# ANEJO Nº 6. ESTRUCTURAS

# 4. Cálculos

# 4.3. CÁLCULOS

# 4.3.1. VIADUCTOS

- **Viaducto sobre vías de ancho ibérico (via P-M)**

AVE PAPIOL UTE

# ANEJO DE CÁLCULOS ESTRUCTURALES DE LAS CIMENTACIONES DE LAS PILAS Y ESTRIBOS DEL VIADUCTO PUERTO-MARTORELL

## REACCIONES VERTICALES

PEDELTA
INGENIERIA DE ESTRUCTURAS

Barcelona, abril 2004

Referencia del Proyecto: L.A.V. Castellbisbal-Papiol. Viaducto Puerto-Marto

APOYO N = 42 (P-1)

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 56.43842 | 0.00000 |
| G2 | 0.00000 | 41.47149 | 0.00000 |
| Pii | 0.00000 | 21.38031 | 0.00000 |
| Pi | 0.00000 | 36.04525 | 0.00000 |
| Pd | 0.00000 | 30.87254 | 0.00000 |
| TEMP | 0.00000 | 7.42191 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 3.47482 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.54884 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -5.09404 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 70.42175 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -5.08498 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 90.54212 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -4.24601 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 89.69112 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -4.24601 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 87.79784 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -8.81548 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 94.87508 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -8.89551 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 82.47585 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -11.63994 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 6.87298 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.76967 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

Reaccion permanente (ELS) = 128.782
Reaccion maxima (ELS) = 231.404
Reaccion minima (ELS) = 116.697
Reaccion minima (ELU) = 106.289

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00008 | 0.00000 | 0.00035 |
| G2 | -0.00006 | 0.00000 | 0.00027 |
| Pii | 0.00022 | 0.00000 | -0.00078 |
| Pi | 0.00037 | 0.00000 | -0.00133 |
| Pd | 0.00031 | 0.00000 | -0.00113 |
| TEMP | 0.00005 | 0.00000 | -0.00016 |
| SC peatonal(100%) Max | 0.00000 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00001 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00003 | 0.00000 | 0.00031 |
| IPF-75 TREN A via 1 (Min) | -0.00008 | 0.00000 | -0.00012 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B1 via 1 (Min) | -0.00003 | 0.00000 | -0.00001 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B2 via 1 (Min) | -0.00003 | 0.00000 | -0.00001 |
| EC-1 TREN LM71 via 1 (Max) | 0.00002 | 0.00000 | 0.00017 |
| EC-1 TREN LM71 via 1 (Min) | -0.00004 | 0.00000 | -0.00006 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00005 | 0.00000 | 0.00054 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00013 | 0.00000 | -0.00021 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00007 | 0.00000 | 0.00062 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00015 | 0.00000 | -0.00027 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 0.00000 | 0.00005 |
| EC-1 TREN 12.5 via 1 (Min) | -0.00001 | 0.00000 | 0.00000 |

COMBINACION DE GIROS DE FLEXION

Acciones permanentes (ELS) = -0.000509
Giro maximo (ELS) = 0.000109
Giro minimo (ELS) = -0.000937

APOYO N = 43 (P-1)

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 55.70967 | 0.00000 |
| G2 | 0.00000 | 34.15025 | 0.00000 |
| Pii | 0.00000 | 23.08817 | 0.00000 |
| Pi | 0.00000 | 38.97637 | 0.00000 |
| Pd | 0.00000 | 33.36087 | 0.00000 |
| TEMP | 0.00000 | 6.86519 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 2.44072 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.58227 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 7.71630 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -0.21339 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 10.50432 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -5.01177 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 8.73186 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -8.72351 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 8.73186 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -8.47445 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 17.48193 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -8.72043 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 17.93536 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -8.73093 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 46.89553 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -11.12393 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 3.90796 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.48008 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

Reaccion permanente (ELS) = 123.221
Reaccion maxima (ELS) = 177.751
Reaccion minima (ELS) = 112.055
Reaccion minima (ELU) = 102.018

