma de programación excluya a las demás.

**Riego a la demanda:**

Los riegos que se activan por demanda, lo hacen en función de variables externas como son sensores ambientales, peticiones de riego, horarios, etc. Son situaciones no programadas inicialmente pero que debido a la situación hídrica de la parcela hacen necesaria la activación del riego.

Podemos hacer un riego a la demanda:

- Por sensores digitales y/o analógicos
- Por orden mediante mensaje de texto (SMS)
- Por interruptor manual
- Por activación desde el módulo de gestión
- Por horarios

La finalización del riego a la demanda no será por unidades consumidas, sino que depende tanto de sensores digitales y/o analógicos como de los parámetros horarios que se hayan definido (horario de disponibilidad de agua) como del deseo del propio usuario de la parcela (paro por SMS, por interruptor, desde el módulo de gestión)

Mediante este tipo de programación es posible limitar la disponibilidad de agua para todos y cada uno de los sectores, permitiendo al usuario hacer uso de esta agua o no según su deseo o necesidad.

**Riego por unidades consumidas de sectores o válvulas:**

Este tipo de riego permite enlazar sectores y que cada uno lleve sus propias unidades de riego a consumir. De esta forma se pueden hacer turnos de riego, donde cada uno tendrá su horario, su tiempo o volumen asignado, etc.

Cada programa podrá tener su propia secuencia de riego, pudiéndose enlazar entre si los programas.

Se podrá trabajar también por caudal, así como realizar el riego turnado. Posibilidad de condicionar el riego, de tal forma que podamos parar el aporte de agua a cualquiera de las válvulas de la secuencia mediante un mensaje GSM.

Para el riego por secuencia se podrá utilizar:

- Programas de secuencia.
- Programas por hidrante y modificación de valores por grupos de sectores.
- Horas de inicio (pudiendo encadenar programas).
- Días de la semana o frecuencia de días.
- Horario activo del día.
- Activaciones diarias o por frecuencia.
- Programación por hidrante.
- Diferentes agrupaciones de sectores.
- Condicionantes para modificar, iniciar o detener el riego.

**Independencia de la comunidad.**

La comunidad podrá en todo momento determinar cómo quiere que los diferentes usuarios puedan administrarse el agua. También indicará cómo se debe hacer la gestión y la programación: si se quiere dejar libertad a los usuarios o debe realizarse siempre a través de la comunidad.

La forma de transmitir la programación al sistema podrá realizarse a través del PC, o también a través del móvil, en función de la libertad de trabajo que se permita. También se pueden tener sensores digitales o analógicos que realizarán la activación del programa cuando la condición que han de cumplir para ello se produzca.

Toda la programación se podrá modificar en cualquier momento, permitiendo trabajar con cualquiera de las formas descritas, con sus propias posibilidades de trabajo.

Habrá una pre-configuración donde determinaremos la forma de trabajar de nuestra comunidad para que a la hora de realizar la programación sea sencilla, intuitiva y fácil tanto para la persona encargada de la comunidad como para los diferentes usuarios si éstos tuvieran acceso.

Otra forma de gestionar la comunidad en la que intervengan los usuarios es por códigos de acceso. Este aspecto incide en que todo usuario tiene su código propio y podrá acceder a la programación de sus sectores, siempre que la comunidad lo permita.

El hecho de trabajar con códigos de acceso también permite tener diferentes niveles de acceso que facilitan la protección de datos y permiten ofrecer a cada usuario sólo los elementos que precisa conocer.

# 7 COBERTURA RADIOELÉCTRICA

Antes del inicio de las obras, se deberá analizar el estado de cobertura radioeléctrica de las frecuencias a utilizar, comprobando los niveles de RSSI ("Receive Signal Strength Indication") y las posibles interferencias con la frecuencia utilizada. Sólo se considerarán como óptimas, en los puntos a instalar equipos, señales de RSSI superiores a 50 dbm; en caso de señales inferiores se tendrá que utilizar módulos Repetidores o bien considerar una nueva ubicación de su receptor de señal.

No obstante, se presenta un primer estudio realizado en fase de redacción de proyecto y en base al cual se ha diseñado la estructura del sistema.

Dentro de la zona regable la comunicación será mediante radiofrecuencia libre 433 MHz.

## 7.1 ESTUDIO RADIO 433MHZ

- **Altura**

  Enlace Radio altura mínima 6 m - Cable de antena subministrado 10 m

  Modulo Radio altura mínima 4,5 m - Cable de antena subministrado 6 m

- **Visibilidad**

  Garantizar visión directa entre antenas

- **Ubicación Concentradoras:**

Enlace Radio nº1: En Oficinas Centro de Control

Enlace Radio nº2: En Hidrante nº H-27 (Coordenadas UTM. X: 707041E Y: 4647226 N)

Enlace Radio nº3: En Hidrante nº H-334 (Coordenadas UTM. X: 709428E Y: 4647352 N)

Enlace Radio nº4: En Hidrante nº H-399 (Coordenadas UTM. X: 711918E Y: 4646455 N)

- **Comunicación indirecta de la Enlace Radio a los módulos, comunicación mediante repetidor**

**Enlace Radio1-En Centro de Control**

Módulo en Hidrante 52 REPITE A->Hidrantes 157-162-166-168-170

Módulo en Hidrante 134 REPITE A-> Hidrante H181 -y BALSA ELEVADA

Módulo en Hidrante 158 REPITE A->Hidrantes H170-171-172-174

**Enlace Radio2 – En Hidrante H27**

Módulo en hidrante H12 REPITE A- Hidrantes 1-2-4-6

Módulo en hidrante H62 REPITE A->Hidrante 64

**Enlace Radio3 – En hidrante H334 SIN REPETIDORES**

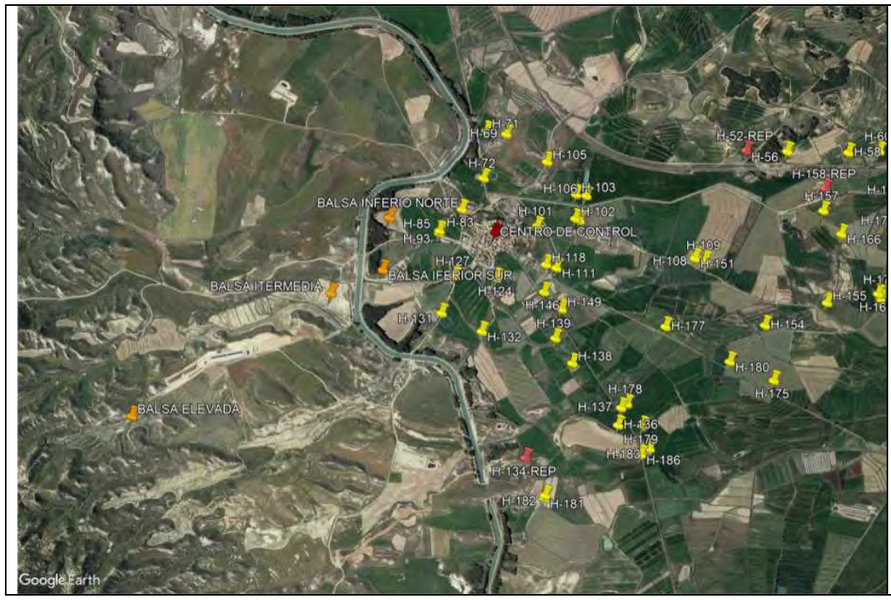
**Enlace Radio4 – En hidrante H399**

Módulo en hidrante H211 REPITE A->Hidrantes 202-203-206-209-400

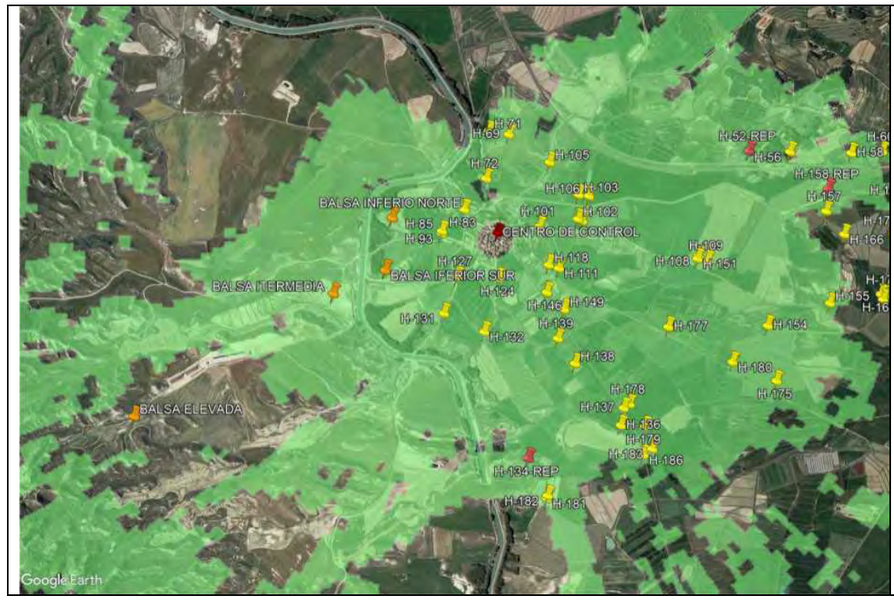
Módullo en Hidrante H284 REPITE A->Hidrnate 282

Módulo en Hidrante H401 REPITE A->Hidrantes 403-405-406-408-412

Módulo En Hidrante H407 REPITE A->Hidrantes 409-410-411-413




Distribución instalación ER1 (Centro Control)




Cobertura ER 1

Cobertura Repetidor H134

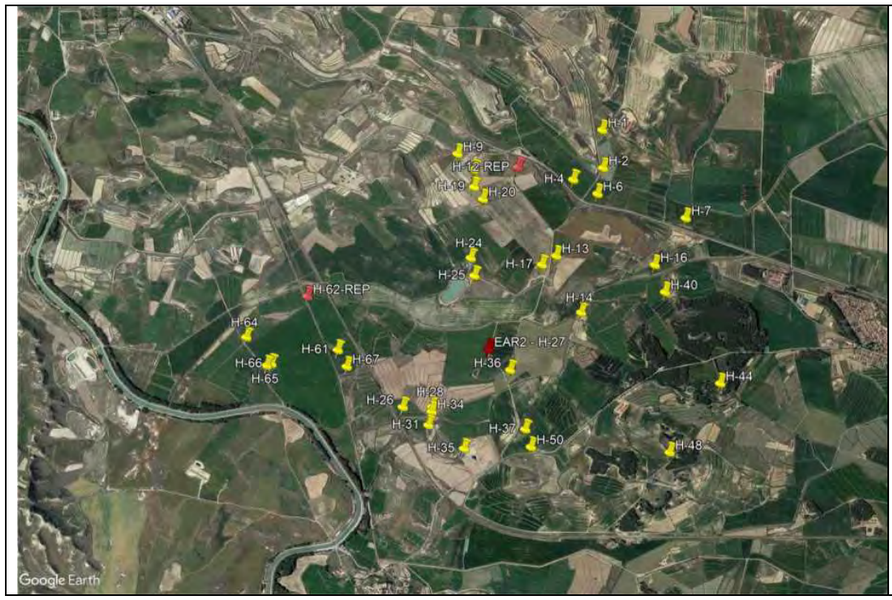
REPITE A->H181 - BALSA ELEVADA

Cobertura Repetidor H52

REPITE A->H157-162-166-168-170

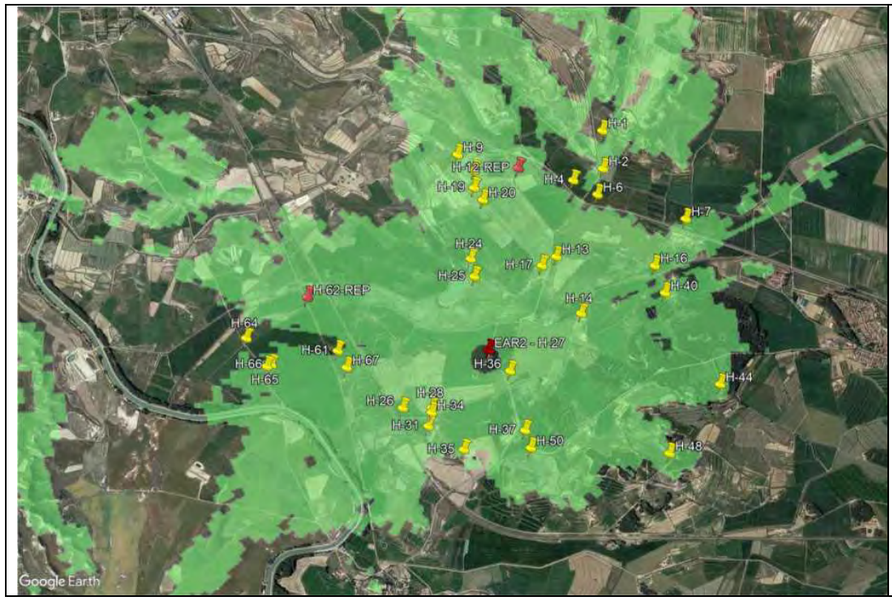
Cobertura Repetidor H158

REPITE A->H170-171-172-174




Distribución Concentradora nº2

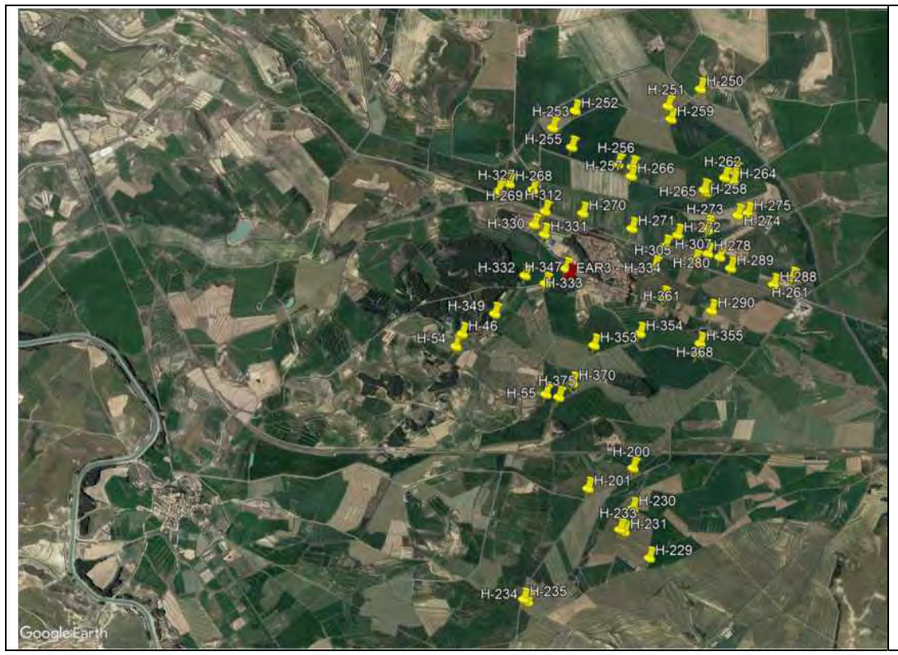
Cobertura Repetidor H12 REPITE A->H1-2-4-6



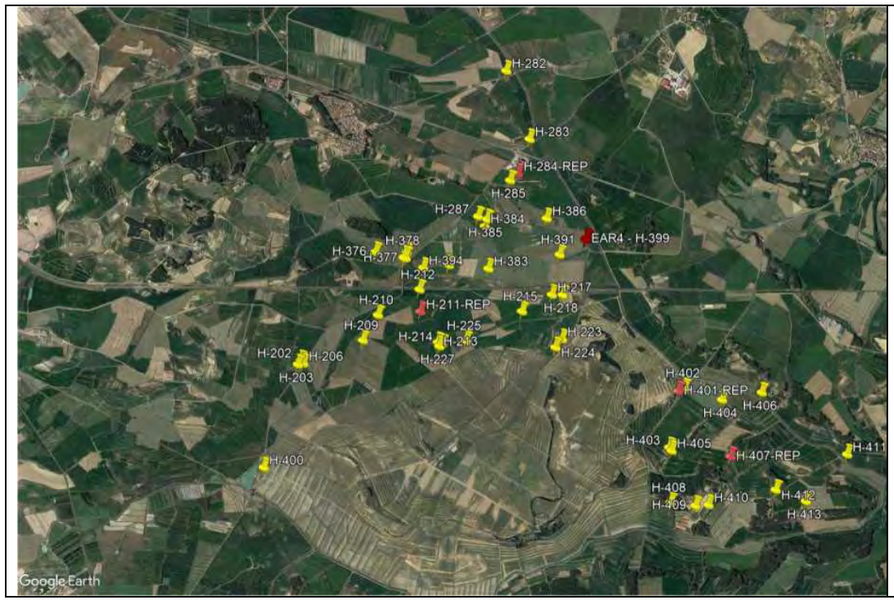

Cobertura Ear nº2

Cobertura Repetidor H62

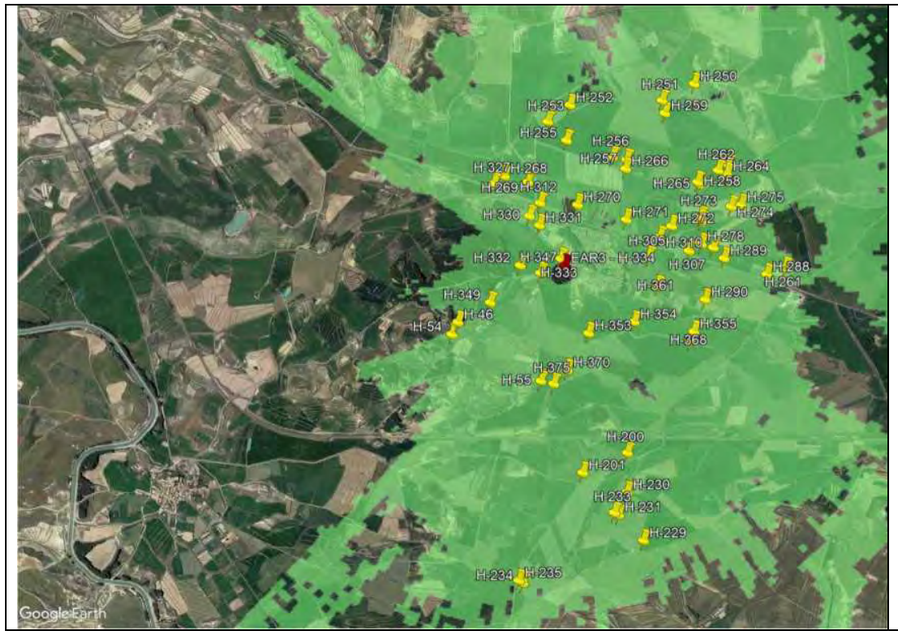
REPITE A->H64



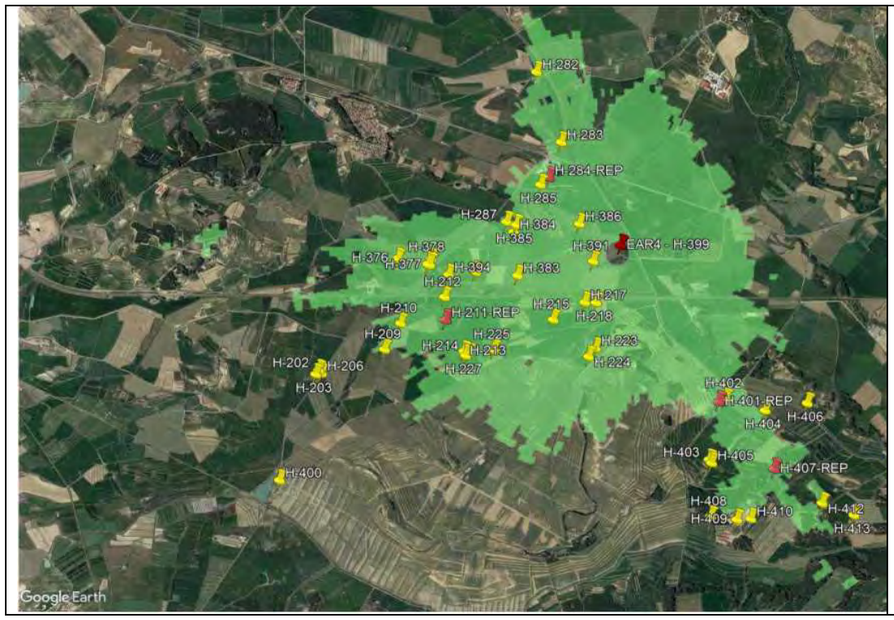

Distribución Concentradora nº3



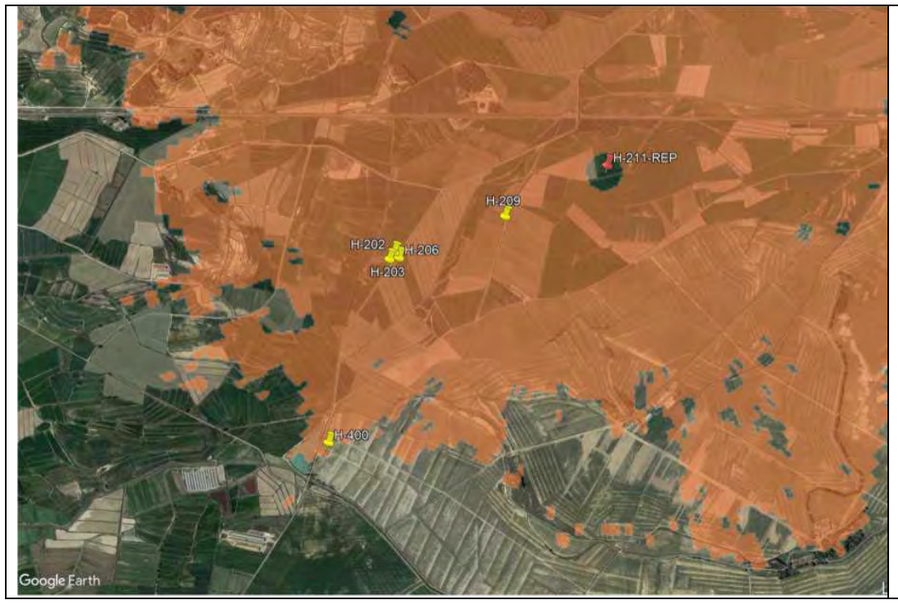

Distribución Concentradoras nº4




Cobertura Ear nº3




Cobertura Ear nº3




Cobertura Repetidor H211

REPITE A->H202-203-206-209-400

Cobertura Repetidor H401

REPITE A->H403-405-406-408-412

Cobertura Repetidor H282

REPITE A->H282

Cobertura Repetidor H407

REPITE A->H409-410-411-413

Se adjunta a continuación la correlación de hidrantes con los que se hizo el estudio y los presentados finalmente en proyecto:

| PISO | HID_ANT | HID_NUEVO |
|---|---|---|
| 1 | 1 | 153 |
| 1 | 2 | 152 |
| 1 | 4 | 155 |
| 1 | 6 | 154 |
| 1 | 9 | 94 |
| 1 | 12 | 95 |
| 1 | 13 | 90 |
| 1 | 14 | 86 |
| 1 | 16 | 88 |
| 1 | 17 | 89 |
| 1 | 18 | 93 |
| 1 | 19 | 92 |
| 1 | 20 | 91 |
| 1 | 25 | 84 |
| 1 | 27 | 83 |
| 1 | 36 | 82 |
| 1 | 37 | 81 |
| 1 | 40 | 87 |
| 1 | 44 | 105 |
| 1 | 46 | 103 |
| 1 | 48 | 101 |
| 1 | 50 | 80 |
| 1 | 52 | 100 |
| 1 | 54 | 102 |
| 1 | 55 | 112 |
| 1 | 56 | 110 |
| 1 | 58 | 104 |
| 1 | 60 | 111 |
| 1 | 101 | 10 |
| 1 | 102 | 8 |
| 1 | 103 | 11 |
| 1 | 105 | 13 |
| 1 | 106 | 12 |
| 1 | 107 | 9 |
| 1 | 108 | 16 |
| 1 | 111 | 7 |
| 1 | 118 | 6 |
| 1 | 124 | 1 |
| 1 | 138 | 4 |

| PISO | HID_ANT | HID_NUEVO |
|---|---|---|
| 1 | 139 | 3 |
| 1 | 146 | 2 |
| 1 | 149 | 5 |
| 1 | 151 | 15 |
| 1 | 154 | 19 |
| 1 | 155 | 20 |
| 1 | 157 | 22 |
| 1 | 160 | 30 |
| 1 | 162 | 24 |
| 1 | 166 | 21 |
| 1 | 168 | 23 |
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| 1 | 170 | 28 |
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| 1 | 177 | 14 |
| 1 | 180 | 17 |
| 1 | 200 | 37 |
| 1 | 201 | 36 |
| 1 | 202 | 35 |
| 1 | 203 | 33 |
| 1 | 206 | 34 |
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| 1 | 223 | 54 |
| 1 | 224 | 53 |
| 1 | 225 | 52 |
| 1 | 227 | 46 |
| 1 | 229 | 45 |
| 1 | 230 | 40 |

| PISO | HID_ANT | HID_NUEVO |
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| 1 | 231 | 39 |
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| 1 | 289 | 130 |
| 1 | 290 | 128 |
| 1 | 305 | 124 |

| PISO | HID_ANT | HID_NUEVO |
|---|---|---|
| 1 | 307 | 126 |
| 1 | 310 | 125 |
| 1 | 312 | 109 |
| 1 | 330 | 108 |
| 1 | 331 | 119 |
| 1 | 332 | 107 |
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| 1 | 389 | 140 |
| 1 | 391 | 139 |
| 1 | 394 | 146 |
| 1 | 501 | 137 |
| 1 | 502 | 127 |
| 1 | 503 | 85 |
| 1 | 400 | 60 |
| 1 | 401 | 61 |
| 1 | 402 | 63 |
| 1 | 403 | 62 |
| 1 | 404 | 64 |
| 1 | 405 | 66 |

| PISO | HID_ANT | HID_NUEVO |
|---|---|---|
| 1 | 406 | 65 |
| 1 | 407 | 67 |
| 1 | 408 | 69 |
| 1 | 410 | 68 |
| 1 | 411 | 71 |
| 1 | 413 | 70 |
| 2 | 24 | 216 |
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| 2 | 28 | 217 |
| 2 | 31 | 219 |
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| 2 | 64 | 212 |
| 2 | 65 | 213 |
| 2 | 66 | 214 |
| 2 | 67 | 209 |
| 2 | 69 | 208 |
| 2 | 71 | 207 |
| 2 | 72 | 206 |
| 2 | 83 | 203 |
| 2 | 85 | 204 |
| 2 | 93 | 202 |
| 2 | 127 | 201 |
| 2 | 131 | 221 |
| 2 | 132 | 222 |
| 2 | 134 | 227 |
| 2 | 136 | 226 |
| 2 | 137 | 223 |
| 2 | 178 | 224 |
| 2 | 179 | 225 |
| 2 | 181 | 229 |
| 2 | 182 | 228 |
| 2 | 186 | 231 |
| 2 | 504 | 205 |
| 2 | 183 | 230 |

# ANEJO Nº 16.- INFORMACIÓN Y DOCUMENTACIÓN FEADER/PNDR 2014-2020

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# ANEJO 16.-. INFORMACIÓN Y DOCUMENTACIÓN FEADER/PNDR 2014-2020

## 1 INTRODUCCIÓN

Este anejo recoge la información y documentación necesaria para poder apreciar el encaje del proyecto en el Programa Nacional de Desarrollo Rural 2014-2020 (en adelante PNDR), esto es: verificar que el proyecto cumple las Condiciones de Admisibilidad (fijadas por el PNDR) y aplicar los Criterios de Selección (fijados por la Autoridad de Gestión de la "Submedida 4.3: Modernización de infraestructuras de regadíos" contemplada en el PNDR.) que permiten seleccionar de entre todos los proyectos "admisibles" aquellos que mejor contribuyen a la estrategia, objetivos y prioridades del PNDR para ser cofinanciados por FEADER.

El apartado sobre documentación complementaria recoge documentos que atestiguan o corroboran los requisitos exigidos por el PNDR en materia de "admisibilidad del beneficiario del proyecto" y "admisibilidad del gasto a subvencionar" como las publicaciones en BOE de la Declaración de Interés General de la zona regable o la documentación ambiental del proyecto, entre otros.

El apartado sobre información complementaria recoge una serie de datos no contemplados en otros apartados del proyecto y que resultan indispensables para las labores de evaluación y selección de proyectos susceptibles de subvención por el FEADER.

La Subdirección General de Regadíos e Infraestructuras Rurales del MAPA, que actúa como Unidad Gestora de la Submedida 4.3, será la encargada de evaluar los proyectos para comprobar si cumplen las Condiciones de Admisibilidad fijadas en el PNDR. Se creará un Comité de Valoración de proyectos compuesto por miembros de la Unidad Gestora de la Submedida 4.3 y de la Autoridad de Gestión del PNDR; este comité se encargará de aplicar los Criterios de Selección a los proyectos considerados "admisibles" por la Unidad Gestora y elegir de entre ellos, los que obtengan mayor puntuación para ser cofinanciados por el FEADER.

## 2 DOCUMENTACIÓN COMPLEMENTARIA

### 2.1 DECLARACIÓN DE INTERÉS GENERAL.

La zona regable pertenece a la COMUNIDAD DE REGANTES SANTA ANA, TRAMO II DEL CANAL DE MONEGROS, y está integrada en la Comunidad de Riegos del Alto Aragón.

Las obras correspondientes a la modernización y consolidación de los regadíos de la COMUNIDAD DE REGANTES SANTA ANA está declarada de Interés General por el Real Decreto Ley 14/2009, de 4 de diciembre por el que se adoptan medidas urgentes para paliar los efectos producidos por la sequía en determinadas cuencas hidrográficas. En las disposiciones generales de dicho decreto ley se insta a la modernización de los regadíos: "Por ello, se hace imprescindible actuar de manera urgente en la modernización de nuestros regadíos y mejorar la eficiencia en la gestión, buscando un ahorro y mayor control que permita una mayor disponibilidad u herramientas de gestión de los escasos recursos". Para ello, se prevé la realización de las obras hidráulicas indicadas en los anexos II y III del decreto. Dentro de las obras hidráulicas del anexo III descritas como; "Obras urgentes de mejora de regadíos, con objeto de obtener un adecuado ahorro de agua que palíe los daños producidos por la sequía" se incluye a la Comunidad de Regantes de base Riegos del Alto Aragón. La declaración, puede ser consultada en el Apéndice 1.

### 2.2 INFORME DE IMPACTO AMBIENTAL

Con objeto de llevar a cabo el proyecto de modernización del regadío, emprendido por la Comunidad de Regantes, se ha redactado la correspondiente Estudio de Impacto Ambiental donde se recogen todos los posibles impactos que pueden surgir durante la ejecución de los trabajos y también durante la explotación de las instalaciones y las medidas a realizar para evitar o reducir su impacto.

Según la resolución publicada el 4 de mayo de 2022 por el Instituto Aragonés de Gestión Ambiental, se adopta la decisión de no someter al procedimiento de evaluación de impacto ambiental ordinaria y se emite el informe de impacto ambiental del Anteproyecto de modernización integral del regadío de la Comunidad de Regantes de Santa Ana, en los términos municipales de Torralba de Aragón, Almuniente, Torres de Barbués, Senes de Alcubierre y Tardienta (Huesca), promovido por la Comunidad de Regantes de Santa Ana. Nº Expte. INAGA/500201/01B/2021/06762.

Dicho Estudio de Impacto Ambiental está en trámite por parte de la Dirección General de Calidad y Evaluación Ambiental y Medio Natural, dependiente de la Secretaría de Estado de Medio Ambiente del Ministerio para la Transición Ecológica y Reto Demográfico.

### 2.3 INFORME DEL REDACTOR DEL PROYECTO SOBRE MEDIDAS AMBIENTALES, MEDICIÓN DE VOLÚMENES DE AGUA Y SEÑALIZACIÓN DE LAS OBRAS

#### 2.3.1 MEDIDAS AMBIENTALES INCLUIDAS EN EL ESTUDIO DE IMPACTO AMBIENTAL

Con objeto de llevar a cabo el proyecto de modernización del regadío, emprendido por la Comunidad de Regantes, se redacta el ESTUDIO DE IMPACTO AMBIENTAL DEL "PROYECTO DE MODERNIZACIÓN DEL REGADIO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA)", que incluye un total de 2.714,5356 has.

La finalidad principal del estudio es, por una parte, la descripción de las obras necesarias para modernización del regadío, por otra parte, la caracterización ambiental de la zona, para poder estudiar la viabilidad medioambiental

de la actuación y por último cumplir con la legislación vigente en materia de Protección Ambiental, siendo esta la Ley 21/2013, de 9 de diciembre, de evaluación ambiental, y sus modificaciones recogidas en la Ley 9/2018, de 5 de diciembre.

En el presente proyecto de modernización se han incluido y presupuestado las medidas ambientales propuestas en el citado Estudio de Impacto Ambiental.

Se indican a continuación las medidas preventivas y correctoras a aplicar sobre los distintos factores del medio, tanto durante la fase de diseño y planificación, como en la fase de construcción y tras la puesta en funcionamiento de las nuevas instalaciones de riego. Todas estas medidas son las incluidas en el Estudio de Impacto Ambiental del proyecto.

## MEDIDAS EN FASE DE DISEÑO Y PLANIFICACIÓN

COORDINACIÓN GENERAL

El promotor comunicará, con un plazo mínimo de un mes de antelación, al Servicio Provincial de Agricultura Ganadería y Medio Ambiente de Huesca las fechas previstas para el comienzo de la ejecución del proyecto. Durante la fase ejecutiva del proyecto, la dirección de obra incorporará a un titulado superior como responsable de medio ambiente, para supervisar la adecuada aplicación de todas las medidas preventivas, correctoras y de vigilancia incluidas en el documento ambiental, así como en el presente condicionado. Se comunicará, antes del inicio de las obras, el nombramiento del técnico responsable de medio ambiente al mencionado servicio provincial.

AUTORIZACIONES Y PERMISOS

Con anterioridad a la ejecución del proyecto, se recabarán todas las autorizaciones legales exigibles, en especial las referentes a las competencias de la Confederación Hidrográfica del Ebro, de la Subdirección Provincial de Carreteras del Gobierno de Aragón, y a las derivadas del ámbito de la seguridad de presas y embalses, y de su clasificación y registro. De forma previa al inicio de las obras, se solicitará en el Instituto Aragonés de Gestión Ambiental la autorización, en su caso, para la ocupación de las vías pecuarias afectadas, de acuerdo a la Ley 10/2005, de 11 de noviembre, de vías pecuarias de Aragón. Asimismo, el proyecto de línea eléctrica se presentará ante el Instituto Aragonés de Gestión Ambiental conforme a lo previsto en el artículo 5 del Decreto 34/2005, de 8 de febrero, del Gobierno de Aragón, por el que se establecen normas de carácter técnico para las instalaciones eléctricas áreas con objeto de proteger la avifauna.

CUMPLIMIENTO DE LA NORMATIVA URBANÍSTICA

Edificación que alberga los equipos de bombeo, se dará cumplimiento a lo establecido en las normas subsidiarias del término municipal donde se ubique en relación a la edificación en suelo no urbanizable genérico. En todo caso, ésta incorpora un diseño adecuado de la red de recogida interior de forma que las aguas potencialmente contaminadas originadas en su interior no alcancen el subsuelo ni la red hidrográfica superficial. La retirada y tratamiento de estas aguas se realizará de acuerdo con la normativa vigente en función del agente contaminante.

CUMPLIMIENTO CON LA PLANIFICACIÓN HIDROLÓGICA

El suministro de caudales establecido es, en todo momento acorde a las cuantías y referencias establecidas al efecto en la planificación hidrológica de cuenca vigente, así como en las diferentes normativas estatales y europeas de aplicación, considerando el tipo de cultivo instaurado. A tal efecto, se dispondrá de los correspondientes dispositivos que permitan determinar el consumo real de agua y controlar que éste es coherente con los anteriores preceptos.

UBICACIÓN ADECUADA DE LAS INSTALACIONES AUXILIARES

Se identificarán las áreas de ocupación temporal destinadas a actividades auxiliares (superficie dedicada al acopio de material, parque de maquinaria, transporte de material y tráfico de maquinaria).

Si fuera necesario ocupar áreas fuera del ámbito del presente estudio, en general, estas zonas no se ubicarán en los siguientes puntos:

- Hábitats naturales y prioritarios incluidos en la Directiva 92/43CEE.
- Yacimientos Arqueológicos.
- Zonas de colusiones y de inestabilidad geotécnica.
- Terrenos con pendiente superior al 25%.

Se realizará un replanteo del área afectada, así como el jalonamiento del perímetro de actuación, con objeto de minimizar la ocupación del suelo y la afección a la vegetación. Las zonas de instalaciones auxiliares y caminos de acceso también se jalonarán para que la circulación de personal y maquinara se restrinja a la zona acotada.

Se llevará a cabo una correcta planificación y control del tráfico de obra.

Se restringirá el paso a las obras a personas no autorizadas (elaboración de acreditaciones, etc.).

FORMACIÓN DEL PERSONAL DE LA OBRA

Se realizará la adecuada formación del personal de obra en relación al medio ambiente con el fin de establecer las medidas oportunas para minimizar los riesgos de afecciones que puedan ser ocasionados sobre el medio, y que son inherentes al desempeño de sus funciones.

Se recogerán un código de buenas prácticas medioambientales, criterios para la determinación de los factores de riesgo y protocolos de actuación ante posibles impactos (vertidos accidentales, etc.). Además, se deberá informar a todos los trabajadores de la obra acerca de las medidas preventivas y correctoras establecidas en el presente documento, así como de las zonas de acceso restringido a la maquinaria.

MEDIDAS DE PROTECCIÓN DEL SUELO

Se planificarán los trabajos de forma que no se genere un tráfico elevado en la zona, ya que las carreteras y caminos son estrechos y así no sería necesaria la creación de nuevos accesos.

En ningún caso se realizarán extracciones de áridos en el Espacio perteneciente a la Red Natura 2000 para la obtención del material a utilizar como cama de apoyo para las tuberías de la red de distribución.

El proyecto incorpora un plan de gestión de residuos, concreto y adaptado a las condiciones particulares de las actuaciones previstas, de acuerdo con lo establecido en el Decreto 148/2008, de 22 de julio, del Gobierno de Aragón, por el que se aprueba el Catálogo Aragonés de Residuos y el Real Decreto 105/2008, de 1 de febrero, por el que se regula la producción y gestión de los residuos de construcción y demolición.

MEDIDAS DE PROTECCIÓN DEL AGUA

Previo al inicio de las actuaciones y definido en el proyecto se habrá elaborado un cronograma de obras conforme a las distintas fases del proyecto y las distintas actividades para, adecuando dicho calendario de obras al periodo reproductor de las especies de fauna y a la época más seca en la ejecución de la obra de toma para minimizar fenómenos de aumento de la turbidez de las actividades relacionadas con los cursos de agua.

En la planificación de las obras se evitará la modificación de los perfiles de los ríos y arroyos que, así como el aterrazamiento de sus cauces, la ocupación de los mismos y se garantizará el discurrir de las aguas.

Concretamente para los cruces con arroyos, se realizarán las obras necesarias para instalar la tubería de forma que se restaure según las condiciones originales, morfología, sección y perfil. Además, las obras se planificarán para realizarse en el periodo de estiaje con objeto de minimizar el impacto.

MEDIDAS DE PROTECCIÓN DE LA VEGETACIÓN

El diseño del trazado se realiza evitando al máximo posibles afecciones a la vegetación natural y vegetación arbolada y cultivos existentes, siguiendo preferentemente el trazado de las líneas de caminos, acequias y límites de parcelas.

Igualmente, la zona regable finalmente definida, ha sido el resultado de la integración tanto del diseño de las fincas de reemplazo, obras complementarias, etc contempladas en los proyectos de concentración parcelaria, como de la incorporación de las medidas y condicionados de las resoluciones ambientales de dichas actuaciones, de forma que se garantice su cumplimiento.

En ningún caso se utilizarán en las revegetaciones y/o en las actuaciones de integración paisajística especies invasoras o alóctonas, así como ejemplares enfermos.

En los terrenos afectados por la red de riego se recuperará el relieve original y la capa superior de tierra vegetal tal y como se explica en el apartado de medidas en fase de construcción.

MEDIDAS DE PROTECCIÓN DE LA FAUNA

Previo al inicio de las actuaciones y definido en el proyecto se habrá elaborado un cronograma de obras conforme a las distintas fases del proyecto y las distintas actividades para, adecuando dicho calendario de obras al periodo reproductor de las especies de fauna y a la época más seca en la ejecución de la obra de toma para minimizar fenómenos de aumento de la turbidez de las actividades relacionadas con los cursos de agua.

Tal y como se ha indicado en informe del estudio específico de la avifauna, se propone establecer un calendario de obras que excluya la época de cría, estimado para las especies catalogadas en la zona de secano entre el 15 de febrero y el 15 de agosto.

En la zona regable, en las zonas donde se han detectado nidos de especies catalogadas o de especial interés, se acometerán las obras fuera de las épocas reproductivas de las especies como el Aguilucho cenizo, Águila perdicera o Garza imperial (Marzo-Julio ambos inclusive), así como en el caso del Águila real (Enero-Junio).

Así mismo, tal y como recoge la Resolución del Instituto Aragonés de Gestión Ambiental, con fecha 4 de mayo de 2022 (Nº Expte. INAGA/500201/01B/2021/06762), por la que se emite el informe de impacto ambiental del Anteproyecto de modernización integral del regadío de la Comunidad de Regantes de Santa Ana, los vallados perimetrales de las balsas y de la instalación fotovoltaica deberán carecer de elementos cortantes o punzantes y garantizarán su visibilidad para la avifauna, incluyendo dispositivos anticolisión, como pueden ser la colocación de dos bandas, una en el extremo superior y otra en el centro, de fleje de alta visibilidad; o bien la instalación de placas que deberán cumplir con los siguientes aspectos: placas metálicas o de plástico con un tamaño de 25 cm x 25 cm con entre 0,6 mm y 2,2 mm de espesor, dependiendo del material. Cada una de estas placas se sujetará al cerramiento en al menos dos puntos con alambre liso acerado para evitar su desplazamiento, colocándose al menos una placa por vano entre postes y con una distribución al tresbolillo en diferentes alturas.

MEDIDAS DE PROTECCIÓN DEL PATRIMONIO CULTURAL

En fase de planificación y diseño del proyecto se ha realizado un análisis de la afección a los bienes culturales recogidos en la carta arqueológica, proporcionada por la Dirección General de Patrimonio Cultural, a lo largo de todo el ámbito de la actuación.

Así mismo, tal y como incluye la contestación de la Dirección General de Cultura y Patrimonio, se realizarán labores de prospección arqueológica previamente a la ejecución de las obras, para asegurar que no se vean afectados los bienes catalogados, u otros nuevos que puedan detectarse durante la ejecución de los trabajos.

En cualquier caso, durante el diseño de las infraestructuras de modernización, se han contemplado medidas para evitar el impacto en dichos bienes, teniendo en cuenta su localización para definir el trazado de las redes de riego, la ubicación de las principales infraestructuras (balsas, estación de bombeo, etc), obras de fábrica, hidrantes, etc, así como de la ubicación de las instalaciones auxiliares

## MEDIDAS EN FASE DE CONSTRUCCIÓN

MEDIDAS DE PROTECCIÓN DE LA CALIDAD DEL AIRE

Los vehículos y maquinaria implicados en la obra deben ser objeto de revisiones para comprobar si están al corriente de las Inspecciones Técnicas de Vehículos para evitar emisiones de gases contaminantes y de ruido más elevadas que las permitidas. Se limitará igualmente la velocidad de circulación de los vehículos por la zona de obra.

El transporte de áridos y demás materiales pulverulentos mediante camiones deberá realizarse con la precaución de cubrir la carga con una lona, para evitar la emisión de polvo.

Se realizarán riegos periódicos sobre los caminos para evitar la emisión de polvo a la atmósfera. De este modo se evitan también afecciones indirectas sobre la vegetación por deposición de polvo.

MEDIDAS DE PROTECCIÓN DEL SUELO

La revisión de la maquinaria, mediante el control de las Inspecciones Técnicas de Vehículos, disminuirá igualmente el riesgo de vertidos accidentales de lubricantes y carburantes por un mal estado de la maquinaria.

Durante la ejecución de las obras será necesario contar un área habilitada para el almacenamiento de los residuos no peligrosos (plásticos, flejes, maderas…) y para el de residuos tóxicos y peligrosos. Los residuos se entregarán a gestor autorizado.

Se habilitarán zonas de manipulación de maquinaria y de productos tóxicos y peligrosos debidamente impermeabilizadas y acondicionadas para evitar derrames accidentales.

Posteriormente, todos estos residuos generados durante la obra serán gestionados convenientemente por gestor autorizado, tanto si proceden de maquinaria propia de empresa ejecutora de las obras como de maquinaria subcontratada o alquilada.

Será necesario habilitar una zona de la obra para el lavado de cubas de hormigón debidamente acondicionada. Los restos de hormigón que queden diseminados por la zona de obras serán retirados y llevados a vertedero autorizado como el resto de los residuos inertes.

Si se produjera un vertido accidental de residuos o productos tóxicos y peligrosos se procederá a la retirada del suelo contaminado que será gestionado convenientemente por gestor autorizado, así como la reposición del suelo.

Una vez que se finalice la obra, todo el ámbito de la actuación quedará libre de residuos y materiales siendo gestionados convenientemente conforme a su naturaleza. Para facilitar esta labor la zona de obras deberá ser dotada de contenedores adecuados al tipo de residuo que se genere para facilitar su almacenamiento hasta la entrega a gestor autorizado o retirada a vertedero controlado.

Los primeros 30 cm de suelo fértil serán acopiados en las inmediaciones de la excavación en lugar adecuado, antes de realizar el movimiento de tierras de zanjas, explanaciones, caminos de acceso, etc, para que éstos se utilicen en la restauración de los taludes de las balsas o en la zona de instalaciones auxiliares y en la reposición del terreno en las zanjas.

Las zonas de acopio temporal y la ubicación de las zonas auxiliares se localizarán en áreas que no tengan presencia de vegetación natural ni sean espacios protegidos.

Una vez finalizada la obra, en aquellas zonas donde el suelo se ha compactado debido a la ubicación de instalaciones auxiliares, de las áreas de acopio temporal o al paso de maquinaria se descompactará el terreno, previamente a su restauración.

A pesar de que el presente Proyecto de Modernización no incluye las actuaciones necesarias para el desmantelamiento y reutilización/reciclado de las infraestructuras de riego que queden en desuso por la puesta en servicio de las obras recogidas en el presente Proyecto de Modernización, se han considerado algunas recomendaciones y propuestas, para minimizar el impacto de las mismas.

De esta forma, se intentarán reutilizar estos elementos en las proximidades desarrollando una economía circular sostenible y así evitar el traslado de este material a centros de gestión autorizados, con recorridos de trasporte con camiones a distancia, que sumado a que se trata de materiales muy voluminosos, podría suponer una alta emisión de contaminantes por el elevado consumo de combustibles fósiles.

Tal y como queda recogido en el apartado de Descripción del Proyecto, se incluyen una serie de medidas con las que se pretende minimizar al máximo el volumen de residuos procedentes de estas infraestructuras de riego obsoletas. En cualquier caso, los volúmenes de estos residuos que finalmente no puedan ser reutilizados/reciclados, serán gestionados en centro autorizado.

Las líneas de trabajo iniciales para la reutilización y/o reciclado, entre otras son las siguientes:

- Aprovechamiento como estructuras de drenaje en desagües abiertos actuales y futuros. Comprende la colocación invertida de canales y el relleno con árido de las canales machacadas. A continuación se recoge una de las secciones propuestas.

- Reutilización como escolleras de rip-rap para reducir la erosión en desagües o balsas y embalses, favoreciendo su estabilidad y mejorando el hábitat faunístico (principalmente de sifones).
- Aprovechamiento para producción de áridos para firmes de subbase en los caminos de las actuaciones próximas (obras complementarias de caminos de concentraciones parcelarias, actuaciones municipales, etc).
- Utilización de áridos en las obras de modernización en la colocación de camas, asientos y rellenos para las tuberías no plásticas.
- Utilización de áridos en las obras de modernización como cama en la colocación de drenajes tanto de las infraestructuras colectivas, como de particulares.

Por otra parte, con la modernización se conseguirán reducir los retornos de riego aproximadamente un 40 %, que sumado a que con los riegos presurizados, parte de los desagües se convertirán en drenajes, esto supone un ahorro en el consumo de materiales plásticos (PEAD, PVC, polipropileno) con lo que habitualmente se construyen dichos drenajes, suponiendo una reducción en el coste medioambiental por efecto de elementos de transporte elevados.

MEDIDAS DE PROTECCIÓN DEL AGUA

A efectos de disminuir las afecciones sobre el suelo y el agua se recomienda priorizar la ejecución de las obras en verano, por ser menos frecuentes las precipitaciones y por lo tanto haber menos riesgo de erosión y arrastre de contaminantes, así como mayor probabilidad de estiaje de los cursos fluviales de la zona de actuación.

Para evitar derramamientos de lubricantes y combustibles en las labores de mantenimiento (lavados, cambios de aceite, reparaciones, etc.) solo se podrán realizar en talleres autorizados de la comarca, en ningún caso en la zona de actuación, ni en los parques de maquinaria habilitados.

Para minimizar el riesgo de vertidos accidentales, todas las tareas de mantenimiento de la maquinaria de obra (limpieza de maquinaria, repostaje, cambios de aceites y filtros, etc.) así como su estacionamiento se llevarán a cabo en el parque de maquinaria designado al efecto.

Este se ubicará en un área llana, alejada del cauce y dotada de alguna medida impermeabilizante del suelo para evitar infiltraciones de posibles vertidos.

Se deberán extremar las precauciones para prevenir la caída de materiales a los cauces.

Las obras proyectadas que afecten a cauces públicos (zona de policía y/o dominio público hidráulico) se ejecutarán conforme a las prescripciones establecidas en la correspondiente autorización de la Confederación Hidrográfica del Ebro.

Durante la ejecución de las actuaciones que afecten a cauces se garantizará el mantenimiento del curso de las aguas, ya que se realizarán en épocas de estiaje.

Se extremarán las precauciones en los trabajos cercanos a cauces. En estas zonas, se evitará el acopio de materiales durante las obras con el fin de evitar el arrastre de los mismos hacia los cauces, minimizando así la posibilidad de contaminación de las aguas superficiales.

MEDIDAS DE PROTECCIÓN DE LA VEGETACIÓN

La modernización del regadío pretendida no significa en ningún caso el cambio de uso de recintos forestales a tierra arable, la eliminación de linderos o la ampliación de la superficie regable tal y como queda descrito en el apartado 8.20 del presente documento. La eliminación de vegetación natural se limita exclusivamente a los tramos de la red de riego y otras obras proyectadas en zonas con vegetación natural que no haya sido posible evitar su afección.

En estos puntos, se respetará al máximo la vegetación natural presente en la zona y minimizar los daños sobre ésta. Para ello, se realizará un jalonamiento en el perímetro de la zona de obras, minimizando el espacio ocupado por la obra en la medida de lo técnicamente viable. Dicho jalonado, se realizará con elementos suficientemente consistentes para impedir su desplazamiento o destrucción a lo largo de toda la fase constructiva.

En la ejecución de las zanjas, se separará y acopiará adecuadamente el horizonte orgánico (primeros 30 cm), para su reposición en superficie una vez instaladas las tuberías, restaurándose adecuadamente los terrenos forestales que resulten afectados por las obras. Las zonas de acopio temporal de áridos y materiales y de parque de maquinaria deberán situarse en terreno agrícola. En caso de que se produzca excedente de tierras que no pueda ser compensado, éste será transportado a áreas de vertido autorizadas. Asimismo, los residuos derivados de la obra serán evacuados de la zona de actuación y gestionados adecuadamente conforme a su condición. Tras la finalización de las obras, el entorno quedará libre de cualquier resto constructivo y en perfectas condiciones de limpieza.

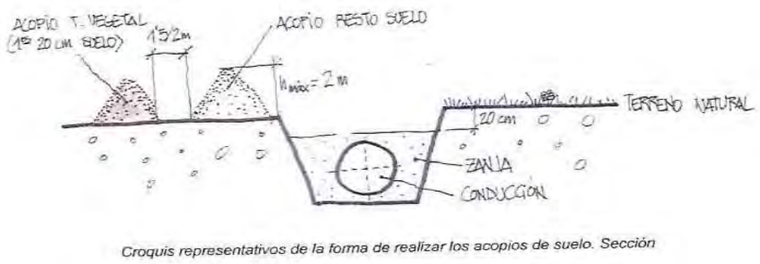



Figura 1. Croquis labor de capaceo.

La ocupación de las obras se ceñirá a lo estrictamente necesario, evitando el paso de maquinaria por zonas de vegetación natural.

Las zonas de instalaciones auxiliares y las de acopio temporal no se ubicarán en zonas de vegetación natural, pero si se afectara a vegetación natural fuera de las parcelas donde se localicen, será restaurado con especies semejantes a las que haya en origen.

Hidrosiembra de los taludes de las balsas inferior mediante una mezcla equilibrada de semillas de especies de la zona.

No se permitirá el paso de maquinaria por vegetación natural.

Por último, se resalta que, según la clasificación de zonas en función del riesgo de incendio forestal, recogida en la ORDEN DRS/1521/2017, de 17 de julio, del Gobierno Aragón, el ámbito de actuación de las obras previstas, se clasifica entre riesgo mínimo o medio, existe dentro la de la zona regable o colindante a ella tres pequeñas zonas de riesgo alto que no se ven afectadas por la actuación. Por ello, se propone instalar varias tomas de hidrante con conexión Tipo Barcelona, para facilitar su utilización a los equipos de extinción de incendios, en las áreas más próximas a las zonas de mayor riesgo de incendio.

MEDIDAS DE PROTECCIÓN DE LA FAUNA

La ocupación de las obras será la estrictamente necesaria.

Se limitará la velocidad en la zona para minimizar el ruido y la emisión de polvo. Además, se realizarán riegos periódicos para minimizar la emisión de polvo a la atmósfera.

Se contemplan en las balsas de regulación a construir, sistemas o dispositivos que faciliten la salida de fauna vertebrada menor (pequeños mamíferos, anfibios y reptiles), así como especialmente aves que puedan quedar atrapadas en su interior, utilizando rampas, revestimientos con pequeñas piedras, cuerdas con nudos, cadenas y/o escalas. Igualmente se dispondrá una o varias plataformas flotantes dentro de la balsa. Asimismo, las obras de fábrica de la captación y red de riego, están adaptadas de forma que se eviten potenciales accidentes de especies de fauna. Para las operaciones de mantenimiento de las balsas, tales como limpiezas u otras que agoten o casi agoten el agua almacenada, se preverá la posible existencia de especies acuícolas y su rescate. Los taludes de las balsas se restaurarán convenientemente y revegetarán incorporando especies propias de la zona.

Se propone establecer un calendario de obras que excluya la época de cría, estimado para las especies catalogadas de la zona de secano entre el 15 de febrero y el 15 de agosto. Respecto a la zona de regadío, se deberá respetar el calendario de obras en las zonas próximas a puntos de nidificación y adaptando dicho calendario al de reproducción de cada especia catalogada o de especial interés que se identifique.

En la zona de secano se construirán algunas balsas de pequeño tamaño (entre 20 y 50 m de diámetro, 20-30 cm de profundidad máxima) como zonas de puntos de agua para las aves y hábitat de macroinvertebrados y anfibios que podrían fomentar el asentamiento de una red trófica más diversa en la zona.

Así mismo, se llevará a cabo la construcción y/o mejora/adecuación de construcciones (por ejemplo, instalación de nidales) que puedan actuar como primillares.

Igualmente se adoptarán el resto de medidas recogidas en dicho informe, como realizar un control del ruido (priorizando los trabajos diurnos), señalización, limitación de la velocidad en los accesos a 30km/h, minimizar el tiempo de apertura de zanjas, evitar la apertura de nuevos viales de acceso, etc.

MEDIDAS DE PROTECCIÓN DEL PATRIMONIO CULTURAL

Tal y como se indica en la contestación de la Dirección General de Cultura y Patrimonio, se realizarán labores de prospección arqueológica previamente a la ejecución de las obras, siguiendo las indicaciones recogidas en la contestación, serán realizadas por personal técnico cualificado, siendo autorizadas previamente, coordinadas y supervisadas por los Servicios Técnicos del Departamento de Educación, Cultura y Deporte del Gobierno de Aragón y remitiendo los resultados de estas prospecciones, con carácter previo a la Dirección General de Patrimonio Cultural para que emita las Resoluciones oportunas o arbitrar las medidas que se consideren adecuadas para la protección del Patrimonio Cultural Aragonés.

Si en el transcurso de la ejecución del proyecto se localiza algún resto arqueológico o paleontológico, se comunicará el hallazgo al Servicio de Prevención y Protección del Patrimonio Cultural quien arbitrará las medidas necesarias para el correcto tratamiento de los restos. Asimismo, se atenderá a lo indicado en su informe, por la Dirección General de Cultura y Patrimonio, en cuanto la realización de labores de prospección arqueológica en la zona.

Cualquier hallazgo que pudiera producirse en el transcurso de las obras en el resto del ámbito que pueda considerarse integrante del Patrimonio será puesto en conocimiento de forma inmediata y obligatoria a la Dirección

General Cultural deberá de Patrimonio Cultural del Departamento de Educación, Cultura y Deporte del Gobierno de Aragón a los efectos oportunos (Ley 311999, de 10 de marzo, del Patrimonio Cultural Aragonés, artículo 69).

En cualquier caso, con objeto de minimizar la afección a dichos bienes en la fase de diseño de las obras se contemplarán medidas como el balizamiento de estos elementos y el control y seguimiento de los trabajos de movimientos de tierras en las proximidades de los mismos.

MEDIDAS DE PROTECCIÓN DEL PAISAJE

Se indicarán los accesos a las zonas de obras.

Se realizarán riegos que minimicen la emisión de polvo a la atmósfera en los movimientos de tierras.

Se procederá a la adecuación del entorno de las arquetas dedicadas a albergar los elementos para la gestión y regulación de la red de riego. Un aspecto fundamental a tener en cuenta en la construcción de estas casetas, es su integración en el entorno, para lo cual se procurará que su arquitectura se adapte a la tradicional de la zona, en la medida de lo posible.

Plantación en el entorno de las balsas, estación de bombeo e instalación fotovoltaica. Para mejorar la integración paisajística se plantarán especies arbóreas y/o arbustivas que forman parte de las sebes o setos de la zona.

En los terrenos afectados por la red de riego se recuperará el relieve original y la capa superior de tierra vegetal tal y como se ha descrito en las medidas de protección de la vegetación.

Se desmantelarán los parques de maquinaria, vallas, casetas y caminos de obra cuando su uso se haga innecesario al finalizar los trabajos. Al acabar la fase de construcción no debe quedar rastro de las obras, ya sean escombros, áridos o restos de material. Estos residuos serán llevados a vertederos autorizados.

Las zonas utilizadas como parque de maquinaria se subsolarán y gradearán de manera que se favorezca la revitalización y regeneración del suelo.

Los caminos afectados durante la ejecución de las obras se restaurarán al finalizar las mismas.

MEDIDAS DE PROTECCIÓN DEL MEDIO SOCIOECONÓMICO

Durante el tiempo que duren las obras, se colocarán señales que anuncien las obras en todos los accesos a los caminos.

Se tomarán las medidas indicadas para minimizar la emisión de polvo y de ruido.

## MEDIDAS EN FASE DE EXPLOTACIÓN

Con carácter general, y en aras a realizar una gestión sostenible de los recursos, se evitará la contaminación de los suelos y las aguas, y se promoverá el ahorro de energía, ajustando lo mejor posible los usos de fertilizantes y fitosanitarios, así como la propia dotación de agua de riego a las necesidades de los cultivos.

La implementación de un sistema de riego presurizado, con mayor eficiencia (y por tanto menores pérdidas), la automatización del riego incluyendo sistemas de medida de los consumos y la utilización de energías renovables disminuyendo las emisiones de $CO_2$, hacen que la utilización de un recurso limitado se realice de forma más coherente con las necesidades productivas y ambientales de la zona afectada.

MEDIDAS DE PROTECCIÓN DEL AGUA

Por Orden AGM/83/2021, de 15 de febrero, se designan y modifican las Zonas Vulnerables a la contaminación de las aguas por nitratos procedentes de fuentes agrarias en la Comunidad Autónoma de Aragón y se aprueba el V Programa de Actuación sobre las Zonas Vulnerables de Aragón.

Tal y como recoge la citada Orden, la nueva designación de Zonas Vulnerables en la Comunidad Autónoma de Aragón, comprenderá todos los territorios cuyas aguas fluyan hacia masas de agua subterráneas o superficiales afectadas por contaminación por nitratos de origen agrario o por eutrofización. Los territorios incluidos en la nueva designación de Zonas Vulnerables de Aragón, figuran en el anexo XIV, ubicados dentro de la zona correspondiente a la masa de agua que ha podido verse afectada por su escorrentía y/o lixiviación.

En este caso, el ámbito de actuación del Proyecto de Modernización queda fuera de las Zonas Vulnerables a la contaminación de las aguas por nitratos, en cualquier caso, se propone cumplir con todas las directrices recogidas en el V Programa de Actuación en Zonas Vulnerables, tanto en lo que respecta a aportes de fertilizantes nitrogenados, uso de estiércoles y otros aportes orgánicos, así como el resto de obligaciones allí recogidas y recomendaciones de buenas prácticas y otras medidas.

De igual forma, se atenderá a lo dispuesto en el Proyecto de Real Decreto por el que se establecen normas para la nutrición sostenible en los suelos agrarios (que fue sometido a información pública hasta el 19 de octubre de 2020), así como al resultado del proceso de actualización Borrador del Real Decreto sobre protección de las aguas contra la contaminación difusa producida por nitratos procedentes de las fuentes agrarias.

Se ha realizado una modelización de los retornos de riego esperables (caudales, concentración de nutrientes, etc) y se ha llevado a cabo el dimensionado y posterior diseño en detalle de un humedal artificial, el cual queda recogido en el Proyecto de Modernización, con el objeto de mejorar las características del agua procedente de retornos de riego, tal y como se describe más adelante.

De forma anticipada la Comunidad General de Riegos del Alto Aragón ha aprobado su incorporación a la plataforma Agrogestor-Agroasesor, que incorpora entre otras funcionalidades el Cuaderno de fertilización y cuya

aplicación a la Masa de Agua 164 Flumen se pretende desplegar hasta el año 2024 en cooperación con la Cooperativa Los Monegros de Sariñena.

Adicionalmente, por medio de la red de humedales y riberas creadas en el marco del Proyecto Life Creamagua http://www.creamagua.com/actuaciones.htm se cuenta con un humedal en la zona de Albalatillo, el cual tiene como objeto la digestión en parte de los nutrientes de agua procedente de los azarbes de regadío.

A través de la Comunidad General de Riegos del Alto Aragón, la Comunidad de Regantes Santa Ana está participando en el Proyecto de Cooperación Nitratos, incluido dentro de PDR de la Comunidad Autónoma de Aragón. Medida Cooperación entre agentes del sector agroalimentario, para el periodo 2014-2020. Dentro de este proyecto se busca la caracterización, y formación para la optimización de la fertilización mineral e inorgánica dentro de las Comunidades de Riegos del Alto Aragón.

Esta formación se promoverá tanto desde la Comunidad General, como desde la Comunidad de Base, mediante jornadas de formación y sensibilización que se complementarán con las campañas de formación y sensibilización que el Departamento de Agricultura, Ganadería y Medio Ambiente desarrolla a través del Centro de Sanidad y Certificación Vegetal, mediante jornadas, cursos, foros, etc.

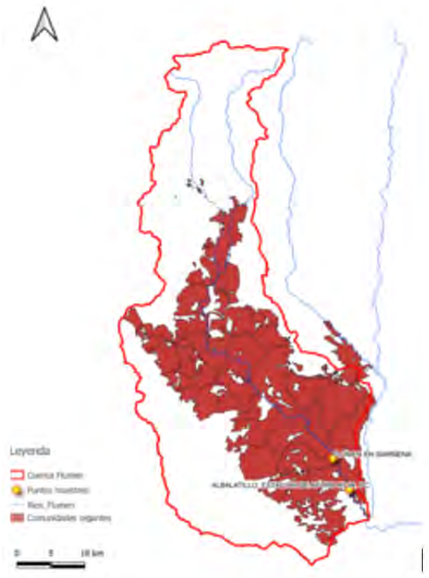
Se llevará un seguimiento del caudal mediante la medición de los retornos de riego en el aforador a instalar en el Arroyo del Reguero, por recoger íntegramente excedentes de riego de la zona regable a modernizar y por dominar gran parte de la zona regable.

En cuanto al seguimiento de la carga contaminante, existe un compromiso por parte de la Comunidad de regantes, para, tras la finalización de las obras, realizar un seguimiento trimestral de las concentraciones de $NH_4$, $NO_2$, $NO_3$, $P_{total}$, $PO_4$, terbutilazina y metolacloro. Al margen del seguimiento que realiza actualmente la Unidad de Suelos y Riegos integrada por CITA-Aragón y EEAD-CSIC. En cuanto al río Flumen, se realizará un seguimiento a partir de la red de aforos de la Confederación Hidrográfica del Ebro.

**Mecanismo de gestión de la contaminación difusa**

Para la gestión de la contaminación difusa, la Comunidad General de Riegos del Alto Aragón ha planteado el siguiente esquema conceptual de trabajo que va a desarrollarse en el período 2021-2024.

La implementación del modelo, se pretende para toda la cuenca del rio Flumen comprendida en la masa de agua M164 Rio Flumen desde el río Isuela hasta la desembocadura en el río Alcanadre.




CR Incluidas:
CR 19 Y 20
CR DE ALBERO BAJO
CR DE ALMUNIENTE
CR DE BARBUES
CR DE MOLINAR DEL FLUMEN
CR DE CALLEN
CR DE CARTUJA-SAN JUAN
CR DE FRULA
CR DE GRAÑEN-FLUMEN
CR DE LALUEZA
CR DE LANAJA
CR DE COLLARADA 2º Sección
CR DE ORILLENA
CR DE PIRACES
CR DE SECTOR VIII DE MONEGROS
CR DE Collarada 1ª Seccion
CR DSECTOR XI FLUMEN
CR DE SODETO-ALBERUELA-LALUEZA
CR DE TARDIENTA
CR DE SANTA ANA
CR DE TRAMACED
CR DEL SECTOR VII DEL CANAL DEL FLUMEN
CR LA CORONA
CR SECTOR X SAN LORENZO DE FLUMEN

Con la previsión de desarrollo de las siguientes acciones y cronograma de trabajo.

La implicación de los usuarios de produce a dos niveles, de un lado a nivel individual a través de la implantación de una herramienta que anticipa la obligatoriedad propuesta por al Borrador de RD de Nutrición sostenible del suelo de llevar un libro de fertilización, en el que se tienen en cuenta todos los elementos de balance de N, desembocando en un HAD de fertilización y HAD de riego que permiten una mejora permanente de la aplicación y la consiguiente reducción de la lixiviación.

Y de otro lado trasladando toda la información a una plataforma gestora que permite el cálculo de indicadores ambientales de las prácticas desarrolladas Complementariamente a esta plataforma, se mantiene la tarea de análisis de masas exportadas, y establecimiento de TMDL para cada unidad definida en la cuenca del río Flumen y la cual se hace coincidir con un modelo de aguas vertientes, como el especificado en el Borrador de RD de contaminación difusa procedentes de fuentes agrarias.

| | | 2021 | | 2022 | | | | 2023 | | | | 2024 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3T | 4T | 1T | 2T | 3T | 4T | 1T | 2T | 3T | 4T | 1T | 2T | 3T |
| OG 1: Implantación y control de TMDL | | | | | | | | | | | | | | |
| 1.1 Suscripción de compromiso con 20 comunidades de regantes. | | | | | | | | | | | | | | |
| AC 1.2: Seguimiento de las masas exportadas | | | | | | | | | | | | | | |
| AC 1.3: Informe anual de situación calidad Masa de Agua 164 Flumen | | | | | | | | | | | | | | |
| AC 1.4: Aportes de nitrógeno de otras fuentes | | | | | | | | | | | | | | |
| AC 1.5 Informe Anual de propuestas de mejora | | | | | | | | | | | | | | |
| OG 2: Trasladar a Riegos del Alto Aragón herramientas de toma de decisions adecuadas al cultivo del maiz y riego por aspersion. | | | | | | | | | | | | | | |
| AC 2.1 Zonas de aplicación de la Plataforma Agroasesor/Agrogestor | | | | | | | | | | | | | | |
| AC 2.2 Identificación y adhesión de usuarios | | | | | | | | | | | | | | |
| AC 2.3 Volcado de datos a la Plataforma. | | | | | | | | | | | | | | |
| AC 2.4. Recomendaciones de riego | | | | | | | | | | | | | | |
| AC 2.5 Recomendaciones de fertilización | | | | | | | | | | | | | | |
| AC 2.6 Análisis comparado de indicadores de sostenibilidad obtenidos de Agrogestor y los derivados del AC1.3 y AC 1.4 | | | | | | | | | | | | | | |
| OG 3 Proponer un sistema de asesoramiento riego-fertilización para Riegos del Alto Aragón que extrapole la experiencia adquirida | | | | | | | | | | | | | | |
| AC. 3. 1 Proponer una red de experimentación-asesoramiento | | | | | | | | | | | | | | |
| AC 3.2 Repercusión coste/hectárea versus ahorro económico potencial | | | | | | | | | | | | | | |
| AC 3.3. Analizar la relación alcance-coste económico para RAA | | | | | | | | | | | | | | |
| AC 3.4. Traducir la experiencia en un documento transferible | | | | | | | | | | | | | | |
| D. Acciones de Divulgación | | | | | | | | | | | | | | |
| Comunicación Interna | D.1.1. Presentación interna | | | | | | | | | | | | | |
| | D.1.2 Convenios de Colaboración | | | | | | | | | | | | | |
| | D.1.3 Presentación externa | | | | | | | | | | | | | |
| | D. 1.4 Encuentros bimensuales | | | | | | | | | | | | | |
| | D.1.5 Presentación Resultados | | | | | | | | | | | | | |
| Comunicación Externa | D.2.1 Web | | | | | | | | | | | | | |
| | D.2.2 Redes sociales | | | | | | | | | | | | | |
| | D.2.3 Videos y NDP | | | | | | | | | | | | | |

**Creación de un humedal artificial**

Con objeto de reducir y mitigar el impacto producido por los retornos de riego esperables, tras la puesta en servicio del Proyecto de Modernización, se propone la ejecución de un humedal artificial que asegure el mantenimiento de la concentración de nitratos por debajo de 25 mg/l (límite requerido para considerar las masas de agua en buen estado, según el R.D. 817/2015 de 11 de septiembre).

De esta forma, en el Anejo 9 del Estudio de Impacto Ambiental se recoge el informe para el dimensionado de los citados humedales, elaborado por AISECO Asociación para la Integración de los Servicios de los Ecosistemas.

Así, se ha diseñado un humedal de 5,37 ha en la parcela 351 del polígono 16 del Término Municipal de Grañen, de forma que reciba todos los retornos de riego de la Comunidad de Regantes Santa Ana. El agua permanecerá en el humedal un tiempo de 5 días aproximadamente (puede variar en función de la temperatura y de la carga de nitratos entre 3 y 7 días). De esta manera habrá tiempo suficiente para que se produzca la desnitrificación y las bacterias desnitrificantes (que se encuentran en el sedimento, entre las raíces de las plantas y en el biofilm, reduzcan los nitratos hasta nitrógeno gas, y éste pase a la atmósfera.

MEDIDAS DE PROTECCIÓN DE LA VEGETACIÓN

Tal y como se recoge en las Medidas de Prevención de Incendios Forestal del apartado 11.1 del presente documento, según la clasificación de zonas en función del riesgo de incendio forestal, recogida en la ORDEN DRS/1521/2017, de 17 de julio, del Gobierno Aragón, el ámbito de actuación de las obras previstas, se clasifica entre riesgo mínimo o medio, existiendo dentro la de la zona regable o colindante a ella tres pequeñas zonas de riesgo alto que no se ven afectadas por la actuación.

Por todo ello se toman una serie de medidas preventivas incluidas a continuación.

Estará prohibido:

- El uso del fuego en terrenos al aire libre, mediante combustibles sólidos que generen residuos en forma de brasas o cenizas, fuera de las excepciones prevista. Para el empleo de otros tipos de combustibles se deberán adoptar medidas precautorias tendentes a evitar cualquier riesgo de propagación del fuego, quedando expresamente prohibido hacer fuego bajo arbolado o sobre materia seca que pueda entrar en ignición u otros tipos de material inflamable.
- Arrojar o depositar en terrenos al aire libre materiales en ignición, como fósforos, puntas de cigarros o cigarrillos, brasas o cenizas.
- Arrojar fuera de los contenedores habilitados a tal efecto o vertederos autorizados, residuos que, con el paso del tiempo u otras circunstancias, puedan provocar combustión o facilitar ésta, tales como vidrios, botellas, papeles, plásticos, materias orgánicas y otros elementos similares.
- Disparar o prender cohetes u otros explosivos similares, independientemente de su lugar de lanzamiento, cuando su alcance pueda incidir sobre terrenos forestales.
- La circulación de vehículos "campo a través", en los montes cuya gestión corresponde a la Comunidad

La Maquinaria agrícola, forestal o de usos diversos deberá adoptar las siguientes medidas:

- Los tractores, cosechadoras y demás máquinas agrícolas o forestales que trabajen en las zonas comprendidas en el ámbito de aplicación de esta orden, especialmente durante la época de peligro, deberán ir provistas de extintores u otros medios auxiliares que puedan colaborar en evitar la propagación del fuego durante una primera intervención.
- Idénticas precauciones deberán adoptarse con aquellas máquinas o equipos de otra índole (sierras, soldadoras, etc.), que puedan generar chispas con motivo de su utilización.

Se deberá dotar de recursos necesarios para la extinción., por lo que, sin necesidad de contar con la autorización de los propietarios respectivos, podrán adoptar las medidas siguientes:

- Entrada de equipos y medios en fincas forestales o agrícolas.
- Circulación por caminos privados.
- Apertura de brechas en muros o cercas.
- Utilización de aguas.
- Apertura de cortafuegos de urgencia.
- Quema anticipada mediante la aplicación de contrafuegos, en zonas que se estime que, dentro de una normal previsión, pueden ser consumidas por el incendio.

Además de las medidas anteriormente expuestas, en fase de explotación los comuneros que realicen quemas agrícolas y forestales requerirán de autorización o notificación previa, en función del tipo de restos vegetales a quemar, su continuidad y la época de ejecución de las mismas.

La C.R. pondrá a disposición de los equipos de extinción todas sus instalaciones, incluyendo el acceso a las balsas de regulación.

MEDIDAS DE PROTECCIÓN DE LA FAUNA

Tal y como se ha indicado en informe del estudio específico de la avifauna, se proponen las siguientes medidas durante la fase de explotación de las instalaciones:

- Ribazos. Para compensar la posible pérdida de algunos ribazos, se podría favorecer a la fauna mejorando la calidad del hábitat en los márgenes entre parcelas, si bien esta medida ya está recogida en el proceso de concentración parcelaria. Otra medida recomendable es la plantación de pies dispersos de especies arbustivas que aporten refugio y recursos (por ejemplo espino albar, rosal silvestre, espino negro, lentisco, aromáticas, etc., que proporcionan flores para polinizadores en primavera y frutos para la fauna vertebrada en otoño.

- Se llevará a cabo un programa de localización de nidos de aguilucho cenizo y adaptación de la actividad agraria, de manera que se respete un pequeño espacio sin cosechar alrededor del nido.
- Se estimulará, en la forma que se vea posible y conveniente, el mantenimiento del cultivo de arroz por inundación y de campos de arroz abandonados, que suponen una importante área de alimentación para especies catalogadas cómo cigüeñas y garza imperial
- Se evitará la apertura de nuevos caminos de acceso, zanjas y caminos interiores en las zonas de secano puesto que conlleva cambios en el suelo y en la cubierta vegetal, y una reducción del hábitat disponible para las aves esteparias: ganga ibérica, alcaraván, alondra común, cogujadas.
- Se mantendrán las balsas existentes, tal y como recoge la Resolución del 14 de julio de 2020 del INAGA por la que se formula Declaración de impacto ambiental del Proyecto de concentración parcelaria de la zona de regadío de Torralba de Aragón (Expediente INAGA 500201/01/2019/02730).

Igualmente, las parcelas en donde se ubican las balsas elevadas e intermedia, una vez ejecutadas todas las instalaciones auxiliares de las mismas, se ubicarán las pequeñas balsas propuestas, como puntos de agua para aves e invertebrados.

MEDIDAS PARA LA GESTIÓN DE RESIDUOS

Con el fin de preservar las aguas y el suelo del ámbito de actuación se contemplarán los siguientes aspectos en lo referente a la gestión adecuada de los residuos generados por el funcionamiento y mantenimiento de las nuevas balsas de regulación.

Los residuos peligrosos generados serán entregados a un gestor autorizado de residuos peligrosos en la Comunidad Autónoma de Aragón. Se considera que el volumen de este tipo de residuos será mínimo.

No obstante, al igual que en la gestión de residuos en fase de construcción, todo lo relacionado con el manejo de residuos tanto urbanos y asimilables a urbanos como residuos vegetales, aceites usados y residuos peligrosos, etc., se regirán según lo dispuesto en la legislación vigente, esto es, la prórroga del Plan de Gestión Integral de Residuos de Aragón (2009-2015) ó el Plan de Gestión Integral de Residuos de Aragón (2016-2022), si este último ya está vigente.

### 2.3.2 MEDICIÓN DE VOLÚMENES DE AGUA.

En el proyecto de Modernización de las infraestructuras de riego de la Comunidad de Regantes Santa Ana, se proyecta la ejecución de una nueva obra de toma en el Canal de Monegros, situada en la cota 388,28 m.s.n.m. que permitirá derivar caudales a una tubería de llenado (PRFVØ1600 mm). Desde esta toma se deriva caudales a la balsa Inferior Sur y por vasos comunicantes, a la balsa Inferior Norte.

Desde la misma tubería que comunica ambas balsas inferiores, se deriva el colector de aspiración a la Estación de Bombeo, en la que se ubican 2 bombeos independientes, uno a Balsa Intermedia, desde la que se regará el Piso 1, y otra hasta la Balsa Elevada, desde la que se regará el Piso 2. El piso 1, regado por la balsa intermedia, cuenta con una superficie de 2.339,96 ha mientras que el piso 2, regado por la balsa elevada suma una superficie de 374,57 ha. En la siguiente imagen puede apreciarse el esquema hidráulico del proyecto.

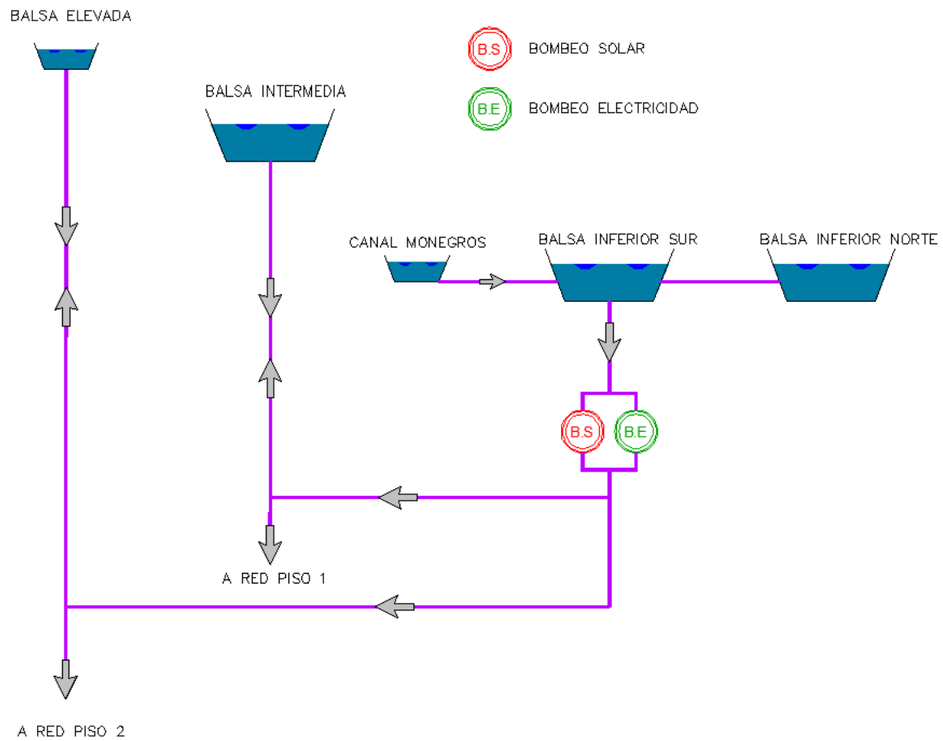



Figura 2. Esquema de funcionamiento por pisos de riego del proyecto.

Los equipos e instalaciones a considerar en la obra de toma, así como en las infraestructuras de llenado de la Balsa, estarán diseñados para un caudal máximo de 2,5 $m^3/s$, con objeto de dotar a la instalación de mayor capacidad de maniobra. Sin embargo, el caudal solicitado será el correspondiente al CFC para la superficie de riego, es decir, 1.818 l/s, el cual proviene del cálculo de las necesidades hídricas de la alternativa de cultivos considerada, calculadas en el Anejo 3 "Estudio Agronómico".

La captación se localiza aproximadamente en el P.K 28+370 del Canal de Monegros, en su margen izquierda, dentro del Término Municipal de Torralba de Aragón (Huesca). La obra de captación la conforman varias infraestructuras, las cuales aparecen enumeradas en el documento "Memoria" del presente proyecto, sin embargo, es del interés de este apartado destacar el sistema empleado en la medición del agua en la captación y, por ende, en la entrada de la Red.

Se proyecta una tubería de PRFV DN1600 PN6 que partirá del muro del canal y conectará con la Balsa Inferior Sur. Sobre la tubería de llenado, se proyecta un caudalímetro de ultrasonidos no invasivo en arqueta accesible. El caudalímetro controlará que el caudal de entrada a la balsa sea el preciso.

Para que el caudalímetro funcione correctamente, la conducción debe trabajar a sección llena, por lo que en la salida de la tubería a la balsa se proyecta un aliviadero invertido de forma que, aunque la balsa esté por debajo del Nivel Máximo (que coincide con la cota de solera del Canal de Monegros), la tubería permanezca llena.

Se dispondrá de un caudalímetro para cada tubería de impulsión. Estos caudalímetros se ubicarán fuera de la estación de bombeo, en una arqueta y en ambos casos serán caudalímetros de ultrasonido no invasivos. En el caso de la impulsión a la balsa intermedia, el caudalímetro se ubica sobre una tubería de PRFV DN1400 PN10. El otro caudalímetro, se ubicará en la tubería de impulsión a la balsa elevada sobre una tubería de PRFV DN700 PN10.

En el siguiente esquema se muestra la distribución de los caudalímetros que contempla el proyecto de forma general.

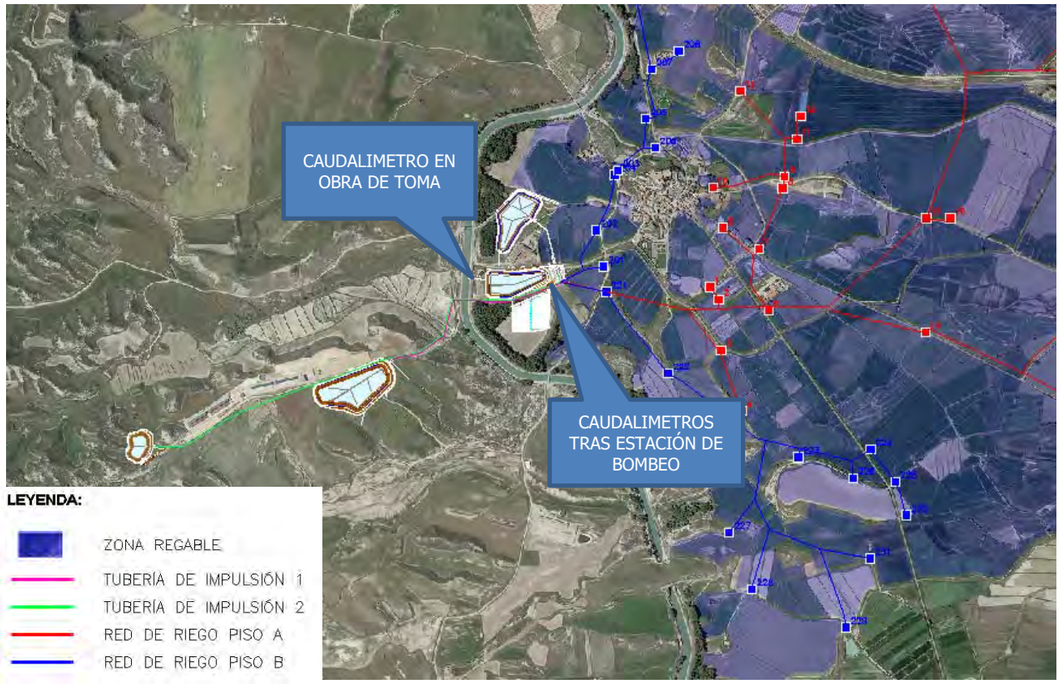



Figura 3. Ubicación de los sistemas de medición de caudales previstos en el proyecto.

De esta forma, en todo momento se puede saber el caudal instantáneo y el volumen de agua consumido en un determinado periodo de tiempo.

A modo de resumen:

Tabla 1. Caudalímetros ubicados a lo largo de la red

| INFRAESTRUCTURA | TIPO CAUDALÍMETRO | Descripción medición |
|---|---|---|
| Toma | Medidores ultrasónicos DN 1600 PN 6 | Medición a Balsa Inferior Sur y Norte |
| Arqueta tras estación de bombeo | Medidores ultrasónicos DN-1400 PN 10 | Medición a Balsa Intermedia |
| | Medidores ultrasónicos DN-700 PN 10 | Medición a Balsa Superior |

Es decir, la infraestructura incorpora un control de caudales y volúmenes por parte del organismo de cuenca a través de la red de aforos y el sistema de gestión de pedido que debe llevar a cabo la CR al servicio de guardería del Canal de Monegros, e interiormente incorpora un control muy exhaustivo de los consumos y volúmenes gestionados a través de la red de caudalímetros en alta.

Además, en cada hidrante (punto de consumo en parcela) se incorpora un contador Woltman con emisor de pulsos que permite, controlar el volumen y el caudal que se sirve a cada explotación in situ, y de forma remota a través del sistema de telecontrol previsto en el proyecto.

A continuación, se adjunta documentación gráfica extraída de los planos del proyecto constructivo donde puede consultarse con más grado de detalle la ubicación de cada uno de ellos.

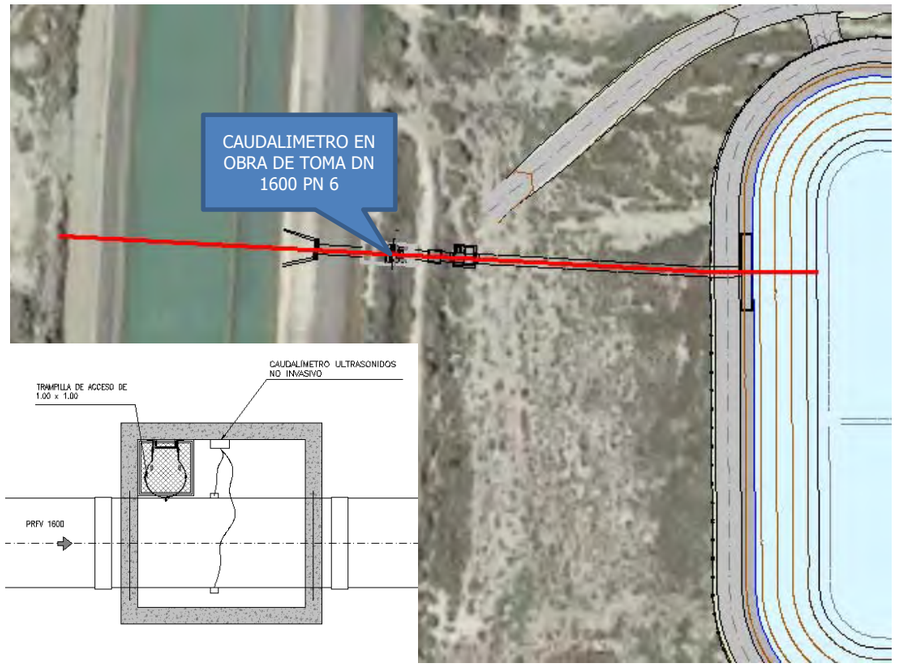



Figura 4. Caudalímetro ultrasónico DN 1600 PN 6 de la obra de toma.

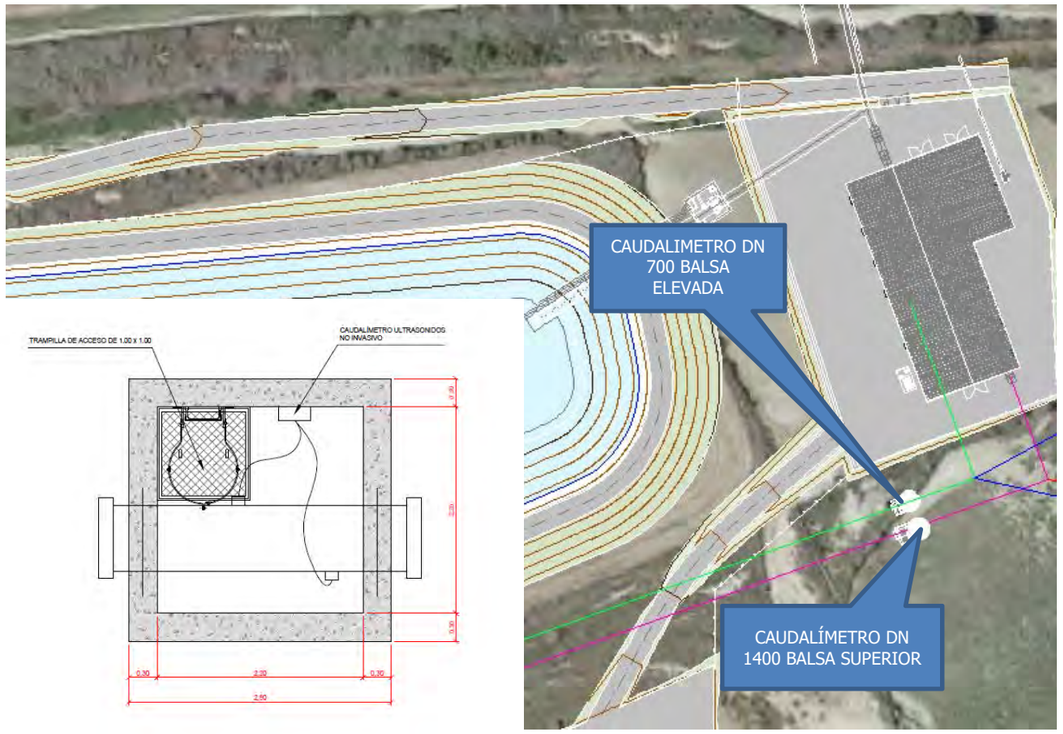



Figura 5. Caudalímetros ultrasónicos DN 1400 PN 10 y DN 700 PN 10 tras la estación de bombeo.

Además, en cada tipo de hidrante (punto de consumo) encontramos un contador con emisor de pulsos que permite controlar el volumen y el caudal que se sirve a cada explotación.

A continuación, se adjunta una imagen extraída de los planos del proyecto, de los hidrantes compartidos e individuales:

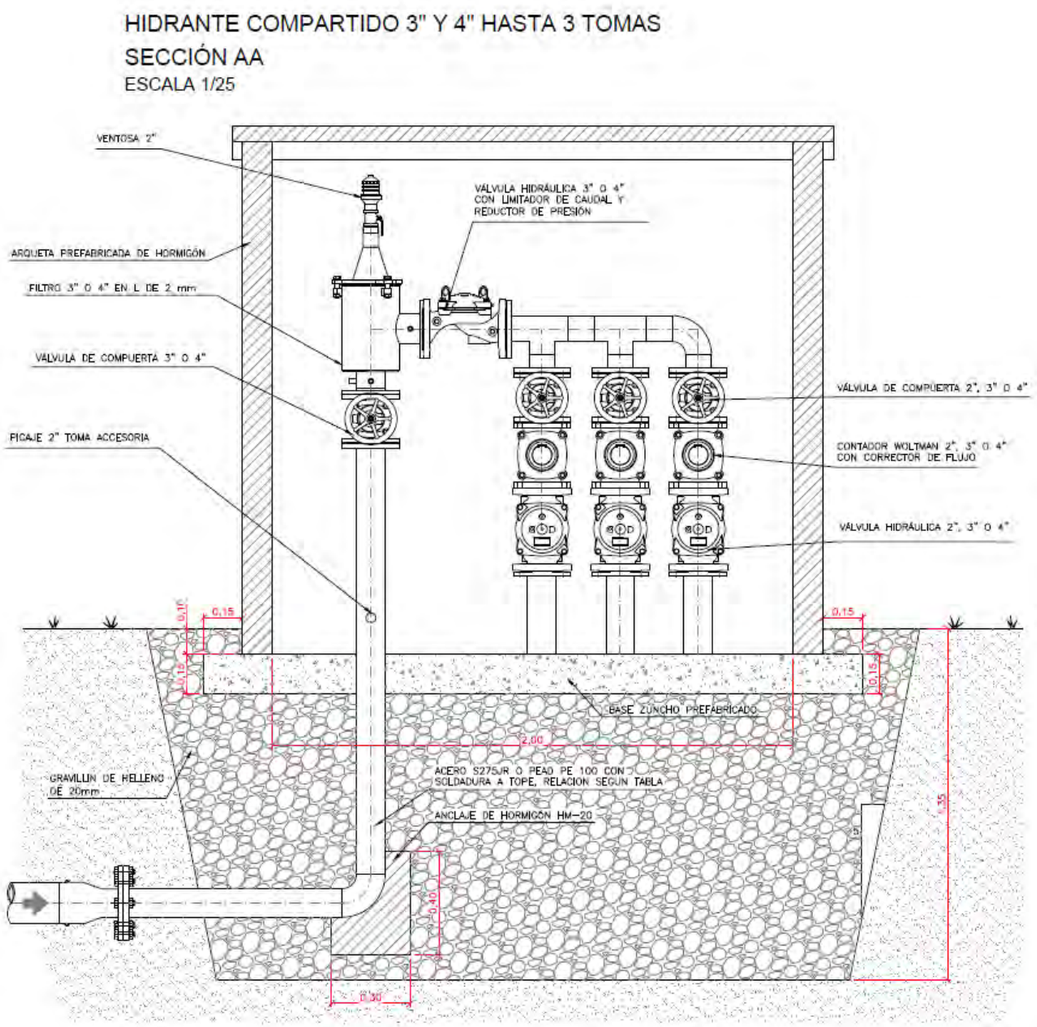



Figura 6. Perfil de Hidrante compartido con 3 tomas y un contador por cada toma.

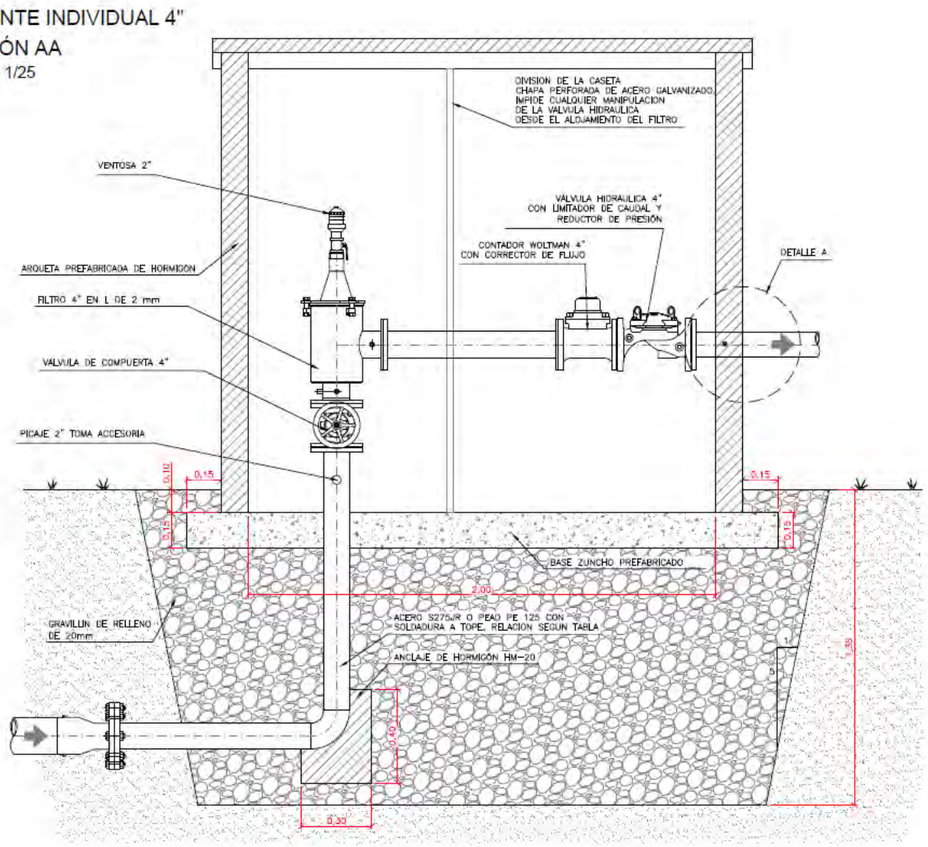



Figura 7. Perfil de Hidrante con un contador.

### 2.3.3 SEÑALIZACIÓN FEADER

Al tratarse de una actuación susceptible de ser cofinanciada por el FEADER, deberá darse cumplimiento a las normas establecidas en materia de información y publicidad detalladas en el Anexo III del Reglamento de Ejecución (UE) 808/2014 de la Comisión.

En caso de ser seleccionado el proyecto para cofinanciación FEADER, se ha recogido en el presupuesto una partida para la colocación de un cartel provisional de dimensiones 2,10 x 1,50 m, informativo de la financiación de la obra por el FEADER durante la ejecución de las obras. Además, para la fase de explotación, está prevista la colocación de 4 placas permanentes en los lugares más representativos de las obras (en este caso, una placa en cada una de las cuatro balsas), de dimensiones 0,42 x 0,42 m.

El diseño, tanto del cartel como de las placas, se puede consultar en el Pliego de Condiciones Técnicas del proyecto, apartado 2.3.4. PUBLICIDAD DE LA OBRA. En el presupuesto se han habilitado las unidades de obra correspondientes para este cometido.

# 3 INFORMACIÓN COMPLEMENTARIA

## 3.1 SISTEMA DE RECUPERACIÓN DE LA INVERSIÓN Y DE LOS COSTES POR LOS SERVICIOS DEL AGUA

### 3.1.1 SISTEMA DE RECUPERACIÓN DE LA INVERSIÓN

En el presente proyecto se contempla la infraestructura necesaria para la modernización integral de la Comunidad de Regantes Santa Ana del Canal de Monegros en el proyecto "PROYECTO DE MODERNIZACIÓN DEL REGADIO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA)"

La relación entre la Comunidad de Regantes Santa Ana y la Sociedad Mercantil Estatal de Infraestructuras Agrarias, S.A. (SEIASA) se articula mediante el "CONVENIO REGULADOR PARA LA FINANCIACIÓN, CONSTRUCCIÓN Y EXPLOTACIÓN DE LAS OBRAS DE MODERNIZACIÓN DE LOS REGADÍOS DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA), suscritos entre SEIASA y la Comunidad de Regantes Santa Ana con fecha 30 de septiembre de 2021, y cuyo objeto es la regulación de las condiciones financieras y de realización de la actuación de modernización de los regadíos de la Comunidad de Regantes Santa Ana. Según establece el esquema financiero que figura en ambos convenios, la financiación de las obras se desarrollará de la siguiente manera:

- El 50% del "coste total de la actuación" será financiado por la COMUNIDAD DE REGANTES mediante el pago a SEIASA de cada una de las facturas emitidas en relación al 50% de todos los conceptos que integran el coste total de la actuación, tanto durante la fase de redacción y tramitación del proyecto, como a lo largo de la ejecución de las obras, y durante el periodo comprendido entre la finalización de las obras y la liquidación de la tarifa de amortización anticipada.

- El 50% restante del "coste total de la actuación" será financiado por SEIASA, con cargo a su capital social y será recuperado de la COMUNIDAD DE REGANTES en veinticinco (25) anualidades a partir del vigésimo sexto año contado desde la terminación de las obras, esto es, del año veintiséis (26) al cincuenta (50), ambos inclusive

### 3.1.2 RECUPERACIÓN DE LOS COSTES POR LOS SERVICIOS DEL AGUA

Las Comunidades de Regantes son organizaciones creadas al amparo de la legislación de aguas para la prestación de servicios a sus miembros relacionados con la utilización de recursos hídricos para riego. En la actualidad tienen encomendada la gestión de una parte sustancial de los sistemas de distribución y control de la mayoría de las aguas de riego. Su organización interna está regida por unos estatutos de funcionamiento donde se reflejan las cuotas y derramas que deben asumir los comuneros. Los ingresos obtenidos por estas entidades en pago a los servicios prestados son los correspondientes a los costes a los que deben hacer frente como consecuencia de su actividad de gestión ("costes por los servicios del agua"). Dichos costes son, a grandes rasgos:

- Costes de la inversión en expropiaciones para la red de abastecimiento
- Los cánones y tarifas que deben satisfacer los asociados por los servicios de suministro de agua.
- La remuneración de los asalariados responsables de las tareas de gestión de la Comunidad de Regantes.
- Costes de mantenimiento, reparación y conservación de las obras
- Costes de explotación
- La parte correspondiente a los Regantes de las amortizaciones de las infraestructuras.
- Otros gastos: trabajos realizados por otras empresas o profesionales, impuestos sobre la producción, etc.

Todos los costes internos incluidos los gastos de explotación de la Comunidad de Regantes Santa Ana se repercuten a cada regante. Para ello la CR Santa Ana aprueba en sus presupuestos anuales una tarifa, de carácter binómico, en la cual se imputa según el agua servida a los usuarios, es decir, con arreglo al volumen en metros cúbicos realmente consumidos por cada regante, y otra parte se imputa a la superficie como "canon de superficie" según la superficie que posee cada regante respecto del total.

## 3.2 INDICADORES ESPECÍFICOS DE REGADÍO (IER)

En el Marco Nacional de Desarrollo Rural 2014-2020 (en adelante MNDR) se definieron una serie de indicadores específicos para la submedida sobre Inversiones en infraestructuras públicas de regadío. Este listado de indicadores es de obligada cumplimentación para las operaciones de modernización de regadíos incluidas en el PNDR, así como para las incluidas en los Programas de Desarrollo Rural de las Comunidades Autónomas (CCAA).

El objetivo de estos indicadores es facilitar la evaluación de las inversiones públicas en modernización de regadíos contempladas por el PNDR y de sus efectos sobre los distintos ámbitos de interés definidos en el

Reglamento (UE) 1305/2013 de ayuda al Desarrollo Rural (FEADER) en base a los cuales se programó la Submedida 4.3

Tabla 2. Indicadores específicos de regadío (IER) del proyecto

| INDICADOR | DENOMINACIÓN DEL INDICADOR | VALOR |
|---|---|---|
| 1 | Superficie de riego controlada con TIC: medidores del uso del agua en parcela (ha) | 2.714,5356 |
| 2 | Superficie de riego controlada con TIC: sistemas inteligentes de telecontrol del riego (ha) | 0 |
| 3 | Superficie de riego controlada con TIC: sistemas inteligentes de fertirrigación (ha) | 0 |
| 4 | Superficie de riego controlada con TIC: con tarifas de la comunidad de Regantes orientadas a la eficiencia en el uso del agua (ha) | 2.714,5356 |
| 5 | Caracterización de las masas de agua afectadas: código, tipo, estado, presiones por extracciones y contaminación difusa. | Ver desarrollo |
| 6 | Concentración de $NO_3$ en el punto de la red de seguimiento del estado de aguas subterráneas más representativo de la zona (mg/l) | 0 |
| 7 | Consumo de energía de la infraestructura modernizada (MWh/ año) | 2.930,51 |
| 8 | Energía renovable generada por instalaciones construidas con la finalidad de autoabastecer la infraestructura (MWh/año) | 1969,87 |
| 9 | Superficie de regadío modernizada (ha) | 2.714,53 |
| 10 | Número de explotaciones afectadas por la modernización. | 220 |
| 11 | Dimensión media de la superficie elemental de riego (ha/ nº hidrantes o toma) | 14,06 |
| 12 | Superficie regada según sistema de riego: gravedad, aspersión, localizado (ha) | Ver desarrollo |
| 13 | Volumen de agua utilizado por campaña según sistema de riego ($m^3$/ha/año, $m^3$/año) | Ver desarrollo |
| 14 | Ahorro potencial de agua derivado de la modernización ($m^3$/año a escala de infraestructura) | 4.986.153,87 |
| 15 | Parte del Ahorro potencial de agua destinado a consolidar regadío ($m^3$/año, $m^3$/ha.año) | 5.647.320,61 $m^3$/año; 2.080,41 m3/ha año |
| 16 | Ahorro efectivo de agua derivado de la modernización ($m^3$/año a escala de infraestructura) | 703.990,67 |
| 17 | Concesión de agua de la infraestructura ($m^3$/año) | 25.405.245,09 |
| 18 | VAB (€/año, €/ha.año, €/$m^3$) | Ver desarrollo |
| **Espacios Red Natura 2000 afectados por la modernización de infraestructuras** | | |
| 19 | Código y denominación | Ninguno |
| 20 | Efecto sobre el régimen hídrico del espacio Natura 2000 ($m^3$/año y %) | Ninguno |

- **INDICADOR 1 Superficie de riego controlada con TIC: Medidores del uso del agua en parcela (ha).**

Todos los hidrantes poseerán válvulas hidráulicas que permitirán ser controladas remotamente desde la centralita de la Comunidad de Regantes Santa Ana. Estas válvulas permiten la regulación y la limitación del caudal que pasa por el hidrante mediante reguladores mecánicos y contabilizar el caudal instantáneo. De esta manera encontramos que todas las hectáreas están controladas por tecnologías TIC por lo que la superficie de riego controlada con TIC para este proyecto es de 2.714,5256 hectáreas

Indicador 1 = 2.714,5256 hectáreas

- **INDICADOR 2 Superficie de riego controlada con TIC: sistemas inteligentes de telecontrol del riego (ha).**

El proyecto prevé la instalación de un sistema que posibilite el telecontrol para la telegestión del riego en alta, es decir a nivel de balsas y estación de bombeo, mediante los cuales se plantea la optimización del sistema de riego.

En esta actuación no se ha previsto ningún sistema inteligente de telecontrol del riego en las tomas de agua de las parcelas.

Indicador 2 = 0

- **INDICADOR 3 Superficie de riego controlada con TIC: sistemas inteligentes de fertirrigación (ha).**

En esta actuación no se ha previsto un sistema de fertirrigación.

Indicador 3 = 0

- **INDICADOR 4 Superficie de riego controlada con TIC: con tarifas de la Comunidad de Regantes orientadas a la eficiencia en el uso del agua (ha).**

Tras la ejecución de la obra y previo a la fase de explotación de la misma, la Comunidad de Regantes Santa Ana se compromete a aplicar una tarifa binómica orientada a fomentar el ahorro en el uso del agua en la zona modernizada. Por lo tanto, cada parcela englobada en las 2.714,5256 hectáreas beneficiadas por la inversión de modernización de la infraestructura pagará en la fase de explotación a la Comunidad de Regantes, una tarifa en función del volumen de agua consumido por dicha parcela (tarifa binómica que incentive la eficiencia

en el uso del agua con penalización a los consumos que superen la dotación media asignada). De hecho, las comunidades de Regantes que integran la red de riegos del Alto Aragón ya cobran el agua a sus regantes por metro cúbico consumido.

Indicador 4 = 2.714,5256 hectáreas

- **INDICADOR 5 Caracterización de las masas de agua afectadas: código, tipo, estado, presiones por extracciones y contaminación difusa.**

La comunidad de Regantes Santa Ana pertenece al Tramo II del Canal de Monegros, y está integrada en la Comunidad de Riegos del Alto Aragón. Hasta este punto van a parar tanto las aguas procedentes del embalse del Grado a través del Cinca, como las aguas procedentes del embalse del Sotonera a través del canal de Monegros en su primer tramo.

La confluencia entre estos dos canales, se produce a la finalización del Tramo I del Canal de Monegros, en el denominado "abrazo de Tardienta", con unas capacidades de transporte de 70 $m^3/s$, al inicio del Tramo II del Canal de Monegros, y de 43 $m^3/s$ a la finalización del Tramo III del Canal del Cinca. Gracias a este punto de unión recibirá el agua de estos dos sistemas.

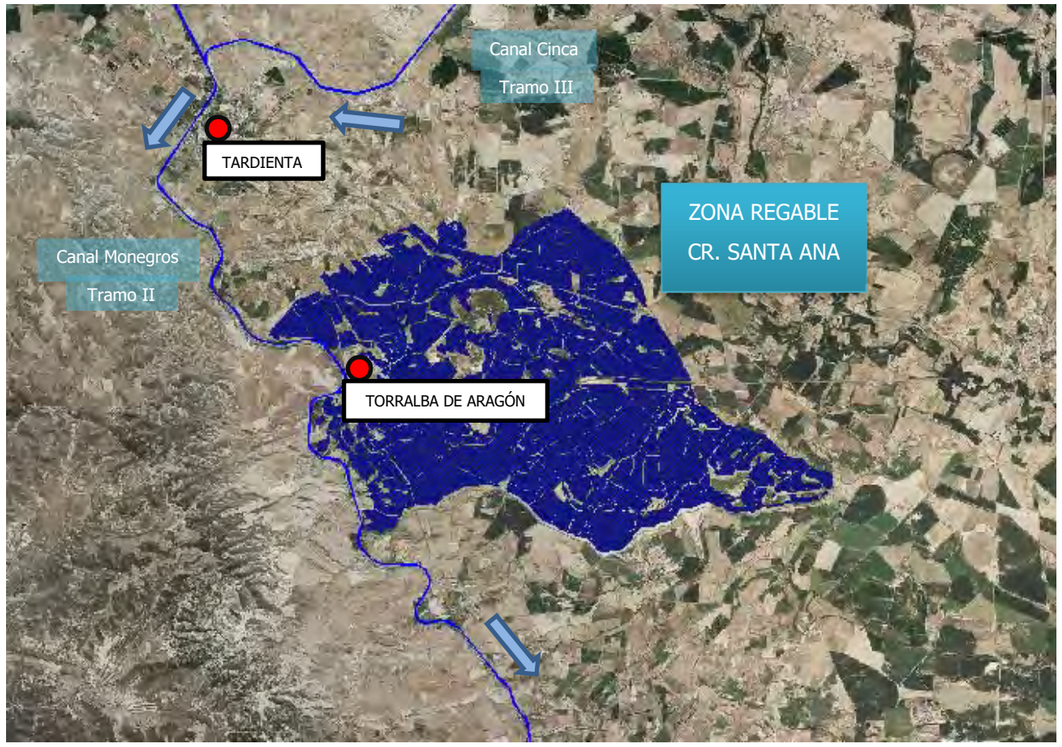



Figura 8. Localización de la zona regable

De acuerdo a la información que figura en el Informe de la Oficina de Planificación Hidrológica de la Confederación Hidrográfica del Ebro de fecha 21 de abril 2021 (el informe se adjunta en el Apéndice 2) se aportan los datos de las tres masas afectadas por la extracción de caudales y de la masa de agua afectada por contaminación difusa.

- 119. Río Sotón desde la Presa de La Sotonera hasta su desembocadura en el río Gállego.
- 678. Río Cinca desde la Presa de El Grado hasta el río Ésera.
- 962. Río Gállego desde el azud de Ardisa hasta el barranco de la Violada.
- 164. Río Flumen desde el rio Isuela hasta su desembocadura en el río Alcanadre

Tabla 3. Características de las masas de agua afectadas

| **CÓDIGO PH/ EU** | **ES091MSPF678** | **ES091MSPF962** | **ES091MSPF119** | **ES091MSPF164** |
|---|---|---|---|---|
| **CÓDIGO EM** | | | | |
| DENOMINACIÓN | RÍO CINCA DESDE LA PRESA DE EL GRADO HASTA EL RÍO ÉSERA. | RÍO GÁLLEGO DESDE EL AZUD DE ARDISA HASTA EL BARRANCO DE LA VIOLADA. | RÍO SOTÓN DESDE LA PRESA DE LA SOTONERA HASTA SU DESEMBOCADURA EN EL RÍO GÁLLEGO | RÍO FLUMEN DESDE EL RIO ISUELA HASTA SU DESEMBOCADURA EN EL RIO ALCANADRE |
| CATEGORÍA | RÍO | RÍO | RÍO | RÍO |
| NATURALEZA | SUPERFICIAL | SUPERFICIAL | SUPERFICIAL | SUPERFICIAL |
| ESTADO ECOLÓGICO | NO ALCANZA BUEN ESTADO | NO ALCANZA BUEN ESTADO | ALCANZA BUEN ESTADO | NO ALCANZA BUEN ESTADO |
| ESTADO QUÍMICO | ALCANZA BUEN ESTADO | ALCANZA BUEN ESTADO | ALCANZA BUEN ESTADO | NO ALCANZA BUEN ESTADO |
| ESTADO CUANTITATIVO | | | | |
| ESTADO GLOBAL | NO ALCANZA BUEN ESTADO | NO ALCANZA BUEN ESTADO | ALCANZA BUEN ESTADO | NO ALCANZA BUEN ESTADO |
| PRESIÓN POR EXTRACCIÓN | NO | NO | NO | |
| PRESIÓN POR CONTAMINACIÓN DIFUSA | | | | SI |

- **INDICADOR 6 Concentración de $NO_3$ en el punto de la red de seguimiento del estado de aguas subterráneas más representativo de la zona (mg/l).**

La Directiva 2000/60/CE, por la que se establece un marco comunitario de actuación en el ámbito de la política de aguas incluye, dentro de sus objetivos, la necesidad de evitar la contaminación de las aguas

subterráneas. Para cumplir con sus objetivos, deben establecerse unos programas de medidas que, entre otras, incluyan las requeridas en la Directiva 91/676/CEE.

Además, las zonas vulnerables establecidas en cumplimiento de la Directiva 91/676/CEE se incluyen en el registro de zonas protegidas de la Directiva 2000/60/CE.

Esta normativa comunitaria establece los criterios y procedimientos para la evaluación del estado químico de las aguas subterráneas, así como las posibles medidas a adoptar para reducir los agentes contaminantes que las afecten. En concreto, para evaluar el estado químico, se establecen, entre otras, unas normas de calidad en relación a los nitratos, fijándose una concentración máxima admisible de 50 mg/l.

La masa de agua subterránea más cercana a la zona regable es la del Aluvial del Cinca, donde existe una estación de medición de nitratos en el municipio de Valmediana, zona vulnerable a la contaminación por nitratos. A persa de ello, la estación se encuentra a más de 20 kilómetros de la zona regable y a 15 de la zona vulnerable por contaminación de nitratos. Por último, es necesario destacar que, debido a las características del territorio, esta masa de agua subterránea no recibirá el agua de los desagües de las parcelas de la CR. Santa Ana. Por lo tanto, debido a la inexistencia de una estación de la red de seguimiento oficial del estado de las masas de agua influenciadas por el regadío, no se ha calculado este indicador.

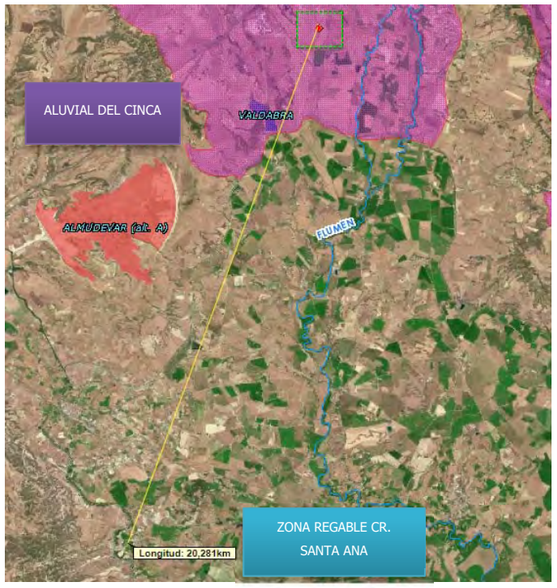



Figura 9. Distancia entre la Zona regable y la estación de medición de nitratos más cercana.

Indicador 6 = 0

- **INDICADOR 7 Consumo de energía de la infraestructura (MWh/ año)**

En el presente proyecto de modernización, en el Anejo 9, "Cálculos hidráulicos", se detallan los equipos de bombeo que se va a disponer y un apéndice de cálculo tal y como se exige para este indicador. De esta manera encontramos dos bombeos diferenciados:

Bombeo a balsa 1: 2.371,55 MWh
Bombeo a balsa 2: 558,96 MWh

Consumo energía infraestructura = Consumo futuro – Consumo actual = 2.930,51- 0 = 2.930,51MWh/año

Indicador 7 = 2.930,51 MWh/año

- **INDICADOR 8 Energía renovable generada por instalaciones construidas con la finalidad de autoabastecer la infraestructura (MWh/año)**

Sistema autosuficiente, consume la energía que genera el parque solar instalado junto a la estación de bombeo. El parque solar tiene la capacidad de producir 1969,87 MWh. Los cálculos se muestran detallados en el Anejo 9 "Cálculos hidráulicos" y en el Anejo 13 "Instalación Fotovoltaica".

Indicador 8 = 1969,87 MWh

- **INDICADOR 9 Superficie de regadío modernizada (ha)**

La superficie de riego modernizada con la presente actuación es de 2.714,5256 hectáreas

Indicador 9 = 2.714,53 hectáreas

- **INDICADOR 10 Número de explotaciones afectadas por la modernización.**

Como se recoge en el Anejo nº 2, existen un total de 220 propietarios diferentes, que son beneficiarios de esta modernización.

Indicador 10 = 220

- **INDICADOR 11 Dimensión media de la superficie elemental de riego (ha/ nº hidrantes o toma)**

La superficie total es de 2.714,5256 hectáreas. El número de hidrantes es de 193. La superficie media por hidrante es de 14,0649 ha.

Indicador 11 = 14,0649

- **INDICADOR 12 Superficie regada según sistema de riego: gravedad, aspersión, localizado (ha)**

- Superficies ACTUALES:
  - Riego por gravedad: 1.801,09 ha
  - Riego por aspersión: 325,74 ha
  - Riego localizado: 587,69 ha
- Superficies estimadas tras el proyecto:
  - Riego por gravedad: 0 ha
  - Riego por aspersión: 1.764,44 ha
  - Riego localizado: 950,084 ha
- Índices deducidos:
  - Gravedad: - 1.801,09 ha
  - Aspersión: +1.438,70 ha
  - Localizado: +362,39 ha

- **INDICADOR 13 Volumen de agua utilizado por campaña según sistema de riego ($m^3$/ha/año, $m^3$/año)**

Debido a que no existe ninguna medida que permita conocer el volumen de agua que la infraestructura sirve a la explotación actualmente de manera exacta, se realiza una estimación considerando cada sistema de riego y las necesidades de los cultivos implantados en la zona.

Tabla 4. Consumos específicos actuales

| Cultivo | $m^3$/ha y año | Superficie (ha) | $m^3$/año |
|---|---|---|---|
| Maíz | 7.907,02 | 325,74 | 2.575.656,69 |
| Alfalfa | 12.285,25 | 624,34 | 7.670.183,65 |
| Cebada | 5.044,25 | 1.176,75 | 5.935.801,35 |
| Almendro | 6.402,94 | 587,69 | 3.762.973,80 |
| TOTAL | | | 19.944.615,48 |

Volúmenes estimados actuales:

- Riego por gravedad/inundación (eficiencia 60%, 1.801,09 ha): 13.605.985 $m^3$/año
- Riego por aspersión/automotriz (eficiencia 75%, 325,74 ha): 2.575.656,69 $m^3$/año
- Riego localizado/goteo (eficiencia 90%, 587,69 ha): 3.762.973,8 $m^3$/año
- Total: 19.944.615,48 $m^3$/año

**Consumos específicos futuros.**

En el Anejo 3 "Estudio Agronómico" del proyecto se realiza el cálculo de las necesidades de riego por cultivos. La superficie destinada para cada cultivo ha cambiado, aumentando en gran medida los cultivos con mayor demanda hídrica.

Tabla 5. Consumos específicos tras proyecto

| Cultivo | $m^3$/ha y año | Superficie (ha) | Necesidades brutas (m3/año) |
|---|---|---|---|
| Maíz | 7.907,02 | 950,08 | 7.512.332,00 |
| Alfalfa | 9.828,20 | 407,18 | 4.001.834,95 |
| Cebada | 4.035,40 | 407,18 | 1.643.128,40 |
| Almendro | 6.402,94 | 950,08 | 6.083.329,47 |
| TOTAL | | | 19.240.624,82 |

Volúmenes estimados tras proyecto:

- Riego por gravedad/inundación (eficiencia 60%, 0 ha): 0 $m^3$/año
- Riego por aspersión/automotriz (eficiencia 75%, 1.764,44 ha): 13.157.295.35 $m^3$/año
- Riego localizado/goteo (eficiencia 90%, 950,08 ha): 6.083.329,47 $m^3$/año
- Total: 19.240.624,82 $m^3$/año

Índices deducidos (volumen):

- Gravedad/inundación: - 13.605.985 $m^3$/año
- Aspersión/automotriz: +10.581.638,66 $m^3$/año
- Localizado/goteo: +2.320.355,67 $m^3$/año
- Ahorro agua: 703.990,67 $m^3$/año

Se proyecta una redistribución en el sistema de riego que pasa, después de ejecutado, a aspersión y localizado, con lo que se consigue generalizar un sistema con una eficiencia de al menos el 95% en las peores condiciones. Indicar que esta diferencia es sin tener en cuenta las pérdidas estimadas en la red tanto en la actualidad como en el futuro.

La mejora en la eficiencia de la instalación será utilizada para implantar cultivos más rentables.

- **INDICADOR 14 Ahorro potencial de agua derivado de la modernización ($m^3$/año a escala de infraestructura)**

AP en porcentaje (%), como la diferencia entre el porcentaje de pérdidas de la infraestructura antes de la operación (PA), y el porcentaje de pérdidas de la infraestructura después de la operación (PD).

AP (%) = PA (%) – PD (%)

La actual infraestructura de riego es llevada a cabo gracias una red de acequias que riega por inundación las explotaciones agrarias. Esta red de acequias se encuentra en mal estado, con un porcentaje de pérdidas estimado en el 30 por ciento en el caso más favorable, pero se adopta este dato para estar del lado de la seguridad.

Por otro lado, la nueva infraestructura mediante tubería presurizada tendrá, en su caso más desfavorable unas pérdidas por fugas en la red del 5%. Por tanto:

AP (%) = 30%-5%=25%

Indicador 14: 4.986.153,87 $m^3$/año

- **INDICADOR 15 Parte del Ahorro potencial de agua destinado a consolidar regadío ($m^3$/año, $m^3$/ha.año)**

Se considera que todo el Ahorro Potencial va destinado a la consolidación del regadío.

La comunidad de Regantes Santa Ana es una comunidad de base, integrada dentro de la Comunidad General de Riegos del Alto Aragón (CGRAA), y como tal no tiene concesión propia si no que es beneficiaria de la concesión de la CGRAA, recibiendo el agua a través de la red de canales y acequias a la que tiene derecho, previo pedido que se cursa a la Confederación Hidrográfica del Ebro a través de la CGRAA. Mediante un sistema de compuertas aforadas se conocerá de forma diaria y puntual el agua servida por la guardería del Canal durante todo el año. La comunidad utilizará el programa ADOR implantado por la comunidad General.

La dotación prevista para el sistema de Riegos del Alto Aragón en el PHN es de 9.359 $m^3$/ha/año

D = 9.359 $m^3$/ha*año x 2.714,53 ha = 25.405.245,09 $m^3$/año.

Como ya se ha indicado antes, gracias a esta modernización se podrá implementar cultivos con mayores necesidades hídricas y por tanto parte del ahorro potencial de agua, irá destinado a ello.

AP ($m^3$/año) = (PA-PD) (%) x D ($m^3$/año) / 100

AP ($m^3$/año) = 25 x 25.405.245,09/100 = 6.351.311,27 $m^3$/año

Gran parte del Ahorro Potencial se va a emplear en consolidar el regadío (APC), el resto del ahorro potencial se considera ahorro efectivo (AE). De modo que:

APC ($m^3$/año) = AP ($m^3$/año) – AE ($m^3$/año)

APC ($m^3$/año) = 6.351.311,27 ($m^3$/año) – 703.990,67 ($m^3$/año)

APC ($m^3$/año) = 5.647.320,61 ($m^3$/año)

APC ($m^3$/año*ha) = 2.080,41 ($m^3$/año*ha)

Así, la parte del ahorro potencial de agua destinado a consolidar el regadío es de un 89 %.

Indicador 15 = 5.647.320,61 $m^3$/año; 2.080,41 $m^3$/ha y año

- **INDICADOR 16 Ahorro efectivo de agua derivado de la modernización ($m^3$/año a escala de infraestructura)**

Dado que la mayor parte del Ahorro Potencial va destinado a la consolidación del regadío, el Ahorro Efectivo representa un 11% del Ahorro Potencial.

Indicador 16 AE = 703.990,67 $m^3$/año

- **INDICADOR 17 Concesión de agua de la infraestructura ($m^3$/año).**

Como ya se ha comentado anteriormente, la comunidad de Regantes Santa Ana es una comunidad de base, integrada dentro de la Comunidad General de Riegos del Alto Aragón (CGRAA), y como tal no tiene concesión propia si no que es beneficiaria de la concesión de la CGRAA, recibiendo el agua a través de la red de canales y acequias a la que tiene derecho, previo pedido que se cursa a la Confederación Hidrográfica del Ebro a través de la CGRAA.

La dotación prevista para el sistema de Riegos del Alto Aragón en el PHN es de 9.359 $m^3$/ha*año, lo que equivale para la superficie de 2.714,53 ha a 25.405.245,09 $m^3$/año.

En el Apéndice 3 se incluye el certificado de la Comunidad General de Riegos del Alto Aragón en el que se define a la Comunidad de Regantes como beneficiaria de la concesión de uso de agua.

Indicador 17 = 25.405.245,09 $m^3$/año

- **INDICADOR 18 Valor Añadido Bruto**

El VAB se ha calculado a partir de los ingresos y costes recogidos en el Anejo 22: "Estudio de viabilidad económica", en donde se calculan tanto los costes como los ingresos previstos tras la modernización.

El VAB se ha calculado como:

V.A.B. = Producción final de la agricultura – Consumos Intermedios

Considerándose como consumos intermedios todos aquellos gastos que es preciso realizar en medios de producción corrientes (semillas selectas y plantones, fertilizantes, energía, piensos, etc.) para el desarrollo del proceso productivo agrario.

En la siguiente tabla se recoge el resumen del cálculo realizado.

Tabla 6. Valor actual Bruto para la rotación de cultivos situación actual.

| CULTIVO | SUPERFICIE | | INGRESOS | COSTES INTERMEDIOS |
|---|---|---|---|---|
| | ha | % | € | € |
| Maíz | 325,74 | 12% | 2.400.759,01 | 621.700,20 |
| Alfalfa | 624,34 | 23% | 6.630.401,90 | 867.921,24 |
| Cebada | 1.176,75 | 43% | 1.449.667,61 | 1.243.539,00 |
| Almendro | 587,69 | 22% | 1.608.237,08 | 1.508.296,94 |
| TOTALES | 2.714,53 | 100% | 12.089.065,61 | 4.241.457,38 |
| **TOTALES MEDIOS POR HA** | | | 4.453,47 | 1.562,50 |
| **VABi (€/año)** | | | 7.847.608,23 | |
| **VABi (€/año y ha)** | | | 2.890,97 | |
| **VABi (€/m³)** | | | 0,39 | |

Tabla 7. Valor actual Bruto para la alternativa de cultivos futura prevista tras la modernización.

| CULTIVO | SUPERFICIE | | INGRESOS | COSTES INTERMEDIOS |
|---|---|---|---|---|
| | ha | % | € | € |
| Maíz | 950,08 | 35,00 | 7.780.237,55 | 1.541.298,41 |
| Alfalfa | 407,18 | 15,00 | 3.203.092,70 | 481.130,25 |
| Cebada | 407,18 | 15,00 | 371.566,73 | 365.746,76 |
| Almendro | 950,08 | 35,00 | 2.888.801,54 | 2.072.602,03 |
| TOTALES | 2.714,53 | 100% | 14.243.698,52 | 4.460.777,46 |
| **TOTALES MEDIOS POR HA** | | | 5.247,21 | 1.643,30 |
| **VABi (€/año)** | | | 9.782.921,07 | |
| **VABi (€/año y ha)** | | | 3.603,92 | |
| **VABi (€/m³)** | | | 0,51 | |

A continuación, se muestra el Impacto del proyecto sobre el VAB como diferencia entre la situación final y la situación inicial:

Tabla 8. Diferencia en el VAB entre la situación inicial y la situación final

| | |
|---|---|
| **VABi (€/año)** | 1.935.312,84 |
| **VABi (€/año y ha)** | 712,95 |
| **VABi (€/m³)** | 0,11 |

- **INDICADOR 19 y 20. Espacios de la Red Natura 2000 afectados por la infraestructura**

La mejora de la infraestructura proyectada no afecta a la red Natura 2000 (LICS Y ZEPAS), quedando fuera de cualquier Lugar de Interés Comunitario (LIC) ni Zonas de Especial Conservación (ZEC). No afecta tampoco a ninguna Zona de Especial Protección para las Aves (ZEPA)

Atendiendo a lo anterior diremos que no hay efecto sobre el régimen hídrico del espacio Natura 2000.

### 3.3 AHORRO POTENCIAL (AP) Y AHORRO EFECTIVO (AE) DE AGUA

Tabla 9. Valores resumen del ahorro del proyecto

| Modernización tipo | Derecho de agua utilizado por la infraestructura ($m^3$/año) | % Pérdidas inicial | % Pérdidas final | AP % | Valor umbral % | AP ($m^3$/año) | AE ($m^3$/año) |
|---|---|---|---|---|---|---|---|
| **Revestimiento y reparación de acequias** | | | | | | | |
| **Cambio distribución en canal a tubería a presión** | 25.405.245,09 | 30 | 5 | 25 | 15 | 6.351.311,27 | 703.990,67 |
| **Reparación y sustitución tuberías** | | | | | | | |
| **TOTAL** | 25.405.245,09 | 30 | 5 | 25 | 15 | 6.351.311,27 | 703.990,67 |

# APÉNDICE 1: DECLARACIÓN DE INTERÉS GENERAL DE LA ACTUACIÓN

# I. DISPOSICIONES GENERALES

## JEFATURA DEL ESTADO

**19563** *Real Decreto-ley 14/2009, de 4 de diciembre, por el que se adoptan medidas urgentes para paliar los efectos producidos por la sequía en determinadas cuencas hidrográficas.*

Las adversas condiciones climáticas sufridas en los últimos años han dado como resultado que algunas cuencas hidrográficas españolas continúen con acusados problemas para el suministro de agua, tanto para los abastecimientos a las poblaciones, como para las explotaciones agrícolas y ganaderas, por lo que es necesario adoptar determinadas medidas urgentes para paliar los efectos de la extraordinaria sequía sufrida.

Si bien el año hidrológico 2004/2005 comenzó con un buen nivel de reservas (al 31 de septiembre de 2004 se disponía de diez puntos porcentuales por encima de la media de los últimos diez años), la evolución marcadamente atípica y deficitaria del mismo, con precipitaciones muy inferiores a la media histórica, significó el inicio de un período de sequía que aún no se ha superado. Durante el transcurso del año hidrológico 2005/2006 se produjo un régimen de precipitaciones en el país superior al año precedente pero aún inferior a la media. Este hecho supuso un aumento transitorio de las reservas hasta la primavera, que fue sin embargo insuficiente para paliar la difícil situación de partida. Como lógica consecuencia, una vez finalizado el año hidrológico 2005/2006 el estado de las reservas fue incluso algo inferior al que había en la misma fecha del anterior año hidrológico. Aunque el año hidrológico siguiente, 2006-2007, se desarrolló con precipitaciones superiores a la media histórica en los meses de febrero, abril y mayo, el carácter seco se siguió manteniendo en las cuencas del sureste de la Península, en la cuenca del Segura, en el sistema Júcar y algunos sistemas del Guadiana y del Guadalquivir, así como en la margen izquierda del Ebro. Así pues, al término del año hidrológico 2006/2007 las reservas embalsadas se mantuvieron en los mismos niveles preocupantes para poder atender todas las demandas con normalidad. Igualmente, en el año hidrológico 2007-2008 la precipitación media estuvo marcada por la escasez, por lo que no fue suficiente en algunas cuencas para solventar el déficit acumulado en los años anteriores. Este déficit de precipitaciones fue más acusado en las cuencas del Guadalquivir y del Segura. La situación tampoco ha mejorado significativamente en el año hidrológico 2008-2009, pues las precipitaciones medias en España han vuelto a ser inferiores a la media, aunque con una distribución bastante irregular, con precipitaciones en el entorno de la normalidad en la cuenca del Guadalquivir y en el litoral mediterráneo e inferiores en las principales cuencas atlánticas. Sin embargo, las precipitaciones han continuado en su tónica de escasa cuantía en las cabeceras de las cuencas del Tajo, Segura y Júcar, así como en ciertos sistemas del Duero, Guadiana, Guadalquivir y Ebro. Durante este año hidrológico se han podido servir los recursos para el abastecimiento, aunque con ciertas medidas, apoyadas en el principio de precaución. Además, la campaña de riego en el año se ha desarrollado con dificultades generalizadas en varias cuencas, siendo las limitaciones de mayor entidad en las cuenca del Segura y en los subsistemas Tajuña de la cuenca del Tajo y Águeda en la cuenca del Duero.

Lógicamente el nuevo año hidrológico 2009-2010 se ha iniciado con un nivel de reservas en los embalses bastante bajo en la mayoría de las cuencas, aunque haya mejorado levemente en las cuencas del Segura, Júcar y Ebro. A nivel nacional, los embalses de uso consuntivo tienen unas reservas inferiores al 36 por ciento, cuando la media de los diez últimos años superaba en la misma fecha el 40 por ciento. La situación más desfavorable se presenta en las cuencas de los ríos Tajo, Segura y Júcar, con reservas globales del orden de apenas el 25 por ciento, pero también en áreas significativas de las

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cuencas del Duero, Guadiana, Guadalquivir y Ebro, con un nivel ciertamente preocupante de las reservas.

Por todo lo anteriormente expuesto y facilitar la gestión de la sequía actual parece conveniente la adopción de medidas efectivas basadas en la experiencia adquirida en los años de escasez precedentes, en los que se ha aplicado los Planes Especiales de Actuación en Situaciones de Alerta y Eventual Sequía.

Procede eximir de las exacciones relativas a la disponibilidad de agua para riego en el pasado año hidrológico 2008-2009. En relación con el Parque Nacional de Las Tablas de Daimiel, dadas las circunstancias excepcionales en las que se encuentra y el bajo aprovechamiento de los recursos trasvasados anteriormente provocado por esas mismas circunstancias, se hace necesario dispensar también de las exacciones correspondientes a los gastos fijos y variables de funcionamiento de la tarifa de conducción de las aguas del Acueducto Tajo-Segura, y la cuota de la tarifa de conducción de las aguas por la infraestructura del postrasvase (cuenca del Segura), correspondientes al año 2009. En consecuencia, es necesario restablecer la normalidad económica en los organismos afectados por la exención mediante las oportunas actuaciones compensatorias de índole financiera. Todas estas medidas, cuya urgencia no admite demora en su adopción, requieren su inclusión en una disposición de rango legal.

En los últimos años se han puesto en marcha experiencias muy positivas para paliar los daños de la sequía mediante la autorización, por una norma con rango legal, del intercambio de derechos de agua entre usuarios de diferentes cuencas, de manera que las cuencas excedentarias pueden aportar recursos adicionales a las zonas deficitarias, con la consiguiente compensación económica a los cedentes. Las experiencias obtenidas en los últimos años acreditan el efecto beneficioso de estos intercambios para las dos partes sin que se hayan manifestado efectos adversos. En consecuencia también se propone la aplicación de este tipo de medidas en la presente normativa.

Las especiales circunstancias de determinados sistemas de explotación de las siete cuencas mencionadas (Duero, Tajo, Guadiana, Guadalquivir, Segura, Júcar y Ebro) aconsejan la introducción en la presente normativa de medidas específicas para gestionar de una manera eficiente durante el período de sequía los sistemas de explotación afectados por la escasez.

La vigencia espacial de esta última componente de la disposición deberá adecuarse temporalmente, en su caso, teniendo como referencia general el estado de los sistemas de explotación en esas cuencas mediante el Sistema Global de Indicadores Hidrológicos del Ministerio de Medio Ambiente, y Medio Rural y Marino, que integran los «Indicadores de estado hidrológico» definidos en los planes especiales de actuación en situación de alerta y eventual sequía redactados en las cuencas intercomunitarias, aprobados por Orden MAM/698/2007, de 21 de marzo, en cumplimiento de lo dispuesto en el artículo 27 de la Ley 10/2001 del Plan Hidrológico Nacional.

Finalmente, la persistencia de la sequía por quinto año consecutivo aconseja reducir aún más las perdidas de agua. En este sentido, conviene aumentar los esfuerzos en la modernización y mejor gestión de las infraestructuras del sector agrario, ya que constituye por la naturaleza de sus producciones y las tecnologías utilizadas el mayor consumidor de agua dentro del Estado. Por tanto, el mayor potencial de ahorro de agua está en conseguir disminuir la cantidad necesaria para el riego.

Por ello, se hace imprescindible actuar de manera urgente en la modernización de nuestros regadíos y mejorar la eficacia en la gestión, buscando un ahorro y mayor control que permita una mayor disponibilidad y herramientas de gestión de los escasos recursos. Se prevé la realización de determinadas obras hidráulicas que se indican en los anexos II y III. En unos casos se declaran de interés general; en otros, se procede a la declaración de utilidad pública de las actuaciones, a efectos de la ocupación temporal y expropiación forzosa de bienes y derechos, así como a la de urgente necesidad de la ocupación. Se trata en todos los casos de concretas actuaciones directamente vinculadas al objetivo de este real decreto-ley de paliar los efectos producidos por la sequía en determinadas cuencas hidrográficas, al margen de otras obras de modernización y consolidación de

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regadíos que, aun siendo muy conveniente afrontar en el marco de una estrategia general de mejora de regadíos, no exigen recurrir a esta excepcional facultad legislativa.

Al tratarse todas ellas de medidas dependientes de la situación hídrica, ha sido preciso esperar a conocer la tendencia del régimen de precipitaciones en el inicio del otoño antes de su adopción.

Concurren, pues, las circunstancias de extraordinaria y urgente necesidad que constituyen el presupuesto habilitante exigido al Gobierno por el artículo 86.1 de la Constitución Española para dictar decretos-leyes, de acuerdo con una consolidada doctrina del Tribunal Constitucional: una situación de necesidad fundamentada en datos concretos; la urgencia de las medidas para subvenir esta situación de necesidad, que no puede atenderse acudiendo al procedimiento legislativo de urgencia; y la existencia de una conexión entre la situación de urgencia definida y las medidas concretas adoptadas para afrontarla.

En su virtud, en uso de la autorización contenida en el artículo 86 de la Constitución, a propuesta de la Ministra de Medio Ambiente, y Medio Rural y Marino y previa deliberación del Consejo de Ministros en su reunión del día 4 de diciembre de 2009, dispongo:

## CAPÍTULO I

### Disposiciones generales

Artículo 1. *Objeto y ámbito de aplicación.*

1. Este real decreto-ley tiene por objeto:

1.º Establecer medidas administrativas excepcionales para la gestión de los recursos hidráulicos.

2.º Establecer medidas urgentes para la regulación de las transacciones de derechos al aprovechamiento de agua.

3.º Establecer medidas de apoyo a los titulares de derechos al uso de agua para riego y abastecimientos en los ámbitos territoriales afectados por la sequía, cuando hayan dispuesto en la pasada campaña de una dotación de agua igual o inferior al 50 por ciento de la facilitada en un año normal. Dichos ámbitos figuran relacionados en el apartado I.2 del anexo I de este real decreto-ley.

4.º Eximir, en relación con el Parque Nacional de las Tablas de Daimiel, de la aportación correspondiente a la tarifa de conducción del Acueducto Tajo-Segura, dado el escaso aprovechamiento de los recursos trasvasados.

2. Los ámbitos territoriales de aplicación de este real decreto-ley serán los sistemas afectados por la sequía de las cuencas hidrográficas de los ríos Duero, Tajo, Guadiana, Guadalquivir, Segura, Júcar y Ebro, definidos en el apartado I.1 del anexo I de este real decreto-ley, si bien para la cuenca del Guadalquivir se limitarán al territorio no incluido en la Comunidad Autónoma de Andalucía.

3. Se faculta a la Ministra de Medio Ambiente, y Medio Rural y Marino para, de acuerdo con la evolución de la sequía en el año hidrológico 2009-2010, siempre según los «Indicadores de estado hidrológico» definidos en los Planes Especiales de Actuación en situación de alerta y eventual sequía redactados en las cuencas intercomunitarias, aprobados por Orden MAM/698/2007 de 21 de marzo, modificar la delimitación territorial del apartado I.1 del anexo I, en orden a la aplicación de las diferentes medidas previstas en el presente real decreto-ley. Dicha facultad se ejercerá una vez oídas las comunidades autónomas, las Juntas de Gobierno de las correspondientes Confederaciones Hidrográficas y las organizaciones representativas del sector.

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## CAPÍTULO II

### Medidas excepcionales de gestión de los recursos hidráulicos

Artículo 2. *Atribuciones de las Juntas de Gobierno y de los Presidentes de las Confederaciones Hidrográficas.*

1. Las Juntas de Gobierno de las Confederaciones Hidrográficas podrán modificar temporalmente las condiciones de utilización del dominio público hidráulico, cualquiera que sea el título habilitante que haya dado derecho a esa utilización, y en particular podrán:

a) Reducir las dotaciones en el suministro de agua que sean precisas para racionalizar la distribución de los recursos hídricos.

b) Modificar los criterios de prioridad para la asignación de recursos a los distintos usos del agua, respetando en todo caso la supremacía del uso consignado en el apartado 1 del artículo 60.3 del texto refundido de la Ley de Aguas, aprobado por el Real Decreto Legislativo 1/2001, de 20 de julio.

c) Imponer la sustitución de la totalidad o de parte de los caudales concesionales por otros de distinto origen y de calidad adecuada para el uso al que está destinado, para racionalizar el aprovechamiento del recurso.

d) Modificar las condiciones fijadas en las autorizaciones de vertido, para proteger la salud pública, el estado de los recursos y el medio ambiente hídrico y el de los sistemas terrestres asociados.

e) Modificar temporalmente las asignaciones y reservas previstas en los planes hidrológicos.

f) Exigir a los usuarios, de conformidad con lo dispuesto en el artículo 55 del texto refundido de la Ley de Aguas, la instalación inmediata de dispositivos de modulación, regulación y medición en las conducciones.

g) Adaptar el régimen de explotación de los aprovechamientos hidroeléctricos a las necesidades, con el fin de compatibilizarlos con otros usos.

2. También podrán modificarse temporalmente y mediante resolución motivada los requerimientos medioambientales establecidos en los planes hidrológicos, procurando asegurar los valores ambientales de los ecosistemas afectados, y aplicar, si se considera necesario, medidas correctoras. Estas medidas garantizarán que no se ponga en peligro la recuperación del estado de dichos ecosistemas.

3. Para el cumplimiento de las funciones anteriores, cada una de las Juntas de Gobierno afectadas constituirá una Comisión Permanente, presidida por el Presidente de la Confederación Hidrográfica, y de la que formarán parte el Comisario de Aguas, el Director Técnico, el Jefe de la Oficina de Planificación Hidrológica, un representante de cada uno del Ministerio de Industria, Turismo y Comercio, un representante de cada comunidad autónoma afectada cuyo territorio esté situado en el ámbito de la Confederación Hidrográfica y un representante por cada uno de los siguientes grupos de usuarios: abastecimiento, regadío y aprovechamientos energéticos. Los representantes serán designados entre los que integran cada grupo dentro de la Junta de Gobierno de las respectivas Confederaciones Hidrográficas, a propuesta de la mayoría de los integrantes de cada uno de los grupos. El Presidente de la Confederación Hidrográfica nombrará al Secretario de la Comisión entre sus miembros.

En el caso de la Confederación Hidrográfica del Segura, por el grupo de usuarios de regadío formarán parte de la Comisión Permanente tres representantes de las vegas tradicionales, uno por cada una de ellas, y uno del Sindicato Central de Regantes del Acueducto Tajo-Segura.

Asimismo, participarán en la Comisión Permanente, con voz pero sin voto, un representante de las asociaciones y organizaciones de defensa de intereses ambientales, dos de las organizaciones sindicales y empresariales mas representativas, y uno de las

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entidades locales cuyo territorio coincida total o parcialmente con el de la cuenca hidrográfica, designados por el Presidente de la Confederación Hidrográfica, a propuesta de los respectivos grupos.

4. Los Presidentes de las Confederaciones Hidrográficas quedan facultados para adoptar cuantas medidas sean precisas para el eficaz cumplimiento de los acuerdos adoptados por la Comisión Permanente, y podrán ordenar, en el caso de incumplimiento de la exigencia prevista en la letra f) del apartado 1 anterior, y en concepto de medidas provisionales, la clausura temporal de las instalaciones de tomas de agua o vertido.

5. Asimismo, se autoriza a los Presidentes de las Confederaciones Hidrográficas para que acuerden la realización o para que impongan la ejecución de aquellas obras de control o de medida de caudales y de evolución de acuíferos que sean necesarias para una mejor distribución del agua, así como para ejecutar obras de captación, transporte o adecuación de infraestructuras.

Artículo 3. *Tramitación de los procedimientos afectados por la aplicación de las medidas excepcionales.*

1. La tramitación de los procedimientos afectados por la aplicación de las medidas excepcionales de gestión previstas en este real decreto-ley tendrá carácter de urgencia, de conformidad con lo previsto en el artículo 50 de la Ley 30/1992, de 26 de noviembre, de Régimen Jurídico de las Administraciones Publicas y del Procedimiento Administrativo Común. En su virtud, todos los plazos previstos en dichos procedimientos quedarán reducidos a la mitad, con las excepciones indicadas en el citado artículo.

2. La tramitación de los procedimientos de modificación en las condiciones de utilización del dominio público hidráulico se efectuará de la siguiente manera:

1.º El procedimiento se iniciará de oficio por el órgano competente, lo que se notificará a los interesados.

2.º El informe y la elaboración de la propuesta de modificación se realizará por parte de la Comisaría de Aguas.

3.º La audiencia a los interesados se reducirá al plazo de cinco días.

4.º La aprobación de la propuesta corresponderá a la Comisión Permanente. La resolución deberá ser motivada.

5.º El Presidente de la Confederación Hidrográfica adoptará las medidas precisas para hacer efectiva la resolución de modificación de las condiciones de utilización del dominio público hidráulico.

3. La resolución adoptada determinará la modificación de las condiciones de utilización del dominio público hidráulico mientras no sea expresamente revocada o se mantenga vigente este real decreto-ley.

Artículo 4. *Modificación de las normas de prelación en los contratos de cesión de derechos de usos de agua.*

El titular del Ministerio de Medio Ambiente, y Medio Rural y Marino, podrá autorizar, con carácter temporal y excepcional, cesiones de derechos de uso de agua que no respeten el orden de preferencia definido en los planes hidrológicos o en el artículo 60.3 del texto refundido de la Ley de Aguas, respetando en todo caso la supremacía del uso consignado en su párrafo primero.

Artículo 5. *Puesta en servicio y ejecución de sondeos.*

Los Presidentes de las Confederaciones Hidrográficas quedan facultados para autorizar la puesta en marcha, por cuenta propia o ajena, de cualquier sondeo, cuente éste con instalación elevadora o no, que permita la aportación provisional de nuevos recursos. Esta facultad incluye la puesta en servicio de sondeos existentes o la ejecución de otros nuevos en la medida en que sean imprescindibles para obtener los caudales suficientes con los que satisfacer las demandas más urgentes y para aportar recursos para el

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mantenimiento de los valores ambientales de los ecosistemas asociados, especialmente en las zonas húmedas con riesgo de sufrir daños ambientales significativos.

Tales sondeos serán clausurados cuando desaparezcan las condiciones de escasez y, en ningún caso, generarán nuevos derechos concesionales.

Artículo 6. *Carácter no indemnizable de las medidas adoptadas.*

De conformidad con lo dispuesto en los artículos 55.2, primer inciso, y 58 del texto refundido de la Ley de Aguas, las limitaciones en el uso del dominio público hidráulico no tendrán carácter indemnizable, salvo que se ocasione una modificación de caudales que genere perjuicios a unos aprovechamientos en favor de otros; en tal caso, los titulares beneficiados deberán satisfacer la oportuna indemnización y corresponderá al organismo de cuenca, en defecto de acuerdo entre las partes, la determinación de su cuantía.

Artículo 7. *Régimen sancionador.*

1. El incumplimiento de las exigencias a que hace referencia el artículo 2.1 f) de este real decreto-ley se entenderá incluido en el tipo definido en el artículo 116.3.g del texto refundido de la Ley de Aguas, teniendo su vulneración la consideración de infracción muy grave, en atención a su especial repercusión en el orden y aprovechamiento del dominio público hidráulico.

2. El incumplimiento por los usuarios de las medidas de reducción de las dotaciones en el suministro de agua que se adopten en aplicación del artículo 2.1 a) de este real decreto-ley se entenderá incluido en el tipo definido en el artículo 116.3.c del texto refundido de la Ley de Aguas, y su vulneración tendrá la consideración de infracción muy grave, en atención a su especial repercusión en el orden y aprovechamiento del dominio público hidráulico.