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00011 | 0.00000 | 0.00035 |
| G2 | -0.00008 | 0.00000 | 0.00027 |
| Pii | 0.00021 | 0.00000 | -0.00079 |
| Pi | 0.00036 | 0.00000 | -0.00136 |
| Pd | 0.00031 | 0.00000 | -0.00115 |
| TEMP | 0.00004 | 0.00000 | -0.00017 |
| SC peatonal(100%) Max | 0.00000 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00001 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00003 | 0.00000 | 0.00032 |
| IPF-75 TREN A via 1 (Min) | -0.00009 | 0.00000 | -0.00012 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B1 via 1 (Min) | -0.00004 | 0.00000 | -0.00001 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B2 via 1 (Min) | -0.00003 | 0.00000 | -0.00001 |
| EC-1 TREN LM71 via 1 (Max) | 0.00002 | 0.00000 | 0.00017 |
| EC-1 TREN LM71 via 1 (Min) | -0.00005 | 0.00000 | -0.00006 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00006 | 0.00000 | 0.00054 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00016 | 0.00000 | -0.00021 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00008 | 0.00000 | 0.00062 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00018 | 0.00000 | -0.00027 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 0.00000 | 0.00005 |
| EC-1 TREN 12.5 via 1 (Min) | -0.00002 | 0.00000 | 0.00000 |

COMBINACION DE GIROS DE FLEXION

Acciones permanentes (ELS) = -0.000531
Giro maximo (ELS) = 0.000091
Giro minimo (ELS) = -0.000967

APOYO N = 44 (P-2)

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 189.04497 | 0.00000 |
| G2 | 0.00000 | 150.59842 | 0.00000 |
| Pii | 0.00000 | -42.47469 | 0.00000 |
| Pi | 0.00000 | -71.67644 | 0.00000 |
| Pd | 0.00000 | -61.35492 | 0.00000 |
| TEMP | 0.00000 | -12.23687 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 15.38483 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -14.73194 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 89.32059 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | 0.00000 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 266.29684 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | 0.01786 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 247.65807 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | 0.01786 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 209.30649 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | 0.00000 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 209.41066 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | 0.00000 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 203.80908 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | 0.02975 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 19.43056 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00248 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

| | | |
|---|---|---|
| Reaccion permanente | (ELS) = | 278.288 |
| Reaccion maxima | (ELS) = | 545.345 |
| Reaccion minima | (ELS) = | 265.260 |
| Reaccion minima | (ELU) = | 253.568 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00001 | 0.00000 | 0.00011 |
| G2 | -0.00001 | 0.00000 | 0.00008 |
| Pii | 0.00001 | 0.00000 | -0.00006 |
| Pi | 0.00002 | 0.00000 | -0.00009 |
| Pd | 0.00001 | 0.00000 | -0.00008 |
| TEMP | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(100%) Max | 0.00001 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00002 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00006 | 0.00000 | 0.00023 |
| IPF-75 TREN A via 1 (Min) | -0.00005 | 0.00000 | -0.00021 |
| IPF-75 TREN B1 via 1 (Max) | 0.00002 | 0.00000 | 0.00008 |
| IPF-75 TREN B1 via 1 (Min) | -0.00002 | 0.00000 | -0.00008 |
| IPF-75 TREN B2 via 1 (Max) | 0.00002 | 0.00000 | 0.00007 |
| IPF-75 TREN B2 via 1 (Min) | -0.00001 | 0.00000 | -0.00008 |
| EC-1 TREN LM71 via 1 (Max) | 0.00003 | 0.00000 | 0.00012 |
| EC-1 TREN LM71 via 1 (Min) | -0.00003 | 0.00000 | -0.00011 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00010 | 0.00000 | 0.00041 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00009 | 0.00000 | -0.00037 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00011 | 0.00000 | 0.00053 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00012 | 0.00000 | -0.00042 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00001 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00004 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | 0.000104 |
| Giro maximo | (ELS) = | 0.000635 |
| Giro minimo | (ELS) = | -0.000320 |

APOYO N = 45 (P-2)