3. Las Confederaciones Hidrográficas podrán ejecutar directamente las medidas de reparación y reposición adoptadas en las correspondientes resoluciones de los expedientes sancionadores. El importe de dichas medidas correrá a cargo de los infractores y podrá exigirse por la vía administrativa de apremio.

Artículo 8. *Suministro de información.*

Para la adecuada gestión y seguimiento de las medidas objeto de este real decreto-ley, las empresas suministradoras de servicios energéticos a que hacen referencia la Ley 34/1998, de 7 de octubre, del sector de hidrocarburos, y la Ley 54/1997, de 27 de noviembre, del sector eléctrico, facilitarán la información que les sea solicitada por las Confederaciones Hidrográficas y, en especial, los consumos realizados por las correspondientes instalaciones de elevación e impulsión de las aguas que éstas gestionan.

Artículo 9. *Relaciones con las Delegaciones del Gobierno.*

Los Presidentes de las Confederaciones Hidrográficas comunicarán a los Delegados del Gobierno en las comunidades autónomas afectadas por este real decreto-ley las actuaciones que deban realizarse con el fin de conseguir el cumplimiento de las medidas contenidas en él.

## CAPÍTULO III

## Regulación de las transacciones de derechos al aprovechamiento de agua.

Artículo 10. *Contratos de cesión de derechos al uso de agua.*

1. Los titulares de derechos al uso de agua adscritos a las zonas regables de iniciativa pública cuyas dotaciones brutas máximas figuren en los Planes Hidrológicos de Cuenca podrán celebrar los contratos de cesión a los que se refiere el artículo 67.1 del texto

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refundido de la Ley de Aguas, sin perjuicio de las formalidades exigidas en el artículo 68.2.

2. Los títulos jurídicos de derechos al uso de agua a que se refiere el apartado anterior se considerarán incluidos en el ámbito del artículo 190 a del Reglamento del Dominio Público Hidráulico, aprobado por el Real Decreto 849/1986, de 11 de abril, a los efectos de su inscripción en el Registro de Aguas.

3. Los títulos jurídicos en virtud de los cuales cada parte haya adquirido el derecho al uso del agua objeto del contrato deberán estar debidamente inscritos en el Registro de Aguas. En caso de no estarlo, deberá instarse su inscripción previa o simultáneamente a la solicitud de autorización del contrato ante el órgano competente.

El órgano competente para la inscripción calificará el título presentado por el solicitante. En el caso de que el título aportado se encuentre incluido entre los supuestos a los que se refieren el apartado 1 de este artículo y el artículo 11, se extenderá una inscripción provisional, a los solos efectos de la autorización, en su caso, del contrato de cesión. La inscripción definitiva se tramitará conforme a lo previsto en el Reglamento del Dominio Público Hidráulico, aprobado por el Real Decreto 849/1986, de 11 de abril.

Artículo 11. *Utilización de infraestructuras de conexión intercuencas.*

1. Las infraestructuras de conexión intercuencas existentes, y en especial el acueducto Tajo-Segura, podrán ser utilizadas para los contratos de cesión de derechos regulados en los artículos 67 a 70 del texto refundido de la Ley de Aguas. La utilización de las infraestructuras para estas transacciones se subordina a los fines prioritarios fijados en las respectivas normas reguladoras de las transferencias.

2. Sin perjuicio de lo dispuesto en el artículo 69.3 del texto refundido de la Ley de Aguas, el régimen económico-financiero aplicable a estas transacciones será el establecido en las normas singulares que regulen el régimen de explotación de las correspondientes infraestructuras.

Artículo 12. *Otros derechos de aprovechamiento de agua derivados de leyes especiales.*

1. Se considerarán incluidos en el ámbito de aplicación del artículo 10 de este real decreto-ley los derechos al aprovechamiento de agua que pudieran derivarse de los volúmenes señalados en la disposición adicional primera de la Ley 52/1980, de 16 de octubre, de régimen económico de explotación del Acueducto Tajo-Segura, con sujeción a los términos, condiciones y limitaciones establecidas en dicha norma y en las restantes disposiciones reguladoras del trasvase y, en particular, a los acuerdos que adopte la Comisión Central de Explotación del acueducto y, en su caso, el Consejo de Ministros, respecto de las decisiones concretas de trasvase.

2. Se considerarán asimismo incluidos en el ámbito de aplicación del artículo 10 de este real decreto-ley los derechos al aprovechamiento de agua derivados de la Ley de 27 de abril de 1946, por la que se reorganiza la Mancomunidad de los Canales del Taibilla, en los términos y condiciones establecidas en dicha norma y en la restante legislación aplicable.

Artículo 13. *Cómputo de los volúmenes objeto de transacción a las cuencas receptoras del acueducto Tajo-Segura.*

Los volúmenes de agua que, en virtud de este real decreto-ley, sean objeto de transferencia a las cuencas receptoras del Acueducto Tajo-Segura, se computarán como volúmenes trasvasados a todos los efectos y, en particular, para el cómputo del límite de los 240 hectómetros cúbicos establecido en la disposición adicional tercera de la ley 10/2001, de 5 de julio, del Plan Hidrológico Nacional.

Artículo 14. *Autorización de las transacciones intercuencas.*

Las transacciones que impliquen la utilización de infraestructuras de conexión intercuencas deberán ser autorizadas por la Dirección General del Agua, previo informe de

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los organismos de cuenca afectados y de las restantes entidades que deban informar de acuerdo con el artículo 68.2 del texto refundido de la Ley de Aguas.

Asimismo, en el plazo previsto en el citado artículo, la Dirección General del Agua podrá ejercer el derecho de adquisición preferente regulado en el artículo 68.3.

## CAPÍTULO IV

## Exención de exacciones

Artículo 15. *Exención de las exacciones relativas a la disponibilidad de agua.*

1. Con efecto para el período impositivo de 2009, para los titulares de derechos al uso de agua para riego y abastecimientos de los sistemas incluidos en el ámbito de aplicación al que se refiere el artículo 1, se conceden las siguientes exenciones:

a) La cuota de la tarifa de utilización del agua y del canon de regulación establecidos en el artículo 114 del texto refundido de la Ley de Aguas.

b) Las aportaciones correspondientes a los gastos fijos y variables de funcionamiento de la tarifa de conducción de las aguas incluidos en los párrafos b y c del artículo 7.1 de la Ley 52/1980, de 16 de octubre, de regulación del régimen económico de la explotación del Acueducto Tajo-Segura.

c) La cuota de la tarifa de conducción de las aguas por la infraestructura del postrasvase (cuenca del Segura), prevista en el artículo 10 de la Ley 52/1980, de 16 de octubre, que fuera aplicable a las aguas propias de la cuenca.

2. En relación con el Parque Nacional de Las Tablas de Daimiel, y con efecto exclusivamente para el período impositivo de 2009, se establece la exención de las aportaciones correspondientes a los gastos fijos y variables de funcionamiento de la tarifa de conducción de las aguas incluidos en los párrafos b y c del artículo 7.1 de la Ley 52/1980, de 16 de octubre, de regulación del régimen económico de la explotación del Acueducto Tajo-Segura.

3. Los sujetos pasivos de las exacciones señaladas en los apartados anteriores que hubieran satisfecho total o parcialmente las cuotas correspondientes al período impositivo al que alcanzan las exenciones tendrán derecho a la devolución de las cantidades ingresadas.

Disposición adicional primera. *Declaración de interés general y de utilidad pública de determinadas actuaciones.*

Se declaran de interés general las actuaciones vinculadas con el objetivo de este real decreto-ley que se incluyen en este concepto en el anexo II y la totalidad de las incluidas en el anexo III.

De conformidad con lo dispuesto en el artículo 58 del texto refundido de la Ley de Aguas, aprobado por Real Decreto Legislativo 1/2001, de 20 de julio, las actuaciones vinculadas con la lucha contra la sequía que se relacionan en los anexos II y III, así como las aprobadas de acuerdo con lo establecido en el capítulo II de este real decreto-ley, llevarán implícita la declaración de utilidad pública a los efectos de la ocupación temporal y expropiación forzosa de bienes y derechos, así como la de urgente necesidad de la ocupación.

Las actuaciones contempladas en el anexo III se realizarán de conformidad con los convenios marco ya suscritos o que se suscriban entre las Sociedades Estatales de Infraestructuras Agrarias y las comunidades autónomas en cuyo ámbito territorial hayan de ejecutarse. La financiación y ejecución de cada una de las obras se atendrá a lo que se estipule en los convenios específicos que se suscriban o se hayan suscrito entre las Sociedades Estatales de Infraestructuras Agrarias, los usuarios de las infraestructuras y, en su caso, las comunidades autónomas, en los que las previsiones de ejecución real

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deberán supeditarse en todo caso a las disponibilidades presupuestarias de cada ejercicio.

Disposición adicional segunda. *Créditos presupuestarios.*

La compensación de las disminuciones de ingresos que se produzcan en las Confederaciones Hidrográficas como consecuencia de las exenciones previstas en el artículo 3 de este Real Decreto-ley, serán financiadas en un 50 por ciento con cargo al Fondo de Contingencia de ejecución presupuestaria. El 50 por ciento restante se financiará con cargo a los créditos del Presupuesto del Ministerio de Medio Ambiente, y Medio Rural y Marino, a cuyos efectos se efectuarán las transferencias de crédito que procedan, sin que resulte de aplicación la limitación contenida en el artículo 52 1 a. de la Ley 47/2003, de 26 de noviembre, General Presupuestaria, respecto de la realización de transferencias de crédito desde operaciones de capital a operaciones corrientes.

Disposición final primera. *Títulos competenciales.*

Este real decreto-ley se dicta al amparo del artículo 149.1.22ª de la Constitución Española, que atribuye al Estado competencia exclusiva en materia de legislación, ordenación y concesión de recursos y aprovechamientos hidráulicos cuando las aguas discurran por más de una comunidad autónoma, a excepción de la disposición adicional primera, que se dicta al amparo de la competencia exclusiva que atribuye al Estado la regla 24.ª del artículo 149.1 del texto constitucional en materia de obras públicas de interés general.

Disposición final segunda. *Suspensión temporal de eficacia.*

Durante la vigencia de este real decreto-ley, quedará sin efecto, en cuanto a la utilización de las infraestructuras de conexión intercuencas y los contratos de cesión de derechos al aprovechamiento de agua a los que se refiere el artículo 3.1, el primer inciso del artículo 72 del texto refundido de la Ley de Aguas, aprobado por el Real Decreto Legislativo 1/2001, de 20 de julio.

Disposición final tercera. *Facultades de desarrollo.*

La Ministra de Medio Ambiente, y Medio Rural y Marino, en el ámbito de sus competencias, dictará las disposiciones necesarias para el desarrollo y ejecución de lo establecido en este real decreto-ley.

Disposición final cuarta. *Entrada en vigor y vigencia*

El presente real decreto-ley entrará en vigor el mismo día de su publicación en el Boletín Oficial del Estado, y tendrá vigencia hasta el 30 de noviembre de 2010.

Dado en Madrid el 4 de diciembre de 2009.

JUAN CARLOS R.

El Presidente del Gobierno,
JOSÉ LUIS RODRÍGUEZ ZAPATERO

**ANEXO I**

**Ámbitos territoriales de aplicación del real decreto-ley**

I.1 *Sistemas incluidos a los efectos de la declaración de la situación de sequía.*

Confederación Hidrográfica del Duero:

Sistema Águeda (Canal y concesiones).

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Sistema Cega-Adaja (Cabecera del Eresma: Abastecimientos desde el río Eresma a Segovia y a la Mancomunidad de la Atalaya).

Confederación Hidrográfica del Tajo:

Cabecera del Tajo.
Sistema Henares.
Sistema Alberche.
Sistema Tajuña.
Bajo Tajo, Alagón y Arrago.

Confederación Hidrográfica del Guadiana:

Sistema Gasset.
Sistema El Vicario.
Zona regable de Peñarroya.
Mancha Occidental.
Guadiana Central.
Sistema general.
Suroccidental de la provincia de Badajoz y Noroeste de Huelva.

Confederación Hidrográfica del Guadalquivir:

Abastecimiento a la ciudad de Ceuta.

Confederación Hidrográfica del Júcar:

Canal Júcar-Turia.
Mancha Oriental.

Confederación Hidrográfica del Segura:

Sistema Global de explotación.
Regadíos Tradicionales del Júcar.
Regadíos Tradicionales del Turia.
Canal Campo del Turia.
Zona regable del Magro.

Confederación Hidrográfica del Ebro:

Sistema Huerva.
Sistemas Bardenas y Arba.

I.2 *Sistemas incluidos a los efectos de exención de exacciones*

Confederación Hidrográfica del Duero:

Sistemas de regadío vinculados al río Águeda (Canal y riegos concesionales).

Confederación Hidrográfica del Tajo:

Sistema Tajuña.

Confederación Hidrográfica del Guadiana:

Sistema Gasset.
Sistema El Vicario.
Zona regable de Peñarroya.

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Confederación Hidrográfica del Gualquivir:

Sistema del Embalse del Pintado en la Provincia de Badajoz.

Confederación Hidrográfica del Segura:

Sistema La Cierva.
Sistema Guadalentín.
Zonas Regables y abastecimientos dotados con recursos del Acueducto Tajo-Segura.

## ANEXO II

**Relación de actuaciones que se declaran de interés general o respecto de las que se efectúa la declaración de utilidad pública y la urgente necesidad de la ocupación a los efectos de la ocupación temporal o expropiación forzosa de bienes y derechos afectados**

Relación de actuaciones declaradas de interés general:

Cuenca del Tajo:

Abastecimiento a la Mancomunidad de Las Tres Torres y del río Ayuela.
Incremento de recursos para el abastecimiento a la nueva Mancomunidad de Aguas de la presa de Santa Lucía.
Mejora del sistema de abastecimiento de la Mancomunidad de San Marcos.

Cuenca del Guadiana:

Apoyo al abastecimiento de la Zona Oriental de la provincia de Cáceres.

Cuenca del Guadalaquivir:

Mejora del abastecimiento a diversos núcleos de población en Ceuta.

Cuenca del Segura:

Ejecución y puesta en marcha de sondeos y conducciones hasta el dominio público hidráulico y acueductos.
Relación de actuaciones respecto de las que se procede a la declaración de utilidad pública y a la de urgente ocupación de los bienes y derechos afectados:

Cuenca del Duero:

Ejecución de nuevos sondeos en la provincia de Segovia para satisfacer las demandas para abastecimiento de la ciudad de Segovia y la Mancomunidad de la Atalaya desde la cuenca del río Eresma.

Cuenca del Tajo:

Abastecimiento a la Mancomunidad de Las Tres Torres y del río Ayuela.
Mejora del Sistema de Abastecimiento a la Mancomunidad de San Marcos.
Refuerzo del sistema de abastecimiento a Navalmoral de la Mata, Talayuela y sus zonas de influencia.
Conducción de refuerzo a La Adrada.
Mejora del abastecimiento a la comarca de Las Hurdes.
Mejora del tratamiento de aguas potables del abastecimiento de Cáceres.
Incremento de recursos para el abastecimiento a la nueva Mancomunidad de Aguas de la presa de Santa Lucía.
Mejora del abastecimiento a la comarca de La Vera.
Mejora del abastecimiento a la futura mancomunidad de Santa Lucía.

cve: BOE-A-2009-19563



Cuenca del Guadiana:

Apoyo al abastecimiento de la Zona Oriental de la provincia de Cáceres.

Cuenca del Guadalaquivir:

Mejora del abastecimiento a diversos núcleos de población en Ceuta.

Cuenca del Segura:

Ejecución y puesta en marcha de sondeos y conducciones hasta el dominio público hidráulico y acueductos.

## ANEXO III

**Obras urgentes de mejora de regadíos, con objeto de obtener un adecuado ahorro de agua que palíe los daños producidos por la sequía**

*SEIASA del Nordeste*

Huesca:

Comunidad de Regantes del Huerto.
Comunidad de Regantes de Lasesa, fase II.
Comunidad de Regantes de base Riegos del Alto Aragón.
Comunidad de Regantes del CAC T.M. Zaidín.
Comunidad de Regantes de base del Canal de Bardenas.
Comunidad de Regantes de base del Canal de Aragón y Cataluña.

Zaragoza:

Comunidad de Regantes de Gelsa.

Tarragona:

Mejora de regadíos de la C.R. Sant Jaume de la Torre del Español.
Modernización y mejora de la infraestructura de riego y desagües de la C.R. Sindicato Agrícola del Ebro Fase 2.

Lérida:

Modernización de la zona regable de Canals d'Urgell a los TT.MM.de Bellvís, Linyola (Pla d'Urgell) y Vallfogona de Balaguer (Noguera).
Modernización del riego de la C.R.de Basa Nova de Almenar.
Construcción de una red de presión para 1249 ha de la C.R. de Raimat.
Transformación de riego a manta a riego a presión en la margen izquierda del río Segre C.R. de Olla i Sagalès.
Mejora de las acequias y ampliación del embalse de la C.R. de Aramunt de Conca da Dalt.

*SEIASA del Norte*

Salamanca:

Comunidad de Regantes de Zorita.
Comunidad de Regantes de Garcibuey.
Comunidad de Regantes M.I. Águeda.

Soria:

Comunidad de Regantes de Campillo de Buitrago.

cve: BOE-A-2009-19563

Comunidad de Regantes Almazán 2.ª fase. Red distribución complementaria y Red de Terciarias.

Valladolid:

Comunidad de Regantes Castronuño.
Comunidad de Regantes Pollos.

Zamora:

Comunidad de Regantes Toro-Zamora (otros sectores).

*SEIASA de la Meseta Sur*

Albacete:

Comunidad de Regantes de Martínez Parras.

Toledo:

Comunidad de Regantes de Valdepusa, sector IV.
Comunidad de Regantes del Canal Bajo del Alberche.

Alicante:

Comunidad de Regantes de la Nucia.
Comunidad de Callosa d'En Sarrià.
Comunidad de Vila-Joiosa.
Comunidad S.A.T. San Enrique.

Badajoz:

Comunidad de Regantes del Zújar.
Comunidad de Regantes de las Vegas Altas II 2.ª Fase.
Comunidad de Regantes de Orellana.

Cáceres:

Comunidad de Regantes de M.I. Rosarito.

*SEIASA del Sur y Este*

Murcia:

Comunidad de Regantes de Blanca, fase II.
Comunidad de Regantes de Arcosur Mar Menor, fase II.
Comunidad de Regantes de Puerto Lumbreras.
Modernización de regadíos que afectan a la comarca del Altiplano.
Modernización de regadíos que afectan a la comarca del Noroeste.

Almería:

Z.R. Costa Levante/Bajo Almanzora.
Z.R. Andarax.
Z.R. Poniente.

cve: BOE-A-2009-19563

# APÉNDICE 2: INFORME DE LA OFICINA DE PLANIFICACIÓN HIDROLÓGICA DE LA CONFEDERACIÓN HIDROGRÁFICA DEL EBRO

Código seguro de Verificación : GEN-67c7-9185-4dbb-e95a-314a-1fdb-46ac-8809 | Puede verificar la integridad de este documento en la siguiente dirección : https://sede.administracion.gob.es/pagSedeFront/servicios/consultaCSV.htm

MINISTERIO
PARA LA TRANSICIÓN ECOLÓGICA
Y EL RETO DEMOGRÁFICO

CONFEDERACIÓN
HIDROGRÁFICA
DEL EBRO

S/REF.
SMG/SGRCNIR
N/REF.

FECHA

ASUNTO Informe OPH

Javier Mur Satué

C/ Santa Cruz, 8, bajo
50003 ZARAGOZA

**Solicitud de informe sobre la compatibilidad con la planificación hidrológica y la directiva marco del agua de las actuaciones previstas en el proyecto de modernización integral del regadío de la comunidad de regantes de Santa Ana, términos municipales de Torralba de Aragón, Almuniente, Torres de Barbués, Senés de Alcubierre y Tardienta (Huesca).**

En relación al asunto referido en el encabezado, la Oficina de Planificación Hidrológica de la Confederación Hidrográfica del Ebro hace constar lo siguiente:

a) El plan hidrológico de la parte española de la demarcación hidrográfica del Ebro actualmente vigente es el aprobado por el Real Decreto 1/2016, de 8 de enero, y publicado en el BOE de 19 de enero de 2016.

b) La Comunidad de Regantes Santa Ana está integrada en Riegos del Alto Aragón que tiene derecho al uso del agua conforme a la Ley de 7 de enero de 1915 de Riegos del Alto Aragón.
https://www.boe.es/datos/pdfs/BOE//1915/008/A00064-00064.pdf
https://www.boe.es/datos/pdfs/BOE//1915/009/A00070-00070.pdf

La disposición adicional quinta de la Ley 10/2001, de 5 de julio, del Plan Hidrológico Nacional, determina que "se mantiene la vigencia de la reserva de agua para los riegos del Alto Aragón establecida por la Ley de 7 de enero de 1915".
https://www.boe.es/buscar/pdf/2001/BOE-A-2001-13042-consolidado.pdf

c) En relación con la compatibilidad con el plan hidrológico, dicho plan incorpora las demandas de Riegos del Alto Aragón en sus análisis, que contemplan escenarios con las previsiones de los efectos futuros del cambio climático. Como resultado de las evaluaciones realizadas puede decirse que no se han encontrado incoherencias entre estas demandas y los objetivos medioambientales, la asignación de recursos, los demás usos del agua, el programa de medidas, el régimen de caudales ecológicos y otras determinaciones del plan hidrológico.

d) Conforme al plan hidrológico, las masas de agua afectadas por esta modernización son:

www.chebro.es

Pº DE SAGASTA Nº 24 – 28
50071 ZARAGOZA
TEL.: 976 71 10 00
FAX.:

CSV : GEN-67c7-9185-4dbb-e95a-314a-1fdb-46ac-8809
DIRECCIÓN DE VALIDACIÓN : https://sede.administracion.gob.es/pagSedeFront/servicios/consultaCSV.htm
FIRMANTE(1) : ROGELIO GALVAN PLAZA | FECHA : 21/04/2021 10:32 | Sin acción específica
FIRMANTE(2) : MIGUEL ANGEL GARCIA VERA | FECHA : 21/04/2021 11:05 | Sin acción específica

Código seguro de Verificación : GEN-67c7-9185-4dbb-e95a-314a-1fdb-46ac-8809 | Puede verificar la integridad de este documento en la siguiente dirección : https://sede.administracion.gob.es/pagSedeFront/servicios/consultaCSV.htm

Para las extracciones:

| | |
|---|---|
| *Código de la masa de agua:* | ES091MSPF678 Río Cinca desde la presa de El Grado hasta el rio Ésera |
| *Naturaleza de la masa de agua:* | Superficial |
| *Carácter de la masa de agua:* | Natural |
| *Estado ecológico:* | No alcanza buen estado |
| *Estado químico:* | Alcanza buen estado |
| *Estado global:* | No alcanza buen estado |
| *Presión por extracciones:* | No |

| | |
|---|---|
| *Código de la masa de agua:* | ES091MSPF962 Río Gállego desde el azud de Ardisa hasta el barranco de la Violada |
| *Naturaleza de la masa de agua:* | Superficial |
| *Carácter de la masa de agua:* | Natural |
| *Estado ecológico:* | No alcanza buen estado |
| *Estado químico:* | Alcanza buen estado |
| *Estado global:* | No alcanza buen estado |
| *Presión por extracciones:* | No |

| | |
|---|---|
| *Código de la masa de agua:* | ES091MSPF119 Río Sotón desde la presa de la Sotonera hasta su desembocadura en el río Gállego |
| *Naturaleza de la masa de agua:* | Superficial |
| *Carácter de la masa de agua:* | Natural |
| *Estado ecológico:* | Alcanza buen estado |
| *Estado químico:* | Alcanza buen estado |
| *Estado global:* | Alcanza buen estado |
| *Presión por extracciones:* | No |

Para la contaminación difusa:

| | |
|---|---|
| *Código de la masa de agua:* | ES091MSPF164 Río Flumen desde el rio Isuela hasta su desembocadura en el río Alcanadre (incluye barranco de Valdabra) |
| *Naturaleza de la masa de agua:* | Superficial |
| *Carácter de la masa de agua:* | Natural |
| *Estado ecológico:* | No alcanza buen estado |
| *Estado químico:* | No alcanza buen estado |
| *Estado global:* | No alcanza buen estado |
| *Presión por contaminación difusa:* | Sí |

El Jefe de Servicio de la Oficina
de Planificación Hidrológica

VBº
El Jefe de la Oficina
de Planificación Hidrológica

Rogelio Galván Plaza

Miguel Ángel García Vera

CSV : GEN-67c7-9185-4dbb-e95a-314a-1fdb-46ac-8809
DIRECCIÓN DE VALIDACIÓN : https://sede.administracion.gob.es/pagSedeFront/servicios/consultaCSV.htm
FIRMANTE(1) : ROGELIO GALVAN PLAZA | FECHA : 21/04/2021 10:32 | Sin acción específica
FIRMANTE(2) : MIGUEL ANGEL GARCIA VERA | FECHA : 21/04/2021 11:05 | Sin acción específica

**APÉNDICE 3: CERTIFICADO USO DE AGUA EMITIDO POR LA COMUNIDAD GENERAL DE RIEGOS DEL ALTO ARAGÓN (CONCESIÓN)**

RIEGOS
del alto aragón

| RIEGOS del alto aragón | |
|---|---|
| Entrada Nº | Salida Nº 891 |
| Referencia | Fecha 7 JUN 2022 |

**Exp. CS/MD/SANTANA/_reemplaza a Ref. 891-2022**

D. José María Olivan Mata, Secretario de la Comunidad General de Riegos del Alto Aragón, CERTIFICO:

Que la Comunidad General de Riegos del Alto Aragón, con CIF G-22006258, dispone para su uso de las aguas reservadas para Riegos del Alto Aragón por Ley de 7 de enero de 1915, de acuerdo con el Art- 4º de sus Ordenanzas, las cuales se distribuyen para su aprovechamiento previa petición realizada por las Comunidades Ordinarias en ella integradas.

Que la Comunidad de Regantes de SANTA ANA, con CIF **G-22040265** está integrada en la Comunidad General de Riegos del Alto Aragón, recibiendo agua a la que tiene derecho, previo pedido que se cursa a la Confederación Hidrográfica del Ebro, a través de compuertas aforadas **ubicadas en los pK: 27,006-27,403-29,657-25,920** del Canal de Monegros y que permiten conocer de forma diaria y puntual el agua servida por la guardería del Canal durante todo el año, disponiendo de series históricas de los consumos realizados por la Comunidad.

Y para que conste expido la presente certificación en Huesca a 6 de junio de 2022

COMUNIDAD GENERAL DE RIEGOS DEL ALTO ARAGÓN · HUESCA

# APÉNDICE 4: CARTA DE COMPROMISO COMUNIDAD DE REGANTES SANTA ANA

COMUNIDAD DE REGANTES
SANTA ANA

COMPROMISO DE LA COMUNIDAD DE REGANTES SANTA ANA

D. Pedro Carlos Revuelta Monesma con NIF 18.039.351 Z, como Presidente de la Comunidad de Regantes Santa Ana, con NIF G22040265 , con domicilio a efecto de notificaciones en Edificio de las Antiguas Escuelas de Torralba de Aragón, C.P. 22254 (Huesca) , EXPONE:

Que en el caso de que la actuación "PROYECTO DE MODERNIZACIÓN DEL REGADIO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA)" resulte beneficiada con financiación FEADER a través del Programa de Desarrollo Rural 2014-2020, la Comunidad de Regantes SANTA ANA se compromete a cumplir los siguientes extremos:

a) Dotarse de un mecanismo bastante para poder exigir a las explotaciones el cumplimiento de las condiciones de la resolución sobre la evaluación de impacto ambiental del proyecto en lo que les afecte.

b) Aplicar una tarifa binómica o similar, orientada a fomentar el ahorro en el uso del agua en la zona modernizada.

c) Contar con personal propio o externalizado con formación técnica adecuada al manejo de la infraestructura y el equipamiento de la infraestructura modernizada.

d) Recoger los datos necesarios de los indicadores específicos de regadíos desde el inicio de la fase de explotación de la infraestructura hasta 5 años después de finalizar las obras objeto de cofinanciación FEADER.

e) Si el regadío preexistente cuyas infraestructuras se pretenden modernizar se alimenta de masas de agua superficiales o subterráneas que, de acuerdo con la planificación hidrológica, no alcanzan el buen estado o potencial por razones cuantitativas, la modernización deberá asegurar un ahorro efectivo del agua a nivel de la infraestructura de al menos el 50% del ahorro potencial que, según las previsiones técnicas, se derivaría de la inversión. En este caso, deberá acreditarse que la Comunidad de Regantes afectada ha comunicado a la Confederación Hidrográfica pertinente el ahorro efectivo de agua previsto tras la modernización.

Y para que asi conste firmo la presente en Torralba de Aragón al dia de la fecha 01/06/2022

Fdo Pedro Carlos Revuelta Monesma

Presidente.

COMUNIDAD DE REGANTES
SANTA ANA
N.I.F. G-22040265
Edificio Antiguas Escuelas, s/n
22254 TORRALBA DE ARAGÓN (Huesca)

Edificio Antiguas Escuelas, s/n • 22254 **TORRALBA DE ARAGÓN** (Huesca)
Tels: 974 25 33 87 / 682 056 629 • E-mail: crsantaana@gmail.com

# ANEJO Nº 17.- PROGRAMACIÓN DE LAS OBRAS

# ÍNDICE

## ANEJO 17.- PROGRAMACIÓN DE LAS OBRAS

**1. OBJETO ..... 1**
**2. PLAN DE OBRA ..... 2**

# ANEJO 17.- PROGRAMACIÓN DE LAS OBRAS

## 1. OBJETO

El Plan de Obra es el instrumento de planificación de todo proceso constructivo. En él, a través de una estimación y relación cuidadosa de las tareas más relevantes del mismo, así como de los rendimientos a aplicar a cada una de ellas, se pueden estimar los siguientes parámetros:

• Duración de cada una de las tareas de obra.

• Asignación de personal a cada equipo de trabajo con el fin de cumplir la programación establecida.

• Establecimiento del número de equipos necesarios en cada tajo específico.

• Disposición de un orden de ejecución de las tareas lógicas para la consecución del plazo temporal marcado.

En la elaboración de la programación de las obras, para calcular la duración de cada una de las tareas se ha considerado en cada caso:

• Los rendimientos tipos de cada tajo, tomando el más desfavorable que condiciona la duración máxima de la partida.

• Los recursos empleados (número de equipos) que se prevé lleve a cabo cada actividad.

• El calendario laboral, que tiene en cuenta la duración total del conjunto de tareas.

Es necesario considerar los plazos de entrega de material de los principales proveedores, especialmente los que requieren mayor tiempo de fabricación o aquellos que intervienen en las tareas consideradas como críticas.

El montaje de las tuberías en este supuesto deberá ser a tajo limpio, de manera que las zanjas queden tapadas, y se restituya el terreno a su cota original, lo antes posible.

A la vista de las obras proyectadas, y ya descritas anteriormente, se puede afirmar que los principales tajos son los correspondientes a la realización de las balsas, construcción de estación de bombeo, la apertura y cierre de zanjas y colocación de tuberías de conducción. En cierta medida, el resto de las tareas se deberán acomodar al ritmo de ejecución de las nombradas. Por ello se considera fundamental el conseguir que los equipos encargados de tales tajos, sean de la adecuada capacidad y número para asegurar un progreso satisfactorio de las obras.

A continuación, se señalan los tajos principales en función de las mediciones de unidades de obra a ejecutar

1. Balsas de regulación.

    a. Movimiento de tierras (desbroces, desmonte, terraplén).
    b. Obras de fábrica: obras de toma, arquetas de válvulas, etc. (encofrado, armadura y hormigonado).
    c. Impermeabilización (instalación de geotextil y geomembrana).

2. Impulsiones.

    a. Movimiento de Tierras (excavación en zanja y rellenos, cama de asiento).
    b. Conducciones: instalación de las tuberías de PRFV en zanja con todos sus elementos hidráulicos.
    c. Obras de fábrica: arquetas de válvulas de corte, etc. (encofrado, armadura y hormigonado).
    d. Reposición de servicios.

3. Redes de riego.

    a. Movimiento de Tierras (excavación en zanja y rellenos, cama de asiento).
    b. Conducciones: instalación de las tuberías de PRFV Y PVC en zanja con todos sus elementos hidráulicos.
    c. Obras de fábrica: obras de toma, arquetas de válvulas de corte, etc. (encofrado, armadura y hormigonado).
    d. Reposición de servicios.

4. Estaciones de Bombeo.

    a. Obra civil.
    b. Instalación de equipos.

5. Electrificación.
    a. Instalación B.T.
    b. Instalación M.T.
6. Automatización y Telecontrol.
7. Pruebas.
    a. Conducciones.
    b. Balsas.
    c. Equipos de bombeo.
    d. Telecontrol.
8. Medidas Correctoras de Impacto Ambiental.
9. Seguridad y Salud.
10. Gestión de residuos.

## 2. PLAN DE OBRA

Fruto de la asignación de equipos y rendimientos reflejada en epígrafes anteriores se ha previsto en el presente Proyecto un periodo de ejecución de obra de VEINTE (20) MESES.

Se presenta a continuación el Diagrama de Gantt de la obra y Plan valorado de la obra.

ANEJO11 - PROGRAMACIÓN DE LAS OBRAS.

DIAFRAMA DE GANTT DEL PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA)

| Id | Nombre de tarea | Duración |
|---|---|---|
| 1 | PLAN DE OBRA CR SANTA ANA | **417 días** |
| 2 | Acta de replanteo de la obra | 0 días |
| 3 | OBRA DE TOMA | **55 días** |
| 4 | Replanteo y accesos | 5 días |
| 5 | Obra civil | 30 días |
| 6 | Equipos | 15 días |
| 7 | Pruebas | 5 días |
| 8 | BALSAS INFERIORES | **210 días** |
| 9 | Desbroce y excavación | 100 días |
| 10 | Terraplén | 40 días |
| 11 | Obra de toma | 15 días |
| 12 | Tomas de fondo | 30 días |
| 13 | Aliviaderos y desagüe | 30 días |
| 14 | Refino de taludes-fondo | 30 días |
| 15 | Drenaje-impermeabilización | 40 días |
| 16 | Viales | 10 días |
| 17 | Varios | 10 días |
| 18 | BALSA INTERMEDIA | **205 días** |
| 19 | Desbroce y excavación | 100 días |
| 20 | Terraplén | 40 días |
| 21 | Toma de fondo | 15 días |
| 22 | Aliviadero y desagüe | 15 días |
| 23 | Refino de taludes-fondo | 25 días |
| 24 | Drenaje-impermeabilización | 40 días |
| 25 | Viales | 10 días |
| 26 | Varios | 10 días |
| 27 | BALSA ELEVADA | **90 días** |
| 28 | Desbroce y excavación | 45 días |
| 29 | Terraplén | 15 días |
| 30 | Toma de fondo | 10 días |
| 31 | Aliviadero y desagüe | 15 días |
| 32 | Refino de taludes-fondo | 15 días |
| 33 | Drenaje-impermeabilización | 15 días |
| 34 | Viales | 6 días |
| 35 | Varios | 9 días |
| 36 | RED DE RIEGO | **417 días** |
| 37 | IMPULSIONES | **141 días** |
| 38 | Excavación | 120 días |
| 39 | Cama de apoyo | 110 días |
| 40 | Colocación de tuberías y piezas especiales | 90 días |
| 41 | Rellenos | 100 días |
| 42 | Colocación de valvulería y anclajes | 60 días |
| 43 | Arquetas | 30 días |
| 44 | RED PRINCIPAL | **276 días** |
| 45 | Excavación | 250 días |
| 46 | Cama de apoyo | 240 días |
| 47 | Colocación de tubería y piezas especiales | 220 días |
| 48 | Rellenos | 235 días |
| 49 | Colocación de valvulería y anclajes | 130 días |
| 50 | Hidrantes | 95 días |
| 51 | Arquetas | 75 días |
| 52 | ESTACIÓN DE REBOMBEO | **149 días** |
| 53 | EDIFICACIÓN | **100 días** |
| 54 | Movimiento de tierras | 15 días |
| 55 | Estructura | 20 días |
| 56 | Cimentación y soleras | 20 días |
| 57 | Cerramiento, albañilería y cubierta | 15 días |
| 58 | Carpintería y cerrajería | 20 días |
| 59 | Impermeabilización cubierta | 10 días |
| 60 | Acabados y urbanización | 15 días |
| 61 | Viales | 3 días |
| 62 | INSTALACIONES DE BOMBEO | **64 días** |
| 63 | Grupos motobomba | 20 días |
| 64 | Equipos de filtrado | 4 días |
| 65 | Valvulería | 15 días |
| 66 | Equipo electromecánicos | 10 días |
| 67 | Calderería | 15 días |
| 68 | BAJA TENSIÓN | 25 días |
| 69 | MEDIA TENSIÓN | 50 días |
| 70 | CRUCES Y REPOSICIONES | 417 días |
| 71 | AUTOMOTIZACIÓN | 30 días |
| 72 | TELECONTROL | 40 días |
| 73 | PRUEBAS | **417 días** |
| 74 | Red de riego | 417 días |
| 75 | Balsas | 233 días |
| 76 | Bombeo | 40 días |
| 77 | Telecontrol | 40 días |
| 78 | CONTROL AMBIENTAL | 417 días |
| 79 | SEGURIDAD Y SALUD | 417 días |
| 80 | GESTIÓN DE RESIDUOS | 417 días |
| 81 | ENTREGA DE OBRA | 1 día |

Anejo 17 - Programación de las obras.
CR SANTA ANA

Tarea · Hito · Resumen del proyecto · Hito externo · Hito inactivo · Tarea manual · Informe de resumen manual · Sólo el comienzo · Fecha límite · Progreso manual
División · Resumen · Tareas externas · Tarea inactiva · Resumen inactivo · Sólo duración · Resumen manual · Sólo fin · Progreso

| PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA) | IMPORTE (P.E.M.) | MESES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M1 | M2 | M3 | M4 | M5 | M6 | M7 | M8 | M9 | M10 |
| OBRA DE TOMA | 146.315,81 € | 2.438,60 € | 48.771,94 € | 95.105,28 € | | | | | | | |
| BALSAS INF. NORTE | 491.761,32 € | 4.098,01 € | 40.980,11 € | 118.842,32 € | 122.940,33 € | 98.352,26 € | 106.548,29 € | | | | |
| BALSA INF. SUR | 574.146,19 € | 4.784,55 € | 47.845,52 € | 138.752,00 € | 143.536,55 € | 114.829,24 € | 124.398,34 € | | | | |
| ESTACIÓN DE BOMBEO | 1.446.596,74 € | | | 14.465,97 € | 144.659,67 € | 650.968,53 € | 419.513,05 € | 216.989,51 € | | | |
| IMPULSIONES | 842.947,29 € | | 35.122,80 € | 105.368,41 € | 140.491,22 € | 210.736,82 € | 210.736,82 € | 140.491,22 € | | | |
| BALSA INTERMEDIA | 803.510,44 € | | | | | | 25.109,70 € | 75.329,10 € | 150.658,21 € | 150.658,21 € | 100.438,81 € |
| BALSA ELEVADA | 199.515,15 € | | | | | | | | 49.878,79 € | 49.878,79 € | 49.878,79 € |
| RED DE RIEGO PISO 1 | 5.473.226,96 € | | | | | | | | 456.102,25 € | 456.102,25 € | 456.102,25 € |
| RED DE RIEGO PISO 2 | 1.000.446,44 € | | | | | | | | 250.111,61 € | 250.111,61 € | 250.111,61 € |
| MEDIA TENSIÓN | 141.601,13 € | | | | | | 70.800,57 € | 70.800,57 € | | | |
| PARQUE FOTOVOLTAICO | 1.180.027,55 € | | | | | | 295.006,89 € | 295.006,89 € | 295.006,89 € | 295.006,89 € | |
| BAJA TENSIÓN Y AUTOMATIZACIÓN | 487.715,40 € | | | | | | 243.857,70 € | 243.857,70 € | | | |
| TELECONTROL | 301.448,80 € | | | | | | 150.724,40 € | 150.724,40 € | | | |
| GESTIÓN DE RESIDUOS | 7.452,75 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € |
| MEDIDAS AMBIENTALES | 269.930,22 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € |
| SEGURIDAD Y SALUD | 94.200,18 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € |
| PUBLICIDAD | 1.166,59 € | 1.166,59 € | | | | | | | | | |
| TOTAL (P.E.M.) | 13.462.008,96 € | | | | | | | | | | |
| **P.E.M. MENSUAL** | | 31.066,91 € | 191.299,52 € | 491.113,13 € | 570.206,92 € | 1.093.466,02 € | 1.665.274,92 € | 1.211.778,54 € | 1.220.336,90 € | 1.220.336,90 € | 875.110,61 € |
| **P.E.M. ACUMULADO** | | 31.066,91 € | 222.366,43 € | 713.479,56 € | 1.283.686,48 € | 2.377.152,50 € | 4.042.427,41 € | 5.254.205,95 € | 6.474.542,85 € | 7.694.879,75 € | 8.569.990,35 € |

| PROYECTO DE MODERNIZACIÓN INTEGRAL DEL REGADÍO DE LA C.R. DE SANTA ANA, TT.MM. DE TORRALBA DE ARAGÓN, ALMUNIENTE, TORRES DE BARBUÉS, SENÉS DE ALCUBIERRE Y TARDIENTA (HUESCA) | IMPORTE (P.E.M.) | MESES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M11 | M12 | M13 | M14 | M15 | M16 | M17 | M18 | M19 | M20 | SUMA |
| OBRA DE TOMA | 146.315,81 € | | | | | | | | | | | 146.315,81 € |
| BALSAS INF. NORTE | 491.761,32 € | | | | | | | | | | | 491.761,32 € |
| BALSA INF. SUR | 574.146,19 € | | | | | | | | | | | 574.146,19 € |
| ESTACIÓN DE BOMBEO | 1.446.596,74 € | | | | | | | | | | | 1.446.596,74 € |
| IMPULSIONES | 842.947,29 € | | | | | | | | | | | 842.947,29 € |
| BALSA INTERMEDIA | 803.510,44 € | 100.438,81 € | 100.438,81 € | 100.438,81 € | | | | | | | | 803.510,44 € |
| BALSA ELEVADA | 199.515,15 € | 49.878,79 € | | | | | | | | | | 199.515,15 € |
| RED DE RIEGO PISO 1 | 5.473.226,96 € | 456.102,25 € | 456.102,25 € | 684.153,37 € | 684.153,37 € | 684.153,37 € | 684.153,37 € | 228.051,12 € | 136.830,67 € | 91.220,45 € | | 5.473.226,96 € |
| RED DE RIEGO PISO 2 | 1.000.446,44 € | 250.111,61 € | | | | | | | | | | 1.000.446,44 € |
| MEDIA TENSIÓN | 141.601,13 € | | | | | | | | | | | 141.601,13 € |
| PARQUE FOTOVOLTAICO | 1.180.027,55 € | | | | | | | | | | | 1.180.027,55 € |
| BAJA TENSIÓN Y AUTOMATIZACIÓN | 487.715,40 € | | | | | | | | | | | 487.715,40 € |
| TELECONTROL | 301.448,80 € | | | | | | | | | | | 301.448,80 € |
| GESTIÓN DE RESIDUOS | 7.452,75 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 372,64 € | 7.452,75 € |
| MEDIDAS AMBIENTALES | 269.930,22 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 13.496,51 € | 269.930,22 € |
| SEGURIDAD Y SALUD | 94.200,18 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 4.710,01 € | 94.200,18 € |
| PUBLICIDAD | 1.166,59 € | | | | | | | | | | | |
| TOTAL (P.E.M.) | 13.462.008,96 € | | | | | | | | | | | |
| **P.E.M. MENSUAL** | | 875.110,61 € | 575.120,21 € | 803.171,33 € | 702.732,53 € | 702.732,53 € | 702.732,53 € | 246.630,28 € | 155.409,83 € | 109.799,61 € | 18.579,16 € | 13.462.008,96 € |
| **P.E.M. ACUMULADO** | | 9.445.100,96 € | 10.020.221,17 € | 10.823.392,50 € | 11.526.125,03 € | 12.228.857,56 € | 12.931.590,08 € | 13.178.220,36 € | 13.333.630,20 € | 13.443.429,80 € | 13.462.008,96 € | |

# ANEJO Nº 18.- JUSTIFICACIÓN DE PRECIOS

# ÍNDICE

## ANEJO 18. JUSTIFICACIÓN DE PRECIOS

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**APÉNDICE 1.- CUADRO DE DESCOMPUESTOS**

# ANEJO 18. JUSTIFICACIÓN DE PRECIOS

## 1. INTRODUCCIÓN

El objeto del presente anejo es la determinación y justificación del coste de ejecución material de los precios unitarios del presente "PROYECTO DE MODERNIZACIÓN DEL REGADÍO DE LA COMUNIDAD DE REGANTES SANTA ANA (HUESCA)"

El precio de cada unidad de obra se descompone en:

- Coste de la mano de obra
- Coste de materiales
- Coste de maquinaria
- Otros
- Costes indirectos

## 2. COSTES DIRECTOS

Los costes de mano de obra, materiales y maquinaria considerados en la justificación corresponden a los precios vigentes correspondientes al contrato del proyecto original, y por otro lado se han creado los necesarios para justificar adecuadamente los nuevos precios creados.

### 2.1 MANO DE OBRA

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| MO021 | Hr | Ayudante electricista | 19,08 € |
| MO007 | h | AYUDANTE ENCOFRADOR | 19,08 € |
| MO002 | h | AYUDANTE GENERAL | 19,08 € |
| MO003 | H | AYUDANTE MONTADOR | 19,08 € |
| O01OA020 | h. | CAPATAZ | 21,71 € |
| MO005 | H | CUADRILLA 1 | 57,37 € |
| M0012 | H | CUADRILLA 2 | 55,62 € |
| MO012 | Hr | Cuadrilla Construcción; Oficial de Primera, Ayudante y Peón | 57,37 € |
| MO005D | h | Cuadrilla Eléctrica; Oficial de Primera, Ayudante y Peón | 57,37 € |
| MO001 | h | Encargado de Obra | 22,57 € |
| MO014 | H | ESPECIALISTA INFORMATICO | 21,71 € |
| MTRECPREOBR | Ud | Mes de recurso preventivo en obra | 60,58 € |
| MOOI10a | h | Montador especializado | 18,19 € |
| MO008 | H | OFICIAL 1A | 20,96 € |
| MO002b | H | OFICIAL 1A ALBAÑIL | 20,96 € |
| MO003B | H | OFICIAL 1A ENCOFRADOR | 20,96 € |
| MO008B | h | Oficial 1ª ferrallista | 20,96 € |
| A012M000 | H | OFICIAL 1A MONTADOR | 20,96 € |
| MO01OB210 | h. | Oficial 2ª especialista | 19,51 € |
| O01OB200 | h. | Oficial de primera especialista | 20,96 € |
| MO004 | Hr | Oficial de primera ferrallista | 20,96 € |
| MO020 | Hr | Oficial primera electricista | 20,96 € |
| MO010 | h | PEÓN | 17,33 € |
| MO009 | h | PEON ESPECIALIZADO | 18,19 € |
| FEJIRU | H | TECNICO ESPECIALISTA | 32,00 € |
| FEJIRUM | H | TECNICO ESPECIALISTA MEDIO | 25,00 € |
| MO015 | Hr | Tecnico Especialista Telecomunicaciones | 21,71 € |

### 2.2 MATERIALES

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| ESS50 | Ud | A.a/2inod,ducha,lav.,termo | 204,50 € |
| MAT462 | Ud. | ABRAZADERA TUBO PVC D=200 | 3,28 € |
| P03VE500 | ud | ACCESORIOS DE UNIÓN A TUBERÍA | 2,10 € |
| MTACB500S | kg | ACERO B500S (PIE DE OBRA) | 0,76 € |
| MAT004 | kg | Acero corrugado B-500 S | 0,76 € |
| MAT006 | kg | Acero en caldereria | 4,30 € |
| P07EM050 | kg | ACERO EN CALDERERÍA | 4,30 € |
| P07EM501 | kg | Acero en Calderería | 4,30 € |
| FON0001 | kg | Acero en rejilla | 4,49 € |
| EACEROA42b | Kg | Acero laminado caliente A-42 | 0,34 € |
| MAT007-235 | kg | Acero laminado en perfil S 235, en obra | 0,52 € |
| MAT007 | kg | Acero laminado en perfil S 275 JR, en obra | 0,60 € |
| P07EM025 | kg | Acero laminado galvanizado en perfil S 275 JO, en obra | 1,30 € |
| ESS80 | Ud | Acomet.prov.elect.a caseta. | 93,71 € |
| ESS90 | Ud | Acomet.prov.fontan.a caseta. | 75,00 € |
| ESS100 | Ud | Acomet.prov.saneamt.a caseta. | 65,00 € |
| MAT010 | m³ | Agua en obra | 0,65 € |
| BT-AISGAL2CH | u | Aislador Galvánico de 2 Canales | 122,00 € |
| DT01BT-CE0801 | Ud. | Aisladores soporte | 75,00 € |
| MAT011 | kg | Alambre atar 1,3 mm. | 2,12 € |
| BT-TC_INTRUS | Ud | Alarma De Intrusión Tipo Imán | 60,00 € |
| ESS700 | Ud | Amarre poliamida | 8,41 € |
| MAT921 | Ud | Analizador de Nitratos, rango 0,1-50 mg/l. NOx-N | 15.772,74 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BT-AN-RD | Ud | Analizador de redes | 400,00 € |
| ESS920 | Ud | Anclaje red a forjado. | 0,30 € |
| TFA 42.6000 | Ud | Anemometro TFA 42.6000 | 63,80 € |
| MAT012 | u | Anodo de magnesio de 4,1 kg preempaquetado | 50,00 € |
| BT-ANT-UO3-01 | Ud | Antena Omnidireccional UFH | 342,00 € |
| ESS610 | Ud | Anticaidas desliz.cuerda 14 m. | 175,00 € |
| LUM-EM-8W | Ud | Aparato autónomo de emergencia 8 W señ., IP-54, 80 Lm, 16 m2. | 41,62 € |
| ESS620 | Ud | Aparato freno paracaidas(arnés) | 60,58 € |
| MAT014 | m3 | Arena de río (0-5mm) | 14,83 € |
| MAT017 | m³ | Árido material granular 6-12 mm en obra | 13,41 € |
| ESS590 | Ud | Arnés segur.homologado | 75,73 € |
| MAT023 | Ud | Arqueta para Hidrante, Tipo Armario Hormigón Arm. 2,00x1,00x1,90 | 760,00 € |
| REAL1 | ud | Arqueta para Hidrante, Tipo Armario Hormigón Arm. 2,00x1,00x1,90 | 914,00 € |
| REAL4 | ud | Arqueta para Hidrante, Tipo Armario Hormigón Arm. 2,50x1,50x2,2 | 1.364,00 € |
| MAT540 | m | Autómata programable con pantalla táctil 12" | 1.750,00 € |
| P11GB061 | m2 | BAL.GRES PORCEL. NATURAL 20X20 | 13,14 € |
| MP01 | m² | Baldosa hidraúlica 20x20x2,5 cm, en obra | 5,09 € |
| ESS120 | Ud | Banco polipropileno 5 pers. | 175,68 € |
| BT-BREJ150X60 | Ud | Bandeja tipo rejiband metálica de 150x60 mm | 9,30 € |
| BT-BREJ400X10 | Ud | Bandeja tipo rejiband metálica de 400x100 mm | 23,55 € |
| ZMAT115 | m | Barandilla metálica, incluso anclajes | 133,14 € |
| PAT07 | Ud. | Barra equipotencial | 16,00 € |
| B03H3002 | t | Barrera de granulado granítico para tractamiento superficial | 14,10 € |
| BT-BM-II-20A | Ud | Base Empotrable Clavija doméstica II+TT | 14,75 € |
| BT-BM-III-16A | Ud | Base Mural con Interruptor Bloqueo III+TT 16A | 45,41 € |
| ZT1 | ud | BASE TIPO ZUNCHO PARA CASETA DE 200X100X190 | 150,00 € |
| ZT2 | ud | BASE TIPO ZUNCHO PARA CASETA DE 250X150X220 | 230,00 € |
| ZMAT302 | ud | Batería 330Ah | 866,22 € |
| BT-BCV-100KVA | Ud | Batería de condensadores 100KVAr e Interruptor | 1.500,00 € |
| MAT01020 | ud | Bloque ceramico 30x19x19 cm para revestir, incluidas piezas | 0,39 € |
| MAT047 | ud | Bloque hueco hormigón tipo Split 40x20x20 cm | 1,47 € |
| MAT019 | t | Bolos, no procedente de cantera, tamaño >100mm | 5,00 € |
| MAT4562 | m | Bordillo de hormigón prefafricado tipo T-2 | 5,35 € |
| MAT456 | m | Bordillo de hormigón prefafricado tipo T-3 | 5,92 € |
| BT-BORN20PT | Ud | Bornero desenchufable de 20 puntos | 18,28 € |
| MAT504C | Ud. | Botella unipolar para cable seco 95 mm2 Al RH-Z1 12/20 KV | 9,65 € |
| L01059 | Ud | Botiquín portátil de obra | 39,53 € |
| U08DA002 | Ud | Bovedilla cerámica 60x25x18 | 0,84 € |
| BT-BOYNIVMAX | Ud | Boya de Nivel Máximo | 85,00 € |
| BOYA | Ud | Boya intermitente con célula | 40,00 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BT-CA-213-04 | Ud | Cable Coaxial RG-213 10m | 61,00 € |
| BT-CABLCONFIM | Ud | Cable Configración Concentradora | 35,00 € |
| MAT065 | m | Cable Cu TV 0,6/1 KV 1*6 mm2 | 0,70 € |
| DT01BT-PT016 | M.l. | Cable de cobre desnudo de 16 mm2 de sección nominal | 0,85 € |
| DT01BT-PT0104 | M.l. | Cable de cobre desnudo de 35 mm2 de sección nominal | 1,68 € |
| BT-DT01PT0104 | m.l. | Cable de cobre desnudo de 35 mm2 de sección nominal | 1,68 € |
| ESS960 | m.l. | Cable de seguridad. | 9,50 € |
| BT-CABETH | M.l | Cable Ethernet Categoría 6 | 1,00 € |
| FO1 | m | CABLE SM 8 FO 1T HOLGADA G652D FV, CORRU | 0,95 € |
| P09REV02 | m | Cable triaxial por unión entre sondas | 1,86 € |
| BT-TRY1X2X1.5 | m | Cable Tronic LiCY 1x2x1.5 | 1,03 € |
| BT-TRY2X2X1.5 | m | Cable Tronic LiCY 2x2x1.5 Apantallado | 1,16 € |
| BT-TRY3X2X1.5 | m | Cable Tronic LiCY 3x2x1.5 | 1,35 € |
| SOL-RV-K-DC10 | M.l | Cable Unipolar Interconexion módulo ZZ-F o ZZ-F DUAL 10 mm2 Cu | 1,21 € |
| SOL-RV-K-DC6 | M.l | Cable Unipolar Interconexion módulo ZZ-F o ZZ-F DUAL 6 mm2 Cu | 0,73 € |
| BT-UNIP-120A | M.l | Cable unipolar RV 0,6/1 KV de 120 mm2 Al | 3,37 € |
| BT-UNIP-240A | M.l | Cable unipolar RV 0,6/1 KV de 240 mm2 Al | 6,75 € |
| BT-UNIP-400A | M.l | Cable unipolar RV 0,6/1 KV de 400 mm2 Al | 11,25 € |
| BT-RV-K-120 | M.l | Cable Unipolar RV-K 0,6/1 KV de 120 mm2 Cu | 14,45 € |
| BT-RV-K-240 | M.l | Cable Unipolar RV-K 0,6/1 KV de 240 mm2 Cu | 28,42 € |
| BT-RV-K-025 | M.l | Cable Unipolar RV-K 0,6/1 KV de 25 mm2 Cu | 3,02 € |
| BT-RV-K-035 | M.l | Cable Unipolar RV-K 0,6/1 KV de 35 mm2 Cu | 4,21 € |
| BT-RV-K-050 | M.l | Cable Unipolar RV-K 0,6/1 KV de 50 mm2 Cu | 6,03 € |
| BT-RV-K-070 | M.l | Cable Unipolar RV-K 0,6/1 KV de 70 mm2 Cu | 8,44 € |
| BT-RV-K-095 | M.l | Cable Unipolar RV-K 0,6/1 KV de 95 mm2 Cu | 11,45 € |
| BT-RZ1-001.5 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 1.5 mm2 Cu | 0,18 € |
| BT-RZ1-120 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 120 mm2 Cu | 14,45 € |
| BT-RZ1-150 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 150 mm2 Cu | 18,07 € |
| BT-RZ1-185 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 185 mm2 Cu | 22,30 € |
| BT-RZ1-002.5 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 2.5 mm2 Cu | 0,32 € |
| BT-RZ1-240 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 240 mm2 Cu | 28,42 € |
| BT-RZ1-004 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 4 mm2 Cu | 0,50 € |
| BT-RZ1-050 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 50 mm2 Cu | 6,03 € |
| BT-RZ1-095 | M.l | Cable Unipolar RZ1-K 0,6/1 KV de 95 mm2 Cu | 11,45 € |
| MAT538-1 | m | Cableado | 158,00 € |
| ZMAT313 | m | Cableado RVK 2x1.5 | 9,66 € |
| ZMAT307 | m | Cableado RVK 2x6 | 14,97 € |
| MAT538 | m | Cableado RVK 4x4 | 17,74 € |
| ZMAT303 | ud | Cableado RVK 4x4 | 17,74 € |
| ZMAT308 | m | Cableado YCY 16x0.5 | 20,10 € |
| ZMAT311 | m | Cableado YCY 5x1.5 | 20,18 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| PAT06 | Ud. | Caja PAT | 18,00 € |
| MAT066 | u | Caja toma potencial 200*200 mm | 250,00 € |
| ESS210 | Ud | Camilla portatil evacuaciones | 129,22 € |
| CSUMREJIL | m | Canal con rejilla 100 X 200 mm | 25,00 € |
| MAT940-2 | Ud | Canal Parshall 9" | 3.264,98 € |
| CANALIZA | m | canalización alumbrado | 8,52 € |
| ZZ022_1 | ud | Carrete de desmontaje brida-brida DN-1000, PN-16 | 2.001,47 € |
| ZZ0120_1 | ud | Carrete de desmontaje brida-brida DN-1200, PN-16 | 2.301,47 € |
| MAT1001 | ud | Carrete de desmontaje brida-brida DN-1400, PN-16 | 2.525,21 € |
| MAT077 | ud | Carrete de desmontaje brida-brida DN-150, PN-16 | 149,50 € |
| MAT1002 | ud | Carrete de desmontaje brida-brida DN-1600, PN-16 | 2.777,00 € |
| ZZ023_1 | ud | Carrete de desmontaje brida-brida DN-200, PN-16 | 133,00 € |
| MAT11300 | ud | Carrete de desmontaje brida-brida DN-300, PN-16 | 250,00 € |
| MAT11305 | ud | Carrete de desmontaje brida-brida DN-350, PN-16 | 400,00 € |
| P05TM115 | ud | Carrete de desmontaje brida-brida DN-400, PN-16 | 400,00 € |
| P05TM116 | ud | Carrete de desmontaje brida-brida DN-500, PN-16 | 550,00 € |
| P05TM1106 | ud | CARRETE DE DESMONTAJE BRIDA-BRIDA DN-600, PN-16 | 700,00 € |
| P05TM1107 | ud | CARRETE DE DESMONTAJE BRIDA-BRIDA DN-700, PN-16 | 900,00 € |
| P05TM1108 | ud | CARRETE DE DESMONTAJE BRIDA-BRIDA DN-800, PN-16 | 1.400,00 € |
| P05TM121 | ud | Carrete de desmontaje brida-brida DN-900, PN-16 | 1.650,00 € |
| ESS300 | Ud | Cartel indic. entrada Obra 2.00x1.50 m | 15,00 € |
| L01048 | Ud | Cartel indicativo de riesgo con soporte | 12,41 € |
| L01047 | Ud | Cartel indicativo riesgo sin soporte | 2,21 € |
| ESS350 | Ud | Casco de seguridad homologado | 2,91 € |
| CSTPREF1 | ud | CASETA PREFABRICADA 12,0X8,0X3,0 | 18.550,00 € |
| P09REV03 | ud | Caudalímetro ultrasonico DN 200-4000 PN 10/16 | 430,69 € |
| MAT507 | ud | Celda de Medida; 3 Trafos Tensión y 3 Trafos Intensidad | 6.150,00 € |
| B051E301 | T | Cemento portland blanco compuesto BL II 32,5, en sacos | 152,25 € |
| MTCHAC480 | KG | CHAPA DE ACERO ST,37,2 NORMA DIN 2440,ESPESOR 4,50 MM. | 1,88 € |
| MAT601 | m | Cinta de balizamiento | 0,22 € |
| ESS290 | m.l. | Cinta de balizamiento reflec. | 0,12 € |
| ESS580 | Ud | Cinturón de seguridad homologado | 63,71 € |
| ESS680 | Ud | Cinturón porta herramientas. | 21,04 € |
| B0A31000 | KG | CLAVO ACERO | 0,94 € |
| MTCO45100 | UD | CODO DE 45º EN CHAPA DE ACERO PARA Ø 100 MM | 10,00 € |
| MTCO45150 | UD | CODO DE 45º EN CHAPA DE ACERO PARA Ø 150 MM | 15,00 € |
| MTCO45200 | UD | CODO DE 45º EN CHAPA DE ACERO PARA Ø 200 MM | 25,00 € |
| MTCO4550 | UD | CODO DE 45º EN CHAPA DE ACERO PARA Ø 50 MM | 5,00 € |
| MTCO4580 | UD | CODO DE 45º EN CHAPA DE ACERO PARA Ø 80 MM | 8,00 € |
| MAT200120 | Ud | Compuerta 2,00x2,00, 3 caras. AISI 304L + epoxy | 8.600,00 € |
| BT-UMAST | Ud | Concentradora Radio | 1.785,00 € |
| MAT515 | m | Conductor cobre desnudo de 50 mm2 | 9,95 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BT-PAT-16HOVK | M.l | Conductor de cobre UNE H07V-K 1x16mm2 Verde/amarillo | 2,16 € |
| BT-PAT-CU50 | M.l | Conductor Desnudo de Cobre de 50mm2 | 3,24 € |
| MAT530C | m | Conductor rh-z1 12/20 kv 3x1x95 mm2 | 2,88 € |
| MAT53185 | m | Conductor rh-z1 18/30 kv 150 mm2 | 2,98 € |
| MAT530 | m | Conductor rh-z1 18/30 kv 3x1x240 mm2 | 3,63 € |
| PAT0005 | Ud. | Conexión a tierra equipos | 48,00 € |
| PAT05 | Ud. | Conexión a tierra estructura | 60,00 € |
| MAT535-1 | Ud | Conjunto baterías Gel 24V 200 Ah | 850,00 € |
| MAT535 | ud | Conjunto baterías Gel 24V 400 Ah | 4.181,65 € |
| MAT509 | ud | Conjunto de celda de Línea. Entrega | 2.675,00 € |
| MAT509M | ud | Conjunto de celda de Línea. Entrega MOTORIZADA | 3.000,00 € |
| MAT510C | ud | Conjunto de celda de Protección general. Automático | 15.500,00 € |
| MAT510B | ud | Conjunto de celda de Protección general. Ruptofusible | 3.500,00 € |
| MAT510BB | ud | Conjunto de celda de Protección general. Ruptofusible MOTORIZADA | 3.800,00 € |
| MAT509R | ud | Conjunto de celda de Remonte | 1.635,00 € |
| U17010 | Ud | Cono asimétrico de hormigón armado | 95,00 € |
| ESS935 | Ud | Cono de balizamiento reflectante 75 cm de altura | 16,80 € |
| BT-ATARJEA | m | Construcción pared para atarjea (con Ladrillo Gero) | 7,84 € |
| INT-AUX-IA | Ud | Contacto auxiliar de señalización abierto/cerrado | 47,10 € |
| BT-CT-2P-16A | Ud | Contactor II 16 A | 29,10 € |
| BT-CT-3P-16A | Ud | Contactor III 16 A | 43,20 € |
| BT-CT-4P-16A | Ud | Contactor IV 16 A | 80,00 € |
| MAT176-10 | Ud | Contador "Woltman" 2". | 198,70 € |
| MTCONT1 | Ud | CONTADOR CHORRO MÚLTIPLE 1" | 74,00 € |
| ZZ030_300 | UD | CONTADOR WOLTIMAN 12" PN16 | 1.500,00 € |
| ZZ030_200W | UD | CONTADOR WOLTIMAN 8" PN16 CORRECTOR | 548,00 € |
| CT5016W | UD | CONTADOR WOLTMAN 2" PN16 CORRECTOR | 185,00 € |
| CT8016W | UD | CONTADOR WOLTMAN 3" PN16 CORRECTOR | 225,00 € |
| CT10016W | UD | CONTADOR WOLTMAN 4" PN16 CORRECTOR | 228,00 € |
| ZZ030_150W | UD | CONTADOR WOLTMAN 6" PN16 CORRECTOR | 428,00 € |
| B0DB1720 | M | CONTRAFUERTE MET.P/PARAM.MURO,H=5-10M,200USOS | 0,47 € |
| CONTROLADOR | ud | CONTROLADOR ELECTRONICO GPRS | 6.500,00 € |
| MAT920 | Ud | Controlador, 5 salidas 4-20 mA, 1 sensor digital | 1.930,48 € |
| BT-CONV24V12V | ud | Convertidor DC/DC 24Vcc/12Vcc 96W | 160,10 € |
| BT-CPUPLCME | Ud | CPU max.1024 ED/SD max256 EA/SA 4.096Kb RAM | 964,32 € |
| MAT521 | ud | Cuadro BT-B2 trafo | 3.300,00 € |
| MAT414_C | UD | Cuadro control y programador de la instalación | 1.000,00 € |
| FV_CC106E125A | Ud | Cuadro secundario de CC (6entradas/20A/125A-1000V) | 1.400,00 € |
| FV_C1_08E100A | Ud | Cuadro secundario de CC (8entradas/20A/100A-1000V) | 1.500,00 € |
| FV_CC108E160A | Ud | Cuadro secundario de CC (8entradas/20A/160A-1000V) | 1.600,00 € |
| ESS630 | m.l. | Cuerda poliam.para fre.p.caid | 4,96 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| ESS180 | Ud | Deposito de basuras de 800 l. | 163,63 € |
| B0DZA000 | L | DESENCOFRANTE | 0,99 € |
| MAT133 | ud | Desencofrante p/encofrado metálico | 1,53 € |
| MAT129 | m² | Doble cristal Climalit 4/6 | 18,91 € |
| MAT510-3 | Ud | Edificio prefabricado modelo PF-301 3.42x3.32 | 5.490,62 € |
| MAT510-3B | Ud | Edificio prefabricado modelo PFU-3 3.28x2.38x3.045 | 5.800,00 € |
| MAT510-3C | Ud | Edificio prefabricado modelo PFU-4 4.46x2.38x3.045 | 6.500,00 € |
| MAT142 | u | Electrodo referencia permanente Cu/CuSO4 | 90,00 € |
| MAT600 | UD | ELEMENTO SEGURIDAD EN BALSA | 254,00 € |
| B055R022 | kg | Emulsión bitum. catonica al 60% de betum, tipo ECR-2 | 0,29 € |
| MAT145 | u | Encapsulación para soldadura cable-tubería de cint | 7,00 € |
| ENCARQIP67 | ud | ENCAPSULADO ARQUETA IP67 4P 12C(1X12) Ø8 | 69,85 € |
| BG7U1AR5 | Ud | Enlace Via Radio 433 MHz 12V | 1.050,00 € |
| ZMAT309 | m | Entubado tubo corrugado PG21 | 23,28 € |
| BT-ENV-PNT13 | Ud | Envolvente hormigón armado tipo ALP 13-2P, 1300x1540x395 | 1.300,00 € |
| BT-ENV-PNT17 | Ud | Envolvente hormigón armado tipo ALP 17-3P, 1700x1780x480 | 1.600,00 € |
| BT-ENV-20808 | Ud | Envolvente metálica 2x0.8x0.8 con placa de montaje | 1.073,85 € |
| BT-ENV-201208 | Ud | Envolvente metálica 2x1.2x0.8 con placa de montaje | 1.602,54 € |
| BT-ENV-201608 | Ud | Envolvente metálica 2x1.6x0.8 con placa de montaje | 1.704,20 € |
| BT-ENV-203008 | Ud | Envolvente metálica 2x3.0x0.8 con placa de montaje | 3.500,00 € |
| MAT3033 | Ud | Envolvente metálica IP 55 800x400x400 mm con soporte y candado | 115,00 € |
| ZMAT314 | ud | Equipo de control C03 compacto estándar 12 o 24 VDC | 4.000,00 € |
| MAT518 | ud | Equipo de Medida Auxiliar | 2.500,00 € |
| ALQ_EQ | ud | Equipo ensayos | 891,64 € |
| BT-MOD-SIM | ud | Equipo módem, tarjeta SIM. | 345,67 € |
| MAT018 | m3 | Escollera roca 30 a 60 cm colocada | 9,71 € |
| SN.440 | m2 | Esmalte final protector (pie obra) | 7,71 € |
| MAT150 | Kg | Esmalte sintético para pintado de estructuras metálicas, en obra | 5,75 € |
| ESTACSOL16 | ud | Estructura atornillada ac. galv. biapoyada 16paneles 2,094x1,038 | 555,00 € |
| UESTUAIRE | Ud | Estufa de aire caliente | 30,00 € |
| UEXTINTCO2 | Ud | Extintor CO2 6 Kg | 105,00 € |
| L01054 | Ud | Extintor polvo ABC 6 kg | 63,55 € |
| BT-EX6300-370 | Ud | Extractor Caudal 6300m3/h 370W 400V | 479,00 € |
| BT-FOETHCONV | u | Fiber óptic/Ethernet conversor | 200,00 € |
| B7B1U010 | m² | FIELTRO POLIPROPILENO P=>150G/M2 | 0,25 € |
| P05VYG90F_ | ud | FILTRO CAZAPIEDRAS 3" EN OBRA | 231,00 € |
| P05VYG90F | ud | FILTRO CAZAPIEDRAS 4" EN OBRA | 271,00 € |
| P05VLG200F | ud | FILTRO CAZAPIEDRAS 8" EN OBRA | 685,00 € |
| FM1 | Ud | FILTRO MALLA 1" | 12,00 € |
| MAT414 | UD | Filtro Tipo W para DN 1400 mm | 61.000,00 € |
| MAT413 | UD | Filtro Tipo W para DN 800 mm | 20.000,00 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| P05VLG150F | ud | FILTROCAZAPIEDRAS 6" EN OBRA | 430,00 € |
| BT-FCARRERA | Ud | Final de Carrera para válvula | 25,72 € |
| BT-F24V10A240 | ud | Fuente Alimentación 24Vcc 10 A 240 W | 127,76 € |
| BT-FA36W | Ud | Fuente de alimentación 220/24Vcc 36W | 378,84 € |
| FV_HN1_250A | Ud | Fusible y base portafusibe tipo NH1 URM 200-250A gPV 1000Vdc | 200,00 € |
| FV_HN1_160A | Ud | Fusible y base portafusibe tipo NH1 URM 32-160A gPV 1000Vdc | 88,70 € |
| FUSFO | ud | FUSION FIBRAS OPTICAS | 272,73 € |
| ESS410 | Ud | Gafas antipolvo. | 2,40 € |
| ESS400 | Ud | Gafas contra impactos. | 6,30 € |
| ESS420 | Ud | Gafas panorámicas líquidos | 9,00 € |
| MAT452 | M2 | Geotextil fibra continua 250 gr | 1,00 € |
| MTDR03 | M2 | Geotextil fibra continua 285 gr | 1,10 € |
| A04HO020-1 | m³ | HOMIGÓN HM-20 EN OBRA | 56,33 € |
| P03016 | m³ | Hormigón en masa HM-20/sp/20, sulforresistente, planta D<= 15km | 73,09 € |
| MAT179 | m³ | Hormigón HA-25/B/15-20/IIa+Qb EN OBRA | 57,80 € |
| MTHA20IIA | m³ | HORMIGÓN HA-25/B/20/IIa, >=275KG/M3 CEMENTO | 67,50 € |
| MTHA25 | m³ | HORMIGÓN HA-25/B/20/IIa, >=275KG/M3 CEMENTO | 67,50 € |
| MAT177 | m³ | Hormigón HA-25/B/20/IIa+Qb EN OBRA | 52,00 € |
| MTHA35 | m³ | HORMIGÓN HA-35/B/20/IIa, >=275KG/M3 CEMENTO | 76,27 € |
| MTHM20 | M3 | HORMIGÓN HM-20/B/20/I | 60,21 € |
| MAT178IIb | m³ | Hormigón HM-20/B/20/IIa EN OBRA | 52,50 € |
| MAT178 | m³ | Hormigón HM-20/B/20/IIa+Qb EN OBRA | 49,60 € |
| ZZ034_1 | M3 | HORMIGÓN HM-35/B/20/ Qc | 80,00 € |
| ESS540 | Ud | Impermeable. | 9,02 € |
| MAT182 | Kg | Imprimación antioxidante para pintado de estructuras metálicas | 11,28 € |
| ZMAT312 | ud | Instalación sensor de intrusismo magnético | 256,46 € |
| BT-IA-2000 FV | Ud | Interruptor Automático Emax DC E 2000A 1000Vcc | 6.400,00 € |
| BT-IA-2P10-15 | Ud | Interruptor Automático II 10A PdeC 15kA | 140,00 € |
| BT-IA-2P10-25 | Ud | Interruptor Automático II 10A PdeC 25kA | 144,22 € |
| BT-IA-2P10-35 | Ud | Interruptor Automático II 10A PdeC 35kA | 165,00 € |
| BT-IA-2P10-45 | Ud | Interruptor Automático II 10A PdeC 4.5kA | 44,00 € |
| BT-IA-2P10-50 | Ud | Interruptor Automático II 10A PdeC 50kA | 200,00 € |
| BT-IA-2P10-70 | Ud | Interruptor Automático II 10A PdeC 70kA | 250,00 € |
| BT-IA-4160-FV | Ud | Interruptor Automático II 160 A, Ireg 160 1000V FV, PdeC 22kA | 820,00 € |
| BT-IA-2P16-10 | Ud | Interruptor Automático II 16A PdeC 10kA | 100,00 € |
| BT-IA-2P16-25 | Ud | Interruptor Automático II 16A PdeC 25kA | 160,00 € |
| BT-IA-2P16-35 | Ud | Interruptor Automático II 16A PdeC 35kA | 167,36 € |
| BT-IA-2P16-45 | Ud | Interruptor Automático II 16A PdeC 4.5kA | 45,00 € |
| BT-IA-2P1-50 | Ud | Interruptor Automático II 16A PdeC 50kA | 210,00 € |
| BT-IA-2P16-70 | Ud | Interruptor Automático II 16A PdeC 70kA | 260,00 € |
| BT-IA-2P20-25 | Ud | Interruptor Automático II 20A PdeC 25 kA | 151,25 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BT-IA-2P20-35 | Ud | Interruptor Automático II 20A PdeC 35kA | 171,92 € |
| BT-IA-2P20-45 | Ud | Interruptor Automático II 20A PdeC 4.5 kA | 46,00 € |
| BT-IA-2P20-50 | Ud | Interruptor Automático II 20A PdeC 50kA | 215,00 € |
| BT-IA-2P20-70 | Ud | Interruptor Automático II 20A PdeC 70kA | 275,00 € |
| BT-IA-4250-FV | Ud | Interruptor Automático II 250 A, Ireg 250 1000V FV, PdeC 22kA | 1.145,00 € |
| BT-IA-2P32-45 | Ud | Interruptor Automático II 32A PdeC 4.5 kA | 50,00 € |
| BT-IA-4400-FV | Ud | Interruptor Automático II 400 A, Ireg 400 1000V FV, PdeC 22kA | 2.000,00 € |
| BT-IA-2P50-45 | Ud | Interruptor Automático II 50A PdeC 4.5 kA | 125,00 € |
| BT-IA-4630-FV | Ud | Interruptor Automático II 630 A, Ireg 630 1000V FV, PdeC 22kA | 2.300,00 € |
| BT-IA1250III5 | Ud | Interruptor Automático III 1250 A Ireg 1118 A 50 kA | 6.025,00 € |
| BT-IA-160-III | Ud | Interruptor Automático III 160 A Ireg 160 A | 886,00 € |
| BT-IA-3P16-25 | Ud | Interruptor Automático III 16A PdeC 22kA | 218,70 € |
| BT-IA-3P16-35 | Ud | Interruptor Automático III 16A PdeC 35kA | 238,00 € |
| BT-IA-3P16-50 | Ud | Interruptor Automático III 16A PdeC 50kA | 250,00 € |
| BT-IA-3P16-70 | Ud | Interruptor Automático III 16A PdeC 70kA | 280,00 € |
| BT-IA-250-III | ud | Interruptor Automático III 250 A Ireg 250 A | 1.245,00 € |
| BT-IA-400III5 | ud | Interruptor Automático III 400 A Ireg 306 A 50 kA | 2.600,00 € |
| BT-IA-400-III | ud | Interruptor Automático III 400 A Ireg 306 A 70 kA | 3.100,00 € |
| BT-IA-630-III | ud | Interruptor Automático III 630 A Ireg 630 A 70 kA | 3.680,00 € |
| BT-IA-800III | Ud | Interruptor Automático III 800 A Ireg 792 A 50 kA | 4.900,00 € |
| BT-IA-1250 IV | Ud | Interruptor Automático IV 1250A | 4.900,00 € |
| BT-IA-1600 IV | Ud | Interruptor Automático IV 1600A | 6.206,23 € |
| BT-IA-416-25 | Ud | Interruptor Automático IV 16A PdeC 25kA | 334,69 € |
| BT-IA-416-35 | Ud | Interruptor Automático IV 16A PdeC 35kA | 334,69 € |
| BT-IA-416-70 | Ud | Interruptor Automático IV 16A PdeC 70kA | 400,00 € |
| BT-IA-4P16-25 | Ud | Interruptor Automático IV 16A PdeC 22kA | 248,70 € |
| BT-IA-2000 IV | Ud | Interruptor Automático IV 2000A | 11.000,00 € |
| BT-IA-2000CC | Ud | Interruptor Automático IV 2000A, Ireg 2000 A | 5.900,00 € |
| BT-IA-2500 IV | Ud | Interruptor Automático IV 2500A | 14.500,00 € |
| BT-IA-3000 IV | Ud | Interruptor Automático IV 3000A | 17.000,00 € |
| BT-IA-0400 IV | Ud | Interruptor Automático IV 400A | 2.393,00 € |
| BT-IA-0630 IV | Ud | Interruptor Automático IV 630A | 3.360,00 € |
| BT-IA-0800 IV | Ud | Interruptor Automático IV 800A | 4.267,00 € |
| BT-IA-0080 IV | Ud | Interruptor Automático IV 80A | 475,00 € |
| BT-IA-2000CCM | Ud | Interruptor Automático Moto. IV 2000A, Ireg 2000 A | 6.400,00 € |
| BT-INT-ENV | Ud | Interruptor de puerta para Envolvente | 19,61 € |
| BT-IA-160_IFV | ud | Interruptor Diferencial II 160 A 300 mA | 616,60 € |
| BT-ID-225-30 | Ud | Interruptor Diferencial II 25 A 30 mA | 156,08 € |
| BT-ID-225-300 | Ud | Interruptor Diferencial II 25 A 300 mA | 70,00 € |
| BT-IA_250_IFV | ud | Interruptor Diferencial II 250 A 300 mA | 968,90 € |
| BT-ID-240-30 | Ud | Interruptor Diferencial II 40 A 30 mA | 159,53 € |
| BT-ID-263-30 | Ud | Interruptor Diferencial II 63 A 30 mA | 404,70 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BT-IA-160-I | ud | Interruptor Diferencial III 160 A 300 mA | 636,60 € |
| BT-ID-325-30 | Ud | Interruptor Diferencial III 25 A 30 mA | 180,00 € |
| BT-ID-325-300 | Ud | Interruptor Diferencial III 25 A 300 mA | 120,00 € |
| BT-IA-250-I | ud | Interruptor Diferencial III 250 A 300 mA | 952,79 € |
| BT-ID-425-30 | Ud | Interruptor Diferencial IV 25 A 30 mA | 297,31 € |
| BT-ID-425-300 | Ud | Interruptor Diferencial IV 25 A 300 mA | 250,16 € |
| BT-ID-440-30 | Ud | Interruptor Diferencial IV 40 A 30 mA | 306,70 € |
| BT-ID-440-300 | Ud | Interruptor Diferencial IV 40 A 300 mA | 260,18 € |
| BT-ID-463-30 | Ud | Interruptor Diferencial IV 63 A 30 mA | 532,93 € |
| BT-ID-463-300 | Ud | Interruptor Diferencial IV 63 A 300 mA | 343,13 € |
| BT-INT6A24VCC | ud | Interruptor Magnético 6A 24Vcc | 84,04 € |
| BT-IS-2000CC | Ud | Interruptor Seccionador IV, 2000A, 1100Vcc | 5.000,00 € |
| BT-IA-0320 FV | Ud | Interruptor Seccionador Tmax T4-D/PV 320A 1100Vcc | 1.850,00 € |
| BT-IA-0630 FV | Ud | Interruptor Seccionador Tmax T5-6-D/PV 630A 1100Vcc | 2.300,00 € |
| BT-IA-0400 FV | Ud | Interruptor Seccionador Tmax T5-D/PV 400A 1100Vcc | 2.000,00 € |
| BT-IA-0800 FV | Ud | Interruptor Seccionador Tmax T6-D/PV 800A 1100Vcc | 3.300,00 € |
| BT-IA-1000 FV | Ud | Interruptor Seccionador Tmax T7-D/PV 1000A 1100Vcc | 4.100,00 € |
| BT-IA-1250 FV | Ud | Interruptor Seccionador Tmax T7-D/PV 1250A 1100Vcc | 4.800,00 € |
| BT-IA-0160 FV | Ud | Interruptor Seccionador Tmax XT1-D/PV 160A 1100Vcc | 630,00 € |
| BT-IA-0250 FV | Ud | Interruptor Seccionador Tmax XT3-D/PV 250A 1100Vcc | 1.350,00 € |
| A_INT | ud | interruptor unipolar | 8,74 € |
| BT-IA-20 IV22 | Ud | Interrutptor Automático Magnetotérmico modular IVx20 A | 220,00 € |
| BT-IA-20 IV | Ud | Interrutptor Automático Magnetotérmico modular IVx20 A PdeC 50kA | 260,00 € |
| MAT800 | Ud | Interuptor diferencial 25 A. | 63,25 € |
| ESS130 | Ud | Jabonera industr.a.inoxidab. | 23,20 € |
| MAT441000 | UD | Jaula Desbaste Toma de Fondo DN1000 | 1.700,00 € |
| MAT451E | UD | Jaula Desbaste Toma de Fondo DN1400 | 2.625,00 € |
| MAT452E | UD | Jaula Desbaste Toma de Fondo DN1600 | 2.880,00 € |
| MAT451C | UD | Jaula Desbaste Toma de Fondo DN700 | 1.250,00 € |
| MAT446-3 | Ud | Jaula Desbaste Toma en acequia 1.00m | 864,00 € |
| BT-TMOD-JSPRD | Ud | Juego de soportes para DIN | 36,00 € |
| MAT181 | Ud | Junta de goma para base de pozo de 150 | 6,44 € |
| MATE3LB123 | m | JUNTA HIDROEXPANSIVA | 1,90 € |
| MAT454 | m² | Lámina PEAD 2mm de Espesor | 4,20 € |
| BT-LAM-ENV9W | Ud | Lámpara de Neón planade 11W 220V para envolvente | 180,64 € |
| B0D31000 | M3 | LATA MADERA PINO | 73,70 € |
| BT-CA-058-05 | Ud | Latiguillo interior cuadro RG-58 1m | 22,00 € |
| MAT028 | t | LIGANTE HIDROCARBONADO, SEGÚN PG-3 | 29,00 € |
| BT-LIM-40KA | Ud | Limitador de Sobretensiones IV clase I de 40 kA 1.2kV | 740,00 € |
| 010101LIM | UD | Limpia rejas 2400 kg | 25.900,00 € |
| MAT215 | kg | Lubricante para tuberías | 0,83 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| 20.081 | kg | LUBRICANTE PARA TUBOS DE PVC | 6,53 € |
| LUMLED-1X104W | Ud. | Luminaria alumbrado exterior LED 104 W. incl lampara | 140,00 € |
| P01033 | m3 | Madera (pie de obra) | 112,87 € |
| ESS990 | m.l. | Malla poliet.1 mt. naranja | 0,96 € |
| ESS550 | Ud | Mandil de cuero para soldador | 14,00 € |
| MAT3030 | m | Manguera flexible tipo Arin Flat Reforzada PVC DN 50 | 2,00 € |
| MAT911 | Ud | Marco de fundición. | 36,38 € |
| ZMAT304 | ud | Mástil troncocónico de 8 m de altura 3 mm de pared | 1.200,00 € |
| MAT537-1 | Ud | Mastil tubular | 142,00 € |
| MAT537 | ud | Mastil tubular/troncocónico 8 m 4 mm | 1.225,00 € |
| u7099010 | Ud | Material auxiliar. | 0,60 € |
| MAT516 | Ud | Material de seguridad del CT-CS | 321,93 € |
| MTGRA2MM | M3 | MATERIAL GRANULAR 6/12 MM. | 15,00 € |
| MAT225 | t | Material granular Z-25 / PG3 | 11,29 € |
| FV_MEDIDOR8E | Ud | Medidor (U,I) en cadenas de módulos, 8 entradas. Ethernet | 250,00 € |
| MAT923 | Ud | Medidor de nivel ultrasónico compacto de corto alcance | 450,00 € |
| BT-MED-AISL | Ud | Medidores de aislamiento | 400,00 € |
| MAT027 | t | MEZCLA BITUMINOSA EN CALIENTE BBTM11A O AC-SEMIDENSA | 29,00 € |
| MAT651 | m² | Mezcla Semillas para Siembra a Voleo | 0,47 € |
| BT-MOD32EDAD | Ud | Módulo de 32 Entradas Digitales | 200,00 € |
| BT-MOD32SD | Ud | Módulo de 32 Salidas Digitales | 293,16 € |
| BT-MOD4SA | Ud | Módulo de 4 Salidas Analógicas | 310,80 € |
| BT-MOD64EDAD | Ud | Módulo de 64 Entradas Digitales | 390,60 € |
| BT-MOD8EA | Ud | Módulo de 8 Entradas Analógicas | 592,20 € |
| BT-MOD8EATEM | Ud | Módulo de 8 Entradas Analógicas sondas Temp | 585,48 € |
| FV_MOD_POL320 | u | Modulo fotovoltaico monocristalino 320 Wp, Rto>19% | 100,00 € |
| BG7U1AR10 | ud | MODULO RADIO 10-10-2 | 935,00 € |
| BG7U1AR16 | ud | MODULO RADIO 16-16-2 | 1.141,35 € |
| BG7U1AR16NIMH | ud | MODULO RADIO 16-16-2 Bat Ni-Mh | 1.125,00 € |
| BG7U1AR4 | ud | MODULO RADIO 4-4-2 | 740,00 € |
| BT-MORE24V80A | ud | Módulo Redundante de FAs 24Vcc 80A | 132,62 € |
| ESS530 | Ud | Mono de trabajo. | 15,63 € |
| SOL_DCGEN | Ud | Montaje, configuración, program. y puesta en marcha instalación | 5.000,00 € |
| A04MO001 | m³ | MORTERO DE CEMENTO M-40 (1:6). | 54,30 € |
| MAT231 | m³ | Mortero de cemento M-40 (1:6). | 71,82 € |
| BOM1110_1 | ud | Motobo hor. cám. partida 110 kw | 24.200,00 € |
| BOM2110_1 | ud | Motobo hor. cám. partida 110 kw | 23.285,00 € |
| BOM1200_1 | ud | Motobo hor. cám. partida 200KW | 39.777,00 € |
| BOM1315_1 | ud | Motobo hor. cám. partida 315 kW | 99.368,00 € |
| ZMAT306 | ud | Motorización 12VDC con herraje sencillo | 5.300,00 € |
| OTROS | ud | P.P PEQUEÑO MATERIAL | 18,00 € |
| BT-BGW2DB3D | Ud | P.p. de accesorios y elementos de acabado para bandejas met. | 2,91 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BT-BGY2ABD1 | Ud | P.p. de elementos de soportes de acero horizontales | 3,10 € |
| B0DZP600 | U | P.P.ELEM.AUX.PANEL MET.50X250CM | 0,15 € |
| PAPLANARB-01 | Pa | PAAI. Plantación de Plantas Arbustivas en Margenes y Ribazos | 3.000,00 € |
| 010101SEX | UD | Pala cadena 8 M | 4.000,00 € |
| MAT180 | m² | Panel Fenólico | 12,97 € |
| MAT816 | m2 | Panel lacado con alma de poliuretano 30mm | 34,30 € |
| B0D81680 | M2 | PANEL MET.50X300CM,50USOS | 1,60 € |
| ZMAT301 | ud | Panel solar 12V/60 W con soporte orientable para mástil | 1.029,50 € |
| MAT539-1 | m | Panel solar 24V 120W con soporte | 36,00 € |
| MAT539 | m | Panel solar 24V 290W con soporte | 1.535,00 € |
| BG7U1305 | ud | PANEL SOLAR 5 W 12V | 85,00 € |
| PATN | Ud | Pantalla 2x58 estanca | 22,89 € |
| LUM-LED47W | Ud. | Pantalla led 47W colgada, incluido anclaje, descuelge, lampara | 175,00 € |
| ESS360 | Ud | Pantalla seguri.para soldador | 11,72 € |
| ESS880 | Ud | Par de botas aislantes elect. | 24,94 € |
| ESS840 | Ud | Par de botas de agua. | 13,56 € |
| ESS860 | Ud | Par de botas seguri.con punt.serr. | 23,44 € |
| ESS870 | Ud | Par de botas seguri.con punt/plan. | 35,50 € |
| ESS800 | Ud | Par de guantes para soldador. | 7,51 € |
| ESS820 | Ud | Par de manguitos soldador | 10,22 € |
| ESS890 | Ud | Par de polainas para soldador | 9,92 € |
| ESS790 | Ud | Par guantes de nitrilo | 3,19 € |
| ESS780 | Ud | Par guantes latex anticorte | 2,70 € |
| BGW21000 | Ud | Parte proporcional de accesorios para tubos rígidos de PVC | 0,14 € |
| P1 | UD | Pate de polipropileno 30 cm * 25 cm (p.o.) | 4,00 € |
| BT-PCWINXP | Ud | Pc 2Gb RAM HD500Gb | 1.350,00 € |
| MAT242 | ud | Pequeño material | 1,44 € |
| ACCESOR02 | Ud. | Pequeño material y accesorios | 400,00 € |
| BT-ACCESOR02 | Ud. | Pequeño material y accesorios | 400,00 € |
| MATE0VA001 | ud | PEQUEÑOS MATERIALES | 0,47 € |
| MAT01004 | ud | Perfileria, fijaciones, tornillería, y anclajes | 4,13 € |
| ESS570 | Ud | Peto reflectante but./amar. | 10,00 € |
| BT-PAT015 | Ud. | Pica Ac-Cu 2000x14 mm con grapa | 12,48 € |
| PAT01 | Ud. | Pica Ac-Cu 2000x14 mm con grapa | 14,00 € |
| U30GA010 | Ud | Pica de tierra 2000/14,3 i/bri | 3,60 € |
| PIGTAIL | m | PIGTAIL LC/UPC SM 9/125 G657A2 0,9MM LSZ | 1,75 € |
| DT01BT-CE0502 | Ud. | Piloto señalización color rojo 230 V CA | 12,00 € |
| DT01BT-CE0501 | Ud. | Piloto señalización color verde 230 V CA | 12,00 € |
| SN.430 | kg | Pintura para tráfico (pie obra) | 0,89 € |
| MAT250 | kg | Pintura plástica blanca | 2,71 € |
| MAT500 | M.l. | Placa cubrecables PE protección y señalización | 0,84 € |
| MAT01003 | m2 | Placa de yeso laminado, lisa, acabado vinilo blanco 60x60x9.5 cm | 9,12 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| BG7U1355 | Ud | Placa Solar 100 W Con Soporte y Bateria 200 A/H | 1.720,00 € |
| FANU02 | Ud | Plataforma flotante en balsa para animales, dimensiones 1,0x1,0m | 290,35 € |
| BT-EMB-00400 | M.l | Pletina de cobre de 1(80x5) | 72,00 € |
| BT-EMB-00500 | M.l | Pletina de cobre de 100x5 | 90,00 € |
| BT-EMB-03200 | M.l | Pletina de cobre de 2(160x10) | 576,00 € |
| BT-EMB-04000 | M.l | Pletina de cobre de 2(200x10) | 720,00 € |
| BT-EMB-02000 | M.l | Pletina de cobre de 200x10 | 360,00 € |
| BT-EMB-00800 | M.l | Pletina de cobre de 80x10 | 144,00 € |
| MTVA02 | UD | Poste esquina acero galv.50 mm | 8,00 € |
| SN.380 | m | Poste galvanizado 80x40 mm (pie obra) | 9,34 € |
| MTVA01 | UD | Poste tubo acero galv. 50 mm | 3,00 € |
| ECAN1 | u | pp Candado | 1,56 € |
| BT-PROTSTD | Ud | Protección Contra Sobretensiones Tipo D 230V | 450,00 € |
| P09REV04 | ud | Protecciones para sobretensiones con señal de salida de 4 - 20 | 2.227,90 € |
| ESS450 | Ud | Protectores auditivos. | 7,51 € |
| MAT519 | ud | Puente de Cables Celda - Trafo | 643,20 € |
| MAT520 | ud | Puente de Cables Celda Medida-Celda Protección | 762,00 € |
| MAT416 | UD | Puente Grúa Birrail 2.500 Kg y 18 m luz | 17.962,00 € |
| MTVA05 | UD | Puerta acce.malla met.doble hoja | 1,00 € |
| MAT110160 | ud | Puerta de paso 1600x2045 mm doble hoja acero galvanizado lacado | 210,27 € |
| MAT11011 | ud | Puerta de paso 900x2045 mm de acero galvanizado | 90,17 € |
| MAT259 | m2 | Puerta doble chapa lisa ciega | 81,42 € |
| DT01BT-CE0504 | Ud. | Pulsador color rojo | 11,00 € |
| DT01BT-CE0503 | Ud. | Pulsador color verde | 11,00 € |
| P01044 | kg | Puntas (pie de obra) | 1,39 € |
| MAT260 | kg | Puntas acero 20x100 | 7,00 € |
| BT-RACK12M | Ud | Rack de 12 Emplazamientos | 200,76 € |
| GEE54792X | Ud | Radiomódem 433 MHz Con Antena Directiva UHF Conector | 1.828,29 € |
| ZMAT305 | ud | Recursos para levantamiento de mástil e instalación de elementos | 500,00 € |
| ESS910 | m² | Red de seguridad h=10 m. | 0,91 € |
| FANU01 | m | Red malla 30x30x5mm, nacho 1,0m | 3,00 € |
| MAT536 | ud | Regulador solar de carga | 115,00 € |
| MAT536-1 | Ud | Regulador solar de carga 12/24 20A | 82,00 € |
| ZMAT300 | ud | Regulador solar de carga 15 A | 349,44 € |
| 010102REJ | UD | Reja 3 x 4 m (20 mm) | 4.900,00 € |
| MAT262 | m² | Reja barra acero 30x15 mm. | 68,04 € |
| MAT261 | m2 | Rejilla | 35,65 € |
| BT-DT01VENT02 | Ud. | Rejilla con filtro | 35,00 € |
| DT01VENT02 | Ud. | Rejilla con filtro | 35,00 € |
| OTRAMEX | m2 | REJILLA TIPO TRAMEX DE 30X30 MM COLOCADA | 42,17 € |
| BT-REL-AUX24V | Ud | Relé Auxiliar 24Vcc | 25,00 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| REL-AUX-24V | Ud | Relé Auxiliar 24Vcc | 25,00 € |
| MAT265 | m | Remata precalado e= 0,7mm y desarrollo de 750mm | 6,90 € |
| L01060 | Ud | Reposición material sanitario | 28,03 € |
| BT-SAI2200KVA | Ud | SAI de 2200VA de Baterías 12 min | 480,00 € |
| BT-SAI750VA | u | SAI de 750VA de Baterías 12min | 219,20 € |
| BT-SCADA | Ud | SCADA para control | 8.000,00 € |
| MAT513 | u | Seccionador tierras | 25,47 € |
| DT01BT-CE0506 | Ud. | Selector tres posiciones | 13,00 € |
| MAT271 | m | Sellado con silicona neutra | 0,98 € |
| P07SR015 | m | SELLADO POLIURETANO E=20 MM | 2,90 € |
| P31IA150 | Ud | Semi-mascarilla 1 filtro | 23,75 € |
| BT-SENSPUER | u | Sensor de lámina para puerta | 22,00 € |
| ZMAT310 | ud | Sensor de nivel con herraje mínimo rozamiento | 850,00 € |
| BT-SENNIVHIDR | Ud | Sensor de Nivel Hidrostático | 585,00 € |
| BT-INTENSIDAD | Ud | Sensor intensidad DC Shunt | 300,00 € |
| BT-IRRADIAN | Ud | Sensor irradiancia | 120,00 € |
| L010406 | Ud | Señal normalizada tráfico con soporte | 69,05 € |
| MAT274 | kg | Separadores para armaduras verticales u horizontales | 0,12 € |
| MAT922 | Ud | Set de montaje en acero inox. para sonda | 777,88 € |
| PAT03 | Ud. | Soldadura aluminotérmica en te cable-cable | 19,00 € |
| PAT04 | Ud. | Soldadura aluminotérmica en te cable-mallazo | 20,80 € |
| P09REV11 | ud | Sonda para inserción en tubería, 15/25 | 596,10 € |
| BT-TEMP | u | Sonda temperatura ambiente | 21,76 € |
| BT-TEMPPLACA | u | Sonda temperatura placa fotovoltaica | 25,00 € |
| ESS230 | Ud | Soporte metálico para señal | 14,69 € |
| ESS1010 | Ud | Soporte tipo sargento. | 12,10 € |
| BP711O03 | ud | SUMINISTRO MÁSTIL 4,5m, ACC. Y ANCLAJE | 77,50 € |
| ESTACSOL2 | ud | Suministro y montaje Bandeja metálica 3m | 23,82 € |
| BT-SW5ETHRJ45 | u | Switch Ethernet Industrial 8 Puertos RJ45 | 200,00 € |
| MAT281 | m² | Tablero Metálico encofrar de 26 mm | 2,11 € |
| ESS330 | m.l. | Tablón madera 0.20x0,07m-3 mt | 2,86 € |
| B0D21030 | M | TABLON MADERA PINO P/10 USOS | 0,75 € |
| MAT282 | m³ | Tablón pino 2,50/5,50x205x76 | 151,80 € |
| MAT097-2 | Ud | Tajadera Simple 0,50x0,50 m | 500,00 € |
| MAT097-3 | Ud | Tajadera Simple 0,50x0,80 m | 800,00 € |
| MAT097-1X1 | Ud | Tajadera Simple 0,50x1,00 m | 1.024,00 € |
| P2951 | Ud | TAPA ACERO INOXIDABLE 2 MM ESPESOR | 20,00 € |
| ETA1005 | m2 | Tapa chapa lagrimada 5 mm 250 micras epoxy | 35,39 € |
| MAT101 | m2 | TAPA DE ACERO GALVANIZADO | 49,95 € |
| MAT910 | Ud | Tapa de fundición de 62.50 cm. | 72,76 € |
| BT-ATJ-TAP | m | Tapa para atarjea | 7,50 € |
| L01021 | Ud | Taquilla metálica individual (1 ud x nº operarios punta x 1,20) | 89,18 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| MAT296 | u | Teja de acero curvada con 10 m. cable Cu RV/ 0.6/1 KV | 20,00 € |
| MAT505B | Ud. | Terminal bimetálico a presión de 95 mm2 | 2,30 € |
| MAT517 | ud | Termómetro1" con 2 contactos | 250,00 € |
| TERM | Ud. | Termostato | 15,00 € |
| BT-ERMNO230P | u | Termostato con contacto NO para Pared | 21,76 € |
| DT01-TC | Ud. | Toma de corriente 230 V, 16 A | 22,00 € |
| U42CXX40 | Ud | Tope | 30,10 € |
| MTVA03 | UD | Tornapunta acero galv. 32 mm | 3,00 € |
| 2000 KVA | Ud | Trafo 2000 kVA | 28.000,00 € |
| BT-TRP016B | ud | Transductor de presión 0-16 bar | 70,00 € |
| BT-TC_TRASP | Ud | Trasductor de presión 0-16bar 4-20mA+conexiones | 100,00 € |
| MAT418 | m | Tubería acero helicosol. 1016/10,0 | 284,30 € |
| MAT418_ | m | Tubería acero helicosol. 1219/10,0 | 375,00 € |
| MAT420_ | m | Tubería acero helicosol. 1626/12,5 | 600,00 € |
| MAT348 | m | Tubería acero helicosol. 410/6,4 | 82,10 € |
| MAT350-3 | m | Tubería acero helicosol. 610/6,4 | 109,64 € |
| MAT350-4 | m | Tubería acero helicosol. 711/6,4 | 135,00 € |
| MAT1012 | m | Tubería acero helicosol. 711/7,9 | 145,90 € |
| MAT346-3 | m | Tubería acero helicosol. 813/7,9 | 165,00 € |
| MAT318 | m | Tubería de hormigón armado vibrocomp. 1000 mm | 49,30 € |
| MAT317 | m | Tubería de hormigón armado vibrocomp. 1200 mm | 59,41 € |
| MAT317A | m | Tubería de hormigón armado vibrocomp. 1400 mm | 69,41 € |
| MAT317B | m | Tubería de hormigón armado vibrocomp. 1600 mm | 79,41 € |
| MAT317_B | m | Tubería de hormigón armado vibrocomp. 1800 mm | 89,41 € |
| MAT300-5 | m | Tubería de hormigón armado vibrocomp. 500 mm. | 17,50 € |
| MAT321 | m | TUBERÍA DE HORMIGÓN ARMADO VIBROCOMP. 600 MM. | 19,40 € |
| MAT321-1 | m | TUBERÍA DE HORMIGÓN ARMADO VIBROCOMP. 800 MM | 36,19 € |
| MATPVC110 | ML | TUBERIA DE PVC DN 110 MM, 10 BAR,P/UNIÓN ELAST. | 2,50 € |
| MATPVC125 | ML | TUBERIA DE PVC DN 125 MM, 10 BAR,P/UNIÓN ELAST. | 3,40 € |
| MATPVC140 | ML | TUBERIA DE PVC DN 140 MM, 10 BAR,P/UNIÓN ELAST. | 4,90 € |
| MATPVC14016 | ML | TUBERIA DE PVC DN 140 MM, 16 BAR,P/UNIÓN ELAST. | 7,50 € |
| MATPVC160 | ML | TUBERIA DE PVC DN 160 MM, 10 BAR,P/UNIÓN ELAST. | 7,10 € |
| MATPVC16016 | ML | TUBERIA DE PVC DN 160 MM, 16 BAR,P/UNIÓN ELAST. | 9,90 € |
| MATPVC20016 | ML | TUBERIA DE PVC DN 200 MM, 16 BAR,P/UNIÓN ELAST. | 19,90 € |
| MATPVC250 | ML | TUBERIA DE PVC DN 250 MM, 10 BAR,P/UNIÓN ELAST. | 20,20 € |
| MATPVC25016 | ML | TUBERIA DE PVC DN 250 MM, 16 BAR,P/UNIÓN ELAST. | 28,30 € |
| MATPVC315 | ML | TUBERIA DE PVC DN 315 MM,10 BAR,P/UNIÓN ELAST. | 33,50 € |
| MATPVC400 | ML | TUBERIA DE PVC DN 400 MM,10 BAR,P/UNIÓN ELAST. | 50,10 € |
| MATPVC500 | ML | TUBERIA DE PVC DN 500 MM,10 BAR,P/UNIÓN ELAST. | 67,00 € |
| P02TE611g | m | Tubería PEAD d=110 mm, 10 atmósferas, soldada | 4,60 € |
| P02TE612g | m | Tubería PEAD d=125 mm, 10 atmósferas, soldada | 5,30 € |
| P02TE607g | m | Tubería PEAD d=75 mm, 10 atmósferas, soldada | 2,00 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| P02TE609g | m | Tubería PEAD d=90 mm, 10 atmósferas, soldada | 3,10 € |
| MAT3032 | m | Tubería PEAD DN50 PN10 PE100 | 2,19 € |
| MATP02TL07a | m | Tubería poliéster centrifugado d=700 mm, SN-5, P-6 | 98,00 € |
| MATP02TL10b | m | Tubería poliéster centrifugado d=1000 mm, SN-5, P-10 | 165,50 € |
| MATP02TL10a | m | Tubería poliéster centrifugado d=1000 mm, SN-5, P-6 | 161,61 € |
| MATP02TL12b | m | Tubería poliéster centrifugado d=1200 mm, SN-5, P-10 | 234,00 € |
| P02TL14b | m | Tubería poliéster centrifugado d=1400 mm, SN-5, P-10 | 295,76 € |
| MATP02TL14a | m | Tubería poliéster centrifugado d=1400 mm, SN-5, P-6 | 276,09 € |
| P02TL16a | m | Tubería poliéster centrifugado d=1600 mm, SN-5, P-6 | 395,00 € |
| MATP02TL05b | m | Tubería poliéster centrifugado d=500 mm, SN-5, P-10 | 74,27 € |
| MATP02TL05a | m | Tubería poliéster centrifugado d=500 mm, SN-5, P-6 | 65,00 € |
| MATP02TL06b | m | Tubería poliéster centrifugado d=600 mm, SN-5, P-10 | 86,00 € |
| MATP02TL06a | m | Tubería poliéster centrifugado d=600 mm, SN-5, P-6 | 80,00 € |
| MATP02TL07b | m | Tubería poliéster centrifugado d=700 mm, SN-5, P-10 | 103,00 € |
| MATP02TL08b | m | Tubería poliéster centrifugado d=800 mm, SN-5, P-10 | 122,00 € |
| MATP02TL08a | m | Tubería poliéster centrifugado d=800 mm, SN-5, P-6 | 120,00 € |
| P02TL09b | m | Tubería poliéster centrifugado d=900 mm, SN-5, P-10 | 155,38 € |
| MAT461 | Ml. | TUBERÍA PVC SANITARIO D=200 | 13,19 € |
| MAT1011B | m | Tuberia. acero helicosol. 1422/10.3 | 450,00 € |
| P02TB064 | m | Tuberia. acero helicosol. 1626/12,7 S 235 JR G2 | 636,00 € |
| BT-TUBCORD20 | M.l | Tubo corrugado de D=20mm | 0,49 € |
| BT-TUBCORD50 | M.l | Tubo corrugado de D=50mm | 2,10 € |
| TUBCORD50 | M.l | Tubo corrugado de D=50mm | 1,75 € |
| BT-TB-140 | M.l. | Tubo curvable corrugado de PVC, de 140mm de diámetro nominal | 4,84 € |
| BT-TB-160 | M.l | Tubo curvable corrugado de PVC, de 160mm de diámetro nominal | 4,54 € |
| BT-TB-180 | M.l | Tubo curvable corrugado de PVC, de 180mm de diámetro nominal | 5,11 € |
| BT-TB-200 | M.l | Tubo curvable corrugado de PVC, de 200mm de diámetro nominal | 5,68 € |
| BT-TB-225 | M.l. | Tubo curvable corrugado de PVC, de 225mm de diámetro nominal | 7,00 € |
| MAT473 | ML | TUBO DE PVC DN 200 MM, 10 BAR,P/UNIÓN ELAST. | 14,20 € |
| P02TM11e | m | Tubo PVC d=110 mm, P = 6 atmósferas, junta elástica | 1,89 € |
| P02TM20e | m | Tubo PVC d=200 mm, P = 6 atmósferas, junta elástica | 5,12 € |
| MAT458_ | M | TUBO PVC DRENAJE,DN 140MM,SERIE D | 4,76 € |
| MAT458 | M | TUBO PVC DRENAJE,DN 160MM,SERIE D | 5,76 € |
| MAT457 | m | TUBO PVC DRENAJE,DN 200MM,SERIE D | 7,15 € |
| MAT457_ | m | TUBO PVC DRENAJE,DN 250MM,SERIE D | 9,15 € |
| MAT460 | m | Tubo PVC Sanitario DN 110 mm junta elástica | 1,75 € |
| P291102 | Ud | TUBO REGISTRO DIAM. 1000*1000 | 97,00 € |
| P2911012 | Ud | TUBO REGISTRO DIAM. 1200*1000 | 150,00 € |
| BG212710 | m | Tubo rígido de PVC, de 20 mm de diámetro nominal | 0,70 € |
| BG212810 | m | Tubo rígido de PVC, de 25 mm de diámetro nominal | 1,02 € |
| FV_MOD-MONPHC | u | Ud. de Wp en módulo fotovoltaico Mono-PERC Half-cut, Rto>20,5% | 0,29 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| VH300DOBLES_ | ud | V.H. DOBLE SOLENOIDE DN300 mm PN16 | 5.395,00 € |
| ESS270 | m.l. | Valla contención peatones | 50,80 € |
| EMTVA04 | m² | Vallado simple tors.ST50/14 gal | 5,00 € |
| MTVA04 | M2 | Vallado simple tors.ST50/14 gal | 1,00 € |
| EVAL25010 | u | Válv. alivio rápido c/bridas Ø 200 PN-16 | 5.650,00 € |
| P05VC110 | ud | VÁLV.COMP. BRIDAS ASIENT. ELÁSTICO D=100 MM, PN-16, I/ACCESORIOS | 86,00 € |
| P05VC115 | ud | VÁLV.COMP. BRIDAS ASIENT. ELÁSTICO D=150 MM, PN-16, I/ACCESORIOS | 170,00 € |
| P05VC200 | ud | VÁLV.COMP. BRIDAS ASIENT. ELÁSTICO D=200 MM, PN-16, I/ACCESORIOS | 250,00 € |
| P05VC120 | ud | Válv.comp. bridas asient.elástico d=200 mm, PN-16, i/accesorios | 347,90 € |
| P05VC1082 | ud | VÁLV.COMP. BRIDAS ASIENT.ELÁSTICO D=50 MM, PN-16, I/ACCESORIOS | 65,00 € |
| P05VC108 | ud | VÁLV.COMP. BRIDAS ASIENT.ELÁSTICO D=80 MM, PN-16, I/ACCESORIOS | 71,00 € |
| u470_10016 | Ud | VÁLVULA LIMITADORA Y REDUCTORA 4" | 286,00 € |
| u470_15016 | Ud | VÁLVULA LIMITADORA Y REDUCTORA 6" | 660,00 € |
| VALCOM-50.1 | U | VÁLVULA BOLA DN50MM PN16 FUND. | 18,00 € |
| MAT371 | Ud | Válvula compuerta bridas d=300 mm PN-16 | 718,57 € |
| MAT374 | Ud | Válvula compuerta bridas d=50 mm PN-16 | 33,81 € |
| P03VE401 | Ud | VÁLVULA DE ESFERA PARA ROSCAR DE 1", PN-16 ATMÓSFERAS | 10,40 € |
| P03VE402 | ud | VÁLVULA DE ESFERA PARA ROSCAR DE 2", PN-16 ATMÓSFERAS | 29,40 € |
| MAT378 | ud | Válvula de retención discos concéntricos 400 mm PN-16 | 2.876,00 € |
| MAT377_5 | ud | Válvula de Retención Discos concentricos DN350 PN16 | 2.544,00 € |
| MAT380B | ud | Válvula de Retención Discos concéntricos DN600 PN16 | 10.789,00 € |
| MAT380B7 | ud | Válvula de Retención Discos concéntricos DN700 PN16 | 20.927,00 € |
| u470_80162_ | Ud | VÁLVULA HIDRAULICA 2" | 255,00 € |
| u470_8016S | Ud | VÁLVULA HIDRAULICA 3" | 265,00 € |
| u470_10016S | Ud | VÁLVULA HIDRAULICA 4" | 275,00 € |
| u470_20016 | Ud | VÁLVULA LIMITADORA 8" y reductora | 1.279,00 € |
| u470_8016 | Ud | VÁLVULA LIMITADORA Y REDUCTORA 3" | 273,00 € |
| P05VMV70 | ud | Válvula mariposa embridada d= 700 motor. PN 16 | 6.900,00 € |
| P05VM110 | ud | Válvula mariposa embridada d=1000 mm, PN-16, incluso accesorios | 10.562,46 € |
| P05VM111 | ud | Válvula mariposa embridada d=1200 mm, PN-16, incluso accesorios | 15.500,00 € |
| MAT01130 | ud | Válvula mariposa embridada d=1400 mm PN-16, con accesorios | 22.000,00 € |
| MAT01130M | ud | Válvula mariposa embridada d=1400 mm PN-16, motorizada | 23.500,00 € |
| MAT01130_ | ud | Válvula mariposa embridada d=1600 mm PN-16, con accesorios | 32.100,00 € |
| P05VM112 | ud | Válvula mariposa embridada d=350 mm, PN-16, incluso accesorios | 1.600,00 € |
| P05VM104 | ud | Válvula mariposa embridada d=400 mm, PN-16, incluso accesorios | 2.031,00 € |
| P05VM105 | ud | Válvula mariposa embridada d=500 mm, PN-16, incluso accesorios | 3.250,00 € |
| P05VM106 | ud | Válvula mariposa embridada d=600 mm, PN-16, incluso accesorios | 4.900,00 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| P05VM107 | ud | Válvula mariposa embridada d=700 mm, PN-16, incluso accesorios | 5.900,00 € |
| P05VM108 | ud | Válvula mariposa embridada d=800 mm, PN-16, incluso accesorios | 6.500,00 € |
| P05VM109 | ud | Válvula mariposa embridada d=900 mm, PN-16, incluso accesorios | 7.212,65 € |
| BT-VAR110KWFV | Ud | Variador 110 kW FV, 540-900 Vcc, 400Vac, IP54, prot, diodos y .. | 14.082,50 € |
| BT-VAR200KWFV | Ud | Variador 200 Kw FV, 540-900 Vcc, 400Vac, IP54 | 19.847,20 € |
| BT-VAR315KWFV | Ud | Variador 315 kW FV, 540-900 Vcc, 400Vac, IP54, prot, diodos y .. | 32.300,00 € |
| MAT400 | m² | Ventanal fijo vid. alum. | 60,52 € |
| P03VE005 | ud | VENTOSA TRIFUNCIONAL D=100 MM, PN-16 ATMÓSFERAS | 605,55 € |
| P03VE006 | ud | Ventosa trifuncional d=150 mm, PN-16 atmósferas | 1.121,20 € |
| P03VE008 | ud | VENTOSA TRIFUNCIONAL D=200 MM, PN-16 ATMÓSFERAS | 2.056,57 € |
| P03VE002 | ud | VENTOSA TRIFUNCIONAL D=50 MM, PN-16 ATMÓSFERAS | 205,70 € |
| P03VE002PN10 | ud | VENTOSA TRIFUNCIONAL D=50 MM, PN-16 ATMÓSFERAS | 100,00 € |
| P03VE004 | ud | VENTOSA TRIFUNCIONAL D=80 MM, PN-16 ATMÓSFERAS | 446,81 € |
| PAT08 | Ud. | Viachipas | 30,00 € |
| U08AA002 | Ml | vigueta.horm.pret. 17 cm. 4/5 m | 2,25 € |
| MAT410 | m³ | Zahorra natural Z-40 PG-3 | 9,72 € |
| u7040051 | Tm | Zahorra natural. | 4,60 € |
| BT-ZOC100 | Ud | Zócalo frontal y trasero de elevación de 100mm | 82,15 € |
| BT-ZOCL100 | Ud | Zócalo lateral de elevación de 100 mm | 15,37 € |

## 2.3 OTROS

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| ADEC.INST.EXI | Ud | Adecuación instalaciones existentes | 10.071,89 € |
| ESS30 | Ud | Alquiler caseta p.vestuarios | 111,4 |
| ESS20 | Ud | Alquiler caseta prefa.comedor | 102,14 |
| MAT901 | Ud | Analítica de fósforo total en retornos de riego | 28,25 € |
| MAT902 | Ud | Analítica de terbutilazina y metolacloro en retornos de riego | 210,35 € |
| M07N060 | m3 | Canon de desbroce a vertedero | 6,72 € |
| ESS1120 | Hr | Comite de segurid.e higiene | 51,22 |
| MAT703 | m² | Construcción de Balsas y Abrevaderos | 1,94 € |
| B2RA6501 | m³ | Deposición controlada a centro Autorizado Residuos Especiales | 640 |
| B2RA8500 | m³ | Deposición controlada a centro Autorizado Residuos Inertes | 5,99 |
| B2RA7360 | m³ | Deposición controlada a centro Autorizado Residuos Inertes Mezcl | 7,24 |
| B2RA6500 | m³ | Deposición controlada a centro Autorizado Residuos No Especiales | 7,48 |
| DERC.SUPERV | Ud | Derechos de Supervisión | 406,10 € |
| ENSAYO_ERZ | ud | Ensayo rigidez cables MT | 713,31 € |
| TENS_PYC | ud | Ensayo tensiones paso y contacto | 600,00 € |
| BT-TC_COBERT | Ud | Estudio coberturas, proyectos y trámites para su legalización | 2.184,00 € |

| CODIGO | UD | DESCRIPCIÓN | PRECIO |
|---|---|---|---|
| L01062 | Hr | Formación en Seguridad y Salud | 15,86 € |
| BT-TC_FORMACI | Ud | Formación personal CR | 1.455,00 € |
| 14.01 | Ud | GESTION DE RESIDUOS PARA LA CONSTRUCCION | 7.138,60 € |
| BT-KIT01 | Ud | Kit Pruebas Concentradora | 60,00 € |
| ESS1160 | Ud | Limpieza y desinfección caseta | 30 |
| ARQUEO-01 | Pa | PAAI. Control y Seguimiento Arqueológico | 6.050,96 € |
| PROSFAU-01 | Pa | PAAI. Control y Seguimiento Fauna | 6.050,96 € |
| PROSFLOR-01 | Pa | PAAI. Control y Seguimiento Flora | 6.050,96 € |
| PANIDIFAVI-01 | Pa | PAAI. Instalación de Nidos Artificiales | 4.000,00 € |
| VIGAMB-01 | Pa | PAAI. Vigilancia Ambiental | 18.152,88 € |
| BT-TC_CONWEB | Ud | Portal Web para usuarios | 12.350,00 € |
| BT-PROGPLC | Ud | Programación PLC | 3.500,00 € |
| PRUEPR | ud | Pruebas presenciadas, funcionam. y puesta en marcha | 1.250,00 € |
| BT-TC_CPUEMAR | Ud | Puesta en marcha | 1.800,00 € |
| BT-PMARCHA | Ud | Puesta en Marcha del Sistema de Automatización | 5.000,00 € |
| BT002-01 | PA | Redacción de Proyecto eléctrico, visados y trámites | 1.000,00 € |
| 16.01 | Ud | SEGURIDAD Y SALUD | 92.457,16 € |
| VAR004 | ud | Tasas vertedero | 15,00 € |
| MAQ045 | Ud | Transp.bidón 200 L | 15,42 |
| MAQ043 | Ud | Transp.contenedor 4-6m3 | 10,53 |
| ESS70 | Ud | Transporte caseta prefabricad | 176,43 |
| MAQ046X | Ud | Tratamiento residuos en planta, incluido canon, permisos y gesti | 128 |
| MAT903 | Ud | Unidad de recogida de muestras y traslado a laboratorio | 89,32 € |

## 3. COSTES INDIRECTOS

Una vez determinados los costes directos que influyen en cada una de las unidades de obra, esto es: la mano de obra directamente empleada, los materiales utilizados y la maquinaria de construcción con la que se han de ejecutar las obras, queda por cuantificar el porcentaje de costes indirectos a considerar en las fichas de composición de precios que, con los tres componentes van a confeccionarse a continuación.

Los costes indirectos considerados en el presente proyecto son los considerados en el proyecto original y que se ajustan a un 3%.

A continuación, se incluye la justificación de estos costes.

### 3.1 CRITERIO DE ESTIMACIÓN

Para la determinación de los costes indirectos que han de aplicarse sobre los costes deducidos de la composición del precio de cada unidad de obra, se aplica lo prescrito en:

- Reglamento General de la Ley de contratos de la Administración Pública, artículos 130 y 131.

- R.D. 1627/1997 de 24 de octubre, sobre obligatoriedad del Estudio de Seguridad y Salud en el Trabajo, en el sentido de no indirectos alguna partida o factor de Seguridad e Higiene.

### 3.2 CÁLCULO JUSTIFICATIVO COSTES INDIRECTOS

El porcentaje k, correspondiente a costes indirectos, es la suma de k1 + k2.

Para obras terrestres, k2 vale habitualmente un 1%, y k1 un 2%, que se puede desglosar aproximadamente como sigue:

| DESGLOSE VALOS "k1" EN COSTES INDIRECTOS | |
|---|---|
| **CONCEPTO** | **%** |
| Encargado | 0,37% |
| **MANO DE OBRA INDIRECTA** | **0,37%** |
| Personal de transporte interior | 0,04% |
| Personal de limpieza general y regado | 0,03% |
| Recogida y transporte útiles y herramientas | 0,03% |
| **MANO DE OBRA AUXILIAR** | **0,09%** |
| Maquinaria, útiles y herramientas | 0,25% |
| **MEDIOS AUXILIARES** | **0,25%** |
| Caseta de obra | 0,07% |
| Acometidas y tendidos provisionales | 0,01% |
| Viales, localización y replanteos | 0,02% |
| **INSTALACIONES Y CONSTRUCCIONES PROVISIONALES** | **0,11%** |
| Técnicos adscritos permanentemente a obra | 1,08% |
| Administrativos adscritos permanentemente a la obra | 0,06% |
| **PERSONAL TÉCNICO Y ADMINISTRATIVO** | **1,14%** |
| Gastos de oficina y almacenes de obra | 0,04% |
| **VARIOS** | **0,04%** |
| **TOTAL COSTES INDIRECTOS S/COSTES DIRECTOS** | **2,00%** |

## 4. JUSTIFICACIÓN DE PRECIOS DE LAS UNIDADES

A continuación, se reproduce el listado de la justificación de los precios que conforman el presente Proyecto.