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 188.49371 | 0.00000 |
| G2 | 0.00000 | 129.62602 | 0.00000 |
| Pii | 0.00000 | -41.89616 | 0.00000 |
| Pi | 0.00000 | -70.68324 | 0.00000 |
| Pd | 0.00000 | -60.50874 | 0.00000 |
| TEMP | 0.00000 | -14.90176 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 2.39172 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.03380 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 23.58789 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 8.33979 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -0.16292 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 23.86232 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -0.16425 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 22.55255 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -0.16425 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 37.07118 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -0.05470 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 42.80487 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -0.05969 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 115.32468 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -0.02498 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 11.14006 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | -0.00208 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

| | | | |
|---|---|---|---|
| Reaccion permanente | (ELS) = | 257.611 |
| Reaccion maxima | (ELS) = | 374.100 |
| Reaccion minima | (ELS) = | 242.530 |
| Reaccion minima | (ELU) = | 231.480 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00004 | 0.00000 | 0.00010 |
| G2 | -0.00003 | 0.00000 | 0.00007 |
| Pii | 0.00002 | 0.00000 | -0.00005 |
| Pi | 0.00003 | 0.00000 | -0.00009 |
| Pd | 0.00003 | 0.00000 | -0.00008 |
| TEMP | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00002 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00005 | 0.00000 | 0.00023 |
| IPF-75 TREN A via 1 (Min) | -0.00006 | 0.00000 | -0.00021 |
| IPF-75 TREN B1 via 1 (Max) | 0.00002 | 0.00000 | 0.00008 |
| IPF-75 TREN B1 via 1 (Min) | -0.00002 | 0.00000 | -0.00009 |
| IPF-75 TREN B2 via 1 (Max) | 0.00002 | 0.00000 | 0.00007 |
| IPF-75 TREN B2 via 1 (Min) | -0.00002 | 0.00000 | -0.00008 |
| EC-1 TREN LM71 via 1 (Max) | 0.00003 | 0.00000 | 0.00012 |
| EC-1 TREN LM71 via 1 (Min) | -0.00003 | 0.00000 | -0.00011 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00009 | 0.00000 | 0.00041 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00011 | 0.00000 | -0.00037 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00010 | 0.00000 | 0.00053 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00014 | 0.00000 | -0.00043 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00001 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00004 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | 0.000090 |
| Giro maximo | (ELS) = | 0.000621 |
| Giro minimo | (ELS) = | -0.000343 |

APOYO N = 46 (E-2)

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 66.91614 | 0.00000 |
| G2 | 0.00000 | 49.62532 | 0.00000 |
| Pii | 0.00000 | 18.71764 | 0.00000 |
| Pi | 0.00000 | 31.56719 | 0.00000 |
| Pd | 0.00000 | 27.02158 | 0.00000 |
| TEMP | 0.00000 | 6.69849 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 6.02574 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.36095 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -5.53323 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 67.24738 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -3.66287 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 96.93536 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -5.90613 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 96.12303 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -5.86197 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 92.54842 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -5.91593 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 94.41661 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -6.46957 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 81.55228 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -7.59739 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 6.16290 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | -0.63312 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

| | | |
|---|---|---|
| Reaccion permanente | (ELS) = | 143.563 |
| Reaccion maxima | (ELS) = | 247.826 |
| Reaccion minima | (ELS) = | 135.470 |
| Reaccion minima | (ELU) = | 126.727 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | 0.00016 | 0.00000 | -0.00061 |
| G2 | 0.00012 | 0.00000 | -0.00047 |
| Pii | -0.00023 | 0.00000 | 0.00102 |
| Pi | -0.00039 | 0.00000 | 0.00174 |
| Pd | -0.00034 | 0.00000 | 0.00148 |
| TEMP | -0.00004 | 0.00000 | 0.00019 |
| SC peatonal(100%) Max | 0.00001 | 0.00000 | 0.00001 |
| SC peatonal(100%) Min | 0.00000 | 0.00000 | -0.00004 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00002 |
| IPF-75 TREN A via 1 (Max) | 0.00010 | 0.00000 | 0.00011 |
| IPF-75 TREN A via 1 (Min) | -0.00003 | 0.00000 | -0.00039 |
| IPF-75 TREN B1 via 1 (Max) | 0.00004 | 0.00000 | 0.00004 |
| IPF-75 TREN B1 via 1 (Min) | -0.00001 | 0.00000 | -0.00015 |
| IPF-75 TREN B2 via 1 (Max) | 0.00004 | 0.00000 | 0.00004 |
| IPF-75 TREN B2 via 1 (Min) | -0.00001 | 0.00000 | -0.00014 |
| EC-1 TREN LM71 via 1 (Max) | 0.00005 | 0.00000 | 0.00006 |
| EC-1 TREN LM71 via 1 (Min) | -0.00001 | 0.00000 | -0.00021 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00016 | 0.00000 | 0.00019 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00005 | 0.00000 | -0.00066 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00021 | 0.00000 | 0.00022 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00005 | 0.00000 | -0.00084 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00002 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00005 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | 0.000398 |
| Giro maximo | (ELS) = | 0.000809 |
| Giro minimo | (ELS) = | -0.000443 |