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0001 | A0000064 | kg | ACERO AEH-42B EN PERFILES LAMINADOS O PLANCHAS PARA ESTRUCTURAS Y REFUERZOS, INCLUSO TRATAMIENTO ANTICORROSIVO MEDIANTE CHORREADO ABRASIVO, CON UNA CAPA DE IMPRIMACIÓN ANTIOXIDANTE Y DOS DE ESMALETE SINTÉTICO, INCLUSO PARTE PROPORCIONAL DE RADIOGRAFIAS DE LAS SOLDADUDRAS, COLOCADO EN OBRA. | UN EUROS con NOVENTA Y OCHO CÉNTIMOS | 1,98 |
| 0002 | A0000217 | ud | PANEL EN MADERA, DE 2.50X1.40 M, PARA SEÑAL INFORMATIVA, PINTADO, INCLUYENDO POSTES DE SUSTENTACIÓN, TORNILLERÍA, EXCAVACIÓN Y HORMIGONADO. | OCHOCIENTOS TREINTA Y OCHO EUROS con DOS CÉNTIMOS | 838,02 |
| 0003 | A0000235 | kg | ACERO S235 JR PARA ESTRUCTURAS Y REFUERZOS EN PERFILES LAMINADOS EN FRIO O PLANCHAS, INCLUSO TRATAMIENTO ANTICORROSIVO, INCLUSO PARTE PROPORCIONAL DE RADIOGRAFÍAS Y LIQUIDOS PENETRANTES DE LAS SOLDADURAS, EQUIPOS DE SOLDADURA EN TALLER Y OBRA, TORNILLERIAS DE UNIÓN, COLOCADO EN OBRA, INCLUYENDO LOS MEDIOS AUXILIARES DE ELEVACIÓN DE PERSONAL Y MATERIALES. | UN EUROS con SETENTA Y NUEVE CÉNTIMOS | 1,79 |
| 0004 | A0000275 | kg | ACERO S275 JR PARA ESTRUCTURAS Y REFUERZOS EN PERFILES LAMINADOS O PLANCHAS, INCLUSO TRATAMIENTO ANTICORROSIVO MEDIANTE CHORREADO ABRASIVO, CON UNA CAPA DE IMPRIMACIÓN ANTIOXIDANTE Y DOS DE ESMALTE SINTÉTICO, INCLUSO PARTE PROPORCIONAL DE RADIOGRAFÍAS Y LIQUIDOS PENETRANTES DE LAS SOLDADURAS, EQUIPOS DE SOLDADURA EN TALLER Y OBRA, TORNILLERIAS DE UNIÓN, COLOCADO EN OBRA, INCLUYENDO LOS MEDIOS AUXILIARES DE ELEVACIÓN DE PERSONAL Y MATERIALES. | UN EUROS con NOVENTA Y NUEVE CÉNTIMOS | 1,99 |
| 0005 | A0000325 | m3 | EXCAVACIÓN MANUAL EN ZANJA, PICADO Y PALEO, HASTA 2 M DE PROFUNDIDAD EN TERRENO COMPACTO. PARA CIMENTACIONES Y OBRAS DE FÁBRICA. | TREINTA Y SIETE EUROS con NOVENTA Y TRES CÉNTIMOS | 37,93 |
| 0006 | A0000404 | ud | COLOCACIÓN DE CARTELES INFORMATIVOS SOBRE EL PELIGRO DE EXPANSIÓN DEL MEJILLÓN CEBRA, Y MALLAS DE CONTROL EN BALSAS, REALIZADOS MEDIANTE PANEL EN MADERA, DE 2.50X1.40 M, PARA SEÑAL INFORMATIVA, PINTADO, INCLUYENDO POSTES DE SUSTENTACIÓN, TORNILLERÍA, EXCAVACIÓN Y HORMIGONADO. | OCHOCIENTOS TREINTA Y OCHO EUROS con DOS CÉNTIMOS | 838,02 |
| 0007 | AFOR9 | Ud | CANAL PARSAHLL 9 "PREFABRICADO CONSTRUIDO EN ACERO INOXIDABLE AISI- 304, PARA DE CAUDALES: QMIN: 8,60 M3/H - QMAX: 720 M3/H, EQUIPADO CON BASTIDOR PARA INSTALAR SENSOR ULTRASÓNICO EN EL PUNTO ADECUADO. CON REGLETA DE INDICACIÓN VISUAL CAUDAL/ALTURA. | TRES MIL CUATROCIENTOS TREINTA EUROS con CUARENTA Y CUATRO CÉNTIMOS | 3.430,44 |
| 0008 | ALSOLAR | ud | INSTALACION, CONEXIONADO Y PUESTA EN MARCHA DE BATERIA MONOBLOCK, ESTANCA Y LIBRE DE MANTENIMIENTO DE 24V 330AH.<br>INSTALACION DE PANEL SOLAR CON DETECCION DE INTRUSION SOBRE MASTIL (INCLUIDO) EN SOPORTE ORIENTABLE, INSTALADO, CONECTADO Y EN FUNCIONAMIENTO.<br>TIRADO DE CABLE TIPO RVK 4X4 POR TUBO INCLUIDO<br>INSTALACION MASTIL TUBULAR/TROCOCONICO DE 8M DE ALTURA Y 4MM DE PARED CON VENTANA DE CONEXIONADO, SOBRE ZAPATA Y ESPERAS INSERTADAS EN OBRA CIVIL. LEVANTADO, NIVELADO Y ATORNILLADO<br>ALQUILER DE VEHICULOS Y/O MEDIOS NECESARIOS PARA EL TRANSPORTE Y LEVANTAMIENTO DE MASTIL JUNTO CON PANEL SOLAR Y OTROS ELEMENTOS SOBRE ESTOS. COLOCACION SOBRE ZAPATA Y ESPERAS EXISTENTES INSERTADAS EN OBRA CIVIL. | CUATRO MIL DOSCIENTOS SETENTA Y TRES EUROS con SEIS CÉNTIMOS | 4.273,06 |
| 0009 | ANCLAJET2 | m | BORDILLO DE 12X15X25CM, TIPO T-2, DE PIEZAS PREFABRICADAS DE HORMIGÓN RECTAS Y CURVAS, COLOCADO EN FONDO DE BALSA PARA ANCLAJE, EN NÚMERO POR METRO LINEAL SEGÚN ESPECIFICACIONES DE PROYECTO. INCLUIDO TRANSPORTE Y PUESTA EN OBRA EN EL FONDO DE BALSA Y TODAS LAS FAENAS PERTINENTES.TOTALMENTE COLOCADO. | SIETE EUROS con NOVENTA Y NUEVE CÉNTIMOS | 7,99 |
| 0010 | ANCLAJET3 | m | BORDILLO DE 14X17X28CM, TIPO T-3, DE PIEZAS PREFABRICADAS DE HORMIGÓN RECTAS Y CURVAS, COLOCADO EN FONDO DE BALSA PARA ANCLAJE, EN NÚMERO POR METRO LINEAL SEGÚN ESPECIFICACIONES DE PROYECTO. INCLUIDO TRANSPORTE Y PUESTA EN OBRA EN EL FONDO DE BALSA Y TODAS LAS FAENAS PERTINENTES.TOTALMENTE COLOCADO. | OCHO EUROS con CINCUENTA Y OCHO CÉNTIMOS | 8,58 |
| 0011 | ANEM-TFA42 | Ud | ANEMÓMETRO PORTÁTIL DIGITAL DE HÉLICE DIRECCIONAL CON TERMÓMETRO. PRECISA ENFRENTARLO AL VIENTO PARA UNA CORRECTA LECTURA. INDICA LA VELOCIDAD DEL VIENTO ACTUAL COMO PROMEDIO DE LOS ÚLTIMOS 4 SEGUNDOS, PUDIENDO AJUSTARSE ENTRE 2 Y 10 SEG. INDICA LA VELOCIDAD DEL VIENTO MÁXIMA Y MEDIA DESDE EL ENCENDIDO.UNIDADES DE MEDIDA: BEAUFORT (BARRAS GRÁFICAS), NUDOS, MPH, M/SEG Y KM/H. RANGO DE MEDIDA: 0,2 A 30 M/SEG. | SESENTA Y CINCO EUROS con SETENTA Y UN CÉNTIMOS | 65,71 |
| 0012 | ARQ1X1M | Ud | ARQUETA DE HORMIGÓN PARA CONTROL DE NIVEL IN SITU DE DIMENSIONES INTERIORES DE 1,00 M. DE ANCHO, 1,00 M. DE LARGO. REALIZADA CON HORMIGÓN HA-25. INCLUSO REJUNTADO CON MORTERO SIN RETRACCIÓN EN LA UNIÓN TANTO EN LAS TAJADERAS COMO EN LA CONEXIÓN CON EL TUBO, INCLUIDA COMPUERTA REGULABLE EN ALTURA DE ACERO. MEDIDA LA UNIDAD EJECUTADA | MIL CUATROCIENTOS CUARENTA Y NUEVE EUROS con NOVENTA Y CINCO CÉNTIMOS | 1.449,95 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0013 | ARQ1X1N | Ud | ARQUETA DE HORMIGÓN PARA CONTROL DE NIVEL IN SITU DE DIMENSIONES INTERIORES DE 1,00 M. DE ANCHO, 1,00 M. DE LARGO. REALIZADA CON HORMIGÓN HA-30. INCLUSO REJUNTADO CON MORTERO SIN RETRACCIÓN EN LA UNIÓN TANTO EN LAS TAJADERAS COMO EN LA CONEXIÓN CON EL TUBO. MEDIDA LA UNIDAD EJECUTADA | TRESCIENTOS NOVENTA Y UN EUROS con SESENTA Y SEIS CÉNTIMOS | 391,66 |
| 0014 | ARQUEO | Pa | PARTIDA ALZADA DE ABONO ÍNTEGRO DE CONTROL Y SEGUIMIENTO ARQUEOLÓGICO, POR TÉCNICO COMPETENTE, CON UNA DEDICACIÓN MÍNIMA DE 2 H/SEMANALES | SEIS MIL CINCUENTA EUROS con NOVENTA Y SEIS CÉNTIMOS | 6.050,96 |
| 0015 | ARQVALV15G | UD | ARQUETA PARA ALOJAMIENTO DE VÁLVULAS DE SECCIONAMIENTO, CONSTRUIDA "IN SITU", DE 1,50 X 1,50 METROS DE DIMENSIONES INTERIORES Y ALTURA VARIABLE, SUPERIOR A 2,50 METROS. CON SOLERA DE 0,3 METROS HORMIGÓN HA-35, PAREDES DE HORMIGÓN ARMADO HA-35 DE 0.3 M DE ESPESOR, ARMADURA EN SOLERA Y PAREDES A BASE DE MALLAZO DE DIÁMETRO 16 MM CADA 20 CENTÍMETROS POR 20 CENTÍMETROS EN CARA INTERIOR Y EXTERIOR, INCLUSO POZO DE ACHIQUE, JUNTA HIDROEXPANSIVA Y TAPA METÁLICA DE ACERO DE 3 MM DE ESPESOR, MARCO DE SUJECIÓN Y CANDADO. INCLUSO MOVIMIENTO DE TIERRAS, EXCAVACIÓN EN CUALQUIER TIPO DE TERRENO INCLUSO BARROSY ROCA, ACHIQUE, RELLENO CON MATERIAL DE LA PROPIA EXCAVACIÓN O DE PRÉSTAMO, COMPACTACIÓN Y DESBROCE. COMPLETAMENTE EJECUTADA. | CINCO MIL SETECIENTOS CINCUENTA Y SEIS EUROS con SETENTA Y OCHO CÉNTIMOS | 5.756,78 |
| 0016 | ARQVALV15P | UD | ARQUETA PARA ALOJAMIENTO DE VÁLVULAS DE SECCIONAMIENTO, CONSTRUIDA "IN SITU", DE 1,50 X 1,50 METROS DE DIMENSIONES INTERIORES Y ALTURA VARIABLE, INFERIOR A 2,50 METROS. CON SOLERA DE 0,25 METROS HORMIGÓN HA-35, PAREDES DE HORMIGÓN ARMADO HA-35 DE 0.2 M DE ESPESOR, ARMADURA EN SOLERA Y PAREDES A BASE DE MALLAZO DE DIÁMETRO 10 MM CADA 15 CENTÍMETROS POR 15 CENTÍMETROS EN SU CARA INTERIOR Y EXTERIOR, INCLUSO POZO DE ACHIQUE, JUNTA HIDROEXPANSIVA Y TAPA METÁLICA DE ACERO DE 3 MM DE ESPESOR, MARCO DE SUJECIÓN Y CANDADO. INCLUSO MOVIMIENTO DE TIERRAS, EXCAVACIÓN EN CUALQUIER TIPO DE TERRENO INCLUSO BARROSY ROCA, ACHIQUE, RELLENO CON MATERIAL DE LA PROPIA EXCAVACIÓN O DE PRÉSTAMO, COMPACTACIÓN Y DESBROCE. COMPLETAMENTE EJECUTADA. | TRES MIL SETECIENTOS TREINTA Y UN EUROS con SETENTA Y TRES CÉNTIMOS | 3.731,73 |
| 0017 | ARQVALV3 | UD | ARQUETA PARA ALOJAMIENTO DE VÁLVULAS DE SECCIONAMIENTO, CONSTRUIDA "IN SITU", DE 3,00 X 2,7 METROS DE DIMENSIONES INTERIORES Y ALTURA VARIABLE, INFERIOR A 3, METROS. CON SOLERA DE 0,30 METROS HORMIGÓN HA-35, PAREDES DE HORMIGÓN ARMADO HA-35 DE 0.3 M DE ESPESOR, ARMADURA EN SOLERA Y PAREDES A BASE DE MALLAZO DE DIÁMETRO 16 MM CADA 20 CENTÍMETROS POR 20 CENTÍMETROS EN CARA INTERIOR Y EXTERIOR, INCLUSO POZO DE ACHIQUE, JUNTA HIDROEXPANSIVA Y TAPA METÁLICA DE ACERO DE 3 MM DE ESPESOR, MARCO DE SUJECIÓN Y CANDADO. INCLUSO MOVIMIENTO DE TIERRAS, EXCAVACIÓN EN CUALQUIER TIPO DE TERRENO INCLUSO BARROSY ROCA, ACHIQUE, RELLENO CON MATERIAL DE LA PROPIA EXCAVACIÓN O DE PRÉSTAMO, COMPACTACIÓN Y DESBROCE. COMPLETAMENTE EJECUTADA. | SIETE MIL OCHOCIENTOS VEINTIOCHO EUROS con SESENTA Y CUATRO CÉNTIMOS | 7.828,64 |
| 0018 | ARQVALV35 | UD | ARQUETA PARA ALOJAMIENTO DE VÁLVULAS DE SECCIONAMIENTO, CONSTRUIDA "IN SITU", DE 3,50 X 3,00 METROS DE DIMENSIONES INTERIORES Y ALTURA VARIABLE, HASTA 3, METROS. CON SOLERA DE 0,30 METROS HORMIGÓN HA-35, PAREDES DE HORMIGÓN ARMADO HA-35 DE 0.3 M DE ESPESOR, ARMADURA EN SOLERA Y PAREDES A BASE DE MALLAZO DE DIÁMETRO 16 MM CADA 20 CENTÍMETROS POR 20 CENTÍMETROS EN CARA INTERIOR Y EXTERIOR, INCLUSO POZO DE ACHIQUE, JUNTA HIDROEXPANSIVA Y TAPA METÁLICA DE ACERO DE 5 MM DE ESPESOR, MARCO DE SUJECIÓN Y CANDADO. INCLUSO MOVIMIENTO DE TIERRAS, EXCAVACIÓN EN CUALQUIER TIPO DE TERRENO INCLUSO BARROS Y ROCA, ACHIQUE, RELLENO CON MATERIAL DE LA PROPIA EXCAVACIÓN O DE PRÉSTAMO, COMPACTACIÓN Y DESBROCE. COMPLETAMENTE EJECUTADA. | OCHO MIL TRESCIENTOS DOS EUROS con CUARENTA Y OCHO CÉNTIMOS | 8.302,48 |
| 0019 | A_SEGUR | Ud | MATERIAL DE SEGURIDAD MT, FORMADO POR:<br><br>UN PAR DE GUANTES AISLANTE PARA MANIOBRA Y PROTECCIÓN DE MT, UNA BANQUETA AISLANTE, CUATRO PLACAS DE PELIGRO DE MUERTE Y UNA PLACA REGLAMENTARIA DE PRIMEROS AUXILIOS. | TRESCIENTOS NOVENTA EUROS con SESENTA Y OCHO CÉNTIMOS | 390,68 |
| 0020 | BALSABR | m² | CONSTRUCCIÓN DE BALSAS Y ABREVADEROS DE ENTRE 20 Y 50 M DE DIÁMETRO, 20-30 CM DE PROFUNDIDAD MÁXIMA, COMO ZONAS DE PUNTOS DE AGUA PARA LAS AVES Y HÁBITAT DE MACROINVERTEBRADOS Y ANFIBIOS | DOS EUROS | 2,00 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0021 | BOM1110 | Ud | UD. GRUPO MOTOBOMBA CENTRÍFUGA HORIZONTAL DE CÁMARA PARTIDA PARA UN CAUDAL DE HASTA 652 M3/H Y 42 M.C.A., RENDIMIENTO A 1491 RPM DEL 86,5% O SUPERIOR, EJE DE ACERO AL CARBONO, IMPULSOR DE BRONCE, MOTOR ELÉCTRICO EN HIERRO FUNDIDO A 1489 RPM, POTENCIA DE 200 KW Y TENSIÓN DE 400 V/50 HZ, PROTECCIÓN IP55, RESIST. CALDEO, 3 SONDAS PT 100 EN DEVANADOS, 2 SONDAS PT 100 EN COJINETES Y REFRIGERACIÓN INTERNA MEDIANTE IMPULSOR INTERNO. DISEÑADA PARA TRABAJAR CON VARIADOR DE FRECUENCIA. LOS PUNTOS DE FUNCIONAMIENTO DEBEN ESTAR AJUSTADOS AL "GRADO1U". INCLUSO DESCARGA Y MONTAJE. COMPLETAMENTE INSTALADA, CONEXIONADA ,CONOS DE AMPLIACIÓN Y REDUCCIÓN, INCLUSO PRUEBAS PRESENCIALES EN FÁBRICA, PRUEBAS DE FUNCIONAMIENTO Y PUESTA EN MARCHA UNA VEZ COLOCADA. | VEINTINUEVE MIL SETECIENTOS TRES EUROS con DIECISIETE CÉNTIMOS | 29.703,17 |
| 0022 | BOM1200 | Ud | UD. GRUPO MOTOBOMBA CENTRÍFUGA HORIZONTAL DE CÁMARA PARTIDA PARA UN CAUDAL DE HASTA 1304 M3/H Y 42 M.C.A., RENDIMIENTO A 1489 RPM DEL 83,9% O SUPERIOR, EJE DE ACERO AL CARBONO, IMPULSOR DE BRONCE, MOTOR ELÉCTRICO EN HIERRO FUNDIDO A 1489 RPM, POTENCIA DE 200 KW Y TENSIÓN DE 400 V/50 HZ, PROTECCIÓN IP55, RESIST. CALDEO, 3 SONDAS PT 100 EN DEVANADOS, 2 SONDAS PT 100 EN COJINETES Y REFRIGERACIÓN INTERNA MEDIANTE IMPULSOR INTERNO. DISEÑADA PARA TRABAJAR CON VARIADOR DE FRECUENCIA. LOS PUNTOS DE FUNCIONAMIENTO DEBEN ESTAR AJUSTADOS AL "GRADO1U". INCLUSO DESCARGA Y MONTAJE. COMPLETAMENTE INSTALADA, CONEXIONADA ,CONOS DE AMPLIACIÓN Y REDUCCIÓN, INCLUSO PRUEBAS PRESENCIALES EN FÁBRICA, PRUEBAS DE FUNCIONAMIENTO Y PUESTA EN MARCHA UNA VEZ COLOCADA. | CUARENTA Y SEIS MIL SEISCIENTOS NOVENTA Y OCHO EUROS con SETENTA Y SEIS CÉNTIMOS | 46.698,76 |
| 0023 | BOM1315 | Ud | UD. GRUPO MOTOBOMBA CENTRÍFUGA HORIZONTAL DE CÁMARA PARTIDA PARA UN CAUDAL DE 1955 M3/H Y 42 M.C.A., RENDIMIENTO DEL 87,2% O SUPERIOR, EJE DE ACERO AL CARBONO, IMPULSOR DE BRONCE, MOTOR ELÉCTRICO EN HIERRO FUNDIDO A 995 RPM, POTENCIA DE 315 KWY TENSIÓN DE 400 V/50 HZ, PROTECCIÓN IP55, RESIST. CALDEO, 3 SONDAS PT 100 EN DEVANADOS, 2 SONDAS PT 100 EN COJINETES Y REFRIGERACIÓN INTERNA MEDIANTE IMPULSOR INTERNO. DISEÑADA PARA TRABAJAR CON VARIADOR DE FRECUENCIA. LOS PUNTOS DE FUNCIONAMIENTO DEBEN ESTAR AJUSTADOS AL "GRADO1U". INCLUSO DESCARGA Y MONTAJE. COMPLETAMENTE INSTALADA, CONEXIONADA ,CONOS DE AMPLIACIÓN Y REDUCCIÓN, INCLUSO PRUEBAS PRESENCIALES EN FÁBRICA, PRUEBAS DE FUNCIONAMIENTO Y PUESTA EN MARCHA UNA VEZ COLOCADA. | CIENTO ONCE MIL SETECIENTOS CUARENTA Y CINCO EUROS con NOVENTA Y TRES CÉNTIMOS | 111.745,93 |
| 0024 | BOM2110 | Ud | UD. GRUPO MOTOBOMBA CENTRÍFUGA HORIZONTAL DE CÁMARA PARTIDA PARA UN CAUDAL DE HASTA 421 M3/H Y 62 M.C.A., RENDIMIENTO A 1491 RPM DEL 82,8% O SUPERIOR, EJE DE ACERO AL CARBONO, IMPULSOR DE BRONCE, MOTOR ELÉCTRICO EN HIERRO FUNDIDO A 1489 RPM, POTENCIA DE 200 KW Y TENSIÓN DE 400 V/50 HZ, PROTECCIÓN IP55, RESIST. CALDEO, 3 SONDAS PT 100 EN DEVANADOS, 2 SONDAS PT 100 EN COJINETES Y REFRIGERACIÓN INTERNA MEDIANTE IMPULSOR INTERNO. DISEÑADA PARA TRABAJAR CON VARIADOR DE FRECUENCIA. LOS PUNTOS DE FUNCIONAMIENTO DEBEN ESTAR AJUSTADOS AL "GRADO1U". INCLUSO DESCARGA Y MONTAJE. COMPLETAMENTE INSTALADA, CONEXIONADA ,CONOS DE AMPLIACIÓN Y REDUCCIÓN, INCLUSO PRUEBAS PRESENCIALES EN FÁBRICA, PRUEBAS DE FUNCIONAMIENTO Y PUESTA EN MARCHA UNA VEZ COLOCADA. | VEINTIOCHO MIL SEISCIENTOS NOVENTA Y TRES EUROS con OCHENTA Y UN CÉNTIMOS | 28.693,81 |
| 0025 | BT-AC-CANL050 | m | M.L. DE TUBO CORRUGADO DE PVC DE 50 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | DOS EUROS con NOVENTA Y NUEVE CÉNTIMOS | 2,99 |
| 0026 | BT-AC-CANL140 | m | M.L. DE TUBO CORRUGADO DE PVC DE 140 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | CINCO EUROS con SETENTA Y SEIS CÉNTIMOS | 5,76 |
| 0027 | BT-AC-CANL160 | m | M.L. DE TUBO CORRUGADO DE PVC DE 180 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | CINCO EUROS con TREINTA Y TRES CÉNTIMOS | 5,33 |
| 0028 | BT-AC-CANL180 | m | M.L. DE TUBO CORRUGADO DE PVC DE 180 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | CINCO EUROS con NOVENTA Y UN CÉNTIMOS | 5,91 |
| 0029 | BT-AC-CANL2 | m | M.L. DE TUBO CORRUGADO DE PVC DE 225 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N, UNO POR TERNA + UNO DE RESERVA. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | OCHO EUROS con SESENTA Y OCHO CÉNTIMOS | 8,68 |
| 0030 | BT-AC-CANL200 | m | M.L. DE TUBO CORRUGADO DE PVC DE 200 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | SEIS EUROS con CINCUENTA CÉNTIMOS | 6,50 |
| 0031 | BT-AC-CANL225 | m | M.L. DE TUBO CORRUGADO DE PVC DE 200 MM DE DIÁMETRO NOMINAL, RESISTENCIA DE COMPRESIÓN 750N. TOTALMENTE INSTALADO Y COLOCADO; MEDIDA DE LA UNIDAD TERMINADA Y EJECUTADA. | SIETE EUROS con OCHENTA Y SEIS CÉNTIMOS | 7,86 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0032 | BT-U001.5X2-0 | m | CABLE UNIPOLAR RZ1-K 0,6/1KV 2X1.5; TOTALMENTE MONTADO, CONECTADO Y PROBADO. | | 1,25 |
| | | | | UN EUROS con VEINTICINCO CÉNTIMOS | |
| 0033 | BT-U001.5X3-0 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR RZ1 0,6/1 KV DE 3X1.50 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 1,38 |
| | | | | UN EUROS con TREINTA Y OCHO CÉNTIMOS | |
| 0034 | BT-U002.5X3-0 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR RZ1 0,6/1 KV DE 3X2.5 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 1,81 |
| | | | | UN EUROS con OCHENTA Y UN CÉNTIMOS | |
| 0035 | BT-U002.5X4-0 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR RZ1 0,6/1 KV DE 4X2.5 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 2,18 |
| | | | | DOS EUROS con DIECIOCHO CÉNTIMOS | |
| 0036 | BT-U002.5X5-0 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR RZ1 0,6/1 KV DE 5X2.5 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 2,47 |
| | | | | DOS EUROS con CUARENTA Y SIETE CÉNTIMOS | |
| 0037 | BT-U095X3-050 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR APANTALLADO RZ1 0,6/1 KV DE 3X95+TTX50 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 42,42 |
| | | | | CUARENTA Y DOS EUROS con CUARENTA Y DOS CÉNTIMOS | |
| 0038 | BT-U150X3-095 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR APANTALLADO RZ1 0,6/1 KV DE 3X150+TTX95 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 68,46 |
| | | | | SESENTA Y OCHO EUROS con CUARENTA Y SEIS CÉNTIMOS | |
| 0039 | BT-U185X3-095 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR APANTALLADO RZ1 0,6/1 KV DE 3X95+TTX50 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 81,53 |
| | | | | OCHENTA Y UN EUROS con CINCUENTA Y TRES CÉNTIMOS | |
| 0040 | BT-URVK1X400A | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR RV-K 0,6/1 KV DE 1X400MM2 DE SECCIÓN NOMINAL EN ALUMINIO, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 18,67 |
| | | | | DIECIOCHO EUROS con SESENTA Y SIETE CÉNTIMOS | |
| 0041 | BT-URVK3X240B | m | ACOMETIDA SUBTERRÁNEA.<br>M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR DE ALUMINIO RV-K 0,6/1 KV DE 1X240MM2, CONSTITUIDO EN UNA TERNA, Y 1X120 PARA CADA TERNA, PARA TENSIÓN DE 0,6-1KV, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | | 36,14 |
| | | | | TREINTA Y SEIS EUROS con CATORCE CÉNTIMOS | |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0042 | BT002-1 | Ud | REDACCIÓN DE PROYECTOS ELÉCTRICOS DE BT NECESARIOS PARA LOS CONDICIONANTES ESPECIFICADOS POR LA COMPAÑÍA Y QUE PUDIERAN SER EXIGIDOS POR LOS DIFERENTES ORGANISMOS, COPIAS DOCUMENTALES, VISADOS, BOLETINES, INCLUIDOS TODO TIPO DE TRÁMITES Y TASAS. | | 1.000,00 |
| | | | | MIL EUROS | |
| 0043 | BT0110 | | ARMARIO BOMBA 110 KW AC/DC CON VARIADOR FV. INCLUYE:<br>- ENVOLVENTE COMBINABLE METÁLICA DE 1231X800X2000 MM, ACORDE A LA NORMA IEC 62208, CON IP 55, IK10, ESTRUCTURA REALIZADA EN ACERDO GALVANIZADO, PUERTA DE 2 HOJAS EN ACERO PLEGADO Y SOLDADO, APERTURA 120º, CON ZÓCALO LATERAL, FRONTAL Y TRASERO DE 100 MM DE ELEVACIÓN, INCLUSO PLACA DE MONTAJE, ILUMINACIÓN INTERIOR POR MEDIO DE LÁMPARA DE NEÓN PLANA Y COMPACTA DE 11W, INTERRUPTOR DE PUERTA, REJILLA CON FILTRO, ELEVACIÓN DE TECHO PARA AIREACIÓN, PLACA DE VENTILACIÓN PARA TECHO CON 3 VENTILADORES DE 170M3/H C/U, 220V,MANETA CON INSERTO DE FORMA Y TERMOSTATO.<br><br>- SECCIONADOR AC<br>- FUSIBLES AC<br>- SECCIONADOR DC<br>- FUSIBLES DC<br>- PROTECTOR CONTRA SOBRETENSIONES<br>- VIGILANTE DE AISLAMIENTO<br>- KIT DE DIODO DE PROTECCIÓN TIRISTOR- DIODO. DIODOS DE BLOQUEO PARA BUS CONTINUA VARIADOR<br>- FUNSIONAMIENTO EN INS. FLOTANTE<br>- INSTALACIÓN PARA CARGA SUAVE DE CONDENSADORES PREVIA A ALIMENTACIÓN POR BUS CONTINUA<br>- SOPORTE PARA EMBARRADOS, INCLUYE PANTALLA DE METACRILATO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>- VARIADOR DE FRECUENCIA FOTOVOLTAICO 110 KW, TIPO CD700SP O SIMILAR, TENSIÓN EN PUENTE RECTIFICADOR 400 VCC, TENSIÓN EN BUS CONTINUA MÁXIMIMA 900 VCC Y MÍNIMA 540 VCC, 150% DURANTE 60SEG, TEMPERATURA AMBIENTE 50ºC, DE DIMENSIONES 431X529X2000 MM, EN ARMARIO IP54 PARA INMUNIDAD RFI. INCLUYE RADIADOR DE ALTA EFICIENCIA, INSTALACIÓN COMPLETA PARA CARGA SUAVE DE CONDENSADORES PREVIA A ALIMENTACIÓN POR BUS CONTINUA. FUENTE DE ALIMENTACIÓN DE 24VCC-100MA DISPONIBLE PARA EL USUARIO PROTEGIDA CONTRA CORTOCIRCUITOS. PUERTO DE COMUNICACIONES SERIE, PROTECCION CONTRA SOBRETENSIONES, SOBRECORRIENTE, SOBRECARGA EN LOS IGBTS, TEMPERATURA, INDUCTANCIA DE LÍNEA, FILTRO EMC, THDI BOBINAS Y FILTRO DV/DT EN SALIDA.<br>-INCLUSO PULSADORES, SECCIONADORES EXTERIORES, SELECTOR DE TRES POSICIONES, POTENCIÓMETROS, PARA MANEJO DE BOMBAS Y LEDS SEÑALIZACIÓN EN PUERTA.<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br><br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | | 14.644,35 |
| | | | | CATORCE MIL SEISCIENTOS CUARENTA Y CUATRO EUROS con TREINTA Y CINCO CÉNTIMOS | |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0044 | BT0200 | | ARMARIO BOMBA 200 KW AC/DC CON VARIADOR FV. INCLUYE:<br>- ENVOLVENTE COMBINABLE METÁLICA DE 1786X800X2000, ACORDE A LA NORMA IEC 62208, CON IP 55, IK10, ESTRUCTURA REALIZADA EN ACERDO GALVANIZADO, PUERTA DE 2 HOJAS EN ACERO PLEGADO Y SOLDADO, APERTURA 120º, CON ZÓCALO LATERAL, FRONTAL Y TRASERO DE 100 MM DE ELEVACIÓN, INCLUSO PLACA DE MONTAJE, ILUMINACIÓN INTERIOR POR MEDIO DE LÁMPARA DE NEÓN PLANA Y COMPACTA DE 11W, INTERRUPTOR DE PUERTA, REJILLA CON FILTRO, ELEVACIÓN DE TECHO PARA AIREACIÓN, PLACA DE VENTILACIÓN PARA TECHO CON 3 VENTILADORES DE 170M3/H C/U, 220V,MANETA CON INSERTO DE FORMA Y TERMOSTATO.<br><br>- SECCIONADOR AC<br>- FUSIBLES AC<br>- SECCIONADOR DC<br>- FUSIBLES DC<br>- PROTECTOR CONTRA SOBRETENSIONES<br>- VIGILANTE DE AISLAMIENTO<br>- KIT DE DIODO DE PROTECCIÓN TIRISTOR- DIODO. DIODOS DE BLOQUEO PARA BUS CONTINUA VARIADOR<br>- FUNSIONAMIENTO EN INS. FLOTANTE<br>- INSTALACIÓN PARA CARGA SUAVE DE CONDENSADORES PREVIA A ALIMENTACIÓN POR BUS CONTINUA<br>- SOPORTE PARA EMBARRADOS, INCLUYE PANTALLA DE METACRILATO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>- VARIADOR DE FRECUENCIA FOTOVOLTAICO 200 KW, TIPO CD700SP O SIMILAR, TENSIÓN EN PUENTE RECTIFICADOR 400 VCC, TENSIÓN EN BUS CONTINUA MÁXIMIMA 900 VCC Y MÍNIMA 540 VCC, 150% DURANTE 60SEG, TEMPERATURA AMBIENTE 50ºC, DE DIMENSIONES 786X529X2000 MM, EN ARMARIO IP54 PARA INMUNIDAD RFI. INCLUYE RADIADOR DE ALTA EFICIENCIA, INSTALACIÓN COMPLETA PARA CARGA SUAVE DE CONDENSADORES PREVIA A ALIMENTACIÓN POR BUS CONTINUA. FUENTE DE ALIMENTACIÓN DE 24VCC-100MA DISPONIBLE PARA EL USUARIO PROTEGIDA CONTRA CORTOCIRCUITOS. PUERTO DE COMUNICACIONES SERIE, PROTECCION CONTRA SOBRETENSIONES, SOBRECORRIENTE, SOBRECARGA EN LOS IGBTS, TEMPERATURA, INDUCTANCIA DE LÍNEA, FILTRO EMC, THDI BOBINAS Y FILTRO DV/DT EN SALIDA.<br>-INCLUSO PULSADORES, SECCIONADORES EXTERIORES, SELECTOR DE TRES POSICIONES, POTENCIÓMETROS, PARA MANEJO DE BOMBAS Y LEDS SEÑALIZACIÓN EN PUERTA.<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br><br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | VEINTE MIL QUINIENTOS OCHENTA Y DOS EUROS | 20.582,00 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0045 | BT025CB | | CUADRO DE ACOMETIDA Y PROTECCIONES CC EN EB, QUE INCLUYE:<br>- ENVOLVENTE COMBINABLE METÁLICA DE 2000X3000X800, ACORDE A LA NORMA IEC 62208, CON IP 55, IK10, ESTRUCTURA REALIZADA EN ACERDO GALVANIZADO, PUERTA DE 2 HOJAS EN ACERO PLEGADO Y SOLDADO, APERTURA 120º, CON ZÓCALO LATERAL, FRONTAL Y TRASERO DE 100 MM DE ELEVACIÓN, INCLUSO PLACA DE MONTAJE, ILUMINACIÓN INTERIOR POR MEDIO DE LÁMPARA DE NEÓN PLANA Y COMPACTA DE 11W, INTERRUPTOR DE PUERTA, REJILLA CON FILTRO, ELEVACIÓN DE TECHO PARA AIREACIÓN, PLACA DE VENTILACIÓN PARA TECHO CON 3 VENTILADORES DE 170M3/H C/U, 220V,MANETA CON INSERTO DE FORMA Y TERMOSTATO.<br>- INCLUYE 1 PLETINAS DE COBRE DE 2(160X5) MM PARA EMBARRADO, DE 3.0M DE LARGO CADA UNA. PARA CC.<br>- 3 INTERRUPTOR AUTOMÁTICO TIPO TMAX T7-D/PV 1250A 1100VCC<br>- 3 INTERRUPTOR AUTOMÁTICO TIPO T5 DE IN 630 A, IREG630A POTENCIA DE CORTE DE 20 KA Y 4POLOS, 1000V<br>- 1 INTERRUPTOR AUTOMÁTICO TIPO T5 DE IN 400 A, IREG400A POTENCIA DE CORTE DE 20 KA Y 4POLOS, 1000V<br>- 4 INTERRUPTOR AUTOMÁTICO TIPO T3 DE IN 250 A, IREG250A POTENCIA DE CORTE DE 22 KA Y 4POLOS, 1000V<br>- 2 DIODOS DE BLOQUEO PARA BUS CONTINUA VARIADOR.<br>- SOPORTE PARA EMBARRADOS, INCLUYE PANTALLA DE METACRILATO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br><br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | TREINTA Y SIETE MIL DOSCIENTOS CINCUENTA Y CUATRO EUROS con CUARENTA Y UN CÉNTIMOS | 37.254,41 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0046 | BT0315 | | ARMARIO BOMBA 315 KW AC/DC CON VARIADOR FV. INCLUYE:<br>- ENVOLVENTE COMBINABLE METÁLICA DE 2732X800X2000 MM, ACORDE A LA NORMA IEC 62208, CON IP 55, IK10, ESTRUCTURA REALIZADA EN ACERDO GALVANIZADO, PUERTA DE 2 HOJAS EN ACERO PLEGADO Y SOLDADO, APERTURA 120º, CON ZÓCALO LATERAL, FRONTAL Y TRASERO DE 100 MM DE ELEVACIÓN, INCLUSO PLACA DE MONTAJE, ILUMINACIÓN INTERIOR POR MEDIO DE LÁMPARA DE NEÓN PLANA Y COMPACTA DE 11W, INTERRUPTOR DE PUERTA, REJILLA CON FILTRO, ELEVACIÓN DE TECHO PARA AIREACIÓN, PLACA DE VENTILACIÓN PARA TECHO CON 3 VENTILADORES DE 170M3/H C/U, 220V,MANETA CON INSERTO DE FORMA Y TERMOSTATO.<br><br>- SECCIONADOR AC<br>- FUSIBLES AC<br>- SECCIONADOR DC<br>- FUSIBLES DC<br>- PROTECTOR CONTRA SOBRETENSIONES<br>- VIGILANTE DE AISLAMIENTO<br>- KIT DE DIODO DE PROTECCIÓN TIRISTOR- DIODO. DIODOS DE BLOQUEO PARA BUS CONTINUA VARIADOR<br>- FUNSIONAMIENTO EN INS. FLOTANTE<br>- INSTALACIÓN PARA CARGA SUAVE DE CONDENSADORES PREVIA A ALIMENTACIÓN POR BUS CONTINUA<br>- SOPORTE PARA EMBARRADOS, INCLUYE PANTALLA DE METACRILATO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>- VARIADOR DE FRECUENCIA FOTOVOLTAICO 315 KW, TIPO CD700SP O SIMILAR, TENSIÓN EN PUENTE RECTIFICADOR 400 VCC, TENSIÓN EN BUS CONTINUA MÁXIMIMA 900 VCC Y MÍNIMA 540 VCC, 150% DURANTE 60SEG, TEMPERATURA AMBIENTE 50ºC, DE DIMENSIONES 1132X529X2000 MM, EN ARMARIO IP54 PARA INMUNIDAD RFI. INCLUYE RADIADOR DE ALTA EFICIENCIA, INSTALACIÓN COMPLETA PARA CARGA SUAVE DE CONDENSADORES PREVIA A ALIMENTACIÓN POR BUS CONTINUA. FUENTE DE ALIMENTACIÓN DE 24VCC-100MA DISPONIBLE PARA EL USUARIO PROTEGIDA CONTRA CORTOCIRCUITOS. PUERTO DE COMUNICACIONES SERIE, PROTECCION CONTRA SOBRETENSIONES, SOBRECORRIENTE, SOBRECARGA EN LOS IGBTS, TEMPERATURA, INDUCTANCIA DE LÍNEA, FILTRO EMC, THDI BOBINAS Y FILTRO DV/DT EN SALIDA.<br>-INCLUSO PULSADORES, SECCIONADORES EXTERIORES, SELECTOR DE TRES POSICIONES, POTENCIÓMETROS, PARA MANEJO DE BOMBAS Y LEDS SEÑALIZACIÓN EN PUERTA.<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br><br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | TREINTA Y TRES MIL CUATROCIENTOS OCHO EUROS con TREINTA Y OCHO CÉNTIMOS | 33.408,38 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0047 | BT036CC | | BATERÍA DE CONDENSADORES AUTOMÁTICA PARA COMPENSACIÓN DE ENERGÍA REACTIVA, DE 100KVAR Y 400VAC TRIFÁSICA A 50HZ, ENVOLVENTE METÁLICA INCLUIDA EN LA ACOMTIDA, REGULADOR DIGITAL DE 96X96MM, PROTECCIÓN POR FUSIBLES, INTERRUPTOR GENERAL MANUAL DE CORTE EN CARGA CON BLOQUEO DE PUERTA, CONTACTOR CON RESISTENCIAS, VENTILADOR Y TERMOSTATO, SOBRECARGA 1,3IN, SOBRETENSIÓN 1,1VN, VALOR ICC EMBARRADO 22KA, 1SG, DISPOSITIVO ANTIEXPLOSIÓN Y RESISTENCIAS DE DESCARGA INCORPORADAS. PROTECCIÓN CONTRA CONTACTOS INDIRECTOS, AUTOTRANSFORMADOR 400/230V INTEGRADO, CONEXIÓN CABLEADO DE POTENCIA POR PARTE INFERIOR MEDIANTE TAPA PASACABLES, INCLUSO TRANSPORTE. TOTALMENTE MONTADA, CONECTADA, INSTALADA Y PROBADA. | MIL SEISCIENTOS OCHENTA EUROS con ONCE CÉNTIMOS | 1.680,11 |
| 0048 | BT039-1C | u | UD. DE VENTILACIÓN, EXTRACCIÓN DE AIRE MONTADA, CONEXIONADA Y PROBADA, TIPO HC-50-6T/H, COMPUESTA POR:<br>- 1 VENTILADOR:<br>- CAUDAL 6300M3/H.<br>- 900 RPM<br>- NIVEL SONORO 59 DB<br>- MARCO SOPORTE EN CHAPA DE ACERO.<br>- SOPORTE MOTOR CON REJILLA DE PROTECCIÓN CONTRA CONTACTOS, SEGÚN NORMAS DIN 24167 Y UNE 20-359-74.<br>- HÉLICE EN POLIAMIDA 6 REFORZADA CON FIBRA DE VIDRIO.<br>- CONJUNTO EQUILIBRADO DINÁMICAMENTE SEGÚN LA NORMA ISO 1940.<br>- ACABADO ANTICORROSIÓN EN RESINA DE POLIESTER, POLIMERIZADA A 180ºC., PREVIO DESENGRASE, FOSFATACIÓN Y PASIVADO.<br>- CAJA DE CONEXIÓN INCLUIDA.<br>- MOTORES ASÍNCRONOS, CON ROTOR DE JAULA DE ARDILLA.<br>- TENSIÓN MOTOR 380-415 V 50 HZ .<br>- POTENCIA CONSUMIDA 370W<br>- AISLAMIENTO CLASE F Y PROTECCIÓN IP-65.<br>- PROTECCIÓN TÉRMICA INCLUIDA PARA PROTEGER EL MOTOR CONTRA SOBRECALENTAMIENTOS PRODUCIDOS POR CUALQUIER ANOMALIA.<br>- INTERRUPTORES PARA INSTALAR AL LADO DEL VENTILADOR, Y DE ESTA FORMA PODER CORTAR LA CORRIENTE ANTES DE MANIPULAR EL VENTILADOR. DE ACUERDO A LA NORMA IEC947-3.<br>-PROTECCIÓN IP-65. | QUINIENTOS CINCUENTA Y DOS EUROS con CUARENTA Y SEIS CÉNTIMOS | 552,46 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0049 | BT043 | u | UD SUMINISTRO DE CUADRO AUTOMATISMO, A INSTALAR EN INTERIOR DE CUADRO AUXILIARES, COMPUESTO POR:<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>-1 CONVERTIDOR DE CORRIENTE CONTINUA, TENSIÓN DE ENTRADA 24 VCC, TENSIÓN DE SALIDA 12VCC, DIMENSIONES 124X32X102, POTENCIA MÁX. 96W, CORRIENTE DE SALIDA 8A<br>- 1MÓDULO REDUNDANTE PARA FUENTES DE ALIMENTACIÓN DE TENSIÓN DE ENTRADA DE 24 VCC Y SALIDA DE 80 A. DOBLE ENTRADA Y ÚNICA SALIDA. PÉRDIDAS DE 50MV A 40A DE CORRIENTE DE SALIDA. PÉRDIDAS DE 2.7 W A 40A Y 8.3W A 80A. TAMAÑO 46X124X127 ENVOLVENTE METÁLICA.<br>- 2 FUENTES ALIMENTACIÓN, SALIDA 24VCC, CORRIENTE DE SALIDA 10A, TAMAÑO 125X100X125, POTENCIA MÁX. DE SALIDA 240W, TENSIÓN DE ENTRADA 85 A 264VAC, TIPO CONMUTADO<br>-4 INTERRUPTORES MAGNÉTICOS 1P DE CORRIENTE CONTINUA CON TENSIÓN 24VCC Y 6A DE CORRIENTE.<br>- 2 INTERRUPTORES BIPOLARES 16 A PDEC DE 35 KA. 230V<br>- 10 RELÉS DE MANDO 24VCC<br>- 2 AISLADORES GALVÁNICOS PARA ENTRADAS ANALÓGICAS DE 2 CANALES.<br>- SAI 2.2 KVA POTENCIA CON VOLTAJE DE 230VAC, CON CAPACIDAD DE BATERÍAS PARA 12 MINUTOS,CON CABLE DE COMUNICACIÓN A PUERTO SERIE CON PC, Y SOFTWARE DE SUPERVISIÓN DEL SAI<br>INCLUYE TRANSPORTE.<br>- 1 MODEM GPRS 3G/GSM CON COMUNICACIÓN POR ETHERNET Y TARJETA SIM PARA COMUNICACIÓN REMOTA CON CENTRO CONTROL CR O PARA AVISOS VÍA SMS (ANTIRROBO, ALARMA).<br>-1PROTECCIÓN CONTRA SOBRETENSIONES TIPO D 230V.<br>-3 SWITCH INDUSTRIAL DE 8 PUERTOS RJ45<br>- INCLUYE LUCES DE SEÑALIZACIÓN.<br>TOTALMENTE MONTADO, INSTALADO, CONECTADO Y PROBADO. | CUATRO MIL CIENTO SETENTA Y SIETE EUROS con SESENTA Y NUEVE CÉNTIMOS | 4.177,69 |
| 0050 | BT0441 | u | UNIDAD PLC PARA CONTROL DE ESTACIÓN DE BOMBEO CONSISTENTE EN:<br>-1XCPU<br>-MAX 1024 VÍAS ED/SD<br>-MAX 256 VÍAS EA/SA<br>-4.098 KB DE RAM DE USO INTERNO<br>-3584KB DE MEMORIA INTERNA PARA ALMACENAMIENTO DE PROGRAMA<br>-1 PUERTO ENLACE SERIE INTEGRADO RJ45 CON INTERFAZ RS232/RS485 PARA PROTOCOLO MODBUS RTU<br>-1 PUERTO ETHERNET INTEGRADO<br>-1 PUERTO USB DE PROGRAMACIÓN.<br>- 1 MÓDULO DE 64 ED 24VCC DE ALTA DENSIDAD<br>- 1 MÓDULO DE 32 ED 24VCC DE ALTA DENSIDAD<br>- 1 MÓDULO DE 32 SALIDAS DIGITALES<br>- 5 MÓDULOS DE ENTRADAS ANALÓGICAS PARA SONDAS DE TEMPERATURA<br>- 3 MÓDULO DE 8 ENTRADAS ANALÓGICAS<br>- 3 MÓDULO DE 4 SALIDAS ANALÓGICAS<br>- 1 RACK DE 12 EMPLAZAMIENTOS<br>- 1 FUENTE DE ALIMENTACIÓN DE 220/24 VCC DE 36W<br>- 10 BORNEROS DESENCHUFABLES DE 20 PUNTOS PARA ENTRADAS ANALÓGICAS<br>- INCLUYE PROGRAMA Y PROGRAMACIÓN DEL PLC.<br>- INCLUYE PUESTA EN MARCHA DEL PLC Y DE TODO EL SISTEMA DE AUTOMATIZACIÓN, INCLUYENDO COMUNICACIÓN CON REMOTAS.<br>- INCLUYE PEQUEÑO MATERIAL AUXILIAR Y DE MONTAJE.<br><br>TOTALMENTE INSTALADO, CONFIGURADO, CONECTADO Y PROBADO. | DIECIOCHO MIL DOSCIENTOS CUARENTA Y TRES EUROS con NOVENTA Y SEIS CÉNTIMOS | 18.243,96 |
| 0051 | BT0451 | u | INSTRUMENTACIÓN NECESARIA PARA CONTROL Y MONITORIZACIÓN DE LA ESTACIÓN DE BOMBEO QUE INCLUYE:<br>- 3 TRANSDUCTOR DE PRESIÓN, TIPO SITRANS P SERIE Z, CON GAMA DE PRESIÓN 0-16 BAR, CONEXIÓN DE PRESIÓN G1/2, SALIDA 4..20 MA., TENSIÓN DE ALIMENTACIÓN 10-36 VCC, CARCASA DE ACERO INOXIDABLE, IP65, TEMPERATURA AMBIENTE -25 +85º, CONEXIÓN 2 HILOS<br>- 2 SENSORES DE LÁMINA DE PUERTA 2 HILOS Y TENSIÓN MÁXIMA DE CONMUTACIÓN DE 30VCC, 1 PARA ESTACIÓN DE BOMBEO Y 1 PARA CT.<br>- 15 FINALES DE CARRERA PARA CONTROL DE APERTURA DE VÁLVULAS PREVIA CONEXIÓN DE EQUIPOS DE BOMBEO. (EN VÁLVULAS COMPUERTA Y MARIPOSA)<br>- 1 TERMOSTATOS PARA PARED CON CONTACTO NO 230V 0 A 60º PARA ACTIVACIÓN DE EXTRACTORES.<br>- 2 BOYA DE NIVEL MÁXMIO TENSIÓN 12VCC, GRADO DE PROTECCIÓN IP68 CON CONTACTO NA/NC<br>- 2 SENSOR DE PRESIÓN HIDROSTÁTICO PARA MEDIDA DE NIVEL, INCLUYE 20M DE CABLE ESPECIAL PARA INMERSIÓN, SALIDA ANALÓGICA 4..20MA, RANGO DE TEMPERATURAS DE FUNCIONAMIENTO DE -20 A 50ºC, SOBREPESIÓN MÁXMA 2 EN ESCALA COMPLETA, IP 68, RANGO DE PRESIÓN DE 0 A 400 BAR, 12VCC, (2 EN VERTIDO ACEQUIA, ANTES Y DESPUES, Y 1 EN CÁNTARA)<br>- INCLUYE PEQUEÑO MATERIAL DE MONTAJE.<br>TOTALMENTE INSTALADO Y PROBADO. | DOS MIL CIENTO TREINTA Y OCHO EUROS con TREINTA Y TRES CÉNTIMOS | 2.138,33 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0052 | BT046 | u | CENTRO DE CONTROL PARA MONITORIZACIÓN Y COMANDO DE ESTACIÓN DE BOMBEO COMPUESTO POR:<br>- SAI DE 750VA DE POTENCIA PARA CONEXIÓN DE PC DE CENTRO DE CONTROL, CON VOLTAJE DE 230VAC, CON CAPACIDAD DE BATERÍAS PARA 12 MINUTOS A MEDIA CARGA, Y 6 MINUTOS A PLENA CARGA,CON CABLE DE COMUNICACIÓN A PUERTO SERIE CON PC, Y SOFTWARE DE SUPERVISIÓN DEL SAI.<br>- PC CON WINDOWS XP, PROCESADOR INTEL CORE 2 DUO O EQUIVALENTE, CON 2 GB DE MEMORIA RAM, DISCO DURO DE 500 GB Y MONITOR DE 21".<br>- IMPRESORA DE INYECCIÓN DE TINTA. COLOR Y B/N INCLUYENDO CARTUCHOS DE TINTA COLOR Y NEGRO<br>- MESA Y SILLA DE OFICINA<br>- INCLUYE SCADA PARA CONTROL DE LAS UNIDADES REMOTAS Y DE LA ESTACIÓN DE BOMBEO. SCADA DE SUPERVISIÓN INCLUYENDO LA PROGRAMACIÓN DE PANTALLAS Y SUBPANTALLAS COMO MINIMO:<br>- PANTALLAS CONTROL FV, CAMPO Y DISPOSITIVOS Y PROTECCIONES. ALMACENAMIENTO EN CONTINUO DE VARIABLES.<br>-PANTALLA DE SITUACIÓN: GESTIÓN DE ACCESO Y PERMISOS.<br>- PANTALLA DE ESTADO GENERAL: VALORES MÁS SIGNIFICATIVOS ON-LINE, VISTA DE LAS BOMBAS Y SALA DE CUADROS, Y ACCESO A OTRAS PANTALLAS.<br>- PANTALLA DE ESTADO DEL GRUPO DE BOMBEO: ESTADO DE LA BOMBA, TEMPERATURAS PT100, GESTIÓN DE ALARMAS, RESULTADOS, VARIABLES ELÉCTRICAS (V, I, P ETC), GRÁFICOS DE VARIABLES, PRESIONES Y CAUDALES, HORAS DE MARCHA, Nº DE CONEXIONES ETC.<br>-PANTALLA DE ESTADO DE EQUIPOS: PROTECCIONES COMUNES DEL BOMBEO, PROTECCIONES ELÉCTRICAS INDIVIDUALES, PROTECCIONES DE FILTROS.<br>- PANTALLA DE ESTADO DEL CT, PROTECCIONES Y CONSUMOS.<br>- PANTALLA DE PROGRAMACIÓN: VALORES DE CAPTACIÓN, VALORES DE LLENADO AUTOMÁTICO, LÍMITES DE LLENADO, FUNCIONEMIENTO, PROGRAMACIÓN DE PERIODOS, PROGRAMACIÓN Nº DE BOMBAS, VALORES DE CIERRE, PROGRAMACIÓN VENTILACIÓN, RANGOS HORARIOS DE BOMBEO Y PERIODOS TARIFARIOS, HORARIO LIMITADO O CONTINUO, PARÁMETROS PARA GESTIÓN DE LA EFICIENCIA ENERGÉTICA, RENDIMIENTO ÓPTIMO, PROGRAMACIÓN DE MÁXIMOS CAUDALES Y PROTENCIA, CONFIGURACIÓN SMS, PROGRAMACIÓN SMS ALARMAS, AVISOS Y Nº DE TELÉFONO ETC. PROGRAMACIÓN PARÁMETROS DE INTRUSIÓN.<br>-PANTALLA DE GRÁFICOS: GRÁFICOLS A ELECCIÓN DEL USUARIO CRUZANDO VARIABLES A LO LARGO DEL TIEMPO GENERAL DE LA INSTALACIÓN, COMO INDIVIDUALES DE LOS EQUIPOS, VISUALIZACIÓN DE GRÁFICOS INSTANTANEOS O EN UN RANGO DE TIEMPOS, ALMACENAMIENTO DE VARIABLES, MODIFICACION DE ESCALAS.<br>-PANTALLA DE ALARMAS Y ADVERTENCIAS: ALMACENAMIENTO DE ALARMAS Y SUCESOS, ALARMAS ACTUALES, FILTRO DE RESULTADOS ETC.<br>-PANTALLA DE INFORMES: GENERACIÓN DE INFORMES EN UN RANGO DE RASTREO DE LAS VARIABLES DESEADA, IMPRESIÓN DE INFORMES<br>TOALMENTE PROGRAMADO, MONTADO,INSTALADO, CONFIGURADO Y PROBADO. | CINCO MIL OCHOCIENTOS TRES EUROS con TREINTA Y SEIS CÉNTIMOS | 5.803,36 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0053 | BT046B | u | CENTRO DE CONTROL EN SEDE CR PARA MONITORIZACIÓN Y COMANDO DE TODA LA INSTALACIÓN COMPUESTO POR:<br>- SAI DE 750VA DE POTENCIA PARA CONEXIÓN DE PC DE CENTRO DE CONTROL, CON VOLTAJE DE 230VAC, CON CAPACIDAD DE BATERÍAS PARA 12 MINUTOS A MEDIA CARGA, Y 6 MINUTOS A PLENA CARGA,CON CABLE DE COMUNICACIÓN A PUERTO SERIE CON PC, Y SOFTWARE DE SUPERVISIÓN DEL SAI.<br>- PC CON WINDOWS XP, PROCESADOR INTEL CORE 2 DUO O EQUIVALENTE, CON 2 GB DE MEMORIA RAM, DISCO DURO DE 500 GB Y MONITOR DE 21".<br>- IMPRESORA DE INYECCIÓN DE TINTA. COLOR Y B/N INCLUYENDO CARTUCHOS DE TINTA COLOR Y NEGRO<br>- MESA Y SILLA DE OFICINA<br>- INCLUYE SCADA PARA CONTROL DE LAS UNIDADES REMOTAS Y DE LAS ESTACIONES DE BOMBEO. SCADA DE SUPERVISIÓN INCLUYENDO LA PROGRAMACIÓN DE PANTALLAS Y SUBPANTALLAS COMO MINIMO:<br>- PANTALLAS CONTROL FV, CAMPO Y DISPOSITIVOS Y PROTECCIONES. ALMACENAMIENTO EN CONTINUO DE VARIABLES.<br>-PANTALLA DE SITUACIÓN: GESTIÓN DE ACCESO Y PERMISOS.<br>- PANTALLA DE ESTADO GENERAL: VALORES MÁS SIGNIFICATIVOS ON-LINE, VISTA DE LAS BOMBAS Y SALA DE CUADROS, Y ACCESO A OTRAS PANTALLAS.<br>- PANTALLA DE ESTADO DEL GRUPO DE BOMBEO: ESTADO DE LA BOMBA, TEMPERATURAS PT100, GESTIÓN DE ALARMAS, RESULTADOS, VARIABLES ELÉCTRICAS (V, I, P ETC), GRÁFICOS DE VARIABLES, PRESIONES Y CAUDALES, HORAS DE MARCHA, Nº DE CONEXIONES ETC.<br>-PANTALLA DE ESTADO DE EQUIPOS: PROTECCIONES COMUNES DEL BOMBEO, PROTECCIONES ELÉCTRICAS INDIVIDUALES, PROTECCIONES DE FILTROS.<br>- PANTALLA DE ESTADO DEL CT, PROTECCIONES Y CONSUMOS.<br>- PANTALLA DE PROGRAMACIÓN: VALORES DE CAPTACIÓN, VALORES DE LLENADO AUTOMÁTICO, LÍMITES DE LLENADO, FUNCIONEMIENTO, PROGRAMACIÓN DE PERIODOS, PROGRAMACIÓN Nº DE BOMBAS, VALORES DE CIERRE, PROGRAMACIÓN VENTILACIÓN, RANGOS HORARIOS DE BOMBEO Y PERIODOS TARIFARIOS, HORARIO LIMITADO O CONTINUO, PARÁMETROS PARA GESTIÓN DE LA EFICIENCIA ENERGÉTICA, RENDIMIENTO ÓPTIMO, PROGRAMACIÓN DE MÁXIMOS CAUDALES Y PROTENCIA, CONFIGURACIÓN SMS, PROGRAMACIÓN SMS ALARMAS, AVISOS Y Nº DE TELÉFONO ETC. PROGRAMACIÓN PARÁMETROS DE INTRUSIÓN.<br>-PANTALLA DE GRÁFICOS: GRÁFICOLS A ELECCIÓN DEL USUARIO CRUZANDO VARIABLES A LO LARGO DEL TIEMPO GENERAL DE LA INSTALACIÓN, COMO INDIVIDUALES DE LOS EQUIPOS, VISUALIZACIÓN DE GRÁFICOS INSTANTANEOS O EN UN RANGO DE TIEMPOS, ALMACENAMIENTO DE VARIABLES, MODIFICACION DE ESCALAS.<br>-PANTALLA DE ALARMAS Y ADVERTENCIAS: ALMACENAMIENTO DE ALARMAS Y SUCESOS, ALARMAS ACTUALES, FILTRO DE RESULTADOS ETC.<br>-PANTALLA DE INFORMES: GENERACIÓN DE INFORMES EN UN RANGO DE RASTREO DE LAS VARIABLES DESEADA, IMPRESIÓN DE INFORMES<br>- CENTRO DE CONTROL DEL SISTEMA DE TELEGESTIÓN DEL RIEGO. EN ESTE PUNTO SE GESTIONARÁ Y ORGANIZARÁ TODO LO RELATIVO AL SISTEMA DE TELEGESTIÓN DEL RIEGO, SIENDO EL PUNTO DE ALMACENAJE DE TODA LA INFORMACIÓN PARA SU ADECUADA GESTIÓN Y FACTURACIÓN.<br>TOALMENTE PROGRAMADO, MONTADO,INSTALADO, CONFIGURADO Y PROBADO. | NUEVE MIL NOVECIENTOS VEINTITRES EUROS con | 9.923,36 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| | | | | TREINTA Y SEIS CÉNTIMOS | |
| 0054 | BT047 | u | CENTRO DE COMUNICACIONES RADIO/GPRS EN EB QUE CONSISTE EN:<br>- CONCENTRADORA RADIO CON RECIBIR INFORMACIÓN Y EMITIR ORDENES CON PROTOCOLO MODBUS RTU 12 VCC<br>- 1 LATIGUILLO INTERIOR CUADRO RG-58 1M N MACHO- N HEMBRA<br>- 1 CABLE COAXIAL RG-213 10 M N MACHO - N MACHO<br>- 1 ANTENA OMNIDIRECCIONAL COLINEAL UHF, 3 DB DE GANANCIA, N HEMBRA, 405-445 MHZ<br>- 1 JUEGO DE SOPORTES PARA RAIL DIN<br>- 1 KIT DE PRUEBAS PARA UNIDAD CONCENTRADORA<br>- 1 KIT DE PRUEBAS PARA UNIDADES REMOTAS<br>- 1 CABLE DE CONFIGURACIÓN DE UNIDAD REMOTA<br>- 1 CABLE DE CONFIGURACIÓN PARA CONCENTRADORA.<br>- 1 MODEM GPRS 3G/GSM CON COMUNICACIÓN POR ETHERNET Y TARJETA SIM PARA COMUNICACIÓN REMOTA CON CENTRO CONTROL CR O PARA AVISOS VÍA SMS (ANTIRROBO, ALARMA).<br>- INCLUYE MASTIL PARA INSTALACIÓN DE ANTENA.<br>TOTALMENTE INSTALADO, CONECTADO Y PROBADO. | 2.851,69 | |
| | | | | DOS MIL OCHOCIENTOS CINCUENTA Y UN EUROS con SESENTA Y NUEVE CÉNTIMOS | |
| 0055 | BT047B | u | CENTRO DE COMUNICACIONES RADIO EN SEDE CR QUE CONSISTE EN:<br>- CONCENTRADORA RADIO CON RECIBIR INFORMACIÓN Y EMITIR ORDENES CON PROTOCOLO MODBUS RTU 12 VCC<br>- 1 LATIGUILLO INTERIOR CUADRO RG-58 1M N MACHO- N HEMBRA<br>- 1 CABLE COAXIAL RG-213 10 M N MACHO - N MACHO<br>- 1 ANTENA OMNIDIRECCIONAL COLINEAL UHF, 3 DB DE GANANCIA, N HEMBRA, 405-445 MHZ<br>- 1 JUEGO DE SOPORTES PARA RAIL DIN<br>- 1 KIT DE PRUEBAS PARA UNIDAD CONCENTRADORA<br>- 1 KIT DE PRUEBAS PARA UNIDADES REMOTAS<br>- 1 CABLE DE CONFIGURACIÓN DE UNIDAD REMOTA<br>- 1 CABLE DE CONFIGURACIÓN PARA CONCENTRADORA.<br>- 1 MODEM GPRS 3G/GSM CON COMUNICACIÓN POR ETHERNET Y TARJETA SIM PARA COMUNICACIÓN REMOTA CON CENTRO CONTROL CR O PARA AVISOS VÍA SMS (ANTIRROBO, ALARMA).<br>- INCLUYE MASTIL PARA INSTALACIÓN DE ANTENA.<br>TOTALMENTE INSTALADO, CONECTADO Y PROBADO. | 2.851,69 | |
| | | | | DOS MIL OCHOCIENTOS CINCUENTA Y UN EUROS con SESENTA Y NUEVE CÉNTIMOS | |
| 0056 | BT047B_ | u | CENTRO DE COMUNICACIONES RADIO/GPRS EN SEDE SR QUE CONSISTE EN:<br>- CONCENTRADORA RADIO/GPRS CON RECIBIR INFORMACIÓN Y EMITIR ORDENES CON PROTOCOLO MODBUS RTU 12 VCC<br>- PASARELA COMUNICACIONES BIDIRECCIONAL CON AUTÓMATA Y PANTALLA 12" EN ARMARIO<br>- RELÉS Y PROTECCIONES<br>- 1 LATIGUILLO INTERIOR CUADRO RG-58 1M N MACHO- N HEMBRA<br>- 1 CABLE COAXIAL RG-213 10 M N MACHO - N MACHO<br>- 1 ANTENA OMNIDIRECCIONAL COLINEAL UHF, 3 DB DE GANANCIA, N HEMBRA, 405-445 MHZ Y GPRS CUATRIBANDA DIRECTIVA<br>- 1 JUEGO DE SOPORTES PARA RAIL DIN<br>- 1 KIT DE PRUEBAS PARA UNIDAD CONCENTRADORA<br>- 1 KIT DE PRUEBAS PARA UNIDADES REMOTAS<br>- 1 CABLE DE CONFIGURACIÓN DE UNIDAD REMOTA<br>- 1 CABLE DE CONFIGURACIÓN PARA CONCENTRADORA.<br>- 1 MODEM GPRS 3G/GSM CON COMUNICACIÓN POR ETHERNET Y TARJETA SIM PARA COMUNICACIÓN REMOTA CON CENTRO CONTROL CR O PARA AVISOS VÍA SMS (ANTIRROBO, ALARMA).<br>- INCLUYE MÁSTIL PARA INSTALACIÓN DE ANTENA.<br>TOTALMENTE INSTALADO, CABLEADO, CONECTADO Y PROBADO. | 2.854,40 | |
| | | | | DOS MIL OCHOCIENTOS CINCUENTA Y CUATRO EUROS con CUARENTA CÉNTIMOS | |
| 0057 | BT049 | u | SUMINISTRO E INSTALACIÓN DE LA INSTRUMENTACIÓN DE LA BALSA INTERMEDIA Y ELEVADA, CONSISTENTE EN:<br>-2 (1+1) BOYA DE NIVEL MÁXMIO TENSIÓN 12VCC, GRADO DE PROTECCIÓN IP68 CON CONTACTO NA/NC<br>-2 (1+1) SENSOR DE PRESIÓN HIDROSTÁTICO PARA MEDIDA DE NIVEL, INCLUYE 20M DE CABLE ESPECIAL PARA INMERSIÓN, SALIDA ANALÓGICA 4..20MA, RANGO DE TEMPERATURAS DE FUNCIONAMIENTO DE -20 A 50ºC, SOBREPESIÓN MÁXMA 2 EN ESCALA COMPLETA, IP 68, RANGO DE PRESIÓN DE 0 A 400 BAR, 12VCC,<br>- 2 (1+1) SENSORES DE LÁMINA DE PUERTA 2 HILOS Y TENSIÓN MÁXIMA DE CONMUTACIÓN DE 30VCC, EN CASETA AUTOMATIZACIÓN.<br>- 2 TRANSDUCTOR DE PRESIÓN, TIPO SITRANS P SERIE Z, CON GAMA DE PRESIÓN 0-16 BAR, CONEXIÓN DE PRESIÓN G1/2, SALIDA 4..20 MA., TENSIÓN DE ALIMENTACIÓN 10-36 VCC, CARCASA DE ACERO INOXIDABLE, IP65, TEMPERATURA AMBIENTE -25 +85º, CONEXIÓN 2 HILOS<br>- INCLUYE PEQUEÑO MATERIAL DE MONTAJE.<br>TOTALMENTE INSTALADO Y PROBADO. | 1.613,67 | |
| | | | | MIL SEISCIENTOS TRECE EUROS con SESENTA Y SIETE CÉNTIMOS | |
| 0058 | BT049B | Ud | SUMINISTRO E INSTALACIÓN ALARMAS DE INTRUSIÓN EN ARQUETAS DE HIDRANTE PARA AVISOS DE OBERTURA Y CIERRE PUERTA DE ACCESO. INCLUSO MICROINTERRUPTOR DE DESCONEXIÓN. INCLUYE PEQUEÑO MATERIAL DE MONTAJE.<br>TOTALMENTE INSTALADO Y PROBADO. | 86,24 | |
| | | | | OCHENTA Y SEIS EUROS con VEINTICUATRO CÉNTIMOS | |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0059 | BT049C | Ud | SUMINISTRO E INSTALACIÓN DE TRASDUCTOR DE PRESIÓN, RANGO DE 0-16 BAR. SALIDA 4-20 MA. COLOCADO EN RED DE RIEGO Y ELEMENTOS PRINCIPALES DE LA RED. INCLUYE CABLEADO APANTALLADO, CONEXIONES Y PEQUEÑO MATERIAL DE MONTAJE.<br><br>TOTALMENTE INSTALADO Y PROBADO. | CIENTO NOVENTA Y TRES EUROS con OCHENTA Y TRES CÉNTIMOS | 193,83 |
| 0060 | BT050 | m | CABLE DE DATOS DE PARES TIPO TRONIC CY DE 2X2X1.5 APANTALLADO RANGO DE TEMPERATURA -30º A 80º RECUBRIMIENTO DE PVC, CONDUCTORES DE COBRE DE ALAMBRE FINO, CONDUCTORES TRENZADOS EN PARES, PARES TRENZADOS, PANTALLA DE COBRE ESTAÑADOTRENZADO, CUBIERTA DE PVC RESISTENTE AL ACEITE, A LOS PRODUCTOS QUIMICOS Y NO PROPAGADORA DE LLAMA.<br>TOTALMENTE INSTALADO, CONECTADO Y PROBADO | CINCO EUROS con OCHENTA Y TRES CÉNTIMOS | 5,83 |
| 0061 | BT051 | m | CABLE DE DATOS DE PARES TIPO TRONIC CY DE 1X2X1.5 APANTALLADO RANGO DE TEMPERATURA -30º A 80º RECUBRIMIENTO DE PVC, CONDUCTORES DE COBRE DE ALAMBRE FINO, CONDUCTORES TRENZADOS EN PARES, PARES TRENZADOS, PANTALLA DE COBRE ESTAÑADOTRENZADO, CUBIERTA DE PVC RESISTENTE AL ACEITE, A LOS PRODUCTOS QUIMICOS Y NO PROPAGADORA DE LLAMA.<br>TOTALMENTE INSTALADO, CONECTADO Y PROBADO | CINCO EUROS con CINCUENTA CÉNTIMOS | 5,50 |
| 0062 | BT052 | m | CABLE DE DATOS DE PARES TIPO TRONIC CY DE 2X2X1.5 APANTALLADO RANGO DE TEMPERATURA -30º A 80º RECUBRIMIENTO DE PVC, CONDUCTORES DE COBRE DE ALAMBRE FINO, CONDUCTORES TRENZADOS EN PARES, PARES TRENZADOS, PANTALLA DE COBRE ESTAÑADOTRENZADO, CUBIERTA DE PVC RESISTENTE AL ACEITE, A LOS PRODUCTOS QUIMICOS Y NO PROPAGADORA DE LLAMA.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | CINCO EUROS con SESENTA Y CUATRO CÉNTIMOS | 5,64 |
| 0063 | BT053 | m | SUMINISTRO Y MONTAJE DE CABLE UTP CATEGORÍA 6 PARA TRANSMISIÓN DE DATOS PARA RED ETHERNET Y MODBUS RTU.<br>TOTALMENTE MONTADO E INSTALADO. | CINCO EUROS con CUARENTA Y SIETE CÉNTIMOS | 5,47 |
| 0064 | BT054 | m | M.L. REALIZACIÓN DE ZANJA EN TIERRA CON LECHO DE ARENA PARA CABLES DE BT DE 0,4 MTS DE ANCHURA Y 0,9 MTS DE PROFUNDIDAD, INCLUYENDO ROTURA Y REPOSICIÓN DE PAVIMENTO EXISTENTE, EXCAVACIÓN CON MEDIOS MECÁNICOS, CAPA DE ARENA FINA DE 30 CM, RELLENO DE ZANJAS CON ZAHORRAS MEDIANTE TONGADAS DE 30 CM, MALLA DE SEÑALIZACIÓN (2 MTS), PLACA DE PVC DE SEÑALIZACIÓN (2 MTS), ASÍ COMO MEDIOS MECANICOS, RETIRADA DE TIERRAS A VERTEDERO, MANO DE OBRA ESPECIALIZADA Y PEQUEÑO MATERIAL AUXILIAR NECESARIO, MEDIDA LA UNIDAD TERMINADA Y EJECUTADA. | SEIS EUROS con OCHENTA Y SIETE CÉNTIMOS | 6,87 |
| 0065 | BT055 | m | M.L. TUBO CORRUGADO DE DOBLE PARED FLEXIBLE DE DIÁMETRO 20MM PARA INSTALACIONES ELÉCTRICAS, RESISTENCIA DE CONPRESIÓN 750N, RIGIDEZ DIELÉCTRICA 2KV, RESISTENCIA AL IMPACTO 2J, RESISTENCIA ELÉCTRICA 100 OHM BAJO 500VCC. INCLUSO PEQUEÑO MATERIAL DE MONTAJE Y UNION.<br>TOTALMENTE INSTALADO Y MONTADO. | UN EUROS con SESENTA CÉNTIMOS | 1,60 |
| 0066 | BT056 | m | M.L. REALIZACIÓN DE ZANJA EN TIERRA CON LECHO DE ARENA PARA CABLES DE BT DE 0,6 MTS DE ANCHURA Y 0,9 MTS DE PROFUNDIDAD, INCLUYENDO ROTURA Y REPOSICIÓN DE PAVIMENTO EXISTENTE, EXCAVACIÓN CON MEDIOS MECÁNICOS, CAPA DE ARENA FINA DE 30 CM, RELLENO DE ZANJAS CON ZAHORRAS MEDIANTE TONGADAS DE 30 CM, MALLA DE SEÑALIZACIÓN (2 MTS), PLACA DE PVC DE SEÑALIZACIÓN (2 MTS), ASÍ COMO MEDIOS MECANICOS, RETIRADA DE TIERRAS A VERTEDERO, MANO DE OBRA ESPECIALIZADA Y PEQUEÑO MATERIAL AUXILIAR NECESARIO, MEDIDA LA UNIDAD TERMINADA Y EJECUTADA. | OCHO EUROS con VEINTICUATRO CÉNTIMOS | 8,24 |
| 0067 | BT057RE15.6 | m | BANDEJA METÁLICA DE REJILLA, GALVANIZADA EN CALIENTE, CON DIMENSIONES 150X60MM, FABRICADA CON VARILLA DE ACERO ELECTROSOLDADA. INCLUSO PARTE PROPORCIONAL DE PEQUEÑO MATERIAL, APOYOS Y ANCLAJES, TOTALMENTE INSTALADO Y EN SERVICIO. | ONCE EUROS con OCHENTA Y CINCO CÉNTIMOS | 11,85 |
| 0068 | BT057RE4.1 | m | BANDEJA METÁLICA DE REJILLA, GALVANIZADA EN CALIENTE, CON DIMENSIONES 400X100MM, FABRICADA CON VARILLA DE ACERO ELECTROSOLDADA. INCLUSO PARTE PROPORCIONAL DE PEQUEÑO MATERIAL, APOYOS Y ANCLAJES, TOTALMENTE INSTALADO Y EN SERVICIO. | VEINTISEIS EUROS con CINCUENTA Y DOS CÉNTIMOS | 26,52 |
| 0069 | BT058 | m | M.L. REALIZACIÓN DE ZANJA EN TIERRA CON LECHO DE ARENA PARA CABLES DE BT DE 0,8 MTS DE ANCHURA Y 0,9 MTS DE PROFUNDIDAD, INCLUYENDO ROTURA Y REPOSICIÓN DE PAVIMENTO EXISTENTE, EXCAVACIÓN CON MEDIOS MECÁNICOS, CAPA DE ARENA FINA DE 30 CM, RELLENO DE ZANJAS CON ZAHORRAS MEDIANTE TONGADAS DE 30 CM, MALLA DE SEÑALIZACIÓN (2 MTS), PLACA DE PVC DE SEÑALIZACIÓN (2 MTS), ASÍ COMO MEDIOS MECANICOS, RETIRADA DE TIERRAS A VERTEDERO, MANO DE OBRA ESPECIALIZADA Y PEQUEÑO MATERIAL AUXILIAR NECESARIO, MEDIDA LA UNIDAD TERMINADA Y EJECUTADA. | NUEVE EUROS con SESENTA Y DOS CÉNTIMOS | 9,62 |
| 0070 | BT059 | m | M.L. TUBO CORRUGADO DE DOBLE PARED FLEXIBLE DE DIÁMETRO 50MM PARA INSTALACIONES ELÉCTRICAS, RESISTENCIA DE CONPRESIÓN 750N, RIGIDEZ DIELÉCTRICA 2KV, RESISTENCIA AL IMPACTO 2J, RESISTENCIA ELÉCTRICA 100 OHM BAJO 500VCC. INCLUSO PEQUEÑO MATERIAL DE MONTAJE Y UNION.<br>TOTALMENTE INSTALADO Y MONTADO. | TRES EUROS con DIECINUEVE CÉNTIMOS | 3,19 |
| 0071 | BT061 | m | EJECUCIÓN DE ATARJEA MEDIANTE LADRILLO DE GERO REVESTIDO CON MORTERO CON DIMENSIONES DE 0,8 DE ANCHURA Y HASTA 0,8 M DE PROFUNDIDAD. INCLUIDA LA EXCAVACIÓN DE ZANJA, EJECUCIÓN DE MUROS Y SOLERA (NIVELADA EN DIRECCIÓN A PUNTO DE EVACUACIÓN DE AGUAS, TAPA REGISTRABLE DE ATARJEA. TOTALMENTE EJECUTADO. | TREINTA Y UN EUROS con OCHENTA Y NUEVE CÉNTIMOS | 31,89 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0072 | BT065 | M.I | CONDUCTOR DE COBRE DESNUDO DE 50 MM2 DE SECCIÓN NOMINAL POR CONDUCCIÓN DE PUESTA A TIERRA ENTERRADA, INCLUYE PEQUEÑO MATERIAL, EXCAVACIÓN, INSTALACIÓN Y PARTE PROPORCIONAL DE SOLDADURAS ALUMINOTÉRMICA | CUATRO EUROS con TREINTA Y SIETE CÉNTIMOS | 4,37 |
| 0073 | BT066-2 | UD. | M.L. SUMINISTRO Y MONTAJE DE PICA DE ACERO-COBREADO DE 1.500X14 MM DE DIMENSIONES, INCLUIDA GRAPA DE CONEXIÓN, ASÍ COMO PEQUEÑO MATERIAL Y MEDIOS AUXILIARES NECESARIOS, TOTALMENTE INSTALADA. | TRECE EUROS con OCHENTA Y NUEVE CÉNTIMOS | 13,89 |
| 0074 | BT_TC_COBERT | Ud | ESTUDIO DE COBERTURAS DE LA INSTALACIÓN PARA LA DISTRIBUCIÓN DE LOS DISTINTOS PUNTOS DE CONTROL DE HIDRANTE Y DE LAS CONCENTRADORAS DE PROGRAMACIÓN Y CONTROL, ASÍ COMO DE LOS REPETIDORES NECESARIOS Y ELEMENTOS ACCESORIOS. INFORME Y JUSTIFICACIÓN TÉCNICA, LEGALIZACIÓN DE LICENCIAS Y BANDAS DE RADIOFRECUENCIA. INCLUIDA LA REALIZACIÓN DE PROYECTOS, TRÁMITES Y TASAS PARA SU LEGALIZACIÓN. | DOS MIL DOSCIENTOS CUARENTA Y NUEVE EUROS con CINCUENTA Y DOS CÉNTIMOS | 2.249,52 |
| 0075 | BT_TC_CONWEB | Ud | PROGRAMA PORTAL WEB. PROGRAMA DE PC PARA LA GESTIÓN DESDE INTERNET PARA CADA USUARIO, SEGÚN UNA CONTRASEÑA DADA POR LA COMUNIDAD DE REGANTES. SERÁ IMPRESCINDIBLE QUE EL USUARIO DE ACCESO DISPONGA DE ADSL-INTERNET. | DOCE MIL SETECIENTOS VEINTE EUROS con CINCUENTA CÉNTIMOS | 12.720,50 |
| 0076 | BT_TC_FORMACI | Ud | FORMACIÓN QUE SE REALIZARÁ AL PERSONAL ASIGNADO POR LA COMUNIDAD PARA LLEVAR LA SUPERVISIÓN Y GESTIÓN DEL TELECONTROL PARA UN COMPLETO CONOCIMIENTO Y APROVECHAMIENTO DEL SISTEMA. INCLUYE MANUALES DE UTILIZACIÓN Y MANTENIMIENTO PARA UN CORRECTO FUNCIONAMIENTO DEL SISTEMA. | MIL CUATROCIENTOS NOVENTA Y OCHO EUROS con SESENTA Y CINCO CÉNTIMOS | 1.498,65 |
| 0077 | BT_TC_PUEMARC | Ud | PARA LA PUESTA EN MARCHA DEL SISTEMA, COMPROBACIÓN DE TODOS ELEMENTOS Y DE SU CORRECTO FUNCIONAMIENTO. APLICACIÓN DEL PROTOCOLO DE PUESTA EN MARCHA PARA UNA CORRECTA IMPLANTACIÓN DEL SISTEMA. | MIL OCHOCIENTOS CINCUENTA Y CUATRO EUROS | 1.854,00 |
| 0078 | CASETA1 | UD | UD. CASETA DE HORMIGÓN ARMADO HA-25 CON MALLAZO ELECTROSOLDADO, DE MEDIDA INTERIOR ÚTIL 200X100X190 CON DOBLE PUERTA DE PLANCHA GALVANIZADA CON REJILLAS DE VENTILACIÓN Y CIERRE PARA CANDADO (INCLUIDO) Y SEPARADOR CENTRAL DE PLANCHA GALVANIZADA PARA ALOJAMIENTO DE HIDRANTES DE 3" Y 4" INDIVIDUALES E HIDRANTES COMPARTIDOS DE HASTA 3 TOMAS. INCLUIDA BASE TIPO ZUNCHO PARA CASETA. TOTALMENTE COLOCADA | MIL CIENTO SESENTA Y OCHO EUROS con OCHENTA Y DOS CÉNTIMOS | 1.168,82 |
| 0079 | CASETA2 | UD | UD. CASETA DE HORMIGÓN ARMADO HA-25 CON MALLAZO ELECTROSOLDADO, DE MEDIDA INTERIOR ÚTIL 250X150X220 CON DOBLE PUERTA DE PLANCHA GALVANIZADA CON REJILLAS DE VENTILACIÓN Y CIERRE PARA CANDADO (INCLUIDO) Y SEPARADOR CENTRAL DE PLANCHA GALVANIZADA PARA ALOJAMIENTO DE HIDRANTES DE 6" Y 8" INDIVIDUALES E HIDRANTES COMPARTIDOS DE 4 O MÁS TOMAS. INCLUIDA BASE TIPO ZUNCHO PARA CASETA. TOTALMENTE COLOCADA | MIL SETECIENTOS CATORCE EUROS con SETENTA Y DOS CÉNTIMOS | 1.714,72 |
| 0080 | CASETAPREF1 | UD | CASETA PREFABRICADA DE 12,0X6,0 M EN PLANTA Y 3,0 M DE ALTURA, FORMADA POR DE PARED PREFEABRICADA DE 15 CM ALIGERADA, CUBIERTA PREFABRICADA DE HORMIGÓN CON TRATAMIENTO DE PROTECCIÓN, SELLADO ENTRE TODOS LOS ELEMENTOS PREFABRICADOS, UNA PUERTA DE CHAPA GALVANIZADA DE 2 HOJAS DE 200X180 CM, 3 VENTANAS DE VIDRIO DOBLE DE 120X80 CM, INCLUYENDO TRANSPORTE, MONTAJE Y ACABADOS, TOTALMENTE EJECUTADA. | VEINTIUN MIL CIENTO NUEVE EUROS con OCHENTA Y NUEVE CÉNTIMOS | 21.109,89 |
| 0081 | CINTBAL | m | CINTA DE BALIZAMIENTO | CERO EUROS con VEINTIOCHO CÉNTIMOS | 0,28 |
| 0082 | COMP01 | M3 | MEZCLA, EXTENDIDO, COMPACTADO Y PERFILADO DE RASANTES, PARA LA CONSTRUCCIÓN DE TERRAPLENES, EN CUERPO DE PRESA, CON TERRENOS SELECCIONADOS PROCEDENTES DE LA EXCAVACIÓN QUE CUMPLAN LAS CONDICIONES QUE ESTABLECE EL PG-3 PARA SUELOS SELECCIONADOS A UNA DISTANCIA DE 5 KM Y COMPACTACIÓN POR CAPAS DE 25 CM, HASTA ALCANZAR EL 98 % PM, INCLUIDO EL TRANSPORTE Y RIEGO CON AGUA INCLUIDO SU SUMINISTRO PAR A LA EJECUCIÓN. MEDIDA EN SU PERFIL FINAL COMPACTADO. | UN EUROS con DIEZ CÉNTIMOS | 1,10 |
| 0083 | COMPMUR | ud | COMPUERTA METÁLICA TIPO MURAL MOTORIZADA CON PERFILES DE REFUERZO, PARA SECCIÓN DE CANAL DE ENTRADA DE DIMENSIONES DE HOJA DE 2,00 X 2,00 M. MATERIALES:<br>CUERPO: AISI 304L; TAJADERA: AISI 304L; CIERRE: EPDM. MECANISMO MEDIANTE HUSILLO NO ASCENDENTE. GUÍA DE POLIETILENO CON JUNTA EPDM DE ESTANQUEIDAD EN UN SENTIDO, CON CIERRE HERMÉTICO DE 4 JUNTAS. TRATAMIENTO EPOXI DE 200 MICRAS. INCLUSO PLATAFORMA PARA ACCIONAMIENTO, ELEMENTOS DE ANCLAJE Y P.P. DE OBRA CIVIL Y DE ACONDICIONAMIENTO DE BANDA NECESARIA PARA TRÁNSITO DE MAQUINARIA EN EJECUCIÓN DE LOS TRABAJOS. COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | NUEVE MIL CUATROCIENTOS NOVENTA Y CUATRO EUROS con DOCE CÉNTIMOS | 9.494,12 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0084 | CONTNIT | Ud | SISTEMA ANALIZADOR DE RETORNOS DE RIEGO Y CONTROL DE CAUDALES, CONSISTENTE EN:<br>- CONTROLADOR INTELIGENTE CON MENÚS ESTRUCTURADOS DE OPERACIÓN DEL SENSOR, CONTROLADOR DE CC: 24 V CC + 15 % - 20 %; 2,5 A (CARGA MÁX. DE SENSORES 20 W),TENSIÓN MÁXIMA DE CONMUTACIÓN: 30 V CA O 42 V CC, CORRIENTE MÁXIMA DE CONMUTACIÓN: 4 A RESISTIVA/1 A INDUCTIVA, POTENCIA MÁXIMA DE CONMUTACIÓN: 125 W RESISTIVA/28 W INDUCTIVA, CINCO SALIDAS ANALÓGICAS DE 0 - 20 MA O 4 - 20 MA EN CADA MÓDULO ANALÓGICO DE SALIDAS, CONECTIVIDAD DE RED (LAN: DOS CONECTORES ETHERNET (10/100 MBPS), MÓVIL: 4G EXTERNO Y WI-FI), PUERTO USB Y COMPATIBLE CON TECNOLOGÍAS RED GSM 3G/4G<br>- SONDA DE INMERSIÓN CONSISTE EN UN FOTÓMETRO DE ABSORBANCIA ULTRAVIOLETA DE DOBLE HAZ CON COMPENSACIÓN EFECTIVA DE TURBIDEZ, MEDIDA POR ABSORCIÓN UV, SIN REACTIVOS, CON RANGO DE MEDIDA CON SOLUCIONES ESTÁNDAR NO3-N: 0,1-100,0 MG/L NO2+3-N (1 MM), 0,1-50,0 MG/L NO2+3-N (2 MM), 0,1-25,0 MG/L NO2+3-N (5 MM), CON TOLERANCIA DE MEDIDA 3 % DEL VALOR MEDIDO (0,5 MG/L), CON ALIMIENTACIÓN 24 V AC/DC ± 25 %, 800 MA<br>- SET DE MONTAJE EN ACERO INOX. PARA SONDA CON ESCUADRA 10 CM A PARED, PERTIGA 2 M. Y ACOPLAMIENTO DE SONDA A 90<br>-MEDIDOR DE NIVEL ULTRASÓNICO COMPACTO DE CORTO ALCANCE. | DIECINUEVE MIL QUINIENTOS SETENTA Y NUEVE EUROS con CUARENTA Y SEIS CÉNTIMOS | 19.579,46 |
| 0085 | CONW12SC | Ud | CONTADOR DE AGUA TIPO WOLTMAN DE DIÁMETRO 12" Y 16 ATM DE PRESIÓN DE TRABAJO, CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | MIL SEISCIENTOS SETENTA EUROS con TREINTA Y SEIS CÉNTIMOS | 1.670,36 |
| 0086 | CONW2 | Ud | CONTADOR DE AGUA TIPO WOLTMAN CON CORRECTOR DE FLUJO, DE DIÁMETRO 2" Y 16 ATM DE PRESIÓN DE TRABAJO, CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | DOSCIENTOS VEINTITRES EUROS con SETENTA Y TRES CÉNTIMOS | 223,73 |
| 0087 | CONW3 | Ud | CONTADOR DE AGUA TIPO WOLTMAN CON CORRECTOR DE FLUJO, DE DIÁMETRO 3" Y 16 ATM DE PRESIÓN DE TRABAJO, CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | DOSCIENTOS SETENTA Y CUATRO EUROS con VEINTICINCO CÉNTIMOS | 274,25 |
| 0088 | CONW4 | Ud | CONTADOR DE AGUA TIPO WOLTMAN CON CORRECTOR DE FLUJO, DE DIÁMETRO 4" Y 16 ATM DE PRESIÓN DE TRABAJO, CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | DOSCIENTOS OCHENTA Y OCHO EUROS con OCHENTA Y NUEVE CÉNTIMOS | 288,89 |
| 0089 | CONW6 | Ud | CONTADOR DE AGUA TIPO WOLTMAN CON CORRECTOR DE FLUJO, DE DIÁMETRO 6" Y 16 ATM DE PRESIÓN DE TRABAJO, CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | QUINIENTOS TRECE EUROS con CUARENTA Y NUEVE CÉNTIMOS | 513,49 |
| 0090 | CONW8 | Ud | CONTADOR DE AGUA TIPO WOLTMAN CON CORRECTOR DE FLUJO, DE DIÁMETRO 8" Y 16 ATM DE PRESIÓN DE TRABAJO, CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | SEISCIENTOS OCHENTA Y NUEVE EUROS con NOVENTA Y NUEVE CÉNTIMOS | 689,99 |
| 0091 | CSUMREJ | ml | SISTEMA DE DRENAJE LINEAL FORMADO POR CANAL DE HORMIGÓN POLIMÉRICO DE 100 MM DE ANCHURA LIBRE Y 200 MM DE ALTURA CON MARCO ZINCADO. CON REJILLA DE ACERO ZINCADO Y RESISTENCIA DE CARGA AL TRÁFICO A15. TOTALMENTE COLOCADA, MONTADA Y PROBADA. | VEINTIOCHO EUROS con TREINTA Y CUATRO CÉNTIMOS | 28,34 |
| 0092 | D03AG004 | m | TUBERÍA/CANALÓN DE PVC SANITARIO SERIE C, DE 200 MM DE DIÁMETRO Y 4.0 MM. DE ESPESOR, UNIÓN POR ADHESIVO, COLOR GRIS, COLOCADA EN RED DE SANEAMIENTO HORIZONTAL COLGADA. INCLUSO P.P. DE PIEZAS ESPECIALES, EMPALMES, CONEXIONES, TERMINALES, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN SEGÚN NTE-ISS-49, UNE 53114, ISO-DIS-3633. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA | VEINTIÚN EUROS con SESENTA Y TRES CÉNTIMOS | 21,63 |
| 0093 | D27GA001 | Ud | UD. TOMA TIERRA CON PICA COBRIZADA DE D=14,3 MM. Y 2 M. DE LONGITUD, CABLE DE COBRE DESNUDO DE 1X35 MM2. CLAVADA A TIERRA Y CON EL DESMONTAJE INCLUIDO. | DIECINUEVE EUROS con TREINTA Y TRES CÉNTIMOS | 19,33 |
| 0094 | D2EGA001 | Ud | UD. INTERRUPTOR DIFERENCIAL DE 25 A. INTENSIDAD NOMINAL, TETRAPOLAR CON SENSIBILIDAD DE 0.3 A. FIJADO A PRESION Y CON DESMONTAJE INCLUIDO. | SETENTA Y NUEVE EUROS con OCHO CÉNTIMOS | 79,08 |
| 0095 | D41CDD04 | Ud | TOPE PARA CAMIONES A INSTALAR EN BORDE ZANJA INCLUIDA LA COLOCACIÓN, Y RETIRADA AL FINAL DEL USO. | TREINTA Y UN EUROS con SETENTA Y UN CÉNTIMOS | 31,71 |
| 0096 | DEML_ACE | m3 | DEMOLICIÓN, PICADO Y CARGADO DE CANALES, ACEQUIAS Y ELEMENTOS DE HORMIGÓN, INCLUIDO SU POSTERIOR TRANSPORTE A VERTEDERO O PLANTA DE TRATAMIENTO AUTORIZADO PARA SU POSTERIOR REUTILIZACIÓN, INCLUIDO TASAS DEL MISMO. | TREINTA Y UN EUROS con NOVENTA Y TRES CÉNTIMOS | 31,93 |
| 0097 | DEML_CORT1 | ml | ML DE CORTE POR MEDIOS MECÁCNICOS Y MANUALES DE ACEQUIAS, PAREDES Y LATERALES DE HORMIGÓN ARMADO DE ESPESOR HASTA 40 CM Y CUALQUIER TIPO DE ARMADO Y CARACTERÍSTICAS DEL HORMIGÓN. CON LA FINALIDAD DE AISLAR ZONAS PARA SU PORTERIOR DEMOLICIÓN CON MAQUINARIA, EQUIPOS PESADOS O PICADO MANUAL. MEDIDA LA UNIDAD REALMENTE EJECUTADA. | DIECISIETE EUROS con SESENTA CÉNTIMOS | 17,60 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0098 | DESTUAIRE | Ud | UD ESTUFA DE AIRE CALIENTE. | TREINTA EUROS con NOVENTA CÉNTIMOS | 30,90 |
| 0099 | DEXTINTABC | Ud | UD EXTINTOR DE POLVO DE 6 KG PARA FUEGOS DE TIPO ABC. | SESENTA Y CINCO EUROS con CUARENTA Y SEIS CÉNTIMOS | 65,46 |
| 0100 | DEXTINTCO2 | Ud | UD EXTINTOR DE CO2 DE 6 KG | CIENTO OCHO EUROS con QUINCE CÉNTIMOS | 108,15 |
| 0101 | DFORJ010 | M2 | M2. FORJADO 17+5 CM., FORMADO A BASE DE VIGUETAS DE HORMIGÓN PRETENSADO, SEPARADAS 70 CM. ENTRE EJES, BOVEDILLA DE 60X25X17 CM. Y CAPA DE COMPRESIÓN DE 5 CM. DE HA-25/B/20/ IIA N/MM2, CON TAMAÑO MÁXIMO DEL ÁRIDO DE 20 MM., ELABORADO EN CENTRAL, CON P.P. DE ZUNCHOS, I/ARMADURA CON ACERO B-500 S EN REFUERZO DE ZONA DE NEGATIVOS. CONECTORES Y MALLAZO DE REPARTO, ENCOFRADO Y DESENCOFRADO, TOTALMENTE TERMINADO SEGÚN EHE. | CINCUENTA EUROS con TREINTA Y SEIS CÉNTIMOS | 50,36 |
| 0102 | DR001 | m² | GEOTEXTIL FABRICADO A BASE DE FIBRAS SINTÉTICAS DE POLIPROPILENO 100%, NO TEJIDO, DE FILAMENTOS CONTINUOS UNIDOS MECÁNICAMENTE POR UN PROCESO DE AGUJADO, DE RESISTENCIA A PERFORACIÓN CBR NO MENOR DE 2850 N (NORMA UNE-EN 12236), DE PERFORACIÓN A CAÍDA LIBRE DE CONO NO MAYOR DE 20 MM (NORMA EN 918), Y PESO NO INFERIOR A 250 G/M² (NORMA UNE-EN 965), INCLUSO SOLAPES, TOTALMENTE COLOCADO. MEDIDA LA SUPERFICIE EFECTIVAMENTE COLOCADA DESCONTANDO SOLAPES, RECORTES, ETC. | UN EUROS con SESENTA Y TRES CÉNTIMOS | 1,63 |
| 0103 | DT02-ENS-RA | UD. | ENSAYO CABLES DE MT INSTALADOS DE FORMA SUBTERRÁNEA SEGÚN NORMAS CÍA SUMINISTRADA, SEGÚN ENSAYO DMD00300.DOC "PROCEDIMIENTO DE ENSAYOS PARA CABLES UNIPOLARES NUEVOS DE MT HASTA 30 KV". | OCHOCIENTOS SESENTA Y NUEVE EUROS con NOVENTA Y CINCO CÉNTIMOS | 869,95 |
| 0104 | DT02IE-BT016 | M.I. | M.L. SUMINISTRO Y MONTAJE DE CONDUCTOR DESNUDO DE COBRE DE 1X16 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUIDO PEQUEÑO MATERIAL Y ACCESORIOS, TOTALMENTE INSTALADO. | DOS EUROS con CINCUENTA Y UN CÉNTIMOS | 2,51 |
| 0105 | DT02IE-BT0803 | M.I. | M.L. SUMINISTRO Y MONTAJE DE CONDUCTOR DESNUDO DE COBRE DE 1X35 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUIDO PEQUEÑO MATERIAL Y ACCESORIOS, TOTALMENTE INSTALADO. | TRES EUROS con TREINTA Y SIETE CÉNTIMOS | 3,37 |
| 0106 | DT02IE-BT0804 | UD. | M.L. SUMINISTRO Y MONTAJE DE PICA DE ACERO-COBREADO DE 2.000X14 MM DE DIMENSIONES, INCLUIDA GRAPA DE CONEXIÓN, ASÍ COMO PEQUEÑO MATERIAL Y MEDIOS AUXILIARES NECESARIOS, TOTALMENTE INSTALADA. | TREINTA Y DOS EUROS con QUINCE CÉNTIMOS | 32,15 |
| 0107 | DT02IE-BT0806 | UD. | UD. SUMINISTRO Y MONTAJE DE SOLDADURA ALUMINOTÉRMICA EN TE CABLE-CABLE, INCLUIDOS MEDIOS AUXLIARES PARA REALIZAR LA SOLDADURA (MOLDE, TENAZAS, PÓLVORA, OTROS) Y PEQUEÑO MATERIAL, TOTALMENTE INSTALADA. | TREINTA Y NUEVE EUROS con CUARENTA Y SEIS CÉNTIMOS | 39,46 |
| 0108 | DT02IE-BT0807 | UD. | UD. SUMINISTRO Y MONTAJE DE SOLDADURA ALUMINOTÉRMICA EN TE CABLE-MALLAZO, INCLUIDOS MEDIOS AUXLIARES PARA REALIZAR LA SOLDADURA (MOLDE, TENAZAS, PÓLVORA, OTROS) Y PEQUEÑO MATERIAL, TOTALMENTE INSTALADA. | CUARENTA Y UN EUROS con TREINTA Y UN CÉNTIMOS | 41,31 |
| 0109 | DT02IE-BT0808 | UD. | UD. SUMINISTRO Y MONTAJE DE CONEXIÓN A TIERRA DE ESTRUCTURA METÁLICA, COMPUESTA POR:<br>- 1 UD. SOLDADURA ALUMINOTÉRMICA EN TE CABLE-CABLE.<br>- 1 UD. PLACA DE ACERO SOLDADA A ESTRUCTURA.<br>- 1 UD. TORNILLO, TUERCAS Y ARANDELAS M20.<br>- 1 UD. TERMINAL EN COBRE A PRESIÓN PARA CABLE DE 35 MM2.<br>- 3 M.L. CABLE DE COBRE DESNUDO DE 35 MM2 DE SECCIÓN NOMINAL.<br>- 1,5 M.L. TUBO DE PVC ENCHUFABLE M25, INCLUIDA P.P. DE MANGUITOS DE UNIÓN, BOQUILLAS EN SUS EXTREMOS, CURVAS Y ELEMENTOS DE SUJECCIÓN A VIGA O PARED. | CIENTO VEINTE EUROS con OCHENTA Y NUEVE CÉNTIMOS | 120,89 |
| 0110 | DT02IE-BT0809 | UD. | UD. SUMINISTRO Y MONTAJE DE CAJA COMPROBACIÓN PUESTA A TIERRA, INCLUYENDO EN SU INTERIOR PUENTE SECCIONADOR, TOTALMENTE INSTALADA. | TREINTA Y OCHO EUROS con CUARENTA Y TRES CÉNTIMOS | 38,43 |
| 0111 | DT02IE-BT0810 | UD. | UD. SUMINISTRO Y MONTAJE DE BARRA EQUIPOTENCIAL DE PUESTA A TIERRA, INCLUIDO PEQUEÑO MATERIAL, TOTALMENTE INSTALADA. | CUARENTA Y SEIS EUROS con SEIS CÉNTIMOS | 46,06 |
| 0112 | DT02IE-BT0811 | UD. | UD. SUMINISTRO Y MONTAJE DE VIACHISPAS, INCLUIDO PEQUEÑO MATERIAL Y ACCESORIOS, TOTALMENTE INSTALADO. | CINCUENTA EUROS con SETENTA Y NUEVE CÉNTIMOS | 50,79 |
| 0113 | DT02IE-BT0812 | UD. | UD. SUMINISTRO Y MONTAJE DE CONEXIÓN A TIERRA DE ESTRUCTURA METÁLICA, COMPUESTA POR:<br>- 1 UD. SOLDADURA ALUMINOTÉRMICA EN TE CABLE-CABLE.<br>- 1 UD. PLACA DE ACERO SOLDADA A BANCADA EQUIPO.<br>- 1 UD. TORNILLO, TUERCAS Y ARANDELAS M20.<br>- 1 UD. TERMINAL EN COBRE A PRESIÓN PARA CABLE DE 35 MM2.<br>- 3 M.L. CABLE DE COBRE DESNUDO DE 35 MM2 DE SECCIÓN NOMINAL.<br>- 1,5 M.L. TUBO DE PVC ENCHUFABLE M25, INCLUIDA P.P. DE MANGUITOS DE UNIÓN, BOQUILLAS EN SUS EXTREMOS, CURVAS Y ELEMENTOS DE SUJECCIÓN A VIGA, PARED O BANCADA. | CIENTO OCHO EUROS con DIECISEIS CÉNTIMOS | 108,16 |

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| 0114 | E-2.1B | ud | CUADRO DE ACOMETIDA Y PROTECCIONES AC EN EB, QUE INCLUYE:<br>- ENVOLVENTE COMBINABLE METÁLICA DE 2000X3000X800, ACORDE A LA NORMA IEC 62208, CON IP 55, IK10, ESTRUCTURA REALIZADA EN ACERDO GALVANIZADO, PUERTA EN ACERO PLEGADO Y SOLDADO, APERTURA 120º, CON ZÓCALO LATERAL, FRONTAL Y TRASERO DE 100 MM DE ELEVACIÓN, INCLUSO PLACA DE MONTAJE, ILUMINACIÓN INTERIOR POR MEDIO DE LÁMPARA DE NEÓN PLANA Y COMPACTA DE 11W, INTERRUPTOR DE PUERTA, REJILLA CON FILTRO, ELEVACIÓN DE TECHO PARA AIREACIÓN, PLACA DE VENTILACIÓN PARA TECHO CON 3 VENTILADORES DE 170M3/H C/U, 220V,MANETA CON INSERTO DE FORMA Y TERMOSTATO.<br>- INCLUYE 3 PLETINAS DE COBRE DE 2(160X10) MM PARA EMBARRADO, DE 2,10M DE LARGO.<br>- SOPORTE PARA EMBARRADO, INCLUYE PANTALLA DE METACRILATO.<br>- 1 INTERRUPTOR AUTOMÁTICO IV DE IN 3000 A, REGULADO 3000 A, CON POTENCIA DE CORTE DE 50 KA<br>- LIMITADOR DE SOBRETENSIONES TRANSITORIAS IV DE CLASE I 40KA 1.2 KV<br>- ANALIZADOR DE REDES 400V CA (3000/5A), MEDIDA MÁXIMA 400V CA, CON PUERTO DE COMUNICACIÓNES CON MODBUS, INSTALADO EN PANEL PUERTA ENVOLVENTE DE ACOMETIDA, INCLUIDO TROQUEL EN CHAPA Y CABLEADO TOTALMENTE INSTALADO.<br>- 3 INTERRUPTOR AUTOMÁTICO MAGNETOTÉRMICO III DE IN 630 A, REGULADO 630 A, CON POTENCIA DE CORTE DE 50 KA<br>- 1 INTERRUPTOR AUTOMÁTICO MAGNETOTÉRMICO III DE IN 400 A, REGULADO 400 A, CON POTENCIA DE CORTE DE 50 KA<br>- 4 INTERRUPTOR AUTOMÁTICO MAGNETOTÉRMICO III DE IN 250 A, REGULADO 250 A, CON POTENCIA DE CORTE DE 50 KA<br>- 1 INTERRUPTOR AUTOMÁTICO MAGNETOTÉRMICO IV DE IN 80 A, REGULADO 77 A, CON POTENCIA DE CORTE DE 50 KA<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | CUARENTA Y NUEVE MIL CUATROCIENTOS DIECIOCHO EUROS con VEINTICUATRO CÉNTIMOS | 49.418,24 |
| 0115 | E-2.3B | ud | CUADRO DE SERVICIOS AUXILIARES EN EB INCLUYE:<br>- ENVOLVENTE COMBINABLE METÁLICA DE 2000X1200X800, ACORDE A LA NORMA IEC 62208, CON IP 55, IK10, ESTRUCTURA REALIZADA EN ACERDO GALVANIZADO, PUERTA DE 2 HOJAS EN ACERO PLEGADO Y SOLDADO, APERTURA 120º, CON ZÓCALO LATERAL, FRONTAL Y TRASERO DE 100 MM DE ELEVACIÓN, INCLUSO PLACA DE MONTAJE, ILUMINACIÓN INTERIOR POR MEDIO DE LÁMPARA DE NEÓN PLANA Y COMPACTA DE 11W, INTERRUPTOR DE PUERTA, REJILLA CON FILTRO, ELEVACIÓN DE TECHO PARA AIREACIÓN, PLACA DE VENTILACIÓN PARA TECHO CON 3 VENTILADORES DE 170M3/H C/U, 220V,MANETA CON INSERTO DE FORMA Y TERMOSTATO.<br>- INCLUYE 3 PLETINAS DE COBRE DE 80X10 MM PARA EMBARRADO, DE 1.5M DE LARGO CADA UNA.<br>- SOPORTE PARA EMBARRADO.<br>- 5 RELÉS 24 VCC PARA MANDO.<br>- 2 INTERRUPTOR AUTOMÁTICO II 16 A P DE C 10 KA<br>- 9 INTERRUPTOR AUTOMÁTICO II 16 A P DE C 25 KA<br>- 2 INTERRUPTOR AUTOMÁTICO II 20 A P DE C 25 KA<br>- 1 INTERRUPTOR AUTOMÁTICO II 10 A P DE C 25 KA<br>- 2 INTERRUPTOR AUTOMÁTICO II 10 A P DE C 35 KA<br>- 3 INTERRUPTOR AUTOMÁTICO II 16 A P DE C 35 KA<br>- 2 INTERRUPTOR AUTOMÁTICO III 16 A P DE C 35 KA<br>- 4 INTERRUPTOR AUTOMÁTICO III 16 A P DE C 50 KA<br>- 2 INTERRUPTOR AUTOMÁTICO IV 16 A P DE C 50 KA<br>- 1 INTERRUPTOR DIFERENCIAL IV 63A 300MA AC<br>- 2 INTERRUPTOR DIFERENCIAL IV 40A 300MA AC<br>- 2 INTERRUPTOR DIFERENCIAL IV 25A 300MA AC<br>- 2 INTERRUPTOR DIFERENCIAL IV 25A 30MA AC<br>- 3 INTERRUPTOR DIFERENCIAL III 25A 30MA AC<br>- 3 CONTACTORES III 16A CON TENSIÓN EN BOBINA DE 230V<br>- 8 CONTACOTES II 16A CON TENSIÓN EN BOBINA DE 230V<br>- INCLUYE PILOTOS DE SEÑALIZACIÓN, PULSADORES Y SELECTORES DE 3 POSICIONES.<br>- INCLUYE TOMA DE CORRIENTE DE 230V<br>- INCLUYE CABLEADO INTERIOR Y MATERIAL PARA CANALIZACIÓN Y CONEXIÓN DEL MISMO.<br>- PEQUEÑO MATERIAL AUXILIAR Y ACCESORIOS.<br><br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADO, CONECTADO Y PROBADO. | TRECE MIL CIENTO TREINTA Y UN EUROS con VEINTISIETE CÉNTIMOS | 13.131,27 |
| 0116 | E-3.6B | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLARRZ1 0,6/1 KV DE 3X4 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | DOS EUROS con CUARENTA Y UN CÉNTIMOS | 2,41 |
| 0117 | E-3.9 | m | M.L. SUMINISTRO Y MONTAJE DE CABLE UNIPOLAR APANTALLADO RZ1 0,6/1 KV DE 3X185+TTX95 MM2 DE SECCIÓN NOMINAL EN COBRE, INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | CIENTO TRES EUROS con CINCUENTA Y SIETE CÉNTIMOS | 103,57 |

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| 0118 | E-4.1B | ud | UD SUMINISTRO Y MONTAJE DE ILUMINACIÓN DE ESTACIÓN DE BOMBEO QUE INCLUYE:<br>- 34 LUMINARIAS (INCLUIDA LAMPARA Y LUMINARIA) PARA INTERIOR, ESTANCA CON PROTECCIÓN IP65 O SUPERIOR, LUZ BLANCA, 6500 LM, 46,6 W Y LONGITUD DE 1600 MM. INCLUIDOS LOS ELEMTNOS DE ANCLAJE A ESTRUCTURAS DE HORMIGÓN Y PERFILES METÁLICOS, FALSOS TECHOS,.... ADEMÁS DE PEQUEÑO MATERIAL DE CONEXIÓN, Y ANCLAJE.<br>- 10 LUMINARIAS DE ALUMBRADO PÚBLICO PARA EXTERIOR (LAMPARA Y LUMINARIA INCLUIDAS) TIPO FOCO, ESTANCO CON PROTECCIÓN IP65 O SUPERIOR, LUZ BLANCA, 15000 LM, 104 W CON SOPORTE METÁLICO INOXIDABLE PARA COLOCACIÓN EN FACHADAS DE HORMIGÓN U OTROS MATERIALES SIMILARES, INCLUYENDO LOS SISTEMAS DE ANCLAJE TORNILLERÍA, ALBAÑILERIA ASOCIADA, Y PEQUÑO MATERIL DE CONEXIÓN ENTRE ELEMENTOS.<br>- 7 LUMINARIAS DE EMERGENCIA CON EQUIPO DE 8 W, CON CARCASA DE POLIESTER, IP54, INCLUIDA LÁMAPRA 8 W, MEDIOS AUXILIARES NECESARIOS DE ELEVACIÓN Y PEQUEÑO MATERIAL, TOTALMENTE INSTALADA.<br>TOTALMENTE INSTALADO, CONECTADO Y PROBADO. | OCHO MIL SEISCIENTOS SETENTA EUROS con CUARENTA Y CINCO CÉNTIMOS | 8.670,45 |
| 0119 | E-4.2 | ud | UD SUMINISTRO Y MONTAJE DE BASES DE ENCHUFE DE ESTACIÓN DE BOMBEO QUE INCLUYE:<br>- 2 BASES TRIFÁSICAS 3P+TT DE 16 A CON INTERRUPTOR DE BLOQUEO, IP 65, 400V, IK08, RESISTENCIA A LA LLAMA Y AL CALOR ANORMAL, MATERIAL AISLANTE AUTOEXTINGUIBLE, CLAVIJAS DE LATÓN NIQUELADOS, ESPIGAS, MUELLES Y TORNILLOS DE ACERO INOXIDABLE.<br>- 2 BASES MONOFÁSICAS CON TT LATERAL DE CLAVIJA DE TIPO DOMÉSTICO, EMPOTRABLE.<br>TOTALMENTE INSTALADO, CONECTADO Y PROBADO. | DOSCIENTOS SIETE EUROS con CUARENTA Y SEIS CÉNTIMOS | 207,46 |
| 0120 | E-6.6 | M.I | CONDUCTOR DE COBRE UNE H07V-K 1X16MM2 PARA INTERCONEXIÓN DE EQUIPOS A TIERRA, INCLUYE PARTE PROPORCIONAL DE PEQUEÑO MATERIAL, TOTALMENTE MONTADO E CONECTADO. | TRES EUROS con CUARENTA Y CUATRO CÉNTIMOS | 3,44 |
| 0121 | E15DRA040 | m² | REJA METÁLICA REALIZADA CON BARRAS DE ACERO LAMINADO EN FRÍO DE 30X15X1,5 MM. EN VERTICAL Y HORIZONTAL, SEPARADOS 15 CM. EN DOS PLANOS, CON GARRAS PARA RECIBIR DE 12 CM, ELABORADA EN TALLER Y MONTAJE EN OBRA. COMPLETAMENTE INSTALADA. | OCHENTA Y DOS EUROS con CUARENTA Y CINCO CÉNTIMOS | 82,45 |
| 0122 | E28RA100 | Ud | SEMI-MASCARILLA ANTIPOLVO UN FILTRO, (AMORTIZABLE EN 3 USOS). CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | OCHO EUROS con QUINCE CÉNTIMOS | 8,15 |
| 0123 | E3504100 | UD | ARQUETA FORMADA POR ANILLO DE HORMIGÓN DIAM. 100 CM Y 1 M. DE ALTURA CERRADO CON CHAPA GALVANIZADA EN FRIO. PROVISTA DE VARILLA PASANTE, CANDADO Y PROLONGADOR EN EL CASO DE QUE LA ARQUETA ALOJE VÁLVULAS DE CORTE. INCLUSO MOVIMIENTO DE TIERRAS NECESARIO PARA SU INSTALACIÓN Y BASE DE GRAVA PARA EL ASIENTO DEL ANILLO | CIENTO CINCUENTA Y SIETE EUROS con OCHENTA Y UN CÉNTIMOS | 157,81 |
| 0124 | E3504120 | UD | ARQUETA FORMADA POR ANILLO DE HORMIGÓN DIAM. 120 CM Y 1 M. DE ALTURA CERRADO CON CHAPA GALVANIZADA EN FRIO. PROVISTA DE VARILLA PASANTE, CANDADO Y PROLONGADOR EN EL CASO DE QUE LA ARQUETA ALOJE VÁLVULAS DE CORTE. INCLUSO MOVIMIENTO DE TIERRAS NECESARIO PARA SU INSTALACIÓN Y BASE DE GRAVA PARA EL ASIENTO DEL ANILLO | DOSCIENTOS DOCE EUROS con CUARENTA CÉNTIMOS | 212,40 |
| 0125 | EG21271J | m | TUBO RÍGIDO DE PVC, DE 20 MM DE DIÁMETRO NOMINAL, AISLANTE Y NO PROPAGADOR DE LA LLAMA, CON UNA RESISTENCIA AL IMPACTO DE 2 J, RESISTENCIA A COMPRESIÓN DE 1250 N Y UNA RIGIDEZ DIELÉCTRICA DE 2000 V, CON UNIÓN ENCHUFADA Y MONTADO SUPERFICIALMENTE | DOS EUROS con CINCUENTA Y UN CÉNTIMOS | 2,51 |
| 0126 | EG21281J | m | TUBO RÍGIDO DE PVC, DE 25 MM DE DIÁMETRO NOMINAL, AISLANTE Y NO PROPAGADOR DE LA LLAMA, CON UNA RESISTENCIA AL IMPACTO DE 2 J, RESISTENCIA A COMPRESIÓN DE 1250 N Y UNA RIGIDEZ DIELÉCTRICA DE 2000 V, CON UNIÓN ENCHUFADA Y MONTADO SUPERFICIALMENTE | DOS EUROS con OCHENTA Y CUATRO CÉNTIMOS | 2,84 |
| 0127 | ENDESACONEX | ud | ENTRONQUE DE LAS INSTALACIONES EN PROYECTO CON LA LÍNEA EXISTENTE LAMT "MAELLA", PARA LO QUE SE NECESITA REALIZAR LOS TRABAJOS DEFINIDOS EN LAS CONDICIONES DE SUMINISTRO TANTO PARA EL "PUNTO DE CONEXIÓN A LA RED DE DISTRIBUCIÓN" COMO LOS "TRABAJOS A REALIZAR EN LA RED DE DISTRIBUCIÓN". TRABAJOS DE CONEXIÓN SUBTERRÁNEA EN MT HASTA EL NUEVO CENTRO DE SECCIONAMIENTO. TODAS ESTAS ACTUACIONES SERÁN LLEVADAS A CABO DIRECTAMENTE POR ENDESA DISTRIBUCIÓN ELÉCTRICA S.L: UNIPERSONAL DE ACUERDO CON LO ESPECIFICADO EN LAS CONDICIONES DE SUMINISTRO QUE SE APORTAN. | DIEZ MIL CUATROCIENTOS SETENTA Y SIETE EUROS con NOVENTA Y NUEVE CÉNTIMOS | 10.477,99 |
| 0128 | ENSAYOS_PAT | UD. | UD. MEDICIÓN DE PUESTA A TIERRA, INCLUIDOS EQUIPOS NECESARIOS Y ELABORACIÓN DE INFORME. | CIENTO VEINTE EUROS con CINCUENTA Y CUATRO CÉNTIMOS | 120,54 |
| 0129 | ENSAYOS_RP | UD. | ENSAYO DE CUADRO DE RELÉS DE PROTECCIÓN, INCLUIDOS EQUIPOS NECESARIOS Y ELABORACIÓN DE INFORME. | MIL CIENTO SETENTA Y SIETE EUROS con OCHENTA Y CINCO CÉNTIMOS | 1.177,85 |
| 0130 | ENSAYOS_TPC | UD. | UD. ENSAYO DE TENSIONES DE PASO Y CONTACTO, INCLUIDOS EQUIPOS NECESARIOS Y ELABORACIÓN DE INFORME. | OCHOCIENTOS SETENTA Y UN EUROS con CUARENTA Y CINCO CÉNTIMOS | 871,45 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0131 | EQCONT | ud | ARMARIO DE CONTROL DE COMPUERTA CON LUTRA GATE 24VDC:<br>SUMINISTRO, INSTALACION, AJUSTE, CONEXIONADO Y PUESTA EN MARCHA DE ARMARIO ELECTRICO CON EQUIPO PARA TELECONTROL Y AUTOMATIZACION DE BAJO CONSUMO (30MA) PARA UNA COMPUERTAS ELECTROMECANICA.CON COMUNICACION GSM-GPRS-3G DE BAJO TRAFICO PARA CONTROL DESDE TELEFONIA MOVIL Y DESDE PUESTO CENTRAL DE CONTROL EN LA NUBE CON PROTOCOLO DE COMUNICACI.N TCP Y UDP. ACCESIBLE POR EL USUARIO A TRAVES DE APLICACION DE ESCRITORIO (WINDOWS), PAGINA WEB Y APLICACIONES PARA TELEFONOS INTELIGENTES (ANDROID E IOS). INCLUYE:<br>MODEM GSM-GPRS-3G CUATRIBANDA (900/1800/850/1900), 1 PUERTO USB 2.0, 1 PUERTO RS485, AMPLIABLE CON HASTA TRES TARJETAS DE EXPANSION. RELOJ A TIEMPO REAL CON CALENDARIO, 11 ENTRADAS DIGITALES, 4 ENTRADAS ANALOGICAS, 1 DETECTOR DE TENSION DE BATERIA, TEMPERATURA INTERIOR DEL NUCLEO, 4 SALIDAS DIGITALES RELE DE ESTADO SOLIDO, 1 FUENTE CONTROLADA 12/24 VDC, 1 TENSION COMUN DIGITALES 10 VDC, ENTRADA DE TENSION DE BACK-UP. 6 ENTRADAS ANALOG. Y 4 DIGITALES. Y 4 SALIDAS ANALOG. PARA TELECONTROL Y AUTOMATIZACION DE COMPUERTAS O VALVULAS EN CANALES Y REDES DE DISTRIBUCION. CON SOFTWARE DE CONTROL DE POSICION, O REGULACION AUTOMATICA. FUNCIONES PRINCIPALES: REGULACION DE NIVEL , SUPERVISION REMOTA DE POSICION; POSIBILIDAD DE POSICIONADO REMOTO; CAMBIO EN CONSIGNA/CONEXION/DESCONEXION DE REGULACION REMOTO; SEÑALIZACION LOCAL Y REMOTA DE ATASCO; SUPERVISION REMOTA DE NIVELES; ENVIO DE DIFERENTES ALARMAS; CONTROL GSM; CONTROL GPRS; POSICION MANUAL/AUTOMATICO INDEPENDIENTE; CONTROL MANUAL LOCAL.<br>TIRADO DE CABLE TIPO YCY5X1,5 POR TUBO INCLUIDO.<br>INSTALACION Y CONEXION DE SENSOR DE INTRUSION MAGNETICO/VARILLA EN LA PUERTA DEL GABINETE O CASETA<br>ESTUDIO DE LA INERCIA HIDRAULICA DE LA CONDUCCI.N PARA EL AJUSTE DE LOS PARAMETROS DEL ALGORITMO DE REGULACION.<br>CONFIGURACION, AJUSTE Y PUESTA EN MARCHA DEL SISTEMA COMPLETO. | CINCO MIL ONCE EUROS con VEINTINUEVE CÉNTIMOS | 5.011,29 |
| 0132 | ESCMALLA | m³ | GAVIÓN ENMALLADO DE CANTOS RODADOS SELECCIONADOS DE PRÉSTAMO, DE 30 A 60 CM DE DIÁMETRO | CUARENTA Y DOS EUROS con SESENTA Y CINCO CÉNTIMOS | 42,65 |
| 0133 | ESTSOL16 | ud | SUMINISTRO, COLOCACIÓN, MONTAJE SUPERFICIAL O HINCADO DE ESTRUCTURA DE ACERO GALVANIZADO BIAPOYADA, EN AW 6063 T66, PARA 16 MÓDULOS SOLARES FOTOVOLTAICOS. INCLUYENDO EL SUMINISTRO DE LA ESTRUCTURA PORTANTE DE ACERO GALVANIZADO Y TORNILLERÍA DE ACERO INOXIDABLE AISI 304 (A2-70), PARA LOS MÓDULOS SOLARES FOTOVOLTAICOS E INCLINACIÓN DE ENTRE 13º Y 30 º RESPECTO A LA PROYECCIÓN HORIZONTAL DEL MÓDULO. LA ESTRUCTURA, AGRUPARÁ 16 MÓDULOS DE 144 CÉLULAS, TAMAÑO MÓDULO 2108X1048X40MM, EN DISPOSICIÓN VERTICAL, ELEVADA 30 CM CON RESPECTO AL SUELO. TOTALMENTE INSTALADA INCLUSO ANCLAJES Y CIMENTACIÓN BAJO NIVEL DEL SUELO PARA AMARRAR LOS SOPORTES AL SUELO. INCLUIDOS LOS MOVIMIENTOS DE TIERRA NECESARIOS PARA LA CIMENTACIÓN, EXCAVACIÓN, CARGA Y TRANSPORTE A VERTEDERO O PREPERFORACIONES.<br>TRIÁNGULOS PREMONTADOS DE FÁBRICA, PARA UNA RÁPIDO MONTAJE. INCLUIDO EL MONTAJE DE LA ESTRUCTURA ASÍ COMO EL MONTAJE DE LOS MÓDULOS SOBRE LAS MISMAINCLUIDO EL MONTAJE DE LA ESTRUCTURA ASÍ COMO EL MONTAJE DE LOS MÓDULOS SOBRE LA MISMA.<br>INCLUSO EL SUMINISTRO, COLOCACIÓN Y MONTAJE DE LAS BANDEJAS METÁLICA DE VARILLA GALVANIZADA EN CALIENTE CON TAPA DE DIMENSIONES 100X30 MM, PARA EL ALOJAMIENTO DE LOS MÓDULOS, INCLUYENDO CANALIZACIÓN ELÉCTRICA, INCLUIDO ACCESORIOS Y PIEZAS ESPECIALES, TOTALMENTE MONTADA, SIN INCLUIR CABLEADO, SEGÚN EL REGLAMENTO ELECTROTÉCNICO DE BAJA TENSIÓN.<br>TRANSPORTE Y MANO DE OBRA INCLUIDOS. | NOVECIENTOS NOVENTA Y CINCO EUROS con DIECISIETE CÉNTIMOS | 995,17 |
| 0134 | EXC03 | m³ | APORTE Y COLOCACIÓN DE PIEDRA O CANTOS RODADOS SELECCIONADOS DE PRESTAMOS DE 30 A 60 CM, A UNA DISTANCIA <25 KM. MEDIDA LA UNIDAD TOTALMENTE COLOCADA. | DIEZ EUROS con NOVENTA Y NUEVE CÉNTIMOS | 10,99 |
| 0135 | F00001 | m2 | REJILLA DE ACERO GALVANIZADO EN FRIO, INCLUSO PARTE PROPORCIONAL DE HERRAJES, PINTURA Y FIJACIÓN. | TREINTA Y TRES EUROS con SETENTA Y NUEVE CÉNTIMOS | 33,79 |
| 0136 | FAUNA1 | m | SUMINISTRO E INSTALACIÓN DE RED DE MATERIAL SINTÉTICO NO PLÁSTICO, TIPO TEXTIL, CON TAMAÑO DE MALLA MÁXIMO DE 30X30MM, CON CUERDA DE 5MM DE ESPESOR, ANCHO DE 1 METRO Y LONGITUD IGUAL AL TALUD DE LA BALSA. DISPUESTA SOBRE LA LÁMINA IMPERMEABILIZANTE Y FIJADA EN CORONACIÓN Y PIE DE TALUD DE FORMA QUE PERMITA LA ADHERENCIA DE LA FAUNA QUE PUEDA CAER AL INTERIOR DEL VASO. INCLUIDA LA PARTE PROPORCIONAL DE SOPORTES Y ELEMENTOS DE FIJACIÓN, INCLUIDOS LOS MOVIMIENTOS DE TIERRAS, CIMENTACIÓN Y LASTRES DE SUJECCIÓN, ASÍ COMO LA ADECUACIÓN Y ACONDICIONAMIENTO DE LA RED. UNIDAD TOTALMENTE COLOCADA. | TREINTA Y SIETE EUROS con SESENTA Y SEIS CÉNTIMOS | 37,66 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0137 | FAUNA2 | Ud | SUMINISTRO E INSTALACIÓN DE PLATAFORMA FLOTANTE EN BALSA APTA PARA ANIMALES, COMPUESTA POR MATERIAL PLÁSTICO RESISTENTE A LA RADIACIÓN SOLAR Y ADHERENCIA ADECUADA PARA EL ACCESO DE ANIMALES, CON DIMENSIONES 1,0X1,0M, INSTALADA EN EL CENTRO DE LA BALSA Y FIJADA AL FONDO DEL EMBALSE MEDIANTE LASTRE DE ARENA. INCLUIDA LA PARTE PROPORCIONAL DE SOPORTES Y ELEMENTOS DE FIJACIÓN, CIMENTACIÓN Y LASTRES DE SUJECCIÓN, ASÍ COMO LA ADECUACIÓN Y ACONDICIONAMIENTO DE LA PLATAFORMA. UNIDAD TOTALMENTE COLOCADA. | TRESCIENTOS TREINTA Y CUATRO EUROS con SETENTA Y SEIS CÉNTIMOS | 334,76 |
| 0138 | FIFMA6032-10 | UD | FILTRO TIPO W DE MALLA AUTOLIMPIANTE PARA CAUDAL HASTA 920 L/S , CON UNA MALLA DE 2MM Y DN 800 MM PN10. EL FILTRO SE COMPONE DE UN CUERPO METÁLICO EN ACERO AL CARBONO, CORONA ROTATIVA EN ACERO INOXIDABLE, COLECTOR DE DESECHOS, VÁLVULA DE APERTURA Y GRUPO MOTOREDUCTOR PARA ACCIONAMIENTO DE LA CORONA ROTATIVA Y ELEMENTOS DE MEDICIÓN Y CONTROL. INCLUYE CUADRO ELÉCTRICO PARA SU CONTROL Y FUNCIONAMIENTO. SISTEMA DE LIMPIEZA, COMPUESTO POR:<br>- BOQUILLAS DE GRAN IMPACTO, PARA LA LIMPIEZA POR CONTRALAVADO DE LA MALLA FILTRANTE.<br>- GRUPO DE PRESIÓN.<br>- ESTANQUEIDAD DE LAS TRES CÁMARAS MEDIANTE CERDAS DE NYLON.<br>CONTROL DEL SISTEMA DE POSICIONAMIENTO DE LA CORONA FILTRANTE Y DE LA APERTURA Y CIERRE DE LA VÁLVULA DE LIMPIEZA POR SECTORES.<br>CUADRO DE CONTROL Y PROGRAMADOR DE LA INSTALACIÓN.<br>INCLUYE MONTAJE, TRANSPORTE Y PUESTA EN MARCHA. | VEINTITRES MIL DOSCIENTOS NOVENTA Y TRES EUROS con OCHENTA Y DOS CÉNTIMOS | 23.293,82 |
| 0139 | FIFMA6056-10 | UD | FILTRO TIPO W DE MALLA AUTOLIMPIANTE PARA CAUDAL HASTA 2523 L/S , CON UNA MALLA DE 2MM. Y DN 1400 MM PN10. EL FILTRO SE COMPONE DE UN CUERPO METÁLICO EN ACERO AL CARBONO, CORONA ROTATIVA EN ACERO INOXIDABLE, COLECTOR DE DESECHOS, VÁLVULA DE APERTURA Y GRUPO MOTOREDUCTOR PARA ACCIONAMIENTO DE LA CORONA ROTATIVA Y ELEMENTOS DE MEDICIÓN Y CONTROL. INCLUYE CUADRO ELÉCTRICO PARA SU CONTROL Y FUNCIONAMIENTO. SISTEMA DE LIMPIEZA, COMPUESTO POR:<br>- BOQUILLAS DE GRAN IMPACTO, PARA LA LIMPIEZA POR CONTRALAVADO DE LA MALLA FILTRANTE.<br>- GRUPO DE PRESIÓN.<br>- ESTANQUEIDAD DE LAS TRES CÁMARAS MEDIANTE CERDAS DE NYLON.<br>CONTROL DEL SISTEMA DE POSICIONAMIENTO DE LA CORONA FILTRANTE Y DE LA APERTURA Y CIERRE DE LA VÁLVULA DE LIMPIEZA POR SECTORES.<br>CUADRO DE CONTROL Y PROGRAMADOR DE LA INSTALACIÓN.<br>INCLUYE MONTAJE, TRANSPORTE Y PUESTA EN MARCHA. | SESENTA Y CINCO MIL QUINIENTOS VEINTITRES EUROS con OCHENTA Y DOS CÉNTIMOS | 65.523,82 |
| 0140 | FV_CC1_8E160A | ud | SUMINISTRO CUADROS SECUNDARIOS DE CORRIENTE CONTINUA (CAJA DE CADENAS/STRINGS 1ºNIVEL). 6 ENTRADAS<br>REALIZADO SOBRE UN CONJUNTO MODULAR DE DOBLE AISLAMIENTO Y CONSTRUIDA CONPOLIESTER REFORZADO CON FIBRA DE VIDRIO Y PLACA DE MONTAJE Y TAPAS OPACAS DEL MISMO MATERIAL, NO HIGROSCOPICAS Y RESISTENTES A LA CORROSIÓN CON GRADO DE PROTECCIÓN IP-65 SEGÚN UNE Y RIGIDEZ DIELÉCTRICA SUPERIOR A 5.000 V. COMPUESTO POR:<br><br>- CUADRO TIPO GEMINI TAMAÑO 2 IP 68 COMPLETO, CON PRENSAESTOPAS Y TUERCAS CON PASO MÉTRICO - IP 68 COMPLETO PARA LA INSTALACIÓN DE ELEMENTOS<br>- INTERRUPTOR MAGNETOTÉRMICO TIPO S800 PV-S125<br>- PROTECTOR CONTRA SOBRETENSIONES TIPO OVR PV 40 1000 P<br>- SECCIONADOR DE FUSIBLES TIPO E 92/32, EN CADENAS/STRINGS Y SOBRETENSIONES<br>- FUSIBLES TIPO 10,3X38 MM 1000 V C.C. 20 A, EN CADENAS/STRINGS<br>- FUSIBLES 20 A TIPO GR PARA PROTECCIÓN DEL OVR<br>- BORNAS DE TORNILLOS DE 2,5 A 240 MM 2, PARA TENSIONES HASTA 1000 V<br>- REGLETA DE PUESTA A TIERRA<br>- MEDIDOR DE CADENAS DE MÓDULOS (U, I) AUTOALIMENTADO CON COMUNICACIÓN ETHERNET.<br>- PARTE PROPORCIONAL PEQUEÑA APARAMENTA Y MATERIAL SOPORTES, EMBARRADOS, DISTRIBUIDORES DE CABLES, PROTECCIONES, ELEMENTOS DE SEGURIDAD, PRENSAESTOPAS, ETC...<br><br>INCLUSO TRANSPORTE, Y PARTE PROPORCIONAL DE SOPORTE Y FIJACIÓN A ESTRUCTURA FV.<br>TOTALMENTE MONTADA, CONECTADA, INSTALADA Y PROBADA. | MIL NOVECIENTOS OCHENTA Y DOS EUROS con CUARENTA Y OCHO CÉNTIMOS | 1.982,48 |
| 0141 | FV_CC2_2X2000 | ud | SUMINISTRO CUADROS GENERAL DE CORRIENTE CONTINUA (CAJA DE 2º NIVEL).<br>REALIZADO SOBRE UN CONJUNTO MODULAR DE DOBLE AISLAMIENTO Y CONSTRUIDA CONPOLIESTER REFORZADO CON FIBRA DE VIDRIO Y PLACA DE MONTAJE Y TAPAS OPACAS DEL MISMO MATERIAL, NO HIGROSCOPICAS Y RESISTENTES A LA CORROSIÓN CON GRADO DE PROTECCIÓN IP-65 SEGÚN UNE Y RIGIDEZ DIELÉCTRICA SUPERIOR A 5.000V. COMPUESTO POR:<br>* ENVOLVENTE HORMIGÓN ARMADO TIPO ALP<br>* ENTRADAS DCBOX PROTEGIDAS CON FUSIBLES DE CUCHILLA DE 160A, TIPO FUSIBLE DE LENGUETA CENTRADO 160A 1000V Y BASE PORTAFUSIBLES.<br>* SALIDA PARA LÍNEAS DE 400 MM², PROTEGIDA MEDIANTE INTERRUPTOR AUTOMÁTICO DE 2000A, 1000VCC, TIPO OT.<br>* 3 UDS. INTERRUPTOR AUTOMÁTICO TMAX DC 1250A 1000VCC<br>* 3 UDS. DESCARGADOR SOBRETENSIONES.<br>* 1 UD. REGLETA DE PUESTA A TIERRA.<br>* 4 UD. SWITCH ETHERNET<br>* 1 UD. CONVERSOR DE COMUNCIACIONES ETHERNET/FO. CONVERSOR DE MEDIOS POE 10/100 BASE TX A 100 BASE-FX<br>* MEDIDORES DE AISLAMIENTO.<br>* INDICADORES LUMINOSOS<br><br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADA, CONECTADA, INSTALADA Y PROBADA. | VEINTICINCO MIL CIENTO TRES EUROS con NUEVE CÉNTIMOS | 25.103,09 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0142 | FV_MODMONOPHO | Wp | SUMINISTRO Y COLOCACIÓN DE UD. DE POTENCIA PICO (WP) EN MÓDULO FOTOVOLTAICO DE ALTA EFICIENCIA BAJA LID MONO-PERC CON TECNOLOGÍA HALF-CUT Y RTO>20,5%, 144 (2X(6X12)) CÉLULAS, ESPECIFICACIONES MÍNIMAS DE LA TABLA INFERIOR Y CON DIMENSIONES 2108X1048X40 MM SUMINISTRADO POR FABRICANTE TIER1. TENSIÓN DE AISLAMIENTO DE 1500V (IEC/UL), SEGURIDAD CLASE II, RESISTENCIA AL FUEGO UL TIPO 1 O 2, TOMA DE PLÁSTICO (PPO), VENTILADA Y CON ALIVIO DE TENSIÓN, AL MENOS IP65. CABLE SOLAR DE 4 MM2 Y 3M DE LONGITUD. VIDRIO FRONTAL TEMPLADO DE 3,2 MM CON BAJO CONTENIDO DE HIERRO. BASTIDOR DE ALUMINIO ANODIZADO ESTABLE EN UN DISEÑO DE SECCIÓN HUECA.<br>INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO, FIJADO Y CABLEADO.<br><br>TECNOLOGÍA MONOCRISTALINO PERC HALF-C<br>Nº CELDAS 144(2X(6X12))<br>TIPO CS3W-445MS<br>PMPP (WP) 445<br>UMPP (V) 40,9<br>IMPP (A) 10,89<br>ISC (A) 11,54<br>UOC (V) 48,9<br>RTO. MÓDULO 20,10%<br>COEF. Tª (V) -0,270%<br>COEF. Tª (A) 0,050%<br>COEF. Tª (P) -0,350%<br>NOCT ºC 42<br>TENSIÓN (V) 1000<br>CORRIENTE FUSIBLE (A) 20<br>Tª MAX 85<br>Tª MIN -40<br>DIODOS BY-PASS 3 | CERO EUROS con TREINTA Y CUATRO CÉNTIMOS | 0,34 |
| 0143 | FV_RV-K120 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE 120MM². (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. CABLE DE INTERCONEXIÓN DCBOX A DC_GENERAL, REALIZADO CON CABLE UNIPOLAR DE COBRE DE 95 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | QUINCE EUROS con TREINTA CÉNTIMOS | 15,30 |
| 0144 | FV_RV-K25 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE 25MM². (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. CABLE DE INTERCONEXIÓN DCBOX A DC_GENERAL, REALIZADO CON CABLE UNIPOLAR DE COBRE DE 25 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | TRES EUROS con CINCUENTA Y DOS CÉNTIMOS | 3,52 |
| 0145 | FV_RV-K35 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE 35MM². (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. CABLE DE INTERCONEXIÓN DCBOX A DC_GENERAL, REALIZADO CON CABLE UNIPOLAR DE COBRE DE 35 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | CUATRO EUROS con SETENTA Y CINCO CÉNTIMOS | 4,75 |
| 0146 | FV_RV-K400AL | m | SUMINISTRO DE CABLE UNIPOLAR DE ALUMINIO 400MM² RV-K DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. REALIZADO CON CABLE UNIPOLAR DE COBRE DE 240 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | VEINTINUEVE EUROS con SESENTA Y OCHO CÉNTIMOS | 29,68 |
| 0147 | FV_RV-K50 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE 50MM². (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. CABLE DE INTERCONEXIÓN DCBOX A DC_GENERAL, REALIZADO CON CABLE UNIPOLAR DE COBRE DE 50 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | SEIS EUROS con SESENTA Y DOS CÉNTIMOS | 6,62 |
| 0148 | FV_RV-K70 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE 70MM². (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. CABLE DE INTERCONEXIÓN DCBOX A DC_GENERAL, REALIZADO CON CABLE UNIPOLAR DE COBRE DE 70 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | NUEVE EUROS con DIEZ CÉNTIMOS | 9,10 |
| 0149 | FV_RV-K95 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE 95MM². (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULADO Y CUBIERTA DE PVC. CABLE DE INTERCONEXIÓN DCBOX A DC_GENERAL, REALIZADO CON CABLE UNIPOLAR DE COBRE DE 95 MM2 RV-K, SEGÚN CÁLCULOS REALIZADOS, DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | DOCE EUROS con VEINTIUN CÉNTIMOS | 12,21 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0150 | FV_SUP2 | ud | SUMINISTRO, MONTAJE Y PUESTA EN MARCHA MONITORIZACIÓN DC, INCLUYE:<br>* UNIDAD DE CUADRO TELEMANDABLE Y GESTINABLE DESDE PLC CENTRAL.<br>* MONITORIZACION DE ENERGIA POR CADA CIRCUITO DE STRING<br>* SENSORES DE:<br>1 UDS. MEDICIÓN DE INTENSIDAD (SHUNT)<br>2 UDS. SONDA IRRADIANCIA (PIRANÓMETRO)<br>2 UDS. SONDA TEMPERATURA AMBIENTE PT100<br>2 UDS. SONDA TEMP. EN SUPERFICIE MÓDULOS. PT100<br>* 1 UD. CONVERSOR DE COMUNCIACIONES ETHERNET/FO. CONVERSOR DE MEDIOS POE 10/100 BASE TX A 100 BASE-FX<br><br>TOTALMENTE INSTALADOS, INCLUIDOS LOS ELEMENTOS DE FIJACIÓN, CABLEADO, COMUNICACIÓN Y PARAMETRIZACIÓN DE LOS EQUIPOS.<br><br>TOTALMENTE INSTALADO, INCLUSO PARTE PROPORCIONAL DE ACCESORIOS NECESARIOS PARA SU INSTALACIÓN. MONTAJE, CONFIGURACIÓN, PROGRAMACIÓN Y PUESTA EN MARCHA INSTALACIÓN<br>INCLUSO TRANSPORTE.<br>TOTALMENTE MONTADA, CONECTADA, INSTALADA Y PROBADA. | SEIS MIL DOSCIENTOS CUARENTA Y UN EUROS con SETENTA Y UN CÉNTIMOS | 6.241,71 |
| 0151 | G04JU2345 | m | JUNTA HIDROEXPANSIVA TIPO MASTERFLEX 610 20*5, INCLUSO PREPARACIÓN DE SUPERFICIES, TOTALMENTE COLOCADA. | OCHO EUROS con SETENTA Y CINCO CÉNTIMOS | 8,75 |
| 0152 | G9K1R010 | m2 | DOBLE TRATAMIENTO SUPERFICIAL (DTS) POR MEDIO DE RIEGO DE DOS CAPAS DE GRANULADOS GANÍTICOS Y EMULSIÓN BITUMINOSA ECR-2, INCLUIDO EL TRANSPORTE A VERTEDERO DEL ARIDO SOBRANTE. | TRES EUROS con OCHO CÉNTIMOS | 3,08 |
| 0153 | GG7U1AR10 | ud | SUMINISTRO E INSTALACIÓN DE TERMINAL DE CONTROL REMOTO VÍA RADIO TIPO PARA EL CONTROL DE 10 ELECTROVÁLVULAS TIPO LATCH DE 2 HILOS, CON 10 ENTRADAS DIGITALES Y 2 ENTRADAS ANALÓGICA. CAJA ALOJAMIENTO IP66 CON CONEXIONES EXTERIORES; SOFTWARE COMPLETO DE CONTROL Y DE COMUNICACIONES; PROTECCIÓN ENTRADAS. DISPONE DE MICROCONTROLADOR DE 16 BITS DE BAJO CONSUMO CON WATCHDOG, MEMORIA FLASH, RAM Y EEPROM CON REGISTRO DE ACUMULADOS, CUMPLIENDO LAS PRESTACIONES DE PROYECTO. ALOJADO EN CAJAS PARA CARRIL DIN E INSTALADAS EN CAJAS CON GRADO DE PROTECCIÓN IP66. ALIMENTADO MEDIANTE PACK DE 3 PILAS DE NI-MH CON PANEL SOLAR 5W. INSTALADO Y PROBADO. NO INCLUYE NI VÁLVULA NI SOLENOIDE. | MIL CIENTO TREINTA Y NUEVE EUROS con CUARENTA Y NUEVE CÉNTIMOS | 1.139,49 |
| 0154 | GG7U1AR16 | ud | SUMINISTRO E INSTALACIÓN DE TERMINAL DE CONTROL REMOTO VÍA RADIO TIPO PARA EL CONTROL DE 16 ELECTROVÁLVULAS TIPO LATCH DE 2 HILOS, CON 16 ENTRADAS DIGITALES Y 2 ENTRADAS ANALÓGICA. CAJA ALOJAMIENTO IP66 CON CONEXIONES EXTERIORES; SOFTWARE COMPLETO DE CONTROL Y DE COMUNICACIONES; PROTECCIÓN ENTRADAS. DISPONE DE MICROCONTROLADOR DE 16 BITS DE BAJO CONSUMO CON WATCHDOG, MEMORIA FLASH, RAM Y EEPROM CON REGISTRO DE ACUMULADOS, CUMPLIENDO LAS PRESTACIONES DE PROYECTO. ALOJADO EN CAJAS PARA CARRIL DIN E INSTALADAS EN CAJAS CON GRADO DE PROTECCIÓN IP66. ALIMENTADO MEDIANTE PACK DE 3 PILAS DE DE NI-MH CON PANEL SOLAR 5W. INSTALADO Y PROBADO. NO INCLUYE NI VÁLVULA NI SOLENOIDE. | MIL TRESCIENTOS CUARENTA Y CINCO EUROS con OCHENTA Y CUATRO CÉNTIMOS | 1.345,84 |
| 0155 | GG7U1AR16-REP | ud | SUMINISTRO E INSTALACIÓN DE TERMINAL DE CONTROL REMOTO VÍA RADIO TIPO PARA EL CONTROL DE 16 ELECTROVÁLVULAS TIPO LATCH DE 2 HILOS, CON 16 ENTRADAS DIGITALES Y 2 ENTRADAS ANALÓGICA. CAJA ALOJAMIENTO IP66 CON CONEXIONES EXTERIORES; SOFTWARE COMPLETO DE CONTROL Y DE COMUNICACIONES; PROTECCIÓN ENTRADAS. DISPONE DE MICROCONTROLADOR DE 16 BITS DE BAJO CONSUMO CON WATCHDOG, MEMORIA FLASH, RAM Y EEPROM CON REGISTRO DE ACUMULADOS, CUMPLIENDO LAS PRESTACIONES DE PROYECTO. ALOJADO EN CAJAS PARA CARRIL DIN E INSTALADAS EN CAJAS CON GRADO DE PROTECCIÓN IP66. ALIMENTADO MEDIANTE PACK DE 3 PILAS NI-MH Y PANEL SOLAR 5W. INSTALADO Y PROBADO. NO INCLUYE NI VÁLVULA NI SOLENOIDE. | MIL CUATROCIENTOS CATORCE EUROS con CUARENTA Y NUEVE CÉNTIMOS | 1.414,49 |
| 0156 | GG7U1AR4 | ud | SUMINISTRO E INSTALACIÓN DE TERMINAL DE CONTROL REMOTO VÍA RADIO TIPO PARA EL CONTROL DE 4 ELECTROVÁLVULAS TIPO LATCH DE 2 HILOS, CON 4 ENTRADAS DIGITALES Y 2 ENTRADAS ANALÓGICA. CAJA ALOJAMIENTO IP66 CON CONEXIONES EXTERIORES; SOFTWARE COMPLETO DE CONTROL Y DE COMUNICACIONES; PROTECCIÓN ENTRADAS. DISPONE DE MICROCONTROLADOR DE 16 BITS DE BAJO CONSUMO CON WATCHDOG, MEMORIA FLASH, RAM Y EEPROM CON REGISTRO DE ACUMULADOS, CUMPLIENDO LAS PRESTACIONES DE PROYECTO. ALOJADO EN CAJAS PARA CARRIL DIN E INSTALADAS EN CAJAS CON GRADO DE PROTECCIÓN IP66. ALIMENTADO MEDIANTE PACK DE 3 PILAS DE NI-MH CON PANEL SOLAR 5W. INSTALADO Y PROBADO. NO INCLUYE NI VÁLVULA NI SOLENOIDE. | NOVECIENTOS CUARENTA Y CUATRO EUROS con CUARENTA Y NUEVE CÉNTIMOS | 944,49 |
| 0157 | I2R24200 | m³ | CLASIFICACIÓN A PIE DE OBRA DE RESIDUOS DE LA CONSTRUCCIÓN EN RESIDUOS INERTES, NO ESPECIALES Y ESPECIALES CON MEDIOS MANUALES (P-1) | VEINTISEIS EUROS con OCHENTA Y CINCO CÉNTIMOS | 26,85 |
| 0158 | I2R5K000 | Ud | TRANSPORTE DE BIDONES DE RESIDUOS ESPECIALES A CENTRO DE RECOGIDA Y TRANSFERENCIA (P-3) | CIENTO NOVENTA Y CINCO EUROS con VEINTINUEVE CÉNTIMOS | 195,29 |
| 0159 | I2R5PL00 | Ud | SUMINISTRO DE BIDÓN DE 200 L PARA RESIDUOS ESPECIALES (P-4) | DIECISEIS EUROS con SETENTA Y OCHO CÉNTIMOS | 16,78 |

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| 0160 | I2R650G0 | m³ | CARGA Y TRANSPORTE DE RESIDUOS A CENTRO DE RECICLAJE, A MONODEPÓSITO, A VERTEDERO ESPECÍFICO O A CENTRO DE RECOGIDA Y TRANSFERENCIA, CON CONTENIDOR, CARGADO CON MEDIOS MECÁNICOS | ONCE EUROS con SESENTA Y TRES CÉNTIMOS | 11,63 |
| 0161 | I2RA6500 | m³ | DEPOSICIÓN CONTROLADA A CENTRO DE RECOGIDA AUTORIZADO Y TRANSFERENCIA DE RESIDUOS NO ESPECIALES. | SIETE EUROS con SETENTA Y UN CÉNTIMOS | 7,71 |
| 0162 | I2RA7360 | m³ | DEPOSICIÓN CONTROLADA A CENTRO DE RECOGIDA AUTORIZADO Y TRANSFERENCIA DE RESIDUOS INERTES MEZCLADOS DE LA CONSTRUCCIÓN | SIETE EUROS con CUARENTA Y SEIS CÉNTIMOS | 7,46 |
| 0163 | I2RA8500 | m³ | DEPOSICIÓN CONTROLADA A CENTRO DE RECOGIDA AUTORIZADO Y TRANSFERENCIA DE RESIDUOS INERTES. | SEIS EUROS con DIECISIETE CÉNTIMOS | 6,17 |
| 0164 | I2RA8620 | m³ | DEPOSICIÓN CONTROLADA A CENTRO DE RECOGIDA AUTORIZADO Y TRANSFERENCIA DE RESIDUOS ESPECIALES. | SEISCIENTOS CINCUENTA Y NUEVE EUROS con VEINTE CÉNTIMOS | 659,20 |
| 0165 | IM002 | m² | LÁMINA IMPERMEABILIZANTE EN POLIETILENO DE ALTA DENSIDAD, FABRICADA MEDIANTE CALANDRADO EN 7,5 M DE ANCHO SIN SOLDADURAS INTERMEDIAS DE 2,0 MM DE ESPESOR, TOTALMENTE INSTALADA Y PROBADA, INCLUSO SOLAPES Y ANCLAJES MECÁNICOS A OBRAS DE FABRICA. MEDIDA LA SUPERFICIE EFECTIVAMENTE COLOCADA DESCONTANDO SOLAPES, RECORTES, ETC. | CINCO EUROS con TREINTA Y TRES CÉNTIMOS | 5,33 |
| 0166 | INNOURBASPOZ2 | Ud | BASE DE POZO DE REGISTRO, EN HA-25 DE 100 X100 CM INTERIOR, ALTURA HASTA 2,00 M, CON TAPA DE REDUCIÓN, REALIZADA "IN SITU" INCLUSO HORMIGÓN DE LIMPIEZA Y RECIBIDO DE TUBERÍA Y CANAL INTERIOR EN EL DIÁMETRO DE LA CONDUCCIÓN, INCLUSO EN GIROS Y SALTOS. | CUATROCIENTOS DOCE EUROS con SETENTA Y DOS CÉNTIMOS | 412,72 |
| 0167 | INNOURCONPOZ | Ud | CONO ASIMÉTRICO PREFABRICADO DE HORMIGÓN, DE 150 CM. DE DIÁMETRO INFERIOR, 62,50 CM. DE DIÁMETRO SUPERIOR, ALTURA 60 CM., INCLUSO MEDIOS AUXILIARES Y COLOCACIÓN. | CIENTO CINCUENTA Y TRES EUROS con VEINTIUN CÉNTIMOS | 153,21 |
| 0168 | INNOURTAPPOZ | Ud | MARCO Y TAPA DE FUNDICIÓN DE 62,50 CM. DE DIÁMETRO, INCLUSO MEDIOS AUXILIARES Y COLOCACIÓN. | CIENTO DIECINUEVE EUROS con DIECISEIS CÉNTIMOS | 119,16 |
| 0169 | INSFIBOPT | | INSTALACIÓN Y TENDIDO EN ZANJA DE CABLE DE FIBRA OPTICA TIPO MONOMODO 8FO G652D FV CORROUGADO METAL CPR-FCA PE NEGRO2 O SIMILIAR ENTRE CENTROS DE TRANSFORMACION DE LA PLANTA SOLAR Y HASTA ESTACIÓN DE BOMBEO, INCLUYENDO CINTA DE SEÑALIZACIÓN, CHAPAS DE PROTECCIÓN, ACCESORIOS Y PEQUEÑO MATERIAL. | OCHO EUROS con NOVENTA Y NUEVE CÉNTIMOS | 8,99 |
| 0170 | IP10AAIDLT2 | Ud | MÉS DE ALQUILER DE CASETA PREFABRICADA PARA ASEOS DE OBRA DE 4.10X1.90 M. CON DOS INODOROS, UNA DUCHA, UN LAVABO TERMO ELÉCTRICO DE 50 LITROS DE CAPACIDAD; CON LAS MISMAS CARACTERISTICAS QUE LAS OFICINAS. SUELO DE CONTRACHAPADO HIDRÓFUGO CON CAPA FENÓLICA ANTIDESLIZANTE Y RESISTENTE AL DESGASTE. PIEZAS SANITARIAS DE FIBRA DE VIDRIO ACABADAS EN GEL-COAT BLANCO Y PINTURA ANTIDESLIZANTE. PUERTAS INTERIORES DE MADERA EN LOS COMPARTIMENTOS. INSTALACIÓN DE FONTANERIA CON TUBERIAS DE POLIBUTILENO E INSTALACIÓN ELÉCTRICA PARA CORRIENTE MONOFÁSICA DE 220 V. PROTEGIDA CON INTERRUPTOR AUTOMÁTICO. | DOSCIENTOS DIEZ EUROS con SESENTA Y CUATRO CÉNTIMOS | 210,64 |
| 0171 | IP10ACPCOME | Ud | MÉS DE ALQUILER DE CASETA PREFABRICADA PARA VESTUARIOS DE OBRA DE 6X2.35 M., CON ESTRUCTURA METÁLICA MEDIANTE PERFILES CONFORMADOS EN FRIO Y CERRAMIENTO CHAPA NERVADA Y GALVANIZADA CON TERMINACIÓN DE PINTURA PRELACADA. AISLAMIENTO INTERIOR CON LANA DE VIDRIO COMBINADA CON POLIESTIRENO EXPANDIDO. REVESTIMIENTO DE P.V.C. EN SUELOS Y TABLERO MELAMINADO EN PAREDES. VENTANAS DE ALUMINIO ANODIZADO, CON PERSIANAS CORREDERAS DE PROTECCIÓN, INCLUSO INSTALACIÓN ELÉCTRICA CON DISTRIBUCIÓN INTERIOR DE ALUMBRADO Y FUERZA CON TOMA EXTERIOR A 220 V. | CIENTO CATORCE EUROS con SETENTA Y CUATRO CÉNTIMOS | 114,74 |
| 0172 | IP10ACPOFIC | Ud | UD. MÉS DE ALQUILER DE CASETA PREFABRICADA PARA COMEDOR DE OBRA DE 6X2.35 M., CON ESTRUCTURA METÁLICA MEDIANTE PERFILES CONFORMADOS EN FRIO Y CERRAMIENTO CHAPA NERVADA Y GALVANIZADA CON TERMINACIÓN DE PINTURA PRELACADA. AISLAMIENTO INTERIOR CON LANA DE VIDRIO COMBINADA CON POLIESTIRENO EXPANDIDO. REVESTIMIENTO DE P.V.C. EN SUELOS Y TABLERO MELAMINADO EN PAREDES. VENTANAS DE ALUMINIO ANODIZADO, CON PERSIANAS CORREDERAS DE PROTECCIÓN, INCLUSO INSTALACIÓN ELÉCTRICA CON DISTRIBUCIÓN INTERIOR DE ALUMBRADO Y FUERZA CON TOMA EXTERIOR A 220 V. | CIENTO CINCO EUROS con VEINTE CÉNTIMOS | 105,20 |
| 0173 | IP10TCPREF | Ud | TRANSPORTE DE CASETA PREFABRICADA A OBRA, INCLUSO DESCARGA Y POSTERIOR RECOGIDA. | DOSCIENTOS DIECISIETE EUROS con CUARENTA Y DOS CÉNTIMOS | 217,42 |
| 0174 | IP20APELECT | Ud | ACOMETIDA PROVISIONAL DE ELECTRICIDAD A CASETA DE OBRA, DESDE EL CUADRO GENERAL FORMADA POR MANGUERA FLEXIBLE DE 4X4 MM2 DE TENSIÓN NOMINAL 750 V., INCORPORANDO CONDUCTOR DE TIERRA COLOR VERDE Y AMARILLO, FIJADA SOBRE APOYOS INTERMEDIOS CADA 2,50 M. INSTALADA. | NOVENTA Y SEIS EUROS con CINCUENTA Y DOS CÉNTIMOS | 96,52 |
| 0175 | IP20APFONT | Ud | UD. ACOMETIDA PROVISIONAL DE FONTANERIA A CASETAS DE OBRA. | SETENTA Y SIETE EUROS con VEINTICINCO CÉNTIMOS | 77,25 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0176 | IP20APSANEA | Ud | UD. ACOMETIDA PROVISIONAL DE SANEAMIENTO A CASETAS DE OBRA. | SESENTA Y SEIS EUROS con NOVENTA Y CINCO CÉNTIMOS | 66,95 |
| 0177 | IP30BOBRA | Ud | UD. BOTIQUÍN DE OBRA INSTALADO. | CUARENTA EUROS con SETENTA Y DOS CÉNTIMOS | 40,72 |
| 0178 | IP30BP5P | Ud | BANCO DE POLIPROPILENO PARA 5 PERSONAS CON SOPORTES METALICOS, COLOCADO. (10 USOS) | VEINTIUN EUROS con SESENTA Y SIETE CÉNTIMOS | 21,67 |
| 0179 | IP30CPEVAC | Ud | UD. CAMILLA PORTÁTIL PARA EVACUACIONES, COLOCADA. (20 USOS) | SEIS EUROS con SESENTA Y SEIS CÉNTIMOS | 6,66 |
| 0180 | IP30DB800L | Ud | UD. DEPOSITO DE BASURAS DE 800 LITROS DE CAPACIDAD REALIZADO EN POLIETILENO INYECTADO, ACERO Y BANDAS DE CAUCHO, CON RUEDAS PARA SU TRANSPORTE, COLOCADO. (10 USOS) | DIECISIETE EUROS con SETENTA Y CINCO CÉNTIMOS | 17,75 |
| 0181 | IP30JINDUS | Ud | UD. JABONERA DE USO INDUSTRIAL CON DOSIFICADOR DE JABÓN, EN ACERO INOXIDABLE, COLOCADA. (10 USOS) | CINCO EUROS con NOVENTA Y SEIS CÉNTIMOS | 5,96 |
| 0182 | IP30RBOTIQ | Ud | UD. REPOSICIÓN DE MATERIAL DE BOTIQUÍN DE OBRA. | VEINTIOCHO EUROS con OCHENTA Y SIETE CÉNTIMOS | 28,87 |
| 0183 | IP30TMINDIV | Ud | TAQUILLA METÁLICA INDIVIDUAL CON LLAVE DE 1.78 M. DE ALTURA COLOCADA. (10 USOS) | DOCE EUROS con SETENTA Y SEIS CÉNTIMOS | 12,76 |
| 0184 | JTOMA1000 | u | JAULA DE DESBASTE PARA TOMA DE FONDO EN DIÁMETRO 1000 MM. EN ACERO INOXIDABLE AISI-316, CON LUZ DE PASO DE 20 MM ENTRE BARRAS VERTICALES Y ALTURA MÍNIMA DE 1,0 M. INCLUYE PLETINAS, TORNILLERÍA Y PP. DE PEQUEÑO MATERIAL PARA ANCLAJE A HORMIGÓN Y CON LÁMINA PLÁSTICA. MEDIDA LA UNIDAD TOTALMENTE MONTADA Y PROBADA. | MIL OCHOCIENTOS CINCUENTA Y OCHO EUROS con VEINTICUATRO CÉNTIMOS | 1.858,24 |
| 0185 | JTOMA1400 | u | JAULA DE DESBASTE PARA TOMA DE FONDO EN DIÁMETRO 1400 MM. EN ACERO INOXIDABLE AISI-316, CON LUZ DE PASO DE 30 MM ENTRE BARRAS VERTICALES Y ALTURA MÍNIMA DE 1,7 M, CON ZÓCALO NO FILTRANTE DE 30 CM. INCLUYE PLETINAS, TORNILLERÍA Y PP. DE PEQUEÑO MATERIAL PARA ANCLAJE A HORMIGÓN Y CON LÁMINA PLÁSTICA. MEDIDA LA UNIDAD TOTALMENTE MONTADA Y PROBADA. | DOS MIL OCHOCIENTOS TREINTA Y DOS EUROS con CUARENTA Y CUATRO CÉNTIMOS | 2.832,44 |
| 0186 | JTOMA1600 | u | JAULA DE DESBASTE PARA TOMA DE FONDO EN DIÁMETRO 1600 MM. EN ACERO INOXIDABLE AISI-316, CON LUZ DE PASO DE 30 MM ENTRE BARRAS VERTICALES Y ALTURA MÍNIMA DE 1,5 M, CON ZÓCALO NO FILTRANTE DE 30 CM. INCLUYE PLETINAS, TORNILLERÍA Y PP. DE PEQUEÑO MATERIAL PARA ANCLAJE A HORMIGÓN Y CON LÁMINA PLÁSTICA. MEDIDA LA UNIDAD TOTALMENTE MONTADA Y PROBADA. | TRES MIL NOVENTA Y CINCO EUROS con NUEVE CÉNTIMOS | 3.095,09 |
| 0187 | JTOMA700 | u | JAULA DE DESBASTE PARA TOMA DE FONDO EN DIÁMETRO 700 MM. EN ACERO INOXIDABLE AISI-316, CON LUZ DE PASO DE 20 MM ENTRE BARRAS VERTICALES Y ALTURA MÍNIMA DE 1,2 M. INCLUYE PLETINAS, TORNILLERÍA Y PP. DE PEQUEÑO MATERIAL PARA ANCLAJE A HORMIGÓN Y CON LÁMINA PLÁSTICA. MEDIDA LA UNIDAD TOTALMENTE MONTADA Y PROBADA. | MIL TRESCIENTOS NOVENTA Y CUATRO EUROS con SETENTA Y CUATRO CÉNTIMOS | 1.394,74 |
| 0188 | MAACD | kg | ACERO EN CALDERERÍA, AL CARBONO DE TIPO S-275-JR, CON ESPESORES DE CHAPA SEGÚN EL DIÁMETRO DE LA TUBERÍA (EN PN 16 ATM; 4 MM HASTA DN 300, 6,4 MM DE DN 350 A DN 600 Y 8 MM DESDE DN 700- EN PN 25 ATM; 6,4 MM HASTA DN 300, 8 MM DE DN 350 A DN 600, 10 MM DE DN 700 A 1.000 Y 12 MM DE DN 1.100 A DN 1.500), CON SOLDADURAS REALIZADAS BAJO PROCEDIMIENTO HOMOLOGADO (SEGÚN CÓDIGO ASME-SECCIÓN IX), TRATAMIENTO DE ACABADO MEDIANTE GRANALLADO DE SUPERFICIE HASTA RUGOSIDAD SA 2,5 (SEGÚN NORMA SIS-05-900) Y POSTERIOR RECUBRIMIENTO DE PINTURA DE POLVO EPOXY, INTERIOR DE 300 MICRAS Y EXTERIOR DE 200 MICRAS. INCLUSO CORTE Y ELABORACIÓN EN TALLER, MONTAJE PARA UNIÓN MEDIANTE SOLDADURA. MEDIDO SEGÚN PESO NOMINAL DEL COLECTOR. PESO DE APOYOS, PERNOS, TORNILLERÍA Y REFUERZOS INCLUIDO EN EL PRECIO. | CINCO EUROS con VEINTE CÉNTIMOS | 5,20 |
| 0189 | MAPCCII | u | SISTEMA DE PROTECCIÓN CATÓDICA FORMADA POR ÁNODO DE MAGNESIO DE 4,1 KG PREEMPAQUETADO COLOCADO Y PROBADO INCLUSO PARTE PROPORCIONAL DE LOS SIGUIENTES ELEMENTOS:<br>- TEJA DE ACERO CURVADA CON 10 M. DE CABLE CU RV 0,6/1KV 1*6 MM2.<br>- ENCAPSULACIÓN PARA LA SOLDADURA CABLE-TUBERÍA DE CINTA ELASTOMÉRICA.<br>- CAJA DE TOMA DE POTENCIAL DE 200*200 MM EN ALEACIÓN DE ALUMINIO IP-65, PLACA DE MONTAJE CON CUATRO BORNAS Y TUBO SOPORTE DE ACERO GALVANIZADO DE 2" Y 2 M. DE LONGITUD.<br>- CABLE DE CU RV 0,6/1KV 1*6 MM2.<br>- ELECTRODO REFERENCIA PERMANENTE CU/CUSO4. | CIENTO DOCE EUROS con SEIS CÉNTIMOS | 112,06 |
| 0190 | MAPG2-5T18 | UD | PUENTE GRÚA BIRRAIL CON POLIPASTO CARRO BIRRAIL DE 2,5 TN, 18 M DE LUZ Y 6 M DE RECORRIDO DEL GANCHO, ALIMENTADO CON 380 V/ 50 HZ. Y UNA TENSIÓN DE MANDO DE 48 V/50 HZ. CON BOTONERA DESPLAZABLE INDEPENDIENTE DEL CARRO. LA GRÚA IRÁ PROVISTA DE TOMACORRIENTES. INCLUIDA LA INSTALACIÓN ELÉCTRICA DE 20 M DE LONGITUD. TRANSPORTE Y MONTAJE INCLUIDO, COMPLETAMENTE INSTALADO Y PROBADO. | DIECIOCHO MIL SETECIENTOS TREINTA Y CINCO EUROS con TRES CÉNTIMOS | 18.735,03 |
| 0191 | MAT327 | m | TUBERÍA HORMIGÓN VIBROCOMPRIMIDO CON ENCHUFE DE CAMPANA DN 400 | ONCE EUROS con CINCUENTA Y SEIS CÉNTIMOS | 11,56 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
|---|---|---|---|---|---|
| 0192 | MEDEIASIE | m² | SIEMBRA A VOLEO DE SUPERFICIES CON ESPECIES LOCALES (INCLUIDAS ESPECIES PERTENECIENTES A LOS HABITATS COMUNITARIOS EXISTENTES EN LA ZONA, RECOGIDOS EN EL ESTUDIO DE IMPACTO AMBIENTAL), INCLUSO APORTACION Y EXTENDIDO DE TIERRA VEGETAL (APROXIMADAMENTE 20 CM) E INCLUIDA LA SEMILLA, SIEMBRA, RIEGO Y CUIDADOS POSTERIORES PARA ADECUADA SUPERVIVENCIA DE LAS ESPECIES IMPLANTADAS. | CERO EUROS con OCHENTA Y TRES CÉNTIMOS | 0,83 |
| 0193 | MO10CSH | Hr | REUNIÓN DE SEGURIDAD Y SALUD, COMPUESTO POR UN TÉCNICO EN MATERIA DE SEGURIDAD CON CATEGORIA DE ENCARGADO, DOS TRABAJADORES CON CATEGORIA DE OFICIAL DE 2ª, UN AYUDANTE Y UN VIGILANTE DE SEGURIDAD CON CATEGORIA DE OFICIAL DE 1ª, CONSIDERANDO UNA REUNIÓN COMO MÍNIMO AL MES. | CINCUENTA Y DOS EUROS con SETENTA Y SEIS CÉNTIMOS | 52,76 |
| 0194 | MO10ELC | Hr | EQUIPO DE LIMPIEZA Y CONSERVACIÓN DE INSTALACIONES PROVISIONALES DE OBRA, CONSIDERANDO UNA HORA CADA DOS DÍAS DE OFICIAL DE 2ª Y DE AYUDANTE | DIECISIETE EUROS con OCHENTA Y CINCO CÉNTIMOS | 17,85 |
| 0195 | MO10ESE | Hr | H. EQUIPO DE LIMPIEZA Y CONSERVACIÓN DE INSTALACIONES PROVISIONALES DE OBRA, CONSIDERANDO UNA HORA DIARIA DE OFICIAL DE 2ª Y DE AYUDANTE. S/R.D. 485/97. | TREINTA Y SEIS EUROS con CINCUENTA Y NUEVE CÉNTIMOS | 36,59 |
| 0196 | MO10FSH | Hr | FORMACIÓN DE SEGURIDAD Y SALUD EN EL TRABAJO, CONSIDERANDO UNA HORA A LA SEMANA Y REALIZADA POR UN ENCARGADO. | DIECISEIS EUROS con TREINTA Y CUATRO CÉNTIMOS | 16,34 |
| 0197 | MO10LDC | Ud | 24 LIMPIEZA Y DESINFECCIÓN DE CASETAS DE OBRA, CONSIDERANDO UNA LIMPIEZA POR CADA DOS SEMANAS. | TREINTA EUROS con NOVENTA CÉNTIMOS | 30,90 |
| 0198 | MOTCOMP | ud | SUMINISTRO E INSTALACION DE ACTUADOR ELCTRICO CON MOTOR DE 24VDC 120NM, REDUCTOR CONICO 1:3,5. CON DETECCION DE INTRUSION. ACOPLADO SOBRE BRIDA NORMALIZADA F14 Y MECANIZADO DE TUERCA DE ARRASTRE PARA ADAPTACION A EJE O HUSILLO, AJUSTE Y PUESTA EN MARCHA. TIRADO DE CABLE TIPO RVK 2X16 (INCLUSO TUBO). TIRADO DE CABLE TIPO YCY 16X0,5 (INCLUSO TUBO). INSTALACION DE TUBO RIGIDO ELECTRICO DE ACERO GALVANIZADO ENCHUFABLE DE DIAMETRO 32MM CON CODOS Y EMPALMES NECESARIOS SUJETO MEDIANTE GRAPAS ATORNILLADAS. | SEIS MIL TRESCIENTOS SESENTA Y CUATRO EUROS con CINCUENTA Y OCHO CÉNTIMOS | 6.364,58 |
| 0199 | MREPREOBR | Ud | MES DE RECURSO PREVENTIVO EN OBRA DE PROYECTO C.R. CARTUJA - SAN JUAN (HUESCA) | SESENTA Y DOS EUROS con CUARENTA CÉNTIMOS | 62,40 |
| 0200 | MT003 | m | CANALIZACIÓN ELÉCTRICA QUE CONSISTENTE EN UNA ZANJA DE 90 CM DE PROFUNDIDAD POR 40 CM DE ANCHURA, CON CAMA DE ARENA DE RÍO DE 5 CM PARA ASIENTO DE LOS CONDUCTORES Y RELLENO CON UNA CAPA DE 15 CM DE LA MISMA ARENA SOBRE LOS CONDUCTORES. SOBRE ÉSTA VA UNA HILADA DE RASILLAS CERÁMICAS O PLACAS DE PE, QUE SERVIRÁN DE PROTECCIÓN MECÁNICA (20 J), Y TESTIGO DE SEÑALIZACIÓN. EL RELLENO FINAL DE ZANJA SE LLEVARÁ A CABO POR TONGADAS DE 20 CM DE TIERRA PROCEDENTE DE LA EXCAVACIÓN, COMPACTADA AL 95 % DEL PRÓCTOR NORMAL. TOTALMENTE TERMINADA INCLUIDO EXCAVACIÓN SOBRE CUALQUIER CLASE DE TERRENO, TRANPORTE A VERTEDERO DE LA TIERRA SOBRANTE Y MANTENIMIENTO DE LOS SERVICIOS EXISTENTES. | TRECE EUROS con UN CÉNTIMOS | 13,01 |
| 0201 | MT004A | m | M.L. SUMINISTRO Y TENDIDO DE CABLE UNIPOLAR DE M.T. EN LECHO DE ARENA, DE AISLAMIENTO SECO RH-Z1 18/30 KV DE 3X1X240 MM2 DE SECCIÓN NOMINAL EN ALUMINIO, INCLUIDO PEQUEÑO MATERIAL PARA EL TENDIDO TENDIDO COMO RODILLOS, CINTURILLAS, ASÍ COMO MEDIOS MECÁNICOS NECESARIOS. | VEINTIOCHO EUROS con TREINTA Y DOS CÉNTIMOS | 28,32 |
| 0202 | MT004C | m | M.L. SUMINISTRO Y TENDIDO DE CABLE TETRAPOLAR DE M.T. EN LECHO DE ARENA, DE AISLAMIENTO SECO RH-Z1 18/30 KV DE 3X1X95 MM2 DE SECCIÓN NOMINAL EN ALUMINIO, INCLUIDA P.P. DE ELEMENTOS DE TENDIDO COMO RODILLOS, CINTURILLAS, ASÍ COMO MEDIOS MECÁNICOS NECESARIOS. | VEINTE EUROS con NOVENTA Y CINCO CÉNTIMOS | 20,95 |
| 0203 | MT005-PFU4 | Ud | CASETA PREFABRICADA TIPO PFU-4 O SIMILAR, MONOBLOQUE, DE HORMIGÓN ARMADO, DE 4460X2380X3045 MM, APTO PARA CONTENER UN TRANSFORMADOR Y LA APARAMENTA NECESARIA. INCLUSO TRANSPORTE Y DESCARGA. INCLUYE EXCAVACIÓN, CAMA DE ARENA, RELLENOS LATERALES, CARGAS Y TRANSPORTES DE MATERIALES NECESARIOS Y EXCEDENTES, EDIFICIO Y TODOS SUS ELEMENTOS EXTERIORES SEGÚN CEI 622171-202, TRANSPORTE, MONTAJE Y ACCESORIOS. TOTALMENTE INSTALADO Y TERMINADO. TOTALMENTE MONTADO. | SIETE MIL NOVENTA Y OCHO EUROS con SESENTA Y TRES CÉNTIMOS | 7.098,63 |
| 0204 | MT005-PFU4ST | Ud | CASETA PREFABRICADA TIPO PFU-4 O SIMILAR, MONOBLOQUE, DE HORMIGÓN ARMADO, DE 4460X2380X3045 MM, APTO PARA CONTENER UN TRANSFORMADOR Y LA APARAMENTA NECESARIA. INCLUSO TRANSPORTE Y DESCARGA. INCLUYE EXCAVACIÓN, CAMA DE ARENA, RELLENOS LATERALES, CARGAS Y TRANSPORTES DE MATERIALES NECESARIOS Y EXCEDENTES, EDIFICIO Y TODOS SUS ELEMENTOS EXTERIORES SEGÚN CEI 622171-202, TRANSPORTE, MONTAJE Y ACCESORIOS. TOTALMENTE INSTALADO Y TERMINADO. TOTALMENTE MONTADO. | SIETE MIL NOVENTA Y OCHO EUROS con SESENTA Y TRES CÉNTIMOS | 7.098,63 |
| 0205 | MT005C | u | UD. SUMINISTRO Y MONTAJE DE BOTELLA INTERIOR TERMINAL UNIPOLAR DE M.T. PARA CABLE SECO 18/30 KV TIPO RH-Z1 DE 1X95 MM2 DE SECCIÓN NOMINAL EN ALUMINIO, INCLUIDO TERMINAL DE CONEXION A PRESIÓN PARA MT, PEQUEÑO MATERIAL, MEDIOS AUXILIARES, TOTALMENTE MONTADA. | CIENTO QUINCE EUROS con SESENTA Y CUATRO CÉNTIMOS | 115,64 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0206 | MT0185 | m | M.L. SUMINISTRO Y TENDIDO DE CABLE UNIPOLAR DE M.T. EN LECHO DE ARENA, DE AISLAMIENTO SECO RH-Z1 18/30 KV DE 3X1X150 MM2 DE SECCIÓN NOMINAL EN ALUMINIO, INCLUIDO PEQUEÑO MATERIAL PARA EL TENDIDO TENDIDO COMO RODILLOS, CINTURILLAS, ASÍ COMO MEDIOS MECÁNICOS NECESARIOS. | VEINTISEIS EUROS con TREINTA Y CUATRO CÉNTIMOS | 26,34 |
| 0207 | MTCELDAS001B | Ud | CELDAS DE PROTECCIÓN PARA CENTRO DE TRANSFORMACIÓN, TIPO ORMAZABAL, SEGÚN DESGLOSE.<br>- 1 CELDA MODULAR DE SECCIONAMIENTO DISPUESTA DE UN INTERRUPTOR-SECCIONADOR, AISLAMIENTO INTEGRO EN SF6 DE 36KV, 16KA Y 630A.<br>- 2 CELDAS MODULAR DE PROTECCIÓN DISPUESTA DE FUSIBLES LIMITADORES Y DE UN INTERRUPTOR-SECCIONADOR DE TRES POSICIONES (CONECTADO, SECCIONADO Y PUESTA A TIERRA, ANTES Y DESPUÉS DE LOS FUSIBLES), SF6 DE 36KV, 16KA Y 400A.<br>SE INCLUYE EL MONTAJE, PASATAPAS Y CONEXIÓN. | DIECIOCHO MIL OCHOCIENTOS TREINTA Y OCHO EUROS con CUARENTA Y TRES CÉNTIMOS | 18.838,43 |
| 0208 | MTCELDAS002 | Ud | CELDAS DE PROTECCIÓN Y MEDIDA PARA CENTRO DE SECCIONAMIENTO Y MEDIDA, TIPO ORMAZABAL, SEGÚN DESGLOSE.<br>- 2 CELDAS MODULARES DE LÍNEA MOTORIZADAS DISPUESTA DE UN INTERRUPTOR-SECCIONADOR DE TRES POSICIONES (CONECTADO, SECCIONADO Y PUESTA A TIERRA), AISLAMIENTO INTEGRO EN SF6 DE 36KV, 16KA Y 630A<br>- 1 CELDA MODULAR DE SECCIONAMIENTO MOTORIZADA DISPUESTA DE UN INTERRUPTOR-SECCIONADOR, AISLAMIENTO INTEGRO EN SF6 DE 36KV, 16KA Y 630A.<br>- 1 CELDA DE REMONTE PARA 36KV Y 630A.<br>- 1 CELDAS MODULAR DE PROTECCIÓN DISPUESTA DE FUSIBLES LIMITADORES Y DE UN INTERRUPTOR-SECCIONADOR DE TRES POSICIONES (CONECTADO, SECCIONADO Y PUESTA A TIERRA, ANTES Y DESPUÉS DE LOS FUSIBLES), SF6 DE 36KV, 16KA Y 400A.<br>- 1 CELDA MODULAR DE MEDIDA DISPUESTA EN EL INTERIOR LOS TRANSFORMADORES DE MEDIDA DE TENSIÓN E INTENSIDAD, DE 36KV.<br>SE INCLUYE EL MONTAJE, PASATAPAS Y CONEXIÓN. | TREINTA Y SIETE MIL CUATROCIENTOS TRES EUROS con NOVENTA Y DOS CÉNTIMOS | 37.403,92 |
| 0209 | MTCUADROBT | ud | CUADRO DE BT ESPECIALMENTE DISEÑADO PARA ESTA APLICACIÓN CON LAS SIGUIENTES CARACTERÍSTICAS:<br>· INTERRUPTOR MANUAL DE CORTE EN CARGA DE 1250 A.<br>· SALIDAS FORMADAS POR BASES PORTAFUSIBLES: 1 SALIDA<br>· TENSIÓN NOMINAL: 440 V<br>· AISLAMIENTO: 10 KV<br>· DIMENSIONES: ALTO: 1820 MM<br>ANCHO: 580 MM<br>FONDO: 300 MM<br>PUENTES, CONEXIONES Y DEMÁS MATERIAL Y TRABAJSO COMPLEMENTARIOS, INLCUIDOS. MEDIDA LA UNIDAD TOTLAMENTE TERMINADA. | TRES MIL QUINIENTOS DIECISIETE EUROS con DIECIOCHO CÉNTIMOS | 3.517,18 |
| 0210 | MTHA20 | m³ | HORMIGÓN HM-20/B/20/IIA, DE CONSISTENCIA PLÁSTICA Y TAMAÑO MÁXIMO DEL ÁRIDO 20 MM, | SETENTA Y CUATRO EUROS con OCHENTA Y SIETE CÉNTIMOS | 74,87 |
| 0211 | MTHA25IIA | m³ | HORMIGÓN HA-25/B/20/IIA, CON ÁRIDO DE 20 MM DE TAMAÑO MÁXIMO, CONSISTENCIA BLANDA, FABRICADO CON CEMENTO I-32,5, ELABORADO EN PLANTA. INCLUIDA PUESTA EN OBRA, VIBRADO Y CURADO. | OCHENTA Y DOS EUROS con SETENTA Y TRES CÉNTIMOS | 82,73 |
| 0212 | MTHA35IIA | m³ | HORMIGÓN HA-35/B/20/IIA, CON ÁRIDO DE 20 MM DE TAMAÑO MÁXIMO, CONSISTENCIA BLANDA, FABRICADO CON CEMENTO I-32,5, ELABORADO EN PLANTA. INCLUIDA PUESTA EN OBRA, VIBRADO Y CURADO. | NOVENTA Y UN EUROS con SETENTA Y SEIS CÉNTIMOS | 91,76 |
| 0213 | MTHA35IIAQC | M3 | HORMIGÓN HA-35/B/20/IIA + QC CON CEMENTO SULFORRESISTENTE, DE CONSISTENCIA BLANDA Y TAMAÑO MÁXIMO DEL ÁRIDO 20 MM, | NOVENTA Y CUATRO EUROS con OCHENTA Y TRES CÉNTIMOS | 94,83 |
| 0214 | MTHAPAV25 | m² | PAVIMENTO CONTINUO DE HORMIGÓN HA-25/B/20/I, DE 30 CM. DE ESPESOR, ARMADO CON MALLAZO DE ACERO 20X20X6, ACABADO SUPERFICIAL FRATASADO, I/PREPARACIÓN DE LA BASE, EXTENDIDO, REGLEADO, VIBRADO, FRATASADO, CURADO, APORTACIÓN DE MORTERO DE CUARZO PARA ACABADO, CORTE DE LA SOLERA EN CUADRICULAS Y EN ZONA DE APOYO DE PILARES, Y P.P.. DE JUNTAS. | VEINTICINCO EUROS con CINCUENTA Y OCHO CÉNTIMOS | 25,58 |
| 0215 | MTHM20IIA | m³ | HORMIGÓN HM-20/B/20/I, DE CONSISTENCIA BLANDA Y TAMAÑO MÁXIMO DEL ÁRIDO 20 MM, | SETENTA Y CUATRO EUROS con OCHENTA Y SIETE CÉNTIMOS | 74,87 |