APOYO N = 47 (E-2)

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 65.02602 | 0.00000 |
| G2 | 0.00000 | 40.68909 | 0.00000 |
| Pii | 0.00000 | 21.27954 | 0.00000 |
| Pi | 0.00000 | 35.93210 | 0.00000 |
| Pd | 0.00000 | 30.74507 | 0.00000 |
| TEMP | 0.00000 | 6.16258 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 0.46522 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.41673 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 8.54005 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -0.13196 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 9.14486 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -3.68813 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 7.90563 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -6.79797 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 7.90563 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -6.56120 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 17.29930 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -6.01145 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 17.67004 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -6.51634 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 44.89305 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -7.35600 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 3.12808 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | -0.61300 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

| | | | |
|---|---|---|---|
| Reaccion permanente | (ELS) = | 136.460 |
| Reaccion maxima | (ELS) = | 188.372 |
| Reaccion minima | (ELS) = | 129.076 |
| Reaccion minima | (ELU) = | 120.596 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | 0.00013 | 0.00000 | -0.00061 |
| G2 | 0.00010 | 0.00000 | -0.00047 |
| Pii | -0.00023 | 0.00000 | 0.00100 |
| Pi | -0.00040 | 0.00000 | 0.00170 |
| Pd | -0.00034 | 0.00000 | 0.00145 |
| TEMP | -0.00004 | 0.00000 | 0.00018 |
| SC peatonal(100%) Max | 0.00001 | 0.00000 | 0.00001 |
| SC peatonal(100%) Min | 0.00000 | 0.00000 | -0.00004 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00002 |
| IPF-75 TREN A via 1 (Max) | 0.00008 | 0.00000 | 0.00011 |
| IPF-75 TREN A via 1 (Min) | -0.00002 | 0.00000 | -0.00038 |
| IPF-75 TREN B1 via 1 (Max) | 0.00003 | 0.00000 | 0.00004 |
| IPF-75 TREN B1 via 1 (Min) | -0.00001 | 0.00000 | -0.00015 |
| IPF-75 TREN B2 via 1 (Max) | 0.00003 | 0.00000 | 0.00004 |
| IPF-75 TREN B2 via 1 (Min) | -0.00001 | 0.00000 | -0.00014 |
| EC-1 TREN LM71 via 1 (Max) | 0.00004 | 0.00000 | 0.00006 |
| EC-1 TREN LM71 via 1 (Min) | -0.00001 | 0.00000 | -0.00020 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00014 | 0.00000 | 0.00019 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00004 | 0.00000 | -0.00065 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00018 | 0.00000 | 0.00022 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00005 | 0.00000 | -0.00083 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00002 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00005 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | 0.000377 |
| Giro maximo | (ELS) = | 0.000780 |
| Giro minimo | (ELS) = | -0.000453 |

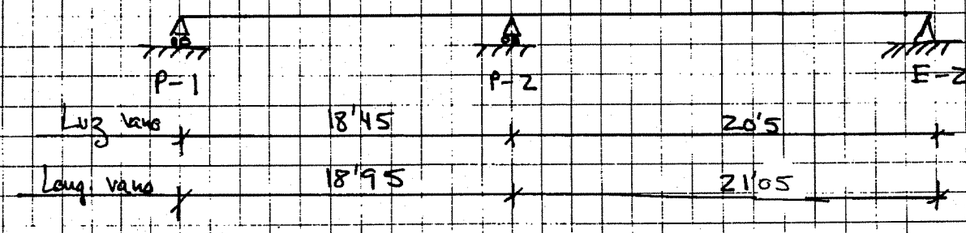
# REACCIONES HORIZONTALES

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DISTRIBUCIÓN DE FUERZAS LONGITUDINALES EN PILAS Y ESTRIBOS.