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| 0216 | MVTEX01 | M3 | EXCAVACION A CIELO ABIERTO CON MEDIOS MECÁNICOS EN CUALQUIER TIPO DE TERRENO INCLUSO ROCA, CON SEPARACION DE LOS 25 CM. SUPERIORES DE TIERRA VEGETAL INCLUYENDOSE SU CARGA, TRANSPORTE Y ACOPIO PARA POSTERIOR REPOSICIÓN DEL TERRENO AL ESTADO ORIGINAL. INCLUSO PERFILADO DE LATERALES Y FONDOS, ENTIBADO Y AGOTAMIENTO, APILADO Y TRASLADO EN OBRA DE PRODUCTOS DE EXCAVACIÓN, APORTACIÓN DE RIEGOS CON CUBA PARA MINIMIZAR LA EMISIÓN DE PARTÍCULAS DE POLVO A LA ATMÓSFERA. INCLUSO LOS MOVIMIENTOS DE TIERRA NECESARIOS PARA LA CREACIÓN DE PISTA DE SERVICIO PARALELA A LA PROPIA ZANJA Y LOS NECESARIOS PARA LA EJECUCIÓN DE TODOS LOS ACCESOS NECESARIOS. INCLUSO TAMBIÉN LA REPARACIÓN DE CAMINOS Y VIALES EXISTENTES, SERVICIOS AFECTADOS (LÍNEAS ELÉCTRICAS, CONDUCCIONES, INSTALACIONES DE RIEGO, ETC), INCLUSO LA PÉRDIDA DE RENDIMIENTO POR LA PRESENCIA DE SERVICIOS, BALATES Y MÁRGENES EXISTENTES ANTES DE LA EXCAVACIÓN. CARGA Y TRANSPORTE A TERRAPLEN O VERTEDERO A DISTANCIA INFERIOR A 5 KM. MEDIDO EL VOLUMEN SOBRE PERFIL NATURAL, CONSIDERANDO LA SECCIÓN TIPO DE PROYECTO Y EL PERFIL TEÓRICO APROBADO POR LA DIRECCIÓN FACULTATIVA DE FORMA PREVIA A SU EJECUCIÓN. | UN EUROS con OCHENTA Y CINCO CÉNTIMOS | 1,85 |
| 0217 | MVTRE01 | M3 | CAMA DE MATERIAL GRANULAR DE 6 A 12 MM, PARA ASIENTO DE TUBERÍAS PROCEDENTE DE PRÉSTAMOS, CON ÁRIDO NATURAL RODADO, CON REPARTO MECÁNICO Y EXTENDIDO MANUAL, INCLUIDO EL RASANTEO PARA EL APOYO CORRECTO DE LA TUBERÍA Y TAPADO. MEDIDO EL VOLUMEN DE MATERIAL UNA VEZ COMPACTADO SOBRE EL PERFIL FINAL EJECUTADO, CONSIDERANDO LA SECCIÓN TIPO DE PROYECTO Y EL PERFIL TEÓRICO APROBADO POR LA DIRECCIÓN FACULTATIVA DE FORMA PREVIA A SU EJECUCIÓN. | VEINTE EUROS con SETENTA Y CUATRO CÉNTIMOS | 20,74 |
| 0218 | MVTRE02 | M3 | RELLENO SELECCIONADO LOCALIZADO CON MATERIAL SELECCIONADO PROCEDENTE DE EXCAVACION CON ELEMENTOS GRUESOS < 25 MM ANTES DE COMPACTAR, INCLUSO REGADO, TENDIDO Y COMPACTADO AL 95 % PROCTOR NORMAL. INCLUIDA LA TRAÍDA DEL MATERIAL DENTRO DE LA OBRA, SI EL DE LA EXCAVACIÓN NO ES ADECUADO E INCLUSO SU CRIBADO AL TAMAÑO INDICADO Y EL TRANSPORTE A VERTEDERO DEL MATERIAL RECHAZADO. MEDIDO EL VOLUMEN DE TIERRAS UNA VEZ CMPACTADAS SOBRE EL PERFIL FINAL EJECUTADO, CONSIDERANDO LA SECCIÓN TIPO DE PROYECTO Y EL PERFIL TEÓRICO APROBADO POR LA DIRECCIÓN FACULTATIVA DE FORMA PREVIA A SU EJECUCIÓN. | UN EUROS con VEINTIDOS CÉNTIMOS | 1,22 |
| 0219 | MVTRE023 | m³ | MATERIAL GRANULAR TIPO Z30 S/PG3 PUESTO EN OBRA, EXTENDIDO, HUMEDECIDO Y COMPACTADO AL 98% DEL PM EN CAPAS DE 10 CM DE ESPESOR EN BASES DE OBRAS SINGULARES EN VIALES | VEINTIDOS EUROS con OCHENTA Y SEIS CÉNTIMOS | 22,86 |
| 0220 | MVTRE03 | M3 | RELLENO DE ZANJA CON TERRENO PROCEDENTE DE LA EXCAVACIÓN, REALIZADO MECÁNICAMENTE, SIN APORTACIÓN DE TIERRAS DE PRÉSTAMOS, AUNQUE INCLUYENDO EL TRANSPORTE DENTRO DE LA PROPIA OBRA, COMPACTADO A UN 85% DEL PRÓCTOR NORMAL. INCLUYENDO SEPARACIÓN DE LA TIERRA VEGETAL Y DEPOSITADA EN SU PARTE SUPERIOR LA TIERRA VEGETAL SEPARADA, INCLUSO EXTENDIDO DE TIERRAS SOBRANTES. MEDIDO EL VOLUMEN DE TIERRAS UNA VEZ COMPACTADAS SOBRE EL PERFIL FINAL EJECUTADO, CONSIDERANDO LA SECCIÓN TIPO DE PROYECTO Y EL PERFIL TEÓRICO APROBADO POR LA DIRECCIÓN FACULTATIVA DE FORMA PREVIA A SU EJECUCIÓN. | CERO EUROS con SESENTA Y DOS CÉNTIMOS | 0,62 |
| 0221 | MVTRE04 | M3 | RELLENO DE MATERIAL GRANULAR DE 6 A 12 MM, PROCEDENTE DE CANTERA O GRAVERA NO NATURAL, CON REPARTO MECÁNICO Y EXTENDIDO MANUAL, MATERIAL INTERRUMPIDO CADA 100 M POR 1 M DE RELLENO SELECCIONADO COMPACTADO AL 98% PN. MEDIDO EL VOLUMEN DE MATERIAL UNA VEZ COMPACTADO SOBRE EL PERFIL FINAL EJECUTADO, CONSIDERANDO LA SECCIÓN TIPO DE PROYECTO Y EL PERFIL TEÓRICO APROBADO POR LA DIRECCIÓN FACULTATIVA DE FORMA PREVIA A SU EJECUCIÓN. | DIECINUEVE EUROS con OCHENTA Y SIETE CÉNTIMOS | 19,87 |
| 0222 | OGB063 | M2 | SOLADO DE BALDOSA DE GRES PORCELÁNICO NATURAL DE 20X20 CM., RECIBIDO CON MORTERO DE CEMENTO Y ARENA DE RÍO 1/6 (M-40), I/CAMA DE 2 CM. DE ARENA DE RÍO, REJUNTADO CON LECHADA DE CEMENTO BLANCO Y LIMPIEZA, S/NTE-RSR-2, MEDIDO EN SUPERFICIE REALMENTE EJECUTADA. | TREINTA Y NUEVE EUROS con CUARENTA Y CINCO CÉNTIMOS | 39,45 |
| 0223 | OT01 | ud | MÁQUINA LIMPIA REJAS DE UN BRAZO ACCIONADA POR SISTEMA OLEOHIDRÁULICO, ACCIONADA POR TEMPORIZADOR, CON CAPACIDA DE CARGA EN REJA DE 2.400 KG. ACABADO CON 2 CAPAS DE PINTURA (IMPRIMACIÓN Y ACABADO). INCLUIDO ARMARIO DE CONTROL CON GRUPO OLEOHIDRÁULICO Y CUADRO ELÉCTRICO (POTENCIA 3 CV CON NEUTRO (220/380 V TRIFÁSICO). TOTALMENTE TERMINADA Y PROBADA. | VEINTINUEVE MIL CUATROCIENTOS NOVENTA Y UN EUROS con NOVENTA Y CUATRO CÉNTIMOS | 29.491,94 |
| 0224 | OT02 | ud | SISTEMA DE EVACUACIÓN DE RESIDUOS FILTRADOS MEDIANTE PALA ACCIONADA POR CADENA, DE 8 M DE CARRERA Y 2 TOLVAS DE ALMACENAJE. TOTALMENTE TERMINADA Y PROBADA. | CINCO MIL CIENTO DOCE EUROS con SESENTA Y SIETE CÉNTIMOS | 5.112,67 |

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| 0225 | OT03 | ud | REJA DE FINOS DE 3000 X 4000 MM, Y 20 MM DE LUZ ENTRE BARROTES, DE LAS SIGUIENTES CARACTERÍSTICAS:<br>- PASAMANO DE 60X6 MM.<br>- LONGITUD DEL PASAMANO DE 3000 MM<br>- EXISTIRÁN 3 ZONAS DE APOYO DE LA REJA:<br>- INFERIOR: PERFIL UPN EN LA QUE SE AJUSTARÁ LA REJA DE FINOS.<br>- MEDIO: BIGA IPE FIJADA A LAS PAREDES DEL CANAL.<br>- SUPERIOR: DE OBRA SOBRE LA CUAL SE APOYARÁ LA REJA.<br>TOTALMENTE TERMINADA Y PROBADA. | SEIS MIL TRESCIENTOS NOVENTA Y CINCO EUROS con TREINTA Y UN CÉNTIMOS | 6.395,31 |
| 0226 | PANEL1 | m2 | CUBIERTA COMPLETA FORMADA POR PANEL DE 30 MM DE ESPESOR TOTAL CONFORMADO CON DOBLE CHAPA DE ACERO DE 0,5 MM DE ESPESOR PERFIL NERVADO, LACADO AL EXTERIOR Y GALVANIZADO EL INTERIOR, CON RELLENO INTERMEDIO DE ESPUMA DE POLIURETANO; PANEL ANCLADO A LA ESTRUCTURA MEDIANTE TORNILLOS AUTORROSCANTES, I/P.P. DE TAPAJUNTAS, REMATES, PIEZAS ESPECIALES DE CUALQUIER TIPO, MEDIOS AUXILIARES, SEGÚN NTE/QTG-7. | CUARENTA Y CUATRO EUROS con OCHENTA Y OCHO CÉNTIMOS | 44,88 |
| 0227 | PANIDIFAVI | Pa | PARTIDA ALZADA DE ABONO ÍNTEGRO PARA LA INSTALACIÓN DE NIDOS ARTIFICIALES EN DIFERENTES PUNTOS DEL ÁMBITO DE ACTUACIÓN (CAJAS NIDO Y/O TORRES DE NIDIFICACIÓN), DESTINADOS A ESPECIES COMO LA LECHUZA COMÚN (TYTO ALBA), EL MOCHUELO (ATHENE NOCTUA) O EL CERNÍCALO PRIMILLA (FALCO NAUMANNI) | CUATRO MIL EUROS | 4.000,00 |
| 0228 | PAPLANARB | Pa | PARTIDA ALZADA DE ABONO ÍNTEGRO DE PLANTACIÓN DE PLANTAS ARBUSTIVAS EN MARGENES Y RIBAZOS, CON ESPECIES COMO ROSAL SILVESTRE (ROSA CANINCA), ESPINO ALBAR (CRATAEGUS MONOGYNA), ESPINO NEGRO (RHAMNUS LYCIOIDES), LENTISCO (PISTACIA LENTISCUS), Y AROMÁTICAS COMO ROMERO (ROSMARINUS OFFICINALIS) Y TOMILLO (THYMUS VULGARIS), ENTRE OTRAS. | TRES MIL EUROS | 3.000,00 |
| 0229 | PC10CATA | m | ML. CABLE DE SEGURIDAD PARA ATADO EN TRABAJOS DE ALTURA, SUJETO MADIANTE ANCLAJES HORMIGONADOS Y SEPARADOS CADA 2ML.I/MONTAJE Y DESMONTAJE. S/R.D. 485/97. | TRECE EUROS con CUARENTA CÉNTIMOS | 13,40 |
| 0230 | PC10RHPH | m² | M2. RED HORIZONTAL PARA PROTECCIÓN DE HUECOS DE POLIAMIDA DE HILO DE D=4 MM. Y MALLA DE 75X75 MM. INCLUSO COLOCACIÓN Y DESMONTADO. S/R.D. 485/97. | CUATRO EUROS con OCHENTA Y SEIS CÉNTIMOS | 4,86 |
| 0231 | PC20BTST | m | ML. BARANDILLA CON SOPORTE TIPO SARGENTO Y TRES TABLÓNES DE 0,20X0,07 M. EN PERÍMETRO DE FORJADOS TANTO DE PISOS COMO DE CUBIERTA, INCLUSO COLOCACIÓN Y DESMONTAJE. S/R.D. 485/97. | SIETE EUROS con CATORCE CÉNTIMOS | 7,14 |
| 0232 | PC20MPS | m | MALLA DE POLIETILENO ALTA DENSIDAD CON TRATAMIENTO PARA PROTECCIÓN DE ULTRAVIOLETAS, COLOR NARANJA DE 1 M. DE ALTURA Y DOBLE ZÓCALO DEL MISMO MATERIAL, I/COLOCACIÓN Y DESMONTAJE. (AMORTIZACIÓN EN DOS PUESTAS). S/R.D. 485/97. | DOS EUROS con VEINTIOCHO CÉNTIMOS | 2,28 |
| 0233 | PP10CS | Ud | UD. CASCO DE SEGURIDAD CON DESUDADOR. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | TRES EUROS | 3,00 |
| 0234 | PP10GA | Ud | UD. GAFAS ANTIPOLVO TIPO VISITANTE INCOLORA, ANTIEMPAÑABES. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | DOS EUROS con CUARENTA Y SIETE CÉNTIMOS | 2,47 |
| 0235 | PP10GCI | Ud | UD. GAFAS CONTRA IMPACTOS ANTIRAYADURA. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | SEIS EUROS con CUARENTA Y NUEVE CÉNTIMOS | 6,49 |
| 0236 | PP10GPL | Ud | UD. GAFAS PANORÁMICAS CONTRA LÍQUIDOS CON VÁLVULAS ANTIEMPAÑANTES. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | NUEVE EUROS con VEINTISIETE CÉNTIMOS | 9,27 |
| 0237 | PP10PA | Ud | UD. PROTECTORES AUDITIVOS. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | SIETE EUROS con SETENTA Y CUATRO CÉNTIMOS | 7,74 |
| 0238 | PP10PSPS | Ud | UD. PANTALLA DE SEGURIDAD PARA SOLDADURA. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | DOCE EUROS con SIETE CÉNTIMOS | 12,07 |
| 0239 | PP30ADC | Ud | UD. ANTICAIDAS DESLIZANTE PARA CUERDA DE 14 MM, C/MOSQUETÓN. CERTIFICADO CE NORMA EN 361. S/R.D. 773/97 Y R.D. 1407/92. | CIENTO OCHENTA EUROS con VEINTICINCO CÉNTIMOS | 180,25 |
| 0240 | PP30AF | Ud | UD. APARATO DE FRENO DE PARACAIDAS. CERTIFICADO CE NORMA EN 361. S/R.D. 773/97 Y R.D. 1407/92. | SESENTA Y DOS EUROS con CUARENTA CÉNTIMOS | 62,40 |
| 0241 | PP30ASCA | Ud | UD. CINTURÓN DE SEGURIDAD CLASE A (SUJECCIÓN), CON CUERDA REGULABLE DE 1,8 M. CON GUARDA CABOS Y 2 MOSQUETONES. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | SESENTA Y CINCO EUROS con SESENTA Y DOS CÉNTIMOS | 65,62 |
| 0242 | PP30ASCC | Ud | UD. ARNÉS DE SEGURIDAD CLASE C (PARACAIDAS), CON CUERDA DE 1 M. Y DOS MOSQUETONES, EN BOLSA DE TRANSPORTE. CERTIFICADO CE NORMA EN 361. S/R.D. 773/97 Y R.D. 1407/92. | SETENTA Y OCHO EUROS | 78,00 |
| 0243 | PP30C14P | m | CUERDA REALIZADA EN POLIAMIDA DE ALTA TENACIDAD DE D=14 MM. INCLUSO BARRA ARGOLLAS EN EXTREMO DE POLIMIDAS REVESTIDAS DE PVC. CERTIFICADO CE NORMA EN 361. S/R.D. 773/97 Y R.D. 1407/92. | CINCO EUROS con ONCE CÉNTIMOS | 5,11 |

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| 0244 | PP30CAP | Ud | UD. CUERDA DE AMARRE DE LONGITUD 1,00 MT, REALIZADO EN POLIAMIDA DE ALTA TENACIDAD DE 14 MM DE DIÁMETRO, I/ ARGOLLAS EN EXTREMOS DE POLIMIDA REVESTIDAS DE PVC. CERTIFICADO CE NORMA EN 361. S/R.D. 773/97 Y R.D. 1407/92. | OCHO EUROS con SESENTA Y SEIS CÉNTIMOS | 8,66 |
| 0245 | PP30CPH | Ud | UD. CINTURÓN PORTAHERRAMIENTAS. CERTIFICADO CE NORMA EN 361. S/R.D. 773/97 Y R.D. 1407/92. | VEINTIUN EUROS con SESENTA Y SIETE CÉNTIMOS | 21,67 |
| 0246 | PP30IMPERM | Ud | UD. IMPERMEABLE DE TRABAJO. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | NUEVE EUROS con VEINTINUEVE CÉNTIMOS | 9,29 |
| 0247 | PP30MONOTRA | Ud | UD. MONO DE TRABAJO. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | DIECISEIS EUROS con DIEZ CÉNTIMOS | 16,10 |
| 0248 | PP30MSS | Ud | UD. MANDIL DE SERRAJE PARA SOLDADOR GRADO A, 60X90 CM. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | CATORCE EUROS con CUARENTA Y DOS CÉNTIMOS | 14,42 |
| 0249 | PP30PRBA | Ud | UD. PETO REFLECTANTE DE SEGURIDAD PERSONAL EN COLORES AMARILLO Y ROJO. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | DIEZ EUROS con TREINTA CÉNTIMOS | 10,30 |
| 0250 | PP50PGLA | Ud | UD. PAR DE GUANTES DE LATEX RUGOSO ANTICORTE. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | DOS EUROS con SETENTA Y OCHO CÉNTIMOS | 2,78 |
| 0251 | PP50PGN | Ud | UD. PAR DE GUANTES DE NITRILO ALTA-RESISTENCIA. 100% AZULTES. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | TRES EUROS con VEINTINUEVE CÉNTIMOS | 3,29 |
| 0252 | PP50PGS34C | Ud | UD. PAR DE GUANTES PARA SOLDADOR SERRAJE FORRADO IGNÍFUGO, LARGO 34 CM., HOMOLOGADO CE. | SIETE EUROS con SETENTA Y CUATRO CÉNTIMOS | 7,74 |
| 0253 | PP50PMSH | Ud | UD. PAR DE MANGUITOS PARA SOLDADOR AL HOMBRO SERRAJE GRADO A, HOMOLOGADO CE. | DIEZ EUROS con CINCUENTA Y TRES CÉNTIMOS | 10,53 |
| 0254 | PP60PBA | Ud | UD. PAR DE BOTAS AISLANTES PARA ELECTRICISTA HASTA 5.000 V. DE TENSIÓN. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | VEINTICINCO EUROS con SESENTA Y NUEVE CÉNTIMOS | 25,69 |
| 0255 | PP60PBAM | Ud | UD. PAR DE BOTAS DE AGUA MONOCOLOR. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | TRECE EUROS con NOVENTA Y SIETE CÉNTIMOS | 13,97 |
| 0256 | PP60PBSPP | Ud | UD. PAR DE BOTAS DE SEGURIDAD S3 PIEL NEGRA CON PUNTERA Y PLANTILLA METÁLICA. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | TREINTA Y SEIS EUROS con CINCUENTA Y SIETE CÉNTIMOS | 36,57 |
| 0257 | PP60PBSPS | Ud | UD. PAR DE BOTAS DE SEGURIDAD S2 SERRAJE/LONA CON PUNTERA Y METÁLICAS. CERTIFICADO CE. S/R.D. 773/97 Y R.D. 1407/92. | VEINTICUATRO EUROS con CATORCE CÉNTIMOS | 24,14 |
| 0258 | PP60PPS | Ud | UD. PAR DE POLAINAS PARA SOLDADOR SERRAJE GRAD A, HOMOLOGADAS CE. | DIEZ EUROS con VEINTIDOS CÉNTIMOS | 10,22 |
| 0259 | PROSPFAU | Pa | PARTIDA ALZADA DE ABONO ÍNTEGRO DE CONTROL Y SEGUIMIENTO DE FAUNA, POR TÉCNICO COMPETENTE, INCLUYENDO INFORME PREOPERACIONAL, ANTES DEL INICIO DE LA OBRA, CON EL OBJETO DE IDENTIFICAR LA PRESENCIA Y VULNERABILIDAD DE ESPECIES SENSIBLES, CON UNA DEDICACIÓN MÍNIMA DE 2 H/SEMANALES | SEIS MIL CINCUENTA EUROS con NOVENTA Y SEIS CÉNTIMOS | 6.050,96 |
| 0260 | PROSPFLOR | Pa | PARTIDA ALZADA DE ABONO ÍNTEGRO DE CONTROL Y SEGUIMIENTO DE FLORA, POR TÉCNICO COMPETENTE, CON UNA DEDICACIÓN MÍNIMA DE 2 H/SEMANALES | SEIS MIL CINCUENTA EUROS con NOVENTA Y SEIS CÉNTIMOS | 6.050,96 |
| 0261 | PTSOLHA25 | m² | SOLERA DE 25 CM DE ESPESOR REALIZADA CON HORMIGÓN HA-25/P/20 TMAX. 20 MM ELABORADO EN CENTRAL, I/VERTIDO Y COMPACTADO, P.P. DE JUNTAS, ASERRADO DE LAS MISMAS, CON MALLAZO, LÁMINA DE PVC, INCLUSO FRATASADO. | TREINTA Y UN EUROS con SETENTA Y DOS CÉNTIMOS | 31,72 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0262 | PUL1HID | Ud | PUNTO DE CARGA DE EQUIPO DE PULVERIZACIÓN AGRÍCOLA CONFORMADO POR:<br>- PREPARACIÓN DE TERRENO Y COMPACTACIÓN DE 50 M2 (PLATAFORMA PARA VEHICULO)<br>- EXCAVACIÓN REQUERIDA PARA ZAPATA, Y PREPARACIÓN DE TERRENO A COMPACTAR.<br>- CIMIENTO DE 0,75X0.75X0.4 M CON ARMADURA B-500S DE 12 MM DE DIAMTERO CADA 15 CM EN AMBAS DIRECCIÓN DE LA CARA INFERIOR (INCLUIDA PATILLA LATERAL DE 15 CM)<br>- ESTRUCTURA METÁLICA MEDIANTE PILAR DE PERFIL IPE 140 DE 5 M DE ALTURA MASTIL REALIZADO CON IPE 100 DE 2 M DE LONGITUD Y REFUERZO ANGULAR MEDIANTE IPE 80. LA UNIÓN ENTRE LOS ELEMENTOS HORIZONTALES Y EL PILAR SE REALIZARÁ MEDIANTE UNA UNIÓN ARTICULADA EN EL EJE HORIZONTAL, TIPO BISAGRA (TUBULAR-BULON) QUE PERMITA EL GIRO DE LA ESTRUCTURA FORMANDO UN SEMICIRCULO RESPECTO AL EJE VERTICAL DEL PILAR (INCLUIDA LA EJECUCIÓN DE LA UNIÓN CON ACERO) ELEMENTOS IMPRIMADOS Y CON DOS CAPAS DE PINTURA DE ACABADO.<br>- TUBERIA DE PEAD DN 50 PN10 PE100 DESDE CONEXIÓN DE HIDRANTE PROXIMO A EXTREMO DE ESTRUCTURA, INCLUIDA LA CALDERERIA DE PIEZAS ESPECIALES UNIONES, Y ADECUACIÓN DEL HIDRANTE.<br>- MANGUERA FLEXIBLE TIPO ARIN FLAT REFORZADA O SIMILAR, DE PVC DN 50 MM REFORZADA CON DOBLE CAPA DE FIBRA TRATADA, UBICADA EN EL PUNTO DE GIRO DE LA ESTRUCTURA Y COLGADA PARA ADECUACIÓN A EQUIPO DE CARGA.<br>- INSTALACIÓN DE VALVULA DE COMPUERTA DN 50MM<br>- INSTALACIÓN DE CONTADOR DN 50MM<br>- ARMARIO/ENVOLVENTE METÁLICA PARA EXTERIOR (IP55) CON ESTRUCTURA Y TORNILLERIA DE ANCLAJE AL PILAR METÁLICO, Y PUERTA BATIENTE DE UNA HOJA CON BISAGRAS Y CIERRE (CERRADURA INTEGRADA O CANDADO).<br>TOTALMENTE EJECUTADO, Y PROBADO | MIL CIENTO SETENTA Y CINCO EUROS con OCHENTA Y SIETE CÉNTIMOS | 1.175,87 |
| 0263 | PVC110P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 110 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | SEIS EUROS con OCHENTA Y SEIS CÉNTIMOS | 6,86 |
| 0264 | PVC125P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 125 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | SIETE EUROS con OCHENTA Y OCHO CÉNTIMOS | 7,88 |
| 0265 | PVC140-RAN | M | CONJUNTO ZANJA DRENAJE, MEDIANTE TUBO DRENANTE PERFORADO DE PVC DN 140 MM DE DOBLE PARED, COLOCADO EN ZANJA DE SECCIÓN 0,50 M. DE ANCHURA Y PROFUNDIDAD MEDIA INFERIOR A 1,0 M., ENVUELTA ÉSTA EN FILTRO DREN A BASE DE GETEXTIL DE 150 GR/M2 Y RELLENA LA ZANJA CON MATERIAL GRANULAR 6/12 MM HASTA 20 CM POR ENCIMA DEL DREN ENVUELTO EN GEOTEXTIL. INCLUIDA PP DE PEQUEÑO MATERIAL Y ELEMENTOS DE CONEXIÓN A COLECTORES. MEDIDA LA LONGITUD TOTAL FINALMENTE INSTALADA Y PROBADA. | NUEVE EUROS con NOVENTA Y TRES CÉNTIMOS | 9,93 |
| 0266 | PVC140P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 140 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | NUEVE EUROS con CINCUENTA Y SIETE CÉNTIMOS | 9,57 |
| 0267 | PVC140P16 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 140 MM, Y 16 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | DOCE EUROS con CINCUENTA CÉNTIMOS | 12,50 |

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| 0268 | PVC160-RAN | M | CONJUNTO ZANJA DRENAJE, MEDIANTE TUBO DRENANTE PERFORADO DE PVC DN 160 MM DE DOBLE PARED, COLOCADO EN ZANJA DE SECCIÓN 0,50 M. DE ANCHURA Y PROFUNDIDAD MEDIA INFERIOR A 1,0 M., ENVUELTA ÉSTA EN FILTRO DREN A BASE DE GETEXTIL DE 150 GR/M2 Y RELLENA LA ZANJA CON MATERIAL GRANULAR 6/12 MM HASTA 20 CM POR ENCIMA DEL DREN ENVUELTO EN GEOTEXTIL. INCLUIDA PP DE PEQUEÑO MATERIAL Y ELEMENTOS DE CONEXIÓN A COLECTORES. MEDIDA LA LONGITUD TOTAL FINALMENTE INSTALADA Y PROBADA. | DIEZ EUROS con NOVENTA Y OCHO CÉNTIMOS | 10,98 |
| 0269 | PVC160P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 160 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | DOCE EUROS con CINCO CÉNTIMOS | 12,05 |
| 0270 | PVC160P16 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 160 MM, Y 16 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | QUINCE EUROS con VEINTIUN CÉNTIMOS | 15,21 |
| 0271 | PVC200-RAN | M | CONJUNTO ZANJA DRENAJE, MEDIANTE TUBO DRENANTE PERFORADO DE PVC DN 200 MM DE DOBLE PARED, COLOCADO EN ZANJA DE SECCIÓN 0,50 M. DE ANCHURA Y PROFUNDIDAD MEDIA INFERIOR A 1,0 M., ENVUELTA ÉSTA EN FILTRO DREN A BASE DE GEOTEXTIL DE 150 GR/M2 Y RELLENA LA ZANJA CON MATERIAL GRANULAR 6/12 MM HASTA 20 CM POR ENCIMA DEL DREN ENVUELTO EN GEOTEXTIL. INCLUIDA PP DE PEQUEÑO MATERIAL Y ELEMENTOS DE CONEXIÓN A COLECTORES. MEDIDA LA LONGITUD TOTAL FINALMENTE INSTALADA Y PROBADA. | DOCE EUROS con CUARENTA Y CUATRO CÉNTIMOS | 12,44 |
| 0272 | PVC200P10 | m | TUBO DE PVC NO PLASTIFICADO, DE ESPECIFICACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE DN. EXTERIOR 200 MM, Y 10 BAR DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMÉRICA DE ESTANQUIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO PARA CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | DIECISIETE EUROS con SETENTA Y OCHO CÉNTIMOS | 17,78 |
| 0273 | PVC200P16 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 200 MM, Y 16 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | VEINTISEIS EUROS con SIETE CÉNTIMOS | 26,07 |
| 0274 | PVC250-RAN | M | CONJUNTO ZANJA DRENAJE, MEDIANTE TUBO DRENANTE PERFORADO DE PVC DN 250 MM DE DOBLE PARED, COLOCADO EN ZANJA DE SECCIÓN 0,50 M. DE ANCHURA Y PROFUNDIDAD MEDIA INFERIOR A 1,0 M., ENVUELTA ÉSTA EN FILTRO DREN A BASE DE GEOTEXTIL DE 150 GR/M2 Y RELLENA LA ZANJA CON MATERIAL GRANULAR 6/12 MM HASTA 20 CM POR ENCIMA DEL DREN ENVUELTO EN GEOTEXTIL. INCLUIDA PP DE PEQUEÑO MATERIAL Y ELEMENTOS DE CONEXIÓN A COLECTORES. MEDIDA LA LONGITUD TOTAL FINALMENTE INSTALADA Y PROBADA. | CATORCE EUROS con CINCUENTA Y CUATRO CÉNTIMOS | 14,54 |
| 0275 | PVC250P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 250 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA.. | VEINTISIETE EUROS con VEINTISIETE CÉNTIMOS | 27,27 |
| 0276 | PVC250P16 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 250 MM, Y 16 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | TREINTA Y CINCO EUROS con CINCUENTA Y CINCO CÉNTIMOS | 35,55 |

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| 0277 | PVC315P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 315 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | CUARENTA Y DOS EUROS con NUEVE CÉNTIMOS | 42,09 |
| 0278 | PVC400P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 400 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA.. | CINCUENTA Y SIETE EUROS con SETENTA Y CINCO CÉNTIMOS | 57,75 |
| 0279 | PVC500P10 | ML | TUBO DE PVC NO PLASTIFICADO , DE ESPECIFIACIONES TÉCNICAS SEGÚN NORMA UNE 1452 DE D.N. EXTERIOR 500 MM, Y 10 ATM DE PRESIÓN. UNIÓN TIPO FLEXIBLE MEDIANTE JUNTA ENCHUFE CON ANILLA ELASTOMERICA DE ESTANQUEIDAD DE EPDM LUBRICADA SEGÚN NORMA UNE-EN 681. INCLUSO P.P. DE PIEZAS ESPECIALES DE ACERO EN CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC), BRIDAS, TORINILLERÍA Y JUNTAS Y ELEMENTOS PARA SU COMPLETA INSTALACIÓN. INCLUIDA P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA UNIDAD TOTALMENTE COLOCADA E INSTALADA EN ZANJA Y PROBADA. | OCHENTA Y OCHO EUROS con CINCUENTA Y NUEVE CÉNTIMOS | 88,59 |
| 0280 | R01DM020 | m² | DESPEJE Y DESBROCE DEL TERRENO VEGETAL, HASTA UN ESPESOR DE 20 CM, INCLUIDO LA EXCAVACIÓN, CON SEPARACIÓN DE ESTOS RESTOS VEGETALES DEL RESTO DE LA TIERRA VEGETAL PARA SU REUTILIZACIÓN, CARGA Y TRANSPORTE AL LUGAR DE EMPLEO O A VERTEDERO PARA SU POSTERIOR REUTILIZACIÓN, A UNA DISTANCIA INFERIOR A 3 KM INCLUIDO EL CANON Y AUTORIZACIONES DE VERTIDO NECESARIAS. MEDIDA LA SUPERFICIE DESBROZADA. | CERO EUROS con TREINTA CÉNTIMOS | 0,30 |
| 0281 | R01DM040 | m² | DESPEJE Y DESBROCE DEL TERRENO VEGETAL, HASTA UN ESPESOR DE 30 CM, INCLUIDO LA EXCAVACIÓN, INCLUSO DEFORESTACIÓN Y TALA DE ARBUSTOS Y DE ÁRBOLES DE CUALQUIER TIPO Y DIMENSIÓN, CON SEPARACIÓN DE ESTOS RESTOS VEGETALES DEL RESTO DE LA TIERRA VEGETAL PARA SU REUTILIZACIÓN, CARGA Y TRANSPORTE AL LUGAR DE EMPLEO O A VERTEDERO PARA SU POSTERIOR REUTILIZACIÓN, A UNA DISTANCIA INFERIOR A 5 KM INCLUIDO EL CANON Y AUTORIZACIONES DE VERTIDO NECESARIAS. MEDIDA LA SUPERFICIE DESBROZADA. | CERO EUROS con SETENTA Y SIETE CÉNTIMOS | 0,77 |
| 0282 | R01DM090 | m² | NIVELACIÓN DEL TERRENO CON UNA DISTANCIA MEDIA DE 150 METROS DE TRANSPORTE A CADA UNO DE LOS BANCALES, INCLUIDA LA CARGA, EL TRANSPORTE DE LA CARGA, DESCARGA Y TRANPORTE EN VACIO, INCLUSO EL TRANSPORTE A VERTEDERO A UNA DISTANCIA INFERIOR A 10 KM INCLUIDO EL CANON Y AUTORIZACIONES DE VERTIDO NECESARIAS. | CERO EUROS con NOVENTA Y CUATRO CÉNTIMOS | 0,94 |
| 0283 | R01EX010 | m³ | EXCAVACIÓN A CIELO ABIERTO REALIZADA CON MEDIOS MECÁNICOS HASTA UNA PROFUNDIDAD MÁXIMA DE 6 M, INCLUIDO UN 10% DE EXCAVACIÓN EN ROCA, INCLUSO PERFILADO DE LATERALES Y FONDOS, ENTIBADO Y AGOTAMIENTO, APILADO Y TRASLADO EN OBRA DE PRODUCTOS DE EXCAVACIÓN, APORTACIÓN DE RIEGOS CON CUBA PARA MINIMIZAR LA EMISIÓN DE PARTÍCULAS DE POLVO A LA ATMÓSFERA. INCLUSO LOS MOVIMIENTOS DE TIERRA NECESARIOS PARA LA CREACIÓN DE PISTA DE SERVICIO PARALELA A LA PROPIA ZANJA Y LOS NECESARIOS PARA LA EJECUCIÓN DE TODOS LOS ACCESOS NECESARIOS. INCLUSO TAMBIÉN LA REPARACIÓN DE CAMINOS Y VIALES EXISTENTES, SERVICIOS AFECTADOS (LÍNEAS ELÉCTRICAS, CONDUCCIONES, ETC.), BALATES Y MÁRGENES EXISTENTES ANTES DE LA EXCAVACIÓN. INLCUIDAS LAS OPERACIONES DE CARGA Y TRANSPORTE A LUGAR DE ACOPIO TEMPORAL PARA SU REUTILIZACIÓN, ASÍ COMO LAS OPERACIONES DE CARGA Y TRANSPORTE AL LUGAR DE ORIGEN. INCLUIDO LA SEPARACIÓN Y ACOPIO DE LA TIERRA VEGETAL PARA SU POSTERIOR REUTILIZACIÓN EN EL CASO QUE NO EXISTA DESBROCE. INCLUSO CARGA Y TRANSPORTE A LUGAR DE EMPLEO, DISTANCIA MÁXIMA DE 2 KM. MEDIDO EL VOLUMEN SOBRE PERFIL NATURAL CON EL PERFIL FINAL Y CON EL PERFIL TEÓRICO DE PROYECTO. | UN EUROS con SETENTA Y CUATRO CÉNTIMOS | 1,74 |
| 0284 | R01RE030 | m³ | RELLENO SELECCIONADO CON DIÁMETRO MÁXIMO DE 25 MM Y COMPACTADO DE TIERRAS, REALIZADO MECÁNICAMENTE, CON VERTIDO EN TONGADAS DE 25 CM DE ESPESOR MÁXIMO ANTES DE COMPACTAR, INCLUSO REGADO, TENDIDO Y COMPACTADO AL 95% DEL PROCTOR NORMAL. INCLUIDA LA TRAÍDA DEL MATERIAL DENTRO DE LA OBRA, SI EL DE LA EXCAVACIÓN NO ES ADECUADO E INCLUSO SU CRIBADO AL TAMAÑO INDICADO Y EL TRANSPORTE A VERTEDERO DEL MATERIAL RECHAZADO.MEDIDO EL VOLUMEN DE TIERRAS UNA VEZ COMPACTADAS SOBRE EL PERFIL FINAL EJECUTADO Y TENIENDO EN CUENTA EL PERFIL TEÓRICO DE PROYECTO. | UN EUROS con DIEZ CÉNTIMOS | 1,10 |
| 0285 | R01TA120 | m³ | EXTENDIDO DE TIERRA VEGETAL DE LA PROPIA OBRA, PROCEDENTE DE ACOPIO, SOBRE TALUDES, INCLUIDA CARGA, TRANSPORTE DESDE EL ACOPIO AL LUGAR DE USO, COLOCACIÓN Y PERFILADO. | UN EUROS con DIECISIETE CÉNTIMOS | 1,17 |

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| 0286 | R02TB040 | m | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 406 MM DE DIÁMETRO Y 6,4 MM DE ESPESOR PN MÁX 20 ATM EN ACERO S235 JR G2 SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:1994, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. INCLUSO P.P. DE PIEZAS ESPECIALES (CODOS, TÉS, DERIVACIONES, ETC.) Y P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA LONGITUD SOLDADA EN PERFIL, COLOCADA Y PROBADA. | NOVENTA Y NUEVE EUROS con SESENTA Y SIETE CÉNTIMOS | 99,67 |
| 0287 | R02TB060 | m | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 610 MM DE DIÁMETRO Y 6,4 MM DE ESPESOR PN MÁX 20 ATM EN ACERO S235 JR G2 SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:1994, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. INCLUSO P.P. DE PIEZAS ESPECIALES (CODOS, TÉS, DERIVACIONES, ETC.) Y P.P. DE MACIZOS DE ANCLAJE Y CONTRARRESTOS. MEDIDA LA LONGITUD SOLDADA EN PERFIL, COLOCADA Y PROBADA. | CIENTO TREINTA EUROS con SIETE CÉNTIMOS | 130,07 |
| 0288 | R02TB064 | m | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 1626 MM DE DIÁMETRO Y 12,7 MM DE ESPESOR PN MÁX 10 ATM EN ACERO S235 JR G2 SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:2006, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. MEDIDA LA LONGITUD EN PERFIL COLOCADA Y PROBADA. | SETECIENTOS TREINTA Y CUATRO EUROS con CINCUENTA Y OCHO CÉNTIMOS | 734,58 |
| 0289 | R02TB070 | m | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 711 MM DE DIÁMETRO Y 7,9 MM DE ESPESOR PN MÁX 20 ATM EN ACERO S235JR SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:1994, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. MEDIDA LA LONGITUD EN PERFIL COLOCADA Y PROBADA. | CIENTO SESENTA Y OCHO EUROS con CUARENTA Y OCHO CÉNTIMOS | 168,48 |
| 0290 | R02TB080 | m | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 813 MM DE DIÁMETRO Y 7,9 MM DE ESPESOR PN MÁX 20 ATM EN ACERO S235JR SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:2006, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. MEDIDA LA LONGITUD EN PERFIL COLOCADA Y PROBADA. | CIENTO NOVENTA EUROS con CUARENTA Y CINCO CÉNTIMOS | 190,45 |
| 0291 | R02TB100 | m | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 1016 MM DE DIÁMETRO Y 10,0 MM DE ESPESOR PN MÁX 20 ATM EN ACERO S235JR SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:1994, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. MEDIDA LA LONGITUD EN PERFIL COLOCADA Y PROBADA. | TRESCIENTOS CATORCE EUROS con OCHENTA Y SIETE CÉNTIMOS | 314,87 |
| 0292 | R02TB256 | | TUBERÍA DE ACERO AL CARBONO SOLDADA HELICOIDALMENTE, DE 1422 MM DE DIÁMETRO Y 10,3 MM DE ESPESOR PN MÁX 20 ATM EN ACERO S235JR SEGÚN NORMA DE FABRICACIÓN UNE EN 10025:2006, CON DOBLE CORDÓN DE SOLDADURA INTERIOR Y EXTERIOR, POR EL PROCEDIMIENTO DE ARCO SUMERGIDO TIPO UNIÓN-MELT. PROTECCIÓN INTERIOR MEDIANTE APLICACIÓN DE PINTURA EPOXI AGUA POTABLE DE 300 MICRAS Y EXTERIOR MEDIANTE APLICACIÓN DE PE EXTRUÍDO EN CALIENTE Y PROCEDIMIENTO TRES CAPAS, PREVIO GRANALLADO DE LA SUPERFICIE EN AMBAS CARAS HASTA EL GRADO SA-2 1/2 DE LA NORMA SIS-055900/67. MEDIDA LA LONGITUD EN PERFIL COLOCADA Y PROBADA. | QUINIENTOS VEINTIDOS EUROS con CINCUENTA Y TRES CÉNTIMOS | 522,53 |
| 0293 | R02TE607C | m | TUBERÍA DE POLIETILENO ALTA DENSIDAD PE100, MRS 10 N/MM2, EN 12201:2000 Y EN 13244:1998, DE 75 MM DE DIÁMETRO NOMINAL Y UNA PRESIÓN DE TRABAJO DE 10 KG/CM2. INCLUSO UNIÓN POR MANGUITO ELECTROSOLDABLE Y PARTE PROPORCIONAL DE PIEZAS ESPECIALES DE ACERO PARA CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.) BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | TRES EUROS con CUATRO CÉNTIMOS | 3,04 |

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| 0294 | R02TE609C | m | TUBERÍA DE POLIETILENO ALTA DENSIDAD PE100, MRS 10 N/MM2, EN 12201:2000 Y EN 13244:1998, DE 90 MM DE DIÁMETRO NOMINAL Y UNA PRESIÓN DE TRABAJO DE 10 KG/CM2. INCLUSO UNIÓN POR SOLDADURA A TOPE Y PARTE PROPORCIONAL DE PIEZAS ESPECIALES DE ACERO PARA CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.) BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CUATRO EUROS con VEINTITRES CÉNTIMOS | 4,23 |
| 0295 | R02TE611C | m | TUBERÍA DE POLIETILENO ALTA DENSIDAD PE100, MRS 10 N/MM2, EN 12201:2000 Y EN 13244:1998, DE 110 MM DE DIÁMETRO NOMINAL Y UNA PRESIÓN DE TRABAJO DE 8 KG/CM2. INCLUSO UNIÓN POR SOLDADURA A TOPE Y PARTE PROPORCIONAL DE PIEZAS ESPECIALES DE ACERO PARA CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.) BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | SEIS EUROS con NOVENTA Y UN CÉNTIMOS | 6,91 |
| 0296 | R02TE612C | m | TUBERÍA DE POLIETILENO ALTA DENSIDAD PE100, MRS 10 N/MM2, EN 12201:2000 Y EN 13244:1998, DE 125 MM DE DIÁMETRO NOMINAL Y UNA PRESIÓN DE TRABAJO DE 6 KG/CM2. INCLUSO UNIÓN POR SOLDADURA A TOPE Y PARTE PROPORCIONAL DE PIEZAS ESPECIALES DE ACERO PARA CALDERERÍA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.) BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | SIETE EUROS con SETENTA Y SIETE CÉNTIMOS | 7,77 |
| 0297 | R02TL05a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 500 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | OCHENTA Y TRES EUROS con UN CÉNTIMOS | 83,01 |
| 0298 | R02TL05b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 500 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | NOVENTA Y TRES EUROS con CUARENTA Y SIETE CÉNTIMOS | 93,47 |
| 0299 | R02TL06a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 600 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO UN EUROS con NOVENTA Y TRES CÉNTIMOS | 101,93 |
| 0300 | R02TL06b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 600 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO OCHO EUROS con SETENTA CÉNTIMOS | 108,70 |
| 0301 | R02TL07a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 700 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO VEINTICUATRO EUROS con DIECINUEVE CÉNTIMOS | 124,19 |
| 0302 | R02TL07b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 700 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO VEINTINUEVE EUROS con OCHENTA Y TRES CÉNTIMOS | 129,83 |

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| 0303 | R02TL08a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 800 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO CINCUENTA EUROS con OCHENTA Y NUEVE CÉNTIMOS | 150,89 |
| 0304 | R02TL08b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 800 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO CINCUENTA Y TRES EUROS con CATORCE CÉNTIMOS | 153,14 |
| 0305 | R02TL09b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 900 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CIENTO SETENTA Y OCHO EUROS con DIECINUEVE CÉNTIMOS | 178,19 |
| 0306 | R02TL10a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 1000 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | DOSCIENTOS UN EUROS con NUEVE CÉNTIMOS | 201,09 |
| 0307 | R02TL10b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 1000 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | DOSCIENTOS CINCO EUROS con CUARENTA Y NUEVE CÉNTIMOS | 205,49 |
| 0308 | R02TL12b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 1200 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | DOSCIENTOS OCHENTA Y DOS EUROS con SETENTA Y SIETE CÉNTIMOS | 282,77 |
| 0309 | R02TL14a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 1400 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | TRESCIENTOS TREINTA Y OCHO EUROS con VEINTIOCHO CÉNTIMOS | 338,28 |
| 0310 | R02TL14b | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 1400 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 10 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA (PIEZAS ESPECIALES EN NUDOS, REDUCCIONES, TÉS, CODOS, EMPALMES, CONEXIONES, TERMINALES, ETC.), MACIZOS DE ANCLAJE, BRIDAS, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | TRESCIENTOS SESENTA EUROS con CUARENTA Y OCHO CÉNTIMOS | 360,48 |
| 0311 | R02TL16a | m | TUBERÍA DE POLIÉSTER REFORZADO CON FIBRA DE VIDRIO DE 1600 MM DE DIÁMETRO NOMINAL, PRESIÓN NOMINAL DE 6 KG/CM2 Y RIGIDEZ SN=5 KN/M2, INCLUSO P.P. PIEZAS ESPECIALES DE UNIÓN CON MANGUITO FLEXIBLE CON JUNTA DE GOMA. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA EN ZANJA SOBRE CAMA MATERIAL GRANULAR Y PROBADA. | CUATROCIENTOS CUARENTA Y TRES EUROS con CUARENTA Y TRES CÉNTIMOS | 443,43 |

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| 0312 | R02TM11e | m | TUBERÍA DE PVC SANITARIA SERIE C, DE 110 MM DE DIÁMETRO Y 4.0 MM. DE ESPESOR, UNIÓN POR ADHESIVO, COLOR GRIS, COLOCADA EN BAJANTES Y RED DE SANEAMIENTO HORIZONTAL COLGADA. INCLUSO P.P. DE PIEZAS ESPECIALES, EMPALMES, CONEXIONES, TERMINALES, TORNILLERÍA Y JUNTAS Y ELEMENTOS NECESARIOS PARA SU COMPLETA INSTALACIÓN SEGÚN NTE-ISS-49, UNE 53114, ISO-DIS-3633. MEDIDA LA UNIDAD TOTALMENTE EJECUTADA E INSTALADA | TRES EUROS con TREINTA Y NUEVE CÉNTIMOS | 3,39 |
| 0313 | R03VE002 | ud | VENTOSA METÁLICA TRIFUNCIONAL EMBRIDADA DE FUNDICIÓN GGG-40 O GGG-50 DE 50 MM DE DN Y 16 ATM DE PN, SEGÚN NORMA AWWA C 512. INCLUIDO VÁLVULA DE ESFERA PARA ROSCA DN 50 MM PN-16 SOBRE TUBERÍA DE ACERO DEL MISMO DIÁMETRO, CON TRATAMIENTO ANTICORROSIÓN EPOXY-POLIESTER ALIMENTARIO 300 MICRAS INTERIOR Y 200 MICRAS EXTERIOR. INCLUIDO TAMBIÉN JUNTAS Y ACCESORIOS PARA SU COLOCACIÓN. CONJUNTO COMPLETAMENTE INSTALADO CON PARTE PROPORCIONAL DE BRIDAS, JUNTAS, TORNILLERÍA Y CALDERERÍA EN ACERO CON EL MISMO TRATAMIENTO INDICADO Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | DOSCIENTOS SESENTA Y TRES EUROS con OCHENTA CÉNTIMOS | 263,80 |
| 0314 | R03VE004 | ud | VENTOSA METÁLICA TRIFUNCIONAL EMBRIDADA DE FUNDICIÓN GGG-40 O GGG-50 DE 80 MM DE DN Y 16 ATM DE PN, SEGÚN NORMA AWWA C 512. INCLUIDO VÁLVULA DE COMPUERTA DN 80 MM Y PN-16 ATM CON CIERRE CON ASIENTO ELÁSTICO Y EMBRIDADA PARA UNIÓN A TUBERÍA DE ACERO DEL MISMO DIÁMETRO, CON TRATAMIENTO ANTICORROSIÓN EPOXY-POLIESTER ALIMENTARIO 300 MICRAS INTERIOR Y 200 MICRAS EXTERIOR. INCLUIDO TAMBIÉN JUNTAS Y ACCESORIOS PARA SU COLOCACIÓN. CONJUNTO COMPLETAMENTE INSTALADO CON PARTE PROPORCIONAL DE BRIDAS, JUNTAS, TORNILLERÍA Y PIEZAS DE CALDERERÍA ESPECIALES EN ACERO CON EL MISMO TRATAMIENTO INDICADO Y ACCESORIOS PARA UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | QUINIENTOS SESENTA Y DOS EUROS con SESENTA Y UN CÉNTIMOS | 562,61 |
| 0315 | R03VE005 | ud | VENTOSA METÁLICA TRIFUNCIONAL EMBRIDADA DE FUNDICIÓN GGG-40 O GGG-50 DE 100 MM DE DN Y 16 ATM DE PN, SEGÚN NORMA AWWA C 512. INCLUIDO VÁLVULA DE COMPUERTA DN 100 MM Y PN-16 ATM CON CIERRE CON ASIENTO ELÁSTICO Y EMBRIDADA PARA UNIÓN A TUBERÍA DE ACERO DEL MISMO DIÁMETRO, CON TRATAMIENTO ANTICORROSIÓN EPOXY-POLIESTER ALIMENTARIO 300 MICRAS INTERIOR Y 200 MICRAS EXTERIOR. INCLUIDO TAMBIÉN JUNTAS Y ACCESORIOS PARA SU COLOCACIÓN. CONJUNTO COMPLETAMENTE INSTALADO CON PARTE PROPORCIONAL DE BRIDAS, JUNTAS, TORNILLERÍA Y PIEZAS DE CALDERERÍA ESPECIALES EN ACERO CON EL MISMO TRATAMIENTO INDICADO Y ACCESORIOS PARA UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | SETECIENTOS CINCUENTA Y SIETE EUROS con CUARENTA Y CUATRO CÉNTIMOS | 757,44 |
| 0316 | R03VE006 | ud | VENTOSA METÁLICA TRIFUNCIONAL EMBRIDADA DE FUNDICIÓN GGG-40 O GGG-50 DE 150 MM DE DN Y 16 ATM DE PN, SEGÚN NORMA AWWA C 512. INCLUIDO VÁLVULA DE COMPUERTA DN 150 MM Y PN-16 ATM CON CIERRE CON ASIENTO ELÁSTICO Y EMBRIDADA PARA UNIÓN A TUBERÍA DE ACERO DEL MISMO DIÁMETRO S-235 JRG2, CON TRATAMIENTO ANTICORROSIÓN EPOXY-POLIESTER ALIMENTARIO 300 MICRAS INTERIOR Y 200 MICRAS EXTERIOR. INCLUIDO TAMBIÉN JUNTAS Y ACCESORIOS PARA SU COLOCACIÓN. CONJUNTO COMPLETAMENTE INSTALADO CON PARTE PROPORCIONAL DE BRIDAS, JUNTAS, TORNILLERÍA Y PIEZAS DE CALDERERÍA ESPECIALES EN ACERO S-235 JRG2 CON EL MISMO TRATAMIENTO INDICADO Y ACCESORIOS PARA UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | MIL TRESCIENTOS OCHENTA Y SIETE EUROS con CINCUENTA CÉNTIMOS | 1.387,50 |
| 0317 | R03VE008 | ud | VENTOSA METÁLICA TRIFUNCIONAL EMBRIDADA DE FUNDICIÓN GGG-40 O GGG-50 DE 200 MM DE DN Y 16 ATM DE PN, SEGÚN NORMA AWWA C 512. INCLUIDO VÁLVULA DE COMPUERTA DN 200 MM Y PN-16 ATM CON CIERRE CON ASIENTO ELÁSTICO Y EMBRIDADA PARA UNIÓN A TUBERÍA DE ACERO DEL MISMO DIÁMETRO S-235 JRG2, CON TRATAMIENTO ANTICORROSIÓN EPOXY-POLIESTER ALIMENTARIO 300 MICRAS INTERIOR Y 200 MICRAS EXTERIOR. INCLUIDO TAMBIÉN JUNTAS Y ACCESORIOS PARA SU COLOCACIÓN. CONJUNTO COMPLETAMENTE INSTALADO CON PARTE PROPORCIONAL DE BRIDAS, JUNTAS, TORNILLERÍA Y PIEZAS DE CALDERERÍA ESPECIALES EN ACERO S-235 JRG2 CON EL MISMO TRATAMIENTO INDICADO Y ACCESORIOS PARA UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | DOS MIL QUINIENTOS TREINTA Y SIETE EUROS con TREINTA Y UN CÉNTIMOS | 2.537,31 |
| 0318 | R04AR030 | m³ | MEZCLA, EXTENDIDO, COMPACTADO Y PERFILADO DE RASANTES, PARA LA CONSTRUCCIÓN DE TERRAPLENES, EN CUERPO DE PRESA, CON TERRENOS SELECCIONADOS PROCEDENTES DE LA EXCAVACIÓN QUE CUMPLAN LAS CONDICIONES QUE ESTABLECE EL PG-3 PARA SUELOS SELECCIONADOS O TOLERABLES, CON LA SEPARACIÓN SELECTIVA DE MATERIALES DE CALIDAD Y DESMENUZADO PREVIO, INCLUSO USO DE RODILLO PATA DE CABRA, Y COMPACTACIÓN POR CAPAS DE 25 CM, HASTA ALCANZAR EL 98 % PM, PREVIO A LA PRIMERA COMPACTACIÓN DEL TERRENO SE REALIZARÁ UN TRATAMIENTO DE LA BASE MEDIANTE LABRADO O RIPADO DEL TERRENO Y POSTERIOR HUMECTACIÓN Y COMPACTACIÓN ENERGICA. INCLUIDO EL TRANSPORTE EN OBRA A 3 KM DE DISTANCIA Y RIEGO CON AGUA (INCLUIDO EL SUMINISTRO), COMPACTACIÓN ENERGICA DEL TERRENO DE BASE PREVIAMENTE AL EXTENDIDO DE MATERIAL. MEDIDA EN SU PERFIL FINAL COMPACTADO. | CERO EUROS con NOVENTA Y CINCO CÉNTIMOS | 0,95 |
| 0319 | R04ARV10_R | m | FORMACIÓN DE CUNETA TRIANGULAR D'1,0 M DE ANCHO Y 0,30 M DE ALTO, REVESTIDA CON HM-20, INCLUÍDA EXCAVACIÓN EN TERRENO NO CLASIFICADO, REFINADO, CARGA Y TRANSPORTE A VERTEDERO DE LOS MATERIALES RESULTANTES. | TRECE EUROS con OCHENTA Y OCHO CÉNTIMOS | 13,88 |

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| 0320 | R04EM010 | m | CERRAMIENTO DE VALLA GALVANIZADA DE SIMPLE TORSIÓN TRAMA 50/14 Y 2,20MM, CON 3 HILOS DE ALAMBRE DE ESPINO Y POSTE DE TUBO DE ACERO GALVANIZADO DE 2,00 M DE ALTURA Y 48X1,2 MM DE ACERO GALVANIZADO POR INMERSIÓN CADA 3,00 M Y POSTE PRINCIPAL CADA 30 M, PROVISTO DE BAYONETA CON TORNAPUNTAS DE ACERO GALVANIZADO DE 32 MM DE DIÁMETRO, TOTALMENTE MONTADA, INCLUSO CIMIENTOS DE HORMIGÓN Y MURETE DE HORMIGÓN PARA SUJECCIÓN DE VALLA PARCIALMENTE EMBEBIDO EN EL TERRENO PARA MINIMIZAR EL PASO DE ANIMALES, INCLUIDA PARTE PROPORCIONAL DE PUERTA PRINCIPAL Y PEATONAL Y PIEZAS ESPECIALES ASÍ COMO ENCOFRADOS. MEDIDA LA UNIDAD EJECUTADA. | OCHO EUROS con VEINTITRES CÉNTIMOS | 8,23 |
| 0321 | R05DE100 | ud | DESAGÜE DE 100 MM DE DIÁMETRO INTERIOR, SOBRE TUBERÍA DE PRESIÓN DE CUALQUIER DIÁMETRO, COMPRENDIENDO VÁLVULA DE COMPUERTA CON CIERRE ELÁSTICO DE 100 MM DE DIÁMETRO NOMINAL, 16 ATM DE PRESIÓN NOMINAL PROVISTA DE VOLANTE Y BRIDAS, CON CUERPO Y TAPA DE FUNDICIÓN NODULAR REVESTIDA DE NEOPRENO Y HUSILLO DE ACERO INOXIDABLE. INCLUIDO EL EJE DE EXTENSIÓN DE TIPO TELESCÓPICO Y PROLONGADOR DE ACERO TODO EN GALVANIZADO HASTA UNA ALTURA DE 3 METROS, CON TODOS LOS MATERIALES NECESARIOS PARA LA COMPLETA MANIOBRA DE LA VÁLVULA ENTERRADA. SE INCLUYE ADEMÁS PIEZAS ESPECIALES EN CALDERERÍA (TÉS, CODOS, BRIDAS, ETC) Y ACCESORIOS DE DN-100 PN-16, PARA LA CONEXIÓN CON TUBERÍA DE PVC DN 110 PN6, A LOS DESAGÜES EXISTENTES O A ARQUETA DE ACHUIQUE. INLCUIDO TAMBIÉN LOS ANCLAJES, CONTRARRESTOS, OBRAS DE TIERRA Y FÁBRICA COMPLEMENTARIAS, COLOCACIÓN Y PRUEBA DE TODA LA UNIDAD. | TRESCIENTOS CINCUENTA Y CINCO EUROS con CUARENTA Y CINCO CÉNTIMOS | 355,45 |
| 0322 | R05DE200 | ud | DESAGÜE DE 200 MM DE DIÁMETRO INTERIOR, SOBRE TUBERÍA DE PRESIÓN DE CUALQUIER DIÁMETRO, COMPRENDIENDO VÁLVULA DE COMPUERTA CON CIERRE ELÁSTICO DE 200 MM DE DIÁMETRO NOMINAL, 16 ATM DE PRESIÓN NOMINAL PROVISTA DE VOLANTE Y BRIDAS, CON CUERPO Y TAPA DE FUNDICIÓN NODULAR REVESTIDA DE NEOPRENO Y HUSILLO DE ACERO INOXIDABLE. INCLUIDO EL EJE DE EXTENSIÓN DE TIPO TELESCÓPICO Y PROLONGADOR DE ACERO TODO EN GALVANIZADO HASTA UNA ALTURA DE 3 METROS, CON TODOS LOS MATERIALES NECESARIOS PARA LA COMPLETA MANIOBRA DE LA VÁLVULA ENTERRADA. SE INCLUYE ADEMÁS PIEZAS ESPECIALES EN CALDERERÍA (TÉS, CODOS, BRIDAS, ETC) Y ACCESORIOS DE DN-200PN-16, PARA LA CONEXIÓN CON TUBERÍA DE PVC DN 200 PN6, A LOS DESAGÜES EXISTENTES O A ARQUETA DE ACHUIQUE. INLCUIDO TAMBIÉN LOS ANCLAJES, CONTRARRESTOS, OBRAS DE TIERRA Y FÁBRICA COMPLEMENTARIAS, COLOCACIÓN Y PRUEBA DE TODA LA UNIDAD. | SETECIENTOS OCHO EUROS con CINCUENTA CÉNTIMOS | 708,50 |
| 0323 | R05EM03 | ud | EQUIPO DE MEDIDA DE CAUDAL POR ULTRASONIDOS, PARA DIÁMETRO ENTRE 200 Y 4000 MM, FORMADO POR DOS SONDAS Y CAUDALÍMETRO ULTRASÓNICO MONTADO A LA TUBERÍA, ELECTRÓNICA DE TRATAMIENTO DE SEÑAL 4-20 MA, CONVERTIDOR DE SEÑALES, SENSORES, Y PROTECCIONES SOBRETENSIONES, CABLE TRIAXIAL, INCLUIDO SUMINISTRO, INSTALACIÓN Y PRUEBAS DE FUNCIONAMIENTO. | CUATRO MIL CIENTO DIEZ EUROS con TREINTA Y OCHO CÉNTIMOS | 4.110,38 |
| 0324 | R05TM1106 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 700 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | NOVECIENTOS UN EUROS con NOVENTA Y UN CÉNTIMOS | 901,91 |
| 0325 | R05TM1107 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 700 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | MIL CIENTO DIECIOCHO EUROS con VEINTIUN CÉNTIMOS | 1.118,21 |
| 0326 | R05TM1108 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 800 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | MIL SEISCIENTOS CINCUENTA Y OCHO EUROS con NOVENTA Y SEIS CÉNTIMOS | 1.658,96 |
| 0327 | R05TM111 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 150 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | CIENTO OCHENTA EUROS con TRECE CÉNTIMOS | 180,13 |

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| 0328 | R05TM1130 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 300 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | TRESCIENTOS VEINTE EUROS con NOVENTA Y TRES CÉNTIMOS | 320,93 |
| 0329 | R05TM1135 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 350 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | CUATROCIENTOS OCHENTA Y TRES EUROS con QUINCE CÉNTIMOS | 483,15 |
| 0330 | R05TM115 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 400 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | QUINIENTOS VEINTINUEVE EUROS con DIECISIETE CÉNTIMOS | 529,17 |
| 0331 | R05TM116 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 500 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | SEISCIENTOS NOVENTA Y UN EUROS con CUARENTA CÉNTIMOS | 691,40 |
| 0332 | R05TM121 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 900 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | MIL NOVECIENTOS VEINTINUEVE EUROS con TREINTA Y TRES CÉNTIMOS | 1.929,33 |
| 0333 | R05TM145 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 1400 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | DOS MIL NOVECIENTOS DIEZ EUROS con CUARENTA Y OCHO CÉNTIMOS | 2.910,48 |
| 0334 | R05TM146 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 1600 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | TRES MIL CIENTO OCHENTA Y DOS EUROS con SETENTA Y NUEVE CÉNTIMOS | 3.182,79 |
| 0335 | R05VC115 | ud | VÁLVULA DE COMPUERTA CON CIERRE ELÁSTICO DE 150 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL PROVISTA DE VOLANTE Y BRIDAS CON CUERPO Y TAPA DE FUNDICIÓN NODULAR, COMPUERTA DE FUNDICIÓN NODULAR REVESTIDA DE NEOPRENO Y HUSILLO DE ACERO INOXIDABLE. INCLUIDO EL EJE DE EXTENSIÓN DE TIPO TELESCÓPICO Y PROLONGADOR DE ACERO TODO EN GALVANIZADO HASTA UNA ALTURA DE 3 METROS, CON TODOS LOS MATERIALES NECESARIOS PARA LA COMPLETA MANIOBRA DE LA VÁLVULA ENTERRADA, CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | DOSCIENTOS VEINTICINCO EUROS con VEINTISIETE CÉNTIMOS | 225,27 |

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| 0336 | R05VC120 | ud | VÁLVULA DE COMPUERTA CON CIERRE ELÁSTICO DE 200 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL PROVISTA DE VOLANTE Y BRIDAS CON CUERPO Y TAPA DE FUNDICIÓN NODULAR, COMPUERTA DE FUNDICIÓN NODULAR REVESTIDA DE NEOPRENO Y HUSILLO DE ACERO INOXIDABLE. INCLUIDO EL EJE DE EXTENSIÓN DE TIPO TELESCÓPICO Y PROLONGADOR DE ACERO TODO EN GALVANIZADO HASTA UNA ALTURA DE 3 METROS, CON TODOS LOS MATERIALES NECESARIOS PARA LA COMPLETA MANIOBRA DE LA VÁLVULA ENTERRADA, CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | CUATROCIENTOS VEINTICINCO EUROS con NOVENTA Y CUATRO CÉNTIMOS | 425,94 |
| 0337 | R05VC130 | Ud | VÁLVULA DE COMPUERTA CON CIERRE ELÁSTICO DE 300 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL PROVISTA DE VOLANTE Y BRIDAS CON CUERPO Y TAPA DE FUNDICIÓN NODULAR, COMPUERTA DE FUNDICIÓN NODULAR REVESTIDA DE NEOPRENO Y HUSILLO DE ACERO INOXIDABLE. INCLUIDO EL EJE DE EXTENSIÓN DE TIPO TELESCÓPICO Y PROLONGADOR DE ACERO TODO EN GALVANIZADO HASTA UNA ALTURA DE 3 METROS, CON TODOS LOS MATERIALES NECESARIOS PARA LA COMPLETA MANIOBRA DE LA VÁLVULA ENTERRADA, CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | OCHOCIENTOS SESENTA EUROS con VEINTISIETE CÉNTIMOS | 860,27 |
| 0338 | R05VM1014 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 1400 MM DE DIÁMETRO NOMINAL Y 10 ATM DE PRESIÓN NOMINAL (BRIDA PN16) CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADO PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | VEINTICUATRO MIL CIENTO CUARENTA Y OCHO EUROS con TREINTA Y OCHO CÉNTIMOS | 24.148,38 |
| 0339 | R05VM1014M | ud | VÁLVULA DE MARIPOSA EMBRIDADA 1400 MM DE DIÁMETRO NOMINAL Y 10 ATM DE PRESIÓN NOMINAL (BRIDA PN16) MOTORIZADA. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | VEINTICINCO MIL SETECIENTOS SETENTA EUROS con SESENTA Y TRES CÉNTIMOS | 25.770,63 |
| 0340 | R05VM1016 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 1600 MM DE DIÁMETRO NOMINAL Y 10 ATM DE PRESIÓN NOMINAL (BRIDA PN16) CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADA PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | TREINTA Y CINCO MIL SETENTA Y UN EUROS con CINCUENTA Y TRES CÉNTIMOS | 35.071,53 |
| 0341 | R05VM104 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 400 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADO PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | DOS MIL TRESCIENTOS TREINTA Y UN EUROS con OCHENTA Y OCHO CÉNTIMOS | 2.331,88 |
| 0342 | R05VM105 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 500 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | TRES MIL SETECIENTOS TREINTA Y TRES EUROS con CINCO CÉNTIMOS | 3.733,05 |
| 0343 | R05VM106 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 600 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADO PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | CINCO MIL QUINIENTOS DIECISIETE EUROS con CINCUENTA Y DOS CÉNTIMOS | 5.517,52 |