Long. tablero = 40 m.

Fuerza de frenado IPF-75

$F_{FR,IPF} = \frac{12 \cdot 30 + 10 \cdot 10}{8} = 57'5$ T (valor máximo)

$F_{A,IPF} = \frac{12 \cdot 30}{8} = 45$ T ← fuerza de arranque

Fuerza de frenado EC-1:

$F_{FR,EC-1} = 2 \cdot 40 = 80$ T

$F_{A,EC-1} = 3'3 \cdot 40 = 132 \not< 100$ T

Fuerza de rozamiento en POTs:

$R_{perm,P-1} = 128'8 + 123'2 = 252\ T$

$R_{perm,P-2} = 278'3 + 257'6 = 536\ T$

$F_{R,P-1} = \mu \cdot R_{perm,P-1} = 12'6\ T$ (valor máximo)

$F_{R,P-2} = 26'8\ T$ (valor máxima)

Fuerza total que ejerce el tablero en el punto fijo del estribo 2:

$$F = F_{R,P-1} + F_{R,P-2} + \max\left\{F_{FR} \text{ ó } F_A\right\}$$

Según IPF-75: $F = 97\ T$

Según EC-1: $F = 139\ T$

Momento repartido en base de estribo:

$$m = \frac{97 \cdot (9'4 + 1'6)}{8'2} = 92'3\ mT/m$$

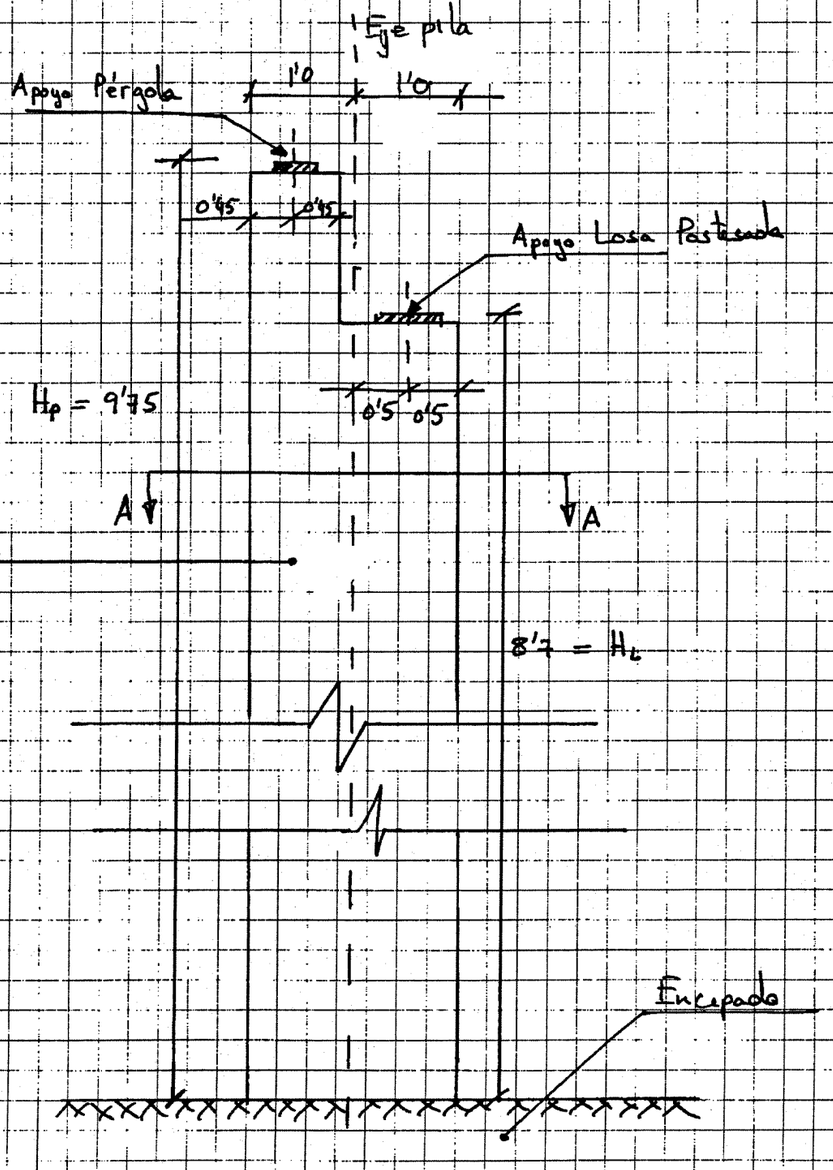
$$m = \frac{139\ (9'4 + 1'6)}{8'2} = 132'2\ mT/m$$

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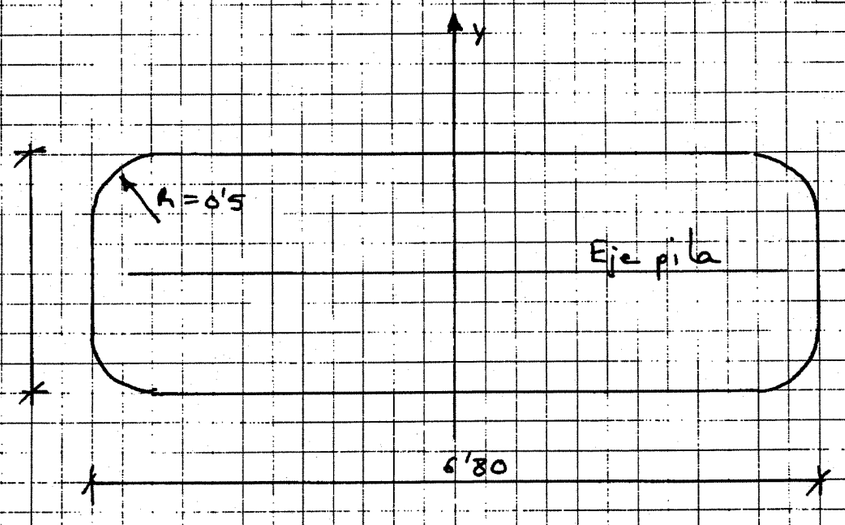
FECHA HOJA

# CÁLCULO DE LA PILA 1. GEOMETRÍA

## SECCIÓN TIPO EN FUSTE




## SECCIÓN A-A




$A = 13'385\ m^2$

$I_x = 4'362\ m^4 \Rightarrow i_x = \sqrt{\frac{I_x}{A}} = 0'571\ m$

$I_y = 50'083\ m^4 \Rightarrow i_y = \sqrt{\frac{I_y}{A}} = 1'934\ m$

$l_p = \beta \cdot \max\{H_p, H_L\} = 2 \cdot 9'75 = 19'5\ m$

$\lambda_x = \frac{l_p}{i_x} = 34'2 < 35$

$\lambda_y = \frac{l_p}{i_y} = 10'1 < 35$

Según art. 43.5 de EHE pueden despreciarse los efectos de 2º orden.

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# CÁLCULO DE LA PILA 1. ACCIONES EN CORONACIÓN

## ACCIONES TRANSMITIDAS POR EL TABLERO TIPO LOSA.

1/ Reacciones Verticales.

Apoyos 42 y 43 del modelo de emparrillado

| | Apoyo 42 | Apoyo 43 |
|---|---|---|
| Permanente | 128'8 | 123'2 |
| Máxima Sobrec. | 102'6 | 54'6 |
| Mínima Sobrec. | -12'1 | -11'1 |

Hipótesis 1. Máxima reacción vertical

$N = N_{perm} + N_{max} = 409'2$ T

$N_{perm} = 128'8 + 123'2 = 252$ T

$N_{max} = 102'6 + 54'6 = 157'2$ T

$M_T = 85'7$ mT

Hipótesis 2. Máxima momento transversal

$N = N_{perm} + 102'6 - 11'1 = 343'5$ T

$M_T = 190'9$ mT

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2/ Reacciones Horizontales Transversales.