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| 0344 | R05VM107 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 700 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADO PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | SEIS MIL QUINIENTOS NOVENTA Y NUEVE EUROS con DOS CÉNTIMOS | 6.599,02 |
| 0345 | R05VM108 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 800 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADO PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | SIETE MIL DOSCIENTOS CUARENTA Y SIETE EUROS con NOVENTA Y DOS CÉNTIMOS | 7.247,92 |
| 0346 | R05VM109 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 900 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | OCHO MIL SETENTA Y UN EUROS con DIECIOCHO CÉNTIMOS | 8.071,18 |
| 0347 | R05VM110 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 1000 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | ONCE MIL SEISCIENTOS NOVENTA Y CUATRO EUROS | 11.694,00 |
| 0348 | R05VM111 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 1200 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | DIECISIETE MIL TREINTA Y TRES EUROS con NOVENTA Y CINCO CÉNTIMOS | 17.033,95 |
| 0349 | R05VM112 | ud | VÁLVULA DE MARIPOSA EMBRIDADA 350 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL CON REDUCTOR DESMULTIPLICADOR MANUAL PARA CIERRE LENTO PROVISTO DE VOLANTE Y BRIDAS Y PREPARADO PARA MOTORIZACIÓN. CON CUERPO DE FUNDICIÓN NODULAR, CON BRIDAS, CON EJE DE ACERO SUPERIOR E INFERIOR DE ACERO INOXIDABLE AISI 431, LENTEJA DE ACERO INOXIDABLE AISI 431, ASIENTO EPDM O NBR VULCANIZADA AL CUERPO Y JUNTAS EPDM O NBR. ESTANQUEIDAD SUPERIOR E INFERIOR SEGÚN PLIEGO DE CONDICIONES. UNIDAD MONTADA CON PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA. | MIL OCHOCIENTOS SESENTA Y CINCO EUROS con SETENTA Y CINCO CÉNTIMOS | 1.865,75 |
| 0350 | R05VMV70 | ud | VÁLVULA DE MARIPOSA DN 700 MOTORIZADA DE CIERRE ELÁSTICO, PN 16 KG/CM2, DE EJE CENTRADO DE ACERO INOXIDABLE AISI TOTALMENTE ENCAPSULADO, JUNTA DE ESTANQUEIDAD CONTINUA, CON BRIDAS SEGÚN DIN-2501, CUERPO DE FUNDICIÓN DÚCTIL GGG-40; DISCO DE LA VÁLVULA DE ACERO INOXIDABLE AISI 316 Y ESTANQUIDAD DE EJES CON JUNTAS TÓRICAS DE EPDM; ACCIONAMENTO ELÉCTRICO TIPO SA+GS CON INDICADOR ABIERTO/CERRADO, INCLUIDO TORNILLERÍA Y ACCESORIOS NECESARIOS PARA EL MONTAJE. TOTALMENTE MONTADA Y PROBADA. | SIETE MIL SEISCIENTOS OCHENTA EUROS con CINCUENTA Y DOS CÉNTIMOS | 7.680,52 |
| 0351 | R05VR2291-1 | ud | VÁLVULA DE RETENCIÓN DN-400 Y PN-16. CON CUERPO DE FUNDICIÓN DÚCTIL GGG-40, TIPO CLASAR O SIMILAR, MONOBLOC CON DISCOS CONCÉNTRICOS PERFILADOS Y ARRIOSTRADOS. CON OBTURADOR MÓVIL DE ELASTÓMERO DE POLIURETANO Y EN SENTIDO LONGITUDINAL, CONSTRUIDO IGUALMENTE DE ANILLOS CONCÉNTRICOS PERFILADOS, CON RESORTE DE APERTURA Y JUNTA DE TAPA Y CUERPO DE NITRILO. INCLUYE PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA, CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA.<br>UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA EN OBRA. | TRES MIL CUATROCIENTOS TREINTA Y DOS EUROS con DIEZ CÉNTIMOS | 3.432,10 |

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| 0352 | R05VR2291-35 | ud | VÁLVULA DE RETENCIÓN DN-350 Y PN-16. CON CUERPO DE FUNDICIÓN DÚCTIL GGG-40, TIPO CLASAR O SIMILAR, MONOBLOC CON DISCOS CONCÉNTRICOS PERFILADOS Y ARRIOSTRADOS. CON OBTURADOR MÓVIL DE ELASTÓMERO DE POLIURETANO Y EN SENTIDO LONGITUDINAL, CONSTRUIDO IGUALMENTE DE ANILLOS CONCÉNTRICOS PERFILADOS, CON RESORTE DE APERTURA Y JUNTA DE TAPA Y CUERPO DE NITRILO. INCLUYE PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA, CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA.<br>UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA EN OBRA. | TRES MIL SETENTA Y TRES EUROS con CINCO CÉNTIMOS | 3.073,05 |
| 0353 | R05VR2291-6 | ud | VÁLVULA DE RETENCIÓN DN-600 Y PN-16. CON CUERPO DE FUNDICIÓN DÚCTIL GGG-40, TIPO CLASAR O SIMILAR, MONOBLOC CON DISCOS CONCÉNTRICOS PERFILADOS Y ARRIOSTRADOS. CON OBTURADOR MÓVIL DE ELASTÓMERO DE POLIURETANO Y EN SENTIDO LONGITUDINAL, CONSTRUIDO IGUALMENTE DE ANILLOS CONCÉNTRICOS PERFILADOS, CON RESORTE DE APERTURA Y JUNTA DE TAPA Y CUERPO DE NITRILO. INCLUYE PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA, CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA.<br>UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA EN OBRA. | DOCE MIL CATORCE EUROS con VEINTE CÉNTIMOS | 12.014,20 |
| 0354 | R05VR2291-7 | ud | VÁLVULA DE RETENCIÓN DN-700 Y PN-16. CON CUERPO DE FUNDICIÓN DÚCTIL GGG-40, TIPO CLASAR O SIMILAR, CON DISCOS CONCÉNTRICOS PERFILADOS Y ARRIOSTRADOS. CON OBTURADOR MÓVIL DE ELASTÓMERO DE POLIURETANO Y EN SENTIDO LONGITUDINAL, CONSTRUIDO IGUALMENTE DE ANILLOS CONCÉNTRICOS PERFILADOS, CON RESORTE DE APERTURA Y JUNTA DE TAPA Y CUERPO DE NITRILO. INCLUYE PARTE PROPORCIONAL DE JUNTAS, TORNILLERÍA, CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA.<br>UNIDAD TOTALMENTE MONTADA EJECUTADA Y PROBADA EN OBRA. | VEINTIDOS MIL NOVECIENTOS SETENTA Y OCHO EUROS con CUARENTA Y CINCO CÉNTIMOS | 22.978,45 |
| 0355 | R07AT060 | m | PASO BAJO CARRETERA O FERROCARRIL MEDIANTE HINCADO O PERFORACIÓN EN ROCA PARA PASO DE TUBERÍAS, EJECUTADO MEDIANTE TUBERÍA DE ACERO DE 610X6,4 MM, A UNA PROFUNDIDAD MÍNIMA DE 1,5 METROS DE LA GENERATRIZ SUPERIOR DE LA TUBERÍA A LA SUPERFICIE DE LA CARRETERA O FERROCARRIL Y DE 0,75 M DE CUNETAS, AJUSTADA A LOS CONDICIONANTES TÉCNICOS DE LA CARRETERA O FERROCARRIL. EL PRECIO UNITARIO INCLUYE EL DESPLAZAMIENTO DEL EQUIPO A LA OBRA, TUBERÍA, PERFORACIÓN, SOLDADURA CON TODOS LOS MEDIOS AUXILIARES NECESARIOS, PRUEBA DE ESTANQUEIDAD, MOVIMIENTOS DE TIERRAS PARA LA EJECUCIÓN DEL FOSO DE ATAQUE (12,00 M X 4,00 M) Y FOSO DE SALIDA (6,00 M X 3,00 M) Y ACHIQUE DE AGUA SI FUERA NECESARIO, ESTABILIZACIÓN DE LOS TERRENOS, AYUDA TOPOGRÁFICA PARA FIJAR ORIENTACIONES. MEDIDA LA UNIDAD COMPLETAMENTE EJECUTADA Y PROBADA. | TRESCIENTOS CINCUENTA Y OCHO EUROS con NOVENTA Y CUATRO CÉNTIMOS | 358,94 |
| 0356 | R07AT070 | m | PASO BAJO CARRETERA O FERROCARRIL MEDIANTE HINCADO O PERFORACIÓN EN ROCA PARA PASO DE TUBERÍAS, EJECUTADO MEDIANTE TUBERÍA DE ACERO DE 7131X6,4 MM, A UNA PROFUNDIDAD MÍNIMA DE 1,5 METROS DE LA GENERATRIZ SUPERIOR DE LA TUBERÍA A LA SUPERFICIE DE LA CARRETERA O FERROCARRIL Y DE 0,75 M DE CUNETAS, AJUSTADA A LOS CONDICIONANTES TÉCNICOS DE LA CARRETERA O FERROCARRIL. EL PRECIO UNITARIO INCLUYE EL DESPLAZAMIENTO DEL EQUIPO A LA OBRA, TUBERÍA, PERFORACIÓN, SOLDADURA CON TODOS LOS MEDIOS AUXILIARES NECESARIOS, PRUEBA DE ESTANQUEIDAD, MOVIMIENTOS DE TIERRAS PARA LA EJECUCIÓN DEL FOSO DE ATAQUE (12,00 M X 4,00 M) Y FOSO DE SALIDA (6,00 M X 3,00 M) Y ACHIQUE DE AGUA SI FUERA NECESARIO, ESTABILIZACIÓN DE LOS TERRENOS, AYUDA TOPOGRÁFICA PARA FIJAR ORIENTACIONES. MEDIDA LA UNIDAD COMPLETAMENTE EJECUTADA Y PROBADA. | TRESCIENTOS OCHENTA Y NUEVE EUROS con VEINTISEIS CÉNTIMOS | 389,26 |
| 0357 | R07AT100 | m | PASO BAJO CARRETERA O FERROCARRIL MEDIANTE HINCADO O PERFORACIÓN EN ROCA PARA PASO DE TUBERÍAS, EJECUTADO MEDIANTE TUBERÍA DE ACERO DE 1000X10 MM, A UNA PROFUNDIDAD MÍNIMA DE 1,5 METROS DE LA GENERATRIZ SUPERIOR DE LA TUBERÍA A LA SUPERFICIE DE LA CARRETERA O FERROCARRIL Y DE 0,75 M DE CUNETAS, AJUSTADA A LOS CONDICIONANTES TÉCNICOS DE LA CARRETERA O FERROCARRIL. EL PRECIO UNITARIO INCLUYE EL DESPLAZAMIENTO DEL EQUIPO A LA OBRA, TUBERÍA, PERFORACIÓN, SOLDADURA CON TODOS LOS MEDIOS AUXILIARES NECESARIOS, PRUEBA DE ESTANQUEIDAD, MOVIMIENTOS DE TIERRAS PARA LA EJECUCIÓN DEL FOSO DE ATAQUE (12,00 M X 4,00 M) Y FOSO DE SALIDA (6,00 M X 3,00 M) Y ACHIQUE DE AGUA SI FUERA NECESARIO, ESTABILIZACIÓN DE LOS TERRENOS, AYUDA TOPOGRÁFICA PARA FIJAR ORIENTACIONES. MEDIDA LA UNIDAD COMPLETAMENTE EJECUTADA Y PROBADA. | SETECIENTOS DIECIOCHO EUROS con CUARENTA Y UN CÉNTIMOS | 718,41 |
| 0358 | R07AT120 | m | PASO BAJO CARRETERA O FERROCARRIL MEDIANTE HINCADO O PERFORACIÓN EN ROCA PARA PASO DE TUBERÍAS, EJECUTADO MEDIANTE TUBERÍA DE ACERO DE 1219X10 MM, A UNA PROFUNDIDAD MÍNIMA DE 1,5 METROS DE LA GENERATRIZ SUPERIOR DE LA TUBERÍA A LA SUPERFICIE DE LA CARRETERA O FERROCARRIL Y DE 0,75 M DE CUNETAS, AJUSTADA A LOS CONDICIONANTES TÉCNICOS DE LA CARRETERA O FERROCARRIL. LONGITUD DE LA HINCA 25 M. EL PRECIO INCLUYE LA CAMISA HASTA LOS 50 M. EL PRECIO UNITARIO INCLUYE EL DESPLAZAMIENTO DEL EQUIPO A LA OBRA, TUBERÍA, PERFORACIÓN, SOLDADURA CON TODOS LOS MEDIOS AUXILIARES NECESARIOS, PRUEBA DE ESTANQUEIDAD, MOVIMIENTOS DE TIERRAS PARA LA EJECUCIÓN DEL FOSO DE ATAQUE (12,00 M X 4,00 M) Y FOSO DE SALIDA (6,00 M X 3,00 M) Y ACHIQUE DE AGUA SI FUERA NECESARIO, ESTABILIZACIÓN DE LOS TERRENOS, AYUDA TOPOGRÁFICA PARA FIJAR ORIENTACIONES. MEDIDA LA UNIDAD COMPLETAMENTE EJECUTADA Y PROBADA. | MIL DOSCIENTOS CUARENTA Y CINCO EUROS con TREINTA Y CINCO CÉNTIMOS | 1.245,35 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0359 | R07AT160 | m | PASO BAJO CARRETERA O FERROCARRIL MEDIANTE HINCADO O PERFORACIÓN EN ROCA PARA PASO DE TUBERÍAS, EJECUTADO MEDIANTE TUBERÍA DE ACERO DE 1626X12,5 MM, A UNA PROFUNDIDAD MÍNIMA DE 1,5 METROS DE LA GENERATRIZ SUPERIOR DE LA TUBERÍA A LA SUPERFICIE DE LA CARRETERA O FERROCARRIL Y DE 0,75 M DE CUNETAS, AJUSTADA A LOS CONDICIONANTES TÉCNICOS DE LA CARRETERA O FERROCARRIL. EL PRECIO UNITARIO INCLUYE EL DESPLAZAMIENTO DEL EQUIPO A LA OBRA, TUBERÍA, PERFORACIÓN, SOLDADURA CON TODOS LOS MEDIOS AUXILIARES NECESARIOS, PRUEBA DE ESTANQUEIDAD, MOVIMIENTOS DE TIERRAS PARA LA EJECUCIÓN DEL FOSO DE ATAQUE (12,00 M X 4,00 M) Y FOSO DE SALIDA (6,00 M X 3,00 M) Y ACHIQUE DE AGUA SI FUERA NECESARIO, ESTABILIZACIÓN DE LOS TERRENOS, AYUDA TOPOGRÁFICA PARA FIJAR ORIENTACIONES. MEDIDA LA UNIDAD COMPLETAMENTE EJECUTADA Y PROBADA. | MIL DOSCIENTOS TREINTA Y CINCO EUROS con DIECISIETE CÉNTIMOS | 1.235,17 |
| 0360 | R07BE01 | m2 | TAPA DE CHAPA LAGRIMADA DE 5 MM DE ESPESOR PINTADA CON PINTURA EPOXY POLIÉSTER DE 250 MICRAS DE ESPESOR, EJECUTADA CON PENDIENTE PARA FACILITAR AGUA DE LLUVIA. COLOCADA SOBRE ESTRUCTURA DE PERFILES LAMINADOS L 50.50.5 FORMANDO CUADROS DE 1 M. * 1 M. DE LADO COMO MÁXIMO PARA UNA RESISTENCIA DE 200 KG/M2 ANCLADA EN EL HORMIGÓN CON OREJETAS DE 60 MM * 60 MM PROVISTAS DE UN TALADRO DE 14 MM. CON PUERTA DE HOMBRE DE 0,8 M. * 0,8 M. CON BISAGRA, ASA, CANDADO Y CHAPA PERFORADA PERIMETRAL PARA VENTILACIÓN DEL INTERIOR. CONJUNTO ACABADO CON PINTURA EPOXY POLIÉSTER DE 250 MICRAS DE ESPESOR. MEDIDA LA SUPERFICIE REALMENTE COLOCADA. | NOVENTA Y DOS EUROS con TREINTA Y CUATRO CÉNTIMOS | 92,34 |
| 0361 | R07BE02 | ud | PATE DE POLIPROPILENO DE 30 * 25 COLOCADO | NUEVE EUROS con TRES CÉNTIMOS | 9,03 |
| 0362 | R07BE06 | u | ANILLADO METÁLICO PARA ESCALERAS DE MANO O PATES REALIZADO MEDIANTE PLETINA DE ACERO CON ANILLO CADA 70 CM DE ALTURA. UNIDAD TOTALMENTE ACABADA. | VEINTIOCHO EUROS con TREINTA Y NUEVE CÉNTIMOS | 28,39 |
| 0363 | R07CA130 | m² | PUERTA DE DOBLE CHAPA LISA DE ACERO DE 1 MM DE ESPESOR, GALVANIZADA Y PROTECCIÓN INTERIOR Y EXTERIOR CON EPOXY, ENGATILLADA, REALIZADA EN DOS BANDEJAS, CON RIGIDIZADORES DE TUBO RECTANGULAR, I/PATILLAS PARA RECIBIR EN FÁBRICAS, Y HERRAJES DE COLGAR Y DE SEGURIDAD. | OCHENTA Y CUATRO EUROS con CUARENTA Y CINCO CÉNTIMOS | 84,45 |
| 0364 | R07CA310 | m² | VENTANAL FIJO DE ALUMINIO ANODIZADO EN COLOR A DETERMINAR DE 13 MICRAS, PERFIL 50X40 MM Y 1,5 MM DE ESPESOR, CON JUNQUILLOS PARA FIJACIÓN DEL VIDRIO. TOTALMENTE COLOCADO EN EL PANEL PREFABRICADO DE HORMIGÓN. | CIENTO QUINCE EUROS con OCHENTA Y NUEVE CÉNTIMOS | 115,89 |
| 0365 | R07CB010 | m² | CERRAMIENTO COMPUESTO POR FÁBRICA DE BLOQUE PREFABRICADO DE HORMIGÓN TIPO "SPLIT", HIDRÓFUGO, DE COLOR, DE MEDIDAS 40X20X20 CM, EJECUTADO A UNA CARA VISTA Y ENFOSCADO POR EL INTERIOR, RECIBIDO CON MORTERO DE CEMENTO Y ARENA DE RÍO, INCLUSO PARTE PROPORCIONAL DE PIEZAS ESPECIALES, ZUNCHO, ROTURAS, APLOMADO, NIVELADO, LLAGUEADO Y LIMPIEZA, TOTALMENTE TERMINADO. | CINCUENTA EUROS con NUEVE CÉNTIMOS | 50,09 |
| 0366 | R07CR050 | m² | PINTURA PLÁSTICA LISA BLANCA EN PARAMENTOS VERTICALES Y HORIZONTALES, LAVABLE DOS MANOS, I/LIJADO Y EMPLASTECIDO. | OCHO EUROS con VEINTICUATRO CÉNTIMOS | 8,24 |
| 0367 | R07CR118 | m2 | FALSO TECHO REGISTRABLE SITUADO A UNA ALTURA MENOR DE 4 M, DECORATIVO, FORMADO POR PLACAS DE YESO LAMINADO, LISAS, ACABADO CON VINILO BLANCO, DE 600X600X9,5 MM, CON PERFILERÍA VISTA. EL PRECIO INCLUYE LA RESOLUCIÓN DE ENCUENTROS Y PUNTOS SINGULARES. | VEINTIDOS EUROS con VEINTITRES CÉNTIMOS | 22,23 |
| 0368 | R07CR119 | m2 | MURO DE CARGA DE 19 CM DE ESPESOR DE FÁBRICA DE BLOQUE CERÁMICO ALIGERADO MACHIHEMBRADO, 30X19X19 CM, PARA REVESTIR, RESISTENCIA A COMPRESIÓN 10 N/MM², RECIBIDA CON MORTERO DE CEMENTO CONFECCIONADO EN OBRA, CON 300 KG/M³ DE CEMENTO, COLOR GRIS, DOSIFICACIÓN 1:5, SUMINISTRADO EN SACOS, CON PIEZAS ESPECIALES TALES COMO MEDIOS BLOQUES, BLOQUES DE ESQUINA Y BLOQUES DE TERMINACIÓN. EL PRECIO NO INCLUYE LOS ZUNCHOS HORIZONTALES NI LA FORMACIÓN DE LOS DINTELES DE LOS HUECOS DEL PARAMENTO. | VEINTICUATRO EUROS con DIEZ CÉNTIMOS | 24,10 |
| 0369 | R07CR120 | m² | ENFOSCADO MAESTREADO Y FRATASADO CON MORTERO DE CEMENTO II-Z/35A Y ARENA DE RÍO 1/4 (M-80) EN PARAMENTOS VERTICALES DE 20 MM DE ESPESOR, I/REGLEADO, SACADO DE ARISTAS Y RINCONES CON MAESTRAS CADA 3 M Y ANDAMIAJE, S/NTE-RPE-7, MEDIDO DEDUCIENDO HUECOS SUPERIORES A 1 M². | QUINCE EUROS con NOVENTA Y SIETE CÉNTIMOS | 15,97 |
| 0370 | R07CV015 | m² | CLIMALIT CON DOS LUNAS INCOLORAS DE 4 MM Y CÁMARA DE AIRE DE 6,8 Ó 12 MM CON JUNTA PLÁSTICA, COLOCADO SOBRE MADERA, ALUMINIO O HIERRO Y SELLADO CON SILICONA INCOLORA. | CUARENTA Y CUATRO EUROS con OCHENTA Y CUATRO CÉNTIMOS | 44,84 |
| 0371 | R07EM001 | kg | ACERO DE DUREZA NATURAL, EN BARRAS CORRUGADAS, TIPO B-500 S PARA ELEMENTOS DE CIMENTACIÓN, MUROS Y ESPERAS DE ESTRUCTURA, INCLUSO CORTE, DOBLADO, COLOCACIÓN CON ATADO CON ALAMBRE, INCLUSO SEPARADORES, ESTRIBOS, ETC, COLOCADO Y MONTADO EN OBRA Y AYUDAS PARA SU HORMIGONADO POSTERIOR, SOLAPES, ETC, SEGÚN EHE. MEDIDO EL PESO NOMINAL TEÓRICO DE PROYECTO. | UN EUROS con ONCE CÉNTIMOS | 1,11 |

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| 0372 | R07EM050 | kg | ACERO EN CALDERERÍA, AL CARBONO DE TIPO S-275-JR, CON ESPESORES DE CHAPA SEGÚN EL DIÁMETRO DE LA TUBERÍA (EN PN 16 ATM; 4 MM HASTA DN 300, 6,4 MM DE DN 350 A DN 600 Y 8 MM DESDE DN 700- EN PN 25 ATM; 6,4 MM HASTA DN 300, 8 MM DE DN 350 A DN 600, 10 MM DE DN 700 A 1.000 Y 12 MM DE DN 1.100 A DN 1.500), CON SOLDADURAS REALIZADAS BAJO PROCEDIMIENTO HOMOLOGADO (SEGÚN CÓDIGO ASME-SECCIÓN IX), TRATAMIENTO DE ACABADO MEDIANTE GRANALLADO DE SUPERFICIE HASTA RUGOSIDAD SA 2,5 (SEGÚN NORMA SIS-05-900) Y POSTERIOR RECUBRIMIENTO DE PINTURA DE POLVO EPOXY, INTERIOR DE 300 MICRAS Y EXTERIOR DE 200 MICRAS. INCLUSO CORTE Y ELABORACIÓN EN TALLER, MONTAJE PARA UNIÓN MEDIANTE SOLDADURA. MEDIDO SEGÚN PESO NOMINAL. | CINCO EUROS con DIECIOCHO CÉNTIMOS | 5,18 |
| 0373 | R07EN020 | m² | ENCOFRADO CON PANELES METÁLICOS A UNA CARA PARA DEJAR A BUENA VISTA, INCLUSO ENTIBACIONES, APUNTALADO Y SEPARADORES, PARA UN PERFECTO APLOMADO, INCLUSO LIMPIEZA Y HUMEDECIDO, APLICACIÓN DESENCOFRANTE, PARTE PROPORCIONAL DE ELEMENTOS COMPLEMENTARIOS PARA SU ESTABILIDAD Y ADECUADA EJECUCIÓN, POSTERIOR DESENCOFRADO Y REPASO DE PARAMENTOS | VEINTICINCO EUROS con SETENTA Y NUEVE CÉNTIMOS | 25,79 |
| 0374 | R07HO020SR | m³ | HORMIGÓN EN MASA HM-20/B/15-20/IIA+QB, CON ÁRIDO RODADO DE TAMAÑO MÁXIMO DE 20 MM Y CONSISTENCIA PLÁSTICA, FABRICADO CON CEMENTO I-32,5/SR, PUESTO EN OBRA, INCLUSO PARTE PROPORCIONAL DE LIMPIEZA DE FONDOS, VIBRADO Y CURADO | SETENTA Y UN EUROS con VEINTIUN CÉNTIMOS | 71,21 |
| 0375 | R07HO025SR | m³ | HORMIGÓN HA-25/B/15-20/IIA+QB, CON ÁRIDO RODADO DE TAMAÑO MÁXIMO DE 20 MM Y CONSISTENCIA BLANDA, FABRICADO CON CEMENTO I-32,5, PUESTO EN OBRA, INCLUSO PARTE PROPORCIONAL DE LIMPIEZA DE FONDOS, SELLADO DE UNIONES ENTRE PARAMENTOS, VIBRADO Y CURADO | OCHENTA Y SEIS EUROS con CATORCE CÉNTIMOS | 86,14 |
| 0376 | R07L12 | m² | FORMACIÓN DE ESCALERA METÁLICA, ELEMENTOS DE ACCESO, PASARELAS, TODO ELLO DE CUALQUIER DIMENSIÓN Y GEOMETRÍA. CONSTRUÍDO SEGÚN PLANOS O INDICACIONES DE LA DIRECCIÓN DE OBRA, CON PERFILES METÁLICOS DE ACERO S275 JO, CON PELDAÑOS FORMACIÓN DE HUELLA DE 21 CM Y CONTRAHUELLA DE 21 CM Y ANCHO DE PASO MÍNMO 90 CM. INLCUIDO BARANDILLAS LATERALES A TODOS LOS FRENTES NECESARIOS, EJECUTADAS TAMBIÉN CON ACERO S275 JO. TODO EL CONJUNTO CON TRATAMIENTO ANTICORROSIÓN POR GALVANIZADO. SE INLCUYE LA FORMACIÓN DE PELDAÑOS CON REJILLA TIPO TRAMEX 30X30 MM DE PLETINA 40.3 MM. INCLUIDO LA COLOCACIÓN DE PLACAS DE ANCLAJE SOLDADAS AL CONJUNTO Y CON PERNOS PARA LA COLOCACIÓN SOBRE FÁBRICAS DE LADRILLO, HORMIGÓN, SOLERAS Y ELEMENTOS DE OBRA CIVIL. MEDIDA LA UNIDAD TOTALMENTE COLOCADA EN OBRA. | OCHENTA Y NUEVE EUROS con CUARENTA Y DOS CÉNTIMOS | 89,42 |
| 0377 | R07PC040 | m | PASO BAJO CAMINO CON TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 400 MM. ZANJA DE ANCHURA EN LA BASE 1,0 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, CAMA DE ARENA DE 15 CM DE ESPESOR, RELLENO CON MATERIAL GRANULAR Y FINALIZANDO CON 10 CENTIMETROS DE ZAHORRAS COMPACTADAS. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | CIENTO TRES EUROS con DIEZ CÉNTIMOS | 103,10 |
| 0378 | R07PC050-90 | m | TUBERÍA DE HORMIGÓN CLASE C-90 O SIMILAR, CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 500 MM PUESTO EN ZANJA, INCLUIDAS LAS JUNTAS Y PARTE PROPORCIONAL PARA CONEXIONES Y ACCESORIOS. COMPLETAMENTE EJECUTADA Y PROBADA. | TREINTA Y CINCO EUROS con OCHENTA Y CINCO CÉNTIMOS | 35,85 |
| 0379 | R07PCA040 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 400 MM. ZANJA DE ANCHURA EN LA BASE 1,0 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | DOSCIENTOS VEINTIUN EUROS con OCHENTA CÉNTIMOS | 221,80 |
| 0380 | R07PCA060 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 600 MM. ZANJA DE ANCHURA EN LA BASE 1,2 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | DOSCIENTOS CINCUENTA EUROS con TREINTA Y UN CÉNTIMOS | 250,31 |
| 0381 | R07PCA080 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 800 MM. ZANJA DE ANCHURA EN LA BASE 1,4 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | DOSCIENTOS SETENTA Y TRES EUROS con SETENTA Y SIETE CÉNTIMOS | 273,77 |

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| 0382 | R07PCA100 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 1000 MM. ZANJA DE ANCHURA EN LA BASE 1,6 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | TRESCIENTOS UN EUROS con SESENTA Y DOS CÉNTIMOS | 301,62 |
| 0383 | R07PCA120 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 1200 MM. ZANJA DE ANCHURA EN LA BASE 1,8 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | TRESCIENTOS VEINTIDOS EUROS con VEINTISEIS CÉNTIMOS | 322,26 |
| 0384 | R07PCA140 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 1400 MM. ZANJA DE ANCHURA EN LA BASE 1,8 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | TRESCIENTOS TREINTA Y DOS EUROS con CINCUENTA Y SEIS CÉNTIMOS | 332,56 |
| 0385 | R07PCA160 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 1600 MM. ZANJA DE ANCHURA EN LA BASE 1,8 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | TRESCIENTOS CUARENTA Y DOS EUROS con OCHENTA Y SEIS CÉNTIMOS | 342,86 |
| 0386 | R07PCA180 | m | PASO BAJO CARRETERA O CAMINO ASFALTADO, MEDIANTE LA INSTALACIÓN DE CAMISA A BASE DE TUBERÍA DE HORMIGÓN CON ENCHUFE DE CAMPANA Y JUNTA DE GOMA DE 1800 MM. ZANJA DE ANCHURA EN LA BASE 2,2 METROS, PROFUNDIDAD VARIABLE, TALUDES 1/5 EN PAREDES, RELLENO CON HORMIGÓN HM 20, TERMINACIÓN CON MEZCLA BITUMINOSA EN CALIENTE DEBIDAMENTE COMPACTADA Y RIEGO ASFÁLTICO DE ADHERENCIA. INCLUSO EXCAVACIÓN CON ROMPEDOR EN CASO NECESARIO. INCLUSO ENTIBACIONES Y AGOTAMIENTOS. COMPLETAMENTE EJECUTADA. | TRESCIENTOS CINCUENTA Y TRES EUROS con DIECISEIS CÉNTIMOS | 353,16 |
| 0387 | R07PGA | ud | PUERTA DE PASO DE UNA HOJA DE 38 MM DE ESPESOR, 800X2045 MM DE LUZ Y ALTURA DE PASO, ACABADO LACADO EN BLANCO FORMADA POR DOS CHAPAS DE ACERO GALVANIZADO DE 0,5 MM DE ESPESOR CON REJILLAS DE VENTILACIÓN TROQUELADAS EN LA PARTE SUPERIOR E INFERIOR, DE 200X250 MM CADA UNA, PLEGADAS, ENSAMBLADAS Y MONTADAS, CON CÁMARA INTERMEDIA RELLENA DE POLIURETANO, SOBRE CERCO DE ACERO GALVANIZADO DE 1,5 MM DE ESPESOR CON GARRAS DE ANCLAJE A OBRA, INCLUSO BISAGRAS SOLDADAS AL CERCO Y REMACHADAS A LA HOJA, CERRADURA EMBUTIDA DE CIERRE A UN PUNTO, CILINDRO DE LATÓN CON LLAVE, ESCUDOS Y MANIVELAS DE NYLON COLOR NEGRO. INCLUIDOS LAS LABORES DE INSTALACIÓN DE PREMARCO Y MARCO, Y ALBAÑILERIA ASOCIADA. | CIENTO TRES EUROS con VEINTIDOS CÉNTIMOS | 103,22 |
| 0388 | R07PGA1.6 | ud | PUERTA DE PASO DE DOS HOJA DE 38 MM DE ESPESOR, 1600X2045 MM DE LUZ Y ALTURA DE PASO, REPARTIDO EN DOS HOJAS DE 800 MM DE LUZ, ACABADO LACADO EN BLANCO FORMADAS LAS HOJAS POR DOS CHAPAS DE ACERO GALVANIZADO DE 0,5 MM DE ESPESOR CON REJILLAS DE VENTILACIÓN TROQUELADAS EN LA PARTE SUPERIOR E INFERIOR, DE 200X250 MM CADA UNA, PLEGADAS, ENSAMBLADAS Y MONTADAS, CON CÁMARA INTERMEDIA RELLENA DE POLIURETANO, SOBRE CERCO DE ACERO GALVANIZADO DE 1,5 MM DE ESPESOR CON GARRAS DE ANCLAJE A OBRA, INCLUSO BISAGRAS SOLDADAS AL CERCO Y REMACHADAS A LA HOJA, CERRADURA EMBUTIDA DE CIERRE A UN PUNTO, CILINDRO DE LATÓN CON LLAVE, ESCUDOS Y MANIVELAS DE NYLON COLOR NEGRO. INCLUIDOS LAS LABORES DE INSTALACIÓN DE PREMARCO Y MARCO, Y ALBAÑILERIA ASOCIADA. | DOSCIENTOS TREINTA Y CUATRO EUROS con DIEZ CÉNTIMOS | 234,10 |
| 0389 | R07SO010 | m² | PAVIMENTO DE BALDOSA HIDRÁULICA DE CEMENTO ACABADO SUPERFICIAL EN RELIEVE, DE 20X20X5 CM., SOBRE SOLERA DE HORMIGÓN HM-20/P/20/I DE 10 CM. DE ESPESOR, SENTADA CON MORTERO DE CEMENTO, I/P.P. DE JUNTA DE DILATACIÓN, ENLECHADO Y LIMPIEZA. | VEINTIUN EUROS con NOVENTA Y SEIS CÉNTIMOS | 21,96 |
| 0390 | RED_TT_HER_CS | ud | INSTALACIÓN PARA TOMA DE TIERRA DE APARELLAJE:<br>4 PICAS DE 2M Y 14MM DE DIAMPETRO,20 M DE CONDUCTOR DE CU DESNUDO S=50 MM2 | CUATROCIENTOS SESENTA Y NUEVE EUROS con NUEVE CÉNTIMOS | 469,09 |

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| 0391 | RED_TT_HER_CT | ud | INSTALACIÓN PARA TOMA DE TIERRA DE APARELLAJE:<br>8 PICAS DE 2M Y 14MM DE DIAMPETRO,20 M DE CONDUCTOR DE CU DESNUDO S=50 MM2<br><br>INSTALACIÓN DE PUESTA A TIERRA DE NEUTRO:<br>3 PICAS DE 2M Y 14MM DE DIÁMETRO, 30M DE CONDUCTOR DE CU DESNUDO S=50MM2 | OCHOCIENTOS SETENTA Y CUATRO EUROS con CUARENTA Y OCHO CÉNTIMOS | 874,48 |
| 0392 | REIGOSUL | Hr | RIEGO DE SUELO CON CISTERNA | TREINTA Y NUEVE EUROS con NOVENTA Y SEIS CÉNTIMOS | 39,96 |
| 0393 | REJ | m² | REJILLA EN FACHADAS | CINCUENTA Y CUATRO EUROS con CINCUENTA Y CINCO CÉNTIMOS | 54,55 |
| 0394 | REST | m² | RESTAURACIÓN SUELO LABOR | CERO EUROS con TREINTA Y DOS CÉNTIMOS | 0,32 |
| 0395 | RTOMA1000 | Ud | REJA DE DESBASTE PARA TOMA DE 1,00M, SOBRE GUÍAS PARA FACILITAR SU LIMPIEZA Y MANTENIMIENTO. EN ACERO INOXIDABLE AISI-316, CON LUZ DE PASO MÁXIMA DE 50 CON REFUERZOS CADA 150 MM Y ALTURA MÍNIMA DE 1,5 M. INCLUYE PLETINAS, TORNILLERÍA Y PP. DE PEQUEÑO MATERIAL PARA ANCLAJE A HORMIGÓN Y CON LÁMINA PLÁSTICA. MEDIDA LA UNIDAD TOTALMENTE MONTADA Y PROBADA. | NOVECIENTOS NOVENTA Y SIETE EUROS con DIECISEIS CÉNTIMOS | 997,16 |
| 0396 | SE10BOYA | Ud | BOYA INTERMITENTE CON CÉLULA FOTOELÉCTRICA PARA SEÑALIZACIÓN NOCTURNA. COLOCADA. S/R.D. 485/97. | CINCUENTA Y DOS EUROS con TREINTA Y TRES CÉNTIMOS | 52,33 |
| 0397 | SE10CIRIS | Ud | UD. CARTEL INDICATIVO DE RIESGO DE 0,30X0,30 M. CON SOPORTE METÁLICO DE HIERRO GALVANIZADO 80X40X2 MM. Y 1,3 M. DE ALTURA, INCLUSO APERTURA DE POZO, HORMIGONADO, COLOCACIÓN Y DESMONTADO. S/R.D. 485/97. | DIECINUEVE EUROS con CUATRO CÉNTIMOS | 19,04 |
| 0398 | SE10CIRSS | Ud | UD. CARTEL INDICATIVO DE RIESGO DE 0,30X0,30 M., SIN SOPORTE METÁLICO, INCLUSO COLOCACIÓN Y DESMONTADO. S/R.D. 485/97. | TRES EUROS con DIECISIETE CÉNTIMOS | 3,17 |
| 0399 | SE10CPRIENT | Ud | CARTEL PROVISIONAL DE RIESGO ENTRADA OBRA/EPI'S. INCLUSO APERTURA DE POZO, HORMIGONADO, COLOCACIÓN Y DESMONTADO. S/R.D. 485/97. | CIENTO TREINTA Y CINCO EUROS con VEINTIOCHO CÉNTIMOS | 135,28 |
| 0400 | SE10SSIS | Ud | SEÑAL DE STOP TIPO OCTOGONAL DE D=600 MM. NORMALIZADA, CON SOPORTE METÁLICO DE HIERRO GALVANIZADO 80X40X2 MM. Y 1,3 M. DE ALTURA INCLUSO PARTE PROPORCIONAL DE APERTURA DE POZO, HORMIGONADO, COLOCACIÓN Y DESMONTADO. (3 USOS) . S/R.D. 485/97. | SETENTA Y SIETE EUROS con TREINTA Y SIETE CÉNTIMOS | 77,37 |
| 0401 | SE20CB | m | ML. CINTA CORRIDA DE BALIZAMIENTO PLÁSTICA PINTADA A DOS COLORES ROJA Y BLANCA, INCLUSO COLOCACIÓN Y DESMONTADO. S/R.D. 485/97. | CERO EUROS con TREINTA CÉNTIMOS | 0,30 |
| 0402 | SE20VCP | Ud | UD. VALLA AUTÓNOMA METÁLICA DE 2,5 M. DE LONGITUD PARA CONTENCIÓN DE PEATONES NORMALIZADA, INCLUSO COLOCACIÓN Y DESMONTAJE. (20 USOS). S/R.D. 485/97. | DOS EUROS con SESENTA Y DOS CÉNTIMOS | 2,62 |
| 0403 | SISFV | Ud | ALIMENTACIÓN ELÉCTRICA MEDIANTE INSTALACIÓN SOLAR FOTOVOLTAICA FORMADA POR:<br>- CONJUNTO DE 12 VASOS LIBRES DE MANTENIMIENTO, DE 2V CADA UNO Y 200AH<br>- REGULADOR DE CARGA 12/24V 20A.<br>- PANEL SOLAR DE APROX. (SEGÚN DISPONIBILIDAD COMERCIAL) 24V 120W CON DETECCIÓN DE INTRUSIÓN SOBRE MÁSTIL EXISTENTE EN SOPORTE ORIENTABLE, COLOCADO SOBRE ZAPATA Y ESPERAS EXISTENTES INSERTADAS EN OBRA CIVIL.<br>- MÁSTIL TUBULAR/TROCOCÓNICO DE 8M DE ALTURA Y 4MM DE PARED CON VENTANA DE CONEXIONADO, SOBRE ZAPATA Y ESPERAS EXISTENTES INSERTADAS EN OBRA CIVIL.<br>- CABLE TIPO RVK 4X4 POR TUBO<br>- ARQUETA PARA ALOJAMIENTO DE LAS BATERIAS REGULADOR, CONSISTENTE EN CASETA PREFABRICADA DE HORMIGÓN CON BASE INTEGRADA O PRESOLERA DE HORMIGÓN HM-20, CON UNAS DIMENSIONES INTERIORES ÚTILES DE 2,00X1,00X1,900, CON APERTURA EN EJE VERTICAL DE DOBLE HOJA, PUERTAS EN GALVANIZADO 1,5 MM, NERVADURA PERIMETRAL DE REFUERZO, REJILLA DE VENTILACIÓN CON MOSQUITERA EN PUERTAS, BISAGRAS CON PERNO DE PALA, CERROJO REFORZADO TIPO AZBE. INCLUIDO SOPORTES, Y CANDADO, INCLUIDOS TODOS LOS MEDIOS AUXILIARES PARA SU COLOCACIÓN Y CIMENTACIÓN PARA MASTIL CONSISTENTE EN HORMIGÓN EN MASA DE 0,8X0,8X1,2M Y 4 PERNOS DE 16 MM DE DIAMETRO DE ACERO B-500S. INCLUIDOS TUBO DE PE CORRUGADO CON GUÍA PARA CABLEADO A LOS ELEMENTOS (VALVULAS Y CAUDALIMETROS, DOS TUBOS POR ELEMNTO), Y EL DESBROCE O PREPARACIÓN DE TERRENO PARA LA PRESOLERA.<br>TOTALMENTE INSTALADO, CONEXIONADO, CONECTADO Y EN FUNCIONAMIENTO. INCLUYENDO EL ALQUILER DE VEHÍCULOS Y/O MEDIOS NECESARIOS PARA EL TRANSPORTE Y LEVANTAMIENTO DE MÁSTIL JUNTO CON PANEL SOLAR Y OTROS ELEMENTOS SOBRE ÉSTOS. | DOS MIL DOSCIENTOS OCHENTA Y SIETE EUROS con SESENTA Y UN CÉNTIMOS | 2.287,61 |
| 0404 | SOL_DCBOX10 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE DE 10 MM2 CU. (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. MONTAJE E INSTALACION DE CABLE UNIPOLAR DE COBRE DE 6 MM2 CU. (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC, COLOCADO EN EL INTERIOR DE TUBO CORRUGADO DE POLIETILENO DOBLE PARED FLEXIBLE PARA INSTALACIONES ELÉCTRICAS DE DIAMETRO 50 MM (SI PROCEDE) . INCLUSO CONEXIONADO A MÓDULOS FOTOVOLTAICOS MEDIANTE EMPALMES Y PUNTERAS TERMINALES. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | DOS EUROS con SIETE CÉNTIMOS | 2,07 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0405 | SOL_DCBOX6 | m | SUMINISTRO DE CABLE UNIPOLAR DE COBRE DE 6 MM2 CU. (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC. MONTAJE E INSTALACION DE CABLE UNIPOLAR DE COBRE DE 6 MM2 CU. (PROTECCION SOLAR) DE TENSIÓN ASIGNADA 0.6/1KV, FLEXIBLIDAD CLASE 5 CON AISLAMIENTO DE POLIETILENO RETICULARDO Y CUBIERTA DE PVC, COLOCADO EN EL INTERIOR DE TUBO CORRUGADO DE POLIETILENO DOBLE PARED FLEXIBLE PARA INSTALACIONES ELÉCTRICAS DE DIAMETRO 50 MM (SI PROCEDE) . INCLUSO CONEXIONADO A MÓDULOS FOTOVOLTAICOS MEDIANTE EMPALMES Y PUNTERAS TERMINALES. INCLUYENDO MEDIOS AUXILIARES, TOTALMENTE INSTALADO. | UN EUROS con CINCUENTA Y OCHO CÉNTIMOS | 1,58 |
| 0406 | SONDA | ud | SUMINISTRO, INSTALACION, AJUSTE Y PUESTA EN MARCHA DE SONDA DE NIVEL DE INMERSION CON MEMBRANA DE ACERO CORRUGADO DE PRECISION 0,125%(BFSL) INSTALADA EN INTERIOR DE TUBO DE ACERO INOXIDABLE/POLIETILENO SOBRE PARED DE CANAL, CONECTADA A CAJA DE CONEXIONES.<br>TIRADO DE CABLE TIPO YCY5X1,5 POR TUBO INCLUIDO. | MIL TRESCIENTOS SESENTA Y OCHO EUROS con TREINTA Y CUATRO CÉNTIMOS | 1.368,34 |
| 0407 | TACC | Ud | TOMA ACCESORIA COMPUESTA POR 1 VÁLVULAS DE ESFERA DE 1", ROSCADA, CON PALANCA MANUAL, INCLUSO ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | DIECISIETE EUROS con NOVENTA Y NUEVE CÉNTIMOS | 17,99 |
| 0408 | TAJ-50X50 | Ud | TAJADERA METÁLICA CON ACCIONAMIENTO MANUAL MEDIANTE VOLANTE CON REDUCTOR SITUADO EN EL BASTIDOR SUPERIOR, CON HUSILLO SIMPLE DE TIPO ASCENDETE Y ROSCA TRAPECIAL, PASO ESTANDARIZADO, REALIZADO EN ACERO AISI 304 DE DIAMETRO 40 MM O SUPERIOR (ACORDE A LA PRESIÓN Y FRICCIÓN DE LA COMPUERTA). TABLERO DE COMPUERTA DE UNAS DIMENSIONES DE 0,4X0.8(H) M REALIZADO EN ACERO AL CARBONO S-275-JR, ESTRUCTURA DEL BASTIDOR REALIZADO CON PERFILES CONFORMADOS MEDIANTE PLEGADO Y REFUERZOS EN ACERO S-275-JR, CON PUENTE SUPERIOR DE APOYO DEL VOLANTE DESMONTABLE PARA EXTRACCIÓN DE HOJA DE COMPUERTA, Y BASTIDOR CON UNA ALTURA SUFICIENTE PARA ASEGURAR UNA ALTURA DEL VOLANTE DE 1,2M SOBRE EL TERRENO O CORONACIÓN DEL CAJERO EXTERIOR DE LA ACEQUIA. CIERRE HERMETICO A 3 JUNTAS UNIDIRECCIONAL MEDIANTE JUNTAS DE GOMA DE EPDM O NEOPRENO, CON FORMA Y TIPOLOGÍA ACORDE A LA FORMA DE LA HOJA Y BASTIDOR. INSTALACIÓN DE GUIAS DESLIZANTES EN PUNTOS DE UNIÓN VERTICAL ENTRE BASTIDOR Y TABLERO REALIZADAS MEDAINTE PIEZAS DE POLIETILENO O NYLON, CON UNIÓN FACILMENTE SUSTITUIBLE. TORNILLERIA EN ACERO INOXIDABLE CALIDAD 8.8 O SUPERIOR. TODAS LAS PIEZAS REALIZADAS EN ACERO S-275 DISPONDRÁN DE TRATAMIENTO MEDIANTE GRANALLADO, DESENGRASADO DE SUPERFICIES, RECUBRIMIENTO DE PINTURA EPOXI RICA EN ZINC (50 MICRAS), RECUBRIMIENTO DE EPOXI POLIAMIDA DE 100 MICRAS Y RECUBRIMIENTO DE PINTURA DE POLIURETANO ALIFATICO DE 50 MICRAS. INCLUSO PLATAFORMA PARA ACCIONAMIENTO, ELEMENTOS DE ANCLAJE Y PEQUEÑO MATERIAL PARA OBRA CIVIL Y DE ACONDICIONAMIENTO DE BANDA NECESARIA PARA TRÁNSITO DE MAQUINARIA EN EJECUCIÓN DE LOS TRABAJOS. COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA Y PROBADA. | SEISCIENTOS SETENTA EUROS con NOVENTA Y DOS CÉNTIMOS | 670,92 |
| 0409 | TAJ-50X80 | Ud | TAJADERA METÁLICA CON ACCIONAMIENTO MANUAL MEDIANTE VOLANTE CON REDUCTOR SITUADO EN EL BASTIDOR SUPERIOR, CON HUSILLO SIMPLE DE TIPO ASCENDETE Y ROSCA TRAPECIAL, PASO ESTANDARIZADO, REALIZADO EN ACERO AISI 304 DE DIAMETRO 40 MM O SUPERIOR (ACORDE A LA PRESIÓN Y FRICCIÓN DE LA COMPUERTA). TABLERO DE COMPUERTA DE UNAS DIMENSIONES DE 0,6X0.8(H) M REALIZADO EN ACERO AL CARBONO S-275-JR, ESTRUCTURA DEL BASTIDOR REALIZADO CON PERFILES CONFORMADOS MEDIANTE PLEGADO Y REFUERZOS EN ACERO S-275-JR, CON PUENTE SUPERIOR DE APOYO DEL VOLANTE DESMONTABLE PARA EXTRACCIÓN DE HOJA DE COMPUERTA, Y BASTIDOR CON UNA ALTURA SUFICIENTE PARA ASEGURAR UNA ALTURA DEL VOLANTE DE 1,2M SOBRE EL TERRENO O CORONACIÓN DEL CAJERO EXTERIOR DE LA ACEQUIA. CIERRE HERMETICO A 3 JUNTAS UNIDIRECCIONAL MEDIANTE JUNTAS DE GOMA DE EPDM O NEOPRENO, CON FORMA Y TIPOLOGÍA ACORDE A LA FORMA DE LA HOJA Y BASTIDOR. INSTALACIÓN DE GUIAS DESLIZANTES EN PUNTOS DE UNIÓN VERTICAL ENTRE BASTIDOR Y TABLERO REALIZADAS MEDAINTE PIEZAS DE POLIETILENO O NYLON, CON UNIÓN FACILMENTE SUSTITUIBLE. TORNILLERIA EN ACERO INOXIDABLE CALIDAD 8.8 O SUPERIOR. TODAS LAS PIEZAS REALIZADAS EN ACERO S-275 DISPONDRÁN DE TRATAMIENTO MEDIANTE GRANALLADO, DESENGRASADO DE SUPERFICIES, RECUBRIMIENTO DE PINTURA EPOXI RICA EN ZINC (50 MICRAS), RECUBRIMIENTO DE EPOXI POLIAMIDA DE 100 MICRAS Y RECUBRIMIENTO DE PINTURA DE POLIURETANO ALIFATICO DE 50 MICRAS. INCLUSO PLATAFORMA PARA ACCIONAMIENTO, ELEMENTOS DE ANCLAJE Y PEQUEÑO MATERIAL PARA OBRA CIVIL Y DE ACONDICIONAMIENTO DE BANDA NECESARIA PARA TRÁNSITO DE MAQUINARIA EN EJECUCIÓN DE LOS TRABAJOS. COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA Y PROBADA. | NOVECIENTOS OCHENTA Y SEIS EUROS con DIEZ CÉNTIMOS | 986,10 |
| 0410 | TEX003 | M3 | EXCAVACION EN DESMONTE CON MEDIOS MECÁNICOS DE TERRENOS DE CUALQUIER NATURALEZA O CONSISTENCIA, INCLUÍDAS LAS ARENISCAS Y MARGAS RIPABLES, CON POTENCIAS IGUALES A 306KW/410CV, ROCA DE MAYOR DUREZA, INCLUSO TERRENOS DE CONSISTENCIA BLANDA. INCLUSO RIPADO PREVIO SEGÚN CARACTERÍSTICAS INDICADAS, CARGA Y TRANSPORTE A TERRAPLÉN, CABALLERO LUGAR DE EMPLEO O VERTEDERO AUTORIZADO (INCLUIDO CANON Y/O TASAS) A DISTANCIA INFERIOR A 10 KM. INCLUIDO EL EXTENDIDO Y PERFILADO DE TALUDES, ENTIBADO Y AGOTAMIENTO, APILADO Y TRASLADO EN OBRA DE PRODUCTOS DE EXCAVACIÓN APORTACIÓN DE RIEGOS CON CUBA PARA MINIMIZAR LA EMISIÓN DE PARTÍCULAS DE POLVO A LA ATMÓSFERA. MEDIDO EL VOLUMEN SOBRE PERFIL NATURAL CON EL PERFIL FINAL Y CON EL PERFIL TEÓRICO DE PROYECTO. | UN EUROS con SESENTA Y UN CÉNTIMOS | 1,61 |
| 0411 | TEX005 | M2 | REFINO Y PERFILADO DE TALUDES INTERIORES Y EXTERIORES DE TERRAPLÉN SEGÚN PLANOS, INCLUSO CON LA UTILIZACIÓN DE MEDIOS MANUALES SI SON PRECISOS, ASEGURANDO LA ELIMINACIÓN TOTAL DE ELEMENTOS GRUESOS VISTOS EN SUPERFICIE CON UN TAMAÑO MAYOR A 2 CM O DE FORMA ANGULOSA. EN EL CASO DE NO PODER REALIZAR ESTA ELIMINACIÓN SE INCLUYE ADEMÁS LA EXTENSIÓN, COLOCACIÓN Y COMPACTACIÓN DE UNA CAPA DE 15 CM DE MATERIAL FINO SELECCIONADO Y CRIBADO OBTENIDO DEL MOVIMIENTO DE TIERRAS DE LOS TALUDES Y ACOPIADO DURANTE SU EJECUCIÓN PREVIA PARA TAL FIN. MEDIDA LA SUPERFICIE FINALIZADA Y EJECUTADA FINAL. | CERO EUROS con TREINTA Y DOS CÉNTIMOS | 0,32 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0412 | TGR | Ud | TOMA DE AGUA PARA GRANJA COMPUESTO POR 2 VÁLVULAS DE ESFERA DE 1", ROSCADAS, CON PALANCA MANUAL, CONTADOR DE AGUA DE CHORRO MÚLTIPLE, DE DIÁMETRO 1" Y 16 ATM DE PRESIÓN DE TRABAJO, Y FILTRO DE MALLA DE 1". INCLUSO JUNTAS, TORNILLERIA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN, COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | CIENTO SESENTA Y CUATRO EUROS con VEINTICUATRO CÉNTIMOS | 164,24 |
| 0413 | TRAF-2000 | UD. | UD. TRANSFORMADOR DE POTENCIA DE 2000 KVA, SERVICIO INTERIOR, AISLAMIENTO SECO, RELACIÓN DE TRANSFORMACIÓN 15 KV / 400 V, +-2,5+-5%,+10% CONEXIÓN DYN11, PANTALLA ELECTROESTÁTICA, CENTRALITA DE TEMPERATURAS Y RELE FOTOVOLTAICO INCLUIDOS MEDIOS AUXILIARES NECESARIOS, INSTALADO, MONTADO Y TRASLADADO. | VEINTINUEVE MIL TRESCIENTOS CUARENTA Y NUEVE EUROS con CUARENTA Y CUATRO CÉNTIMOS | 29.349,44 |
| 0414 | TRAMEX | M2 | CELOSÍA METÁLICA "TRAMEX" FORMADA POR MALLA DE ACERO 30X30 MM, PLETINA 40.3 Y BASTIDOR CON UNIONES ELECTROSOLDADAS. INCLUSO SOLDADURA Y AJUSTE A OTROS ELEMENTOS. | CIENTO ONCE EUROS con SESENTA Y NUEVE CÉNTIMOS | 111,69 |
| 0415 | TT08 | ud | SUMINISTRO E INSTALACIÓN ENLACE RADIO (EAR) 433 MHZ A 12V QUE PERMITE MEDIANTE PROTOCOLO MOBBUS LA COMUNICACIÓN HASTA 60 MÓDULOS AGRÓNIC RADIO. ALIMENTACIÓN A 12 VDC. INCLUYE PLACA SOLAR DE 100W CON SOPORTE METÁLICO, BATERÍA DE 200 A/H Y REGULADOR. INCLUYE TAMBIÉN RADIOMÓDEM UHF DE 1W 446 MHZ PARA COMUNICACIÓN CON PC CON ANTENA DIRECTIVA 5 ELEMENTOS. INCLUYE MÁTILES TIPUS FAROLA O TORRETA 8 METROS DE ALTURA CON CIMENTACIÓN EN TERRENO. | CUATRO MIL NOVECIENTOS TREINTA Y OCHO EUROS con VEINTINUEVE CÉNTIMOS | 4.938,29 |
| 0416 | U01BQ010 | m2 | DESBROCE Y LIMPIEZA SUPERFICIAL DE TERRENO DE BOSQUE POR MEDIOS MECÁNICOS, HASTA UNA PROFUNDIDAD DE 20 CM. Y RETIRADO DE ARBOLADO DE DIÁMETRO MENOR DE 10 CM., CARGA Y TRANSPORTE DE LA TIERRA VEGETAL Y DE LOS PRODUCTOS RESULTANTES A VERTEDERO O LUGAR DE EMPLEO. | TRES EUROS con NOVENTA Y DOS CÉNTIMOS | 3,92 |
| 0417 | VA001 | ML | CERCADO CON ENREJADO METALICO GALVANIZADO DE MALLA DE SIMPLE TORSION. TRAMA 50/14 Y 3 HILOS DE ALAMBRE DE ESPINO Y POSTES DE TUBO DE ACERO GALVANIZADO POR INMERSION DE 50 MM. DE DIAMETRO Y 2,00 M.DE ALTURA, PROVISTO DE BAYONETA CON TORNAPUNTAS DE ACERO GALVANIZADO DE 32 MM. DE DIAMETRO, TOTALMENTE MONTADA,I/REPLANTEO Y RECIBIDO CON HORMIGON HM-20, ELABORADO EN OBRA, TENSORES, GRUPILLAS, ACCESORIOS Y PARTE PROPORCIONAL DE PUERTA DE ACCESO DE DOBLE HOJA Y PIEZAS ESPECIALES. MEDIDA LA UNIDAD EJECUTADA. | CATORCE EUROS con VEINTIOCHO CÉNTIMOS | 14,28 |
| 0418 | VA005 | ud | ELEMENTO DE SEGURIDAD EN LA BALSA, FORMADO POR CABLE DE NYLON DE 12 MM. DE DIAMETRO CON FLOTADOR Y SUJETO A POSTE ANCLADO EN CORONACION DE BALSA, INCLUSO SUMINISTRO, COLOCACION Y SUJECIONES. | DOSCIENTOS SESENTA Y CINCO EUROS con SETENTA Y CINCO CÉNTIMOS | 265,75 |
| 0419 | VARTF_CS2 | ud | VARIOS EQUIPOS CONEXIÓN INSTALACIÓN EN CS CONSISTENTES EN:<br>- EQUIPO DE MEDIDA AUXILAR CONSISTENTE EN:<br>-1 CONTADOR DE ENERGÍA REACTIVA<br>-1 CONTADOR DE ENERGÍA ACTIVA<br>-1 MODEM GSM<br>- 1 COMUNICACIONES Y ACCIONAMIENTO REMOTO CELDAS MOTORIZADAS<br>-PUENTE DE CABLES MT CONECTOR 400 A. KIT TERMINAL 3X1X95MM2 AL DE CELDA DE PROTECCIÓN A CELDA DE MEDIDA, 2.5M | TRES MIL CUATROCIENTOS SETENTA Y OCHO EUROS con CUATRO CÉNTIMOS | 3.478,04 |
| 0420 | VARTF_CT | ud | VARIOS EQUIPOS CONEXIÓN INSTALACIÓN EN CT CONSISTENTES EN:<br>- TERMÓMETRO 1" CON 2 CONTACTOS PARA CONTROL DE Tª DE TRANSFORMADOR<br>- PUENTE DE CABLES MT CONECTOR 630 A. KIT TERMINAL 3X1X95MM2 AL DE CELDA DE PROTECCIÓN A TRANSFORMADOR, 8M<br>- ILUMINACIÓN PREFABRICADO | MIL TRESCIENTOS VEINTIUN EUROS con SESENTA Y DOS CÉNTIMOS | 1.321,62 |
| 0421 | VASP001 | ud | | SEIS MIL CUATROCIENTOS DIECINUEVE EUROS con SESENTA Y SIETE CÉNTIMOS | 6.419,67 |
| 0422 | VH2 | Ud | VÁLVULA HIDRÁULICA DE 2" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | CUATROCIENTOS SESENTA Y UN EUROS con CINCUENTA Y SEIS CÉNTIMOS | 461,56 |
| 0423 | VH3 | Ud | VÁLVULA HIDRÁULICA DE 3" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | CUATROCIENTOS SETENTA Y OCHO EUROS con CUATRO CÉNTIMOS | 478,04 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0424 | VH300DOBLES | ud | CONJUNTO DE 3 VÁLVULAS HIDRÁULICA CON DIAFRAGMA INTEGRAL DE 12" Y 16 ATM DE PRESIÓN DE TRABAJO, MODELO S-100 O SIMILAR, COMANDADAS MEDIANTE CONTROLADOR ELECTRÓNICO INCLUIDO, CON CON DOBLE SOLENOIDE PARA EL CONTROL DE LA ENTRADA Y SALIDA DE AGUA DE LA CÁMARA DE CONTROL DE LA VÁLVULA. CAUDAL DE DISEÑO TOTAL DE 860 L/S, PRESIÓN APROXIMADA DE ENTRADA 60 MCA, PRESIÓN DE SALIDA APROXIMADA 30 MCA. INCLUSO PILOTO DE EMERGENCIA PARA EL CASO DE FALLO DE ALIMENTACIÓN DEL CONTROLADOR ELECTRÓNICO. INCLUSO TRANSDUCTORES DE PRESIÓN AGUAS ARRIBA Y AGUAS ABAJO DE LA VÁLVULA. INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | VEINTICINCO MIL SEISCIENTOS CINCO EUROS con VEINTIUN CÉNTIMOS | 25.605,21 |
| 0425 | VH4 | Ud | VÁLVULA HIDRÁULICA DE 4" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | QUINIENTOS CINCUENTA Y TRES EUROS con SETENTA Y SEIS CÉNTIMOS | 553,76 |
| 0426 | VHIDF3 | Ud | HIDRANTE COMPUESTO POR VÁLVULA HIDRÁULICA DE 3" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, CON PILOTO LIMITADOR DE CAUDAL DE PALETA DE 3 VÍAS, Y PILOTO LIMITADOR DE PRESIÓN, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, VENTOSA 2", FILTRO EN L 3" CON MALLA DE 2 MM (CON POSIBILIDAD DE IMPLEMENTAR VALVULAERÍA PARA SISTEMA DE LAVADO), INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | OCHOCIENTOS CINCUENTA Y TRES EUROS con NOVENTA Y NUEVE CÉNTIMOS | 853,99 |
| 0427 | VHIDF4 | Ud | HIDRANTE COMPUESTO POR VÁLVULA HIDRÁULICA DE 4" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, CON PILOTO LIMITADOR DE CAUDAL DE PALETA DE 3 VÍAS, Y PILOTO LIMITADOR DE PRESIÓN, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, VENTOSA 2", FILTRO EN L 4" CON MALLA DE 2 MM (CON POSIBILIDAD DE IMPLEMENTAR VALVULAERÍA PARA SISTEMA DE LAVADO), INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | NOVECIENTOS SETENTA Y SEIS EUROS con SEIS CÉNTIMOS | 976,06 |
| 0428 | VHIDF6 | Ud | HIDRANTE COMPUESTO POR VÁLVULA HIDRÁULICA DE 6" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, CON PILOTO LIMITADOR DE CAUDAL DE PALETA DE 3 VÍAS, Y PILOTO LIMITADOR DE PRESIÓN, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, VENTOSA 2", FILTRO EN L 6" CON MALLA DE 2 MM (CON POSIBILIDAD DE IMPLEMENTAR VALVULAERÍA PARA SISTEMA DE LAVADO), INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | MIL SEISCIENTOS OCHENTA Y SIETE EUROS con NOVENTA Y SIETE CÉNTIMOS | 1.687,97 |
| 0429 | VHIDF8 | Ud | HIDRANTE COMPUESTO POR VÁLVULA HIDRÁULICA DE 8" Y 16 ATM DE PRESIÓN DE TRABAJO, SERIE 470 O SIMILAR, CON PILOTO LIMITADOR DE CAUDAL DE PALETA DE 3 VÍAS, Y PILOTO LIMITADOR DE PRESIÓN, VÁLVULA MANUAL DE 3 VÍAS, SOLENOIDE, VÁLVULA DE SECCIONAMIENTO, VENTOSA 2", FILTRO EN L 8" CON MALLA DE 2 MM (CON POSIBILIDAD DE IMPLEMENTAR VALVULAERÍA PARA SISTEMA DE LAVADO), INCLUSO CALDERERÍA, BRIDAS, JUNTAS, TORNILLERÍA PERFILES DE SUJECIÓN Y ELEMENTOS DE UNIÓN. TODO ELLO PARA UNA PRESIÓN DE TRABAJO DE 16 ATM. COMPLETAMENTE COLOCADA Y PROBADA. MEDIDA LA UNIDAD INSTALADA. | DOS MIL SETECIENTOS CUARENTA Y CINCO EUROS con SETENTA Y SEIS CÉNTIMOS | 2.745,76 |
| 0430 | VIGAMB | Pa | PARTIDA ALZADA DE ABONO ÍNTEGRO DE VIGILANCIA AMBIENTAL GENERAL CON UNA DEDICACIÓN MÍNIMA DE 6 H/SEMANALES | DIECIOCHO MIL CIENTO CINCUENTA Y DOS EUROS con OCHENTA Y OCHO CÉNTIMOS | 18.152,88 |
| 0431 | YSB060 | Ud | CONO DE BALIZAMIENTO REFLECTANTE DE 75 CM DE ALTURA, DE 1 PIEZA DE POLIETILENO CON LASTRE DE ARENA, CON 2 BANDAS REFLECTANTES DE 150 MM DE ANCHURA Y RETRORREFLECTANCIA NIVEL 1 (E.G.), AMORTIZABLE EN 10 USOS. INCLUSO ARENA UTILIZADA PARA EL LASTRADO DE LAS PIEZAS, MANTENIMIENTO EN CONDICIONES SEGURAS DURANTE TODO EL PERIODO DE TIEMPO QUE SE REQUIERA Y DESMONTAJE. | DOS EUROS con SESENTA Y CINCO CÉNTIMOS | 2,65 |
| 0432 | Z005 | Ud | | SEISCIENTOS DOCE EUROS con VEINTICUATRO CÉNTIMOS | 612,24 |
| 0433 | Z019 | Ud | ELABORACIÓN Y COLOCACIÓN DE PLACAS PERMANENTES INFORMATIVAS DE LA EVENTUAL FINANCIACIÓN DE LA OBRA POR EL FEADER, SOLO APLICABLE EN EL CASO DE QUE EL PROYECTO ACABE SIENDO ELEGIDO PARA SU FINANCIACIÓN EN EL MARCO DEL PNDR, EN METACRILATO DE 0,42 X 0,42 M². DISEÑO SEGÚN PLIEGO DE PRESCRIPCIONES TÉCNICAS. EN CASO DE QUE EL PROYECTO NO RESULTE FINALMENTE SELECCIONADO, ESTA UNIDAD DE OBRA NO SE EJECUTARÍA. | CIENTO DIEZ EUROS con OCHENTA Y SIETE CÉNTIMOS | 110,87 |
| 0434 | Z21 | Ud | UNIDAD DE ANÁLISIS DE FÓSFORO TOTAL ICP-MS. | VEINTINUEVE EUROS con DIEZ CÉNTIMOS | 29,10 |

| Nº | CÓDIGO | UD | DESCRIPCIÓN | PRECIO EN LETRA | IMPORTE |
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| 0435 | Z22 | Ud | UNIDAD DE ANÁLISIS DE METOLACLORO Y TERBUTILAZINA POR HRGC-MS/MS. | DOSCIENTOS DIECISEIS EUROS con SESENTA Y SEIS CÉNTIMOS | 216,66 |
| 0436 | Z23 | Ud | UNIDAD DE RECOGIDA DE MUESTRA PARA ANALÍTICAS DE NITRATOS, FÓSFORO TOTAL, METOLACLORO Y TERBUTILAZINA. INCLUYE MANO DE OBRA, MATERIAL NECESARIO Y DESPLAZAMIENTO DEL TÉCNICO PARA LA RECOGIDA DE MATERIAL. | NOVENTA Y DOS EUROS | 92,00 |
| 0437 | ZPC033 | m | SUMINISTRO Y COLOCACIÓN DE BARANDILLA DE ACERO GALVANIZADO A PARTIR DE TUBO METÁLICO FORMANDO UNA ESTRUCTURA ATORNILLADA Y SOLDADA, INCLUSO CORTE Y TALADRADO, ELABORACIÓN EN TALLER, MONTAJE PARA UNIÓN CON TORNILLOS CALIBRADOS, INCLUSO P.P. DE PLETINAS DE ANCLAJE Y TORNILLOS DE UNIÓN. | CIENTO NOVENTA Y SEIS EUROS con SESENTA Y DOS CÉNTIMOS | 196,62 |
| 0438 | ZZ0120 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 1200 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | DOS MIL SEISCIENTOS TREINTA Y TRES EUROS con NOVENTA CÉNTIMOS | 2.633,90 |
| 0439 | ZZ015 | m2 | M2 DE REPOSICIÓN DE CAMINO O VÍA DE SERVICIO A SU ESTADO INICIAL, INCLUYENDO PERFILADO PLANO DE FUNDACIÓN, EJECUCIÓN SEGÚN SECCIÓN TIPO ZANJA, SUSTITUYENDO EL RELLENO ORDINARIO POR RELLENO SELECCIONADO COMPACTADO AL 95% DEL PM, GEOTEXTIL Y FINALIZANDO CON 20 CM DE ZAHORRA NATURAL COMPACTADA AL 98% P.M., CONSTRUCCIÓN DE FIRME Y LIMPIEZA Y REFINO DE CUNETAS HASTA SU ESTADO INICIAL Y PEDRAPLÉN EN CASO DE SER NECESARIO. TOTALMENTE TERMINADO Y PROBADO. | DIECISEIS EUROS con CINCUENTA Y DOS CÉNTIMOS | 16,52 |
| 0440 | ZZ022 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 1000 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | DOS MIL TRESCIENTOS NUEVE EUROS con CUARENTA Y CINCO CÉNTIMOS | 2.309,45 |
| 0441 | ZZ023 | ud | CARRETE TELESCÓPICO DE DESMONTAJE DE 200 MM DE DIÁMETRO NOMINAL Y 16 ATM DE PRESIÓN NOMINAL. CON UNA SOLA BRIDA DIN CENTRAL DE IGUAL TAMAÑO Y CARACTERÍSTICAS A LA DE LOS EXTREMOS, PARA EL ALOJAMIENTO DE LA JUNTA DE ESTANQUEIDAD DE SECCIÓN PIRAMIDAL Y DE GOMA EPDM SIENDO EL MONTAJE SIEMPRE CON TORNILLOS CINCADOS CON CALIDAD 8,8 PASANTES ENTRE AMBAS CARAS DEL CARRETE A TRAVÉS DE LA BRIDA CENTRAL. PROVISTO DE LA PARTE PROPORCIONAL DE PIEZAS ESPECIALES EN JUNTAS, TORNILLERÍA Y CALDERERÍA Y ACCESORIOS DE UNIÓN A LA TUBERÍA. MEDIDA LA UNIDAD INSTALADA EJECUTADA Y PROBADA. | DOSCIENTOS DOCE EUROS con OCHENTA Y TRES CÉNTIMOS | 212,83 |
| 0442 | ZZ052 | ud | ANILLADO METÁLICO PARA ESCALERAS DE MANO O PATES REALIZADO MEDIANTE PLETINA DE ACERO CON ANILLO CADA 70 CM DE ALTURA. UNIDAD TOTALMENTE ACABADA. | VEINTISIETE EUROS con SESENTA Y TRES CÉNTIMOS | 27,63 |
| 0443 | ZZ0801 | ud | ALIMENTACIÓN ELÉCTRICA MEDIANTE INSTALACIÓN SOLAR FOTOVOLTAICA Y AUTÓMATA DE CONTROL CON PANTALLA 12" TÁCTIL Y SCADA INTALADO EN ARMARIO FORMADA POR:<br>- 1 CONJUNTO DE 12 VASOS LIBRES DE MANTENIMIENTO, DE 2V CADA UNO Y 400AH<br>- 1 REGULADOR DE CARGA 12/24V.<br>- 2 PANEL SOLAR DE APROX. (SEGÚN DISPONIBILIDAD COMERCIAL) 24V 290W CON DETECCIÓN DE INTRUSIÓN SOBRE MÁSTIL EXISTENTE EN SOPORTE ORIENTABLE, COLOCADO SOBRE ZAPATA Y ESPERAS EXISTENTES INSERTADAS EN OBRA CIVIL.<br>- 1 MÁSTIL TUBULAR/TROCOCÓNICO DE 8M DE ALTURA Y 4MM DE PARED CON VENTANA DE CONEXIONADO, SOBRE ZAPATA Y ESPERAS EXISTENTES INSERTADAS EN OBRA CIVIL.<br>- PROTECCIONES<br>- CABLE TIPO RVK 4X4 POR TUBO PREVIAMENTE INSTALADO.<br>TOTALMENTE INSTALADO, CONEXIONADO, CONECTADO Y EN FUNCIONAMIENTO. INCLUYENDO EL ALQUILER DE VEHÍCULOS Y/O MEDIOS NECESARIOS PARA EL TRANSPORTE Y LEVANTAMIENTO DE MÁSTIL JUNTO CON PANEL SOLAR Y OTROS ELEMENTOS SOBRE ÉSTOS.<br><br>AUTÓMATA DE CONTROL:<br>UNIDAD PLC CON PANTALLA 12" Y SCADA PARA CONTROL DE VÁLVULA MOTORIZADA Y VÁLVULAS HIDRÁULICAS DE REGULACIÓN EN FUNCIÓN DE LECTURA DE CAUDALÍMETRO Y TRASDUCTOR DE PRESIÓN Y NIVEL EN BALSA, CONSISTENTE EN:<br><br>-1XCPU. MEMORIA INTERNA Y ENLACE RJ45, CON INTERFAZ RS232/RS485 PARA PROTOCOLO MODBUS RTU. PUERTO ETHERNET INTEGRADO Y USB DE PROGRAMACIÓN. MÓDULOS DE CONEXIÓN ED/SD, EA/SA, ALIMENTACIÓN 24 VDC, BORNEROS ENCHUFABLES. EN ENVOLVENTE IP67.<br>- INCLUYE PROGRAMA Y PROGRAMACIÓN DEL PLC.<br>- INCLUYE PUESTA EN MARCHA DEL PLC Y DE TODO EL SISTEMA DE AUTOMATIZACIÓN.<br>- INCLUYE PEQUEÑO MATERIAL AUXILIAR Y DE MONTAJE.<br>TOTALMENTE INSTALADO, CONEXIONADO, CONFIGURADO, CONECTADO Y PROBADO. | DOCE MIL OCHOCIENTOS SESENTA Y OCHO EUROS con CUARENTA Y TRES CÉNTIMOS | 12.868,43 |

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| 0444 | ZZ0802 | m3 | M3. RELLENO DE FONDO DE ZANJA A BASE DE ÁRIDO TIPO BOLO, NO PROCEDENTE DE CANTERA, DE TAMAÑO MAYOR DE 100 MM, PARA ESTABILIZACIÓN Y SANEO DE ZANJAS EN ZONA DE LODOS, COMPACTADO. INCLUSO ADQUISICIÓN, EXTRACCIÓN, CLASIFICACIÓN, CARGA, TRANSPORTE, EXTENDIDO Y COMPACTACIÓN. TOTALMENTE COLOCADO Y RASANTEADO, INCLUSO AGOTAMIENTO. | ONCE EUROS con CUATRO CÉNTIMOS | 11,04 | | | | | | |
| 0445 | d8510010 | m3 | SUBBASE A BASE DE EXTENDIDO Y COMPACTADO DE ZAHORRA NATURAL COMPACTADA AL 98% DEL P.M. EN CAPA DE 10 CM DE ESPESOR EN BASES DE OBRAS SINGULARES Y SOBRE CORONACION DE BALSAS | DIEZ EUROS con CINCUENTA Y UN CÉNTIMOS | 10,51 | | | | | | |

Zaragoza, mayo de 2022

D. Daniel Cameo Moreno

Colegiado Nº 1059 del Colegio Oficial de

Ingenieros Agrónomos de Aragón, Navarra y País Vasco