Lazo → $F_T = 5$ T

Centrífuga → $F_T = 53'0$ T

Viento → $F_T = 12'4$ T

Viento Conc. → $F_T = 15'7$ T

3/ Reacciones Horizontales Longitudinales.

Por rozamiento de los apoyos tipo PoT:

$\mu = 0'05$ a $0'01$

$F_{L,max} = 12'6$ T

$F_{L,min} = 2'5$ T

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## CÁLCULO DE LA PILA 1. ACCIONES EN CORONACIÓN

### ACCIONES TRANSMITIDAS POR LA PÉRGOLA

1) Reacciones Verticales

Cargas Permanentes ⟶ 48'1 T

Sobrecarga ⟶ 13'5 T

Hipótesis 1. Máxima reacción vertical

$N = 48'1 + 13'5 = 61'6$ T

$M_T = N \cdot 3'0 = 184'8$ mT

Hipótesis 2. Máximo momento transversal

$N = 61'6$ T

$M_T = 184'8$ mT

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CÁLCULO DE LA PILA 1. ACCIONES EN CORONACIÓN

### ACCIONES TRANSMITIDAS POR LA LOSA

1) Reacciones Verticales

Permanentes (total) = 29'1 T

Máximas:

Apoyo 334 ⟶ 22'9 T

" 597 ⟶ 62'8 T

85'7 T (56'6 T)

2) Reacciones Horizontales Longitudinales

Fuerza total de frenado sobre la pérgola:

$F_{fr} = (12 \cdot 30 + 10 \cdot 33'9)\frac{1}{8} = 87'4$ T

$L_{pérgola} = 30 + 33'9 = 63'9$ m

Por simetría del tablero lo repartimos entre el E-1 y la P-1 a partes iguales:

$F_{fr,P-1} = 43'7$ T

Como hay 3 apoyos en P-1:

$F_{fr,apoyo} = 14'6$ T/apoyo

Por otra parte supondremos que bajo cargas permanentes (por retracción y fluencia) el acortamiento de la pérgola produce una fuerza longitudinal de 4 T por apoyo:

$$F_{L,perm} = 4\ T/apoyo = 12\ T \text{ en } P-1$$



RESUMEN DE ACCIONES EN CORONACIÓN DE PILA 1

CASO 2. PERMANENTES LOSA

$F_y = -12'6\ T$
$F_z = -128'8\ T$
$M_x = 64'4\ mT$
$M_y = 9'0\ mT$

CASO 3. PERMANENTES PÉRGOLA

$F_y = 12\ T$
$F_z = -77'2\ T$
$M_x = -77{,}2 \cdot 0'55 = -42'5\ mT$
$M_y = 48'1 \cdot 3 - 3'8 \cdot 2'6 = 124'0\ mT$

CASO 4. SOBRECARGAS LOSA HIP. 1.

$F_z = -153'2\ T$
$M_x = 78'6\ mT$
$M_y = 36'7\ mT$

CASO 5. SOBRECARGAS PÉRGOLA HIP. 1.

$F_z = -70'1$ T

$M_x = -38'6$ mT

$M_y = -15'3 \cdot 2'6 + 13'5 \cdot 3 \simeq 0$ mT

CASO 6. SOBRECARGAS LOSA HIP. 2.

$F_z = -91'5$ T

$M_x = 45'8$ mT

$M_y = 181'9$ mT

CASO 7. SOBRECARGAS PÉRGOLA HIP. 2.

$F_z = -13'5$ T

$M_x = -7'4$ mT

$M_y = 40'5$ mT

CASO 8. LAZO + CENTRIF + 0'6 · VIENTO CONC

$F_x = 67'4$ T

CASO 9. 0'8 (LAZO + CENTRIF.) + VIENTO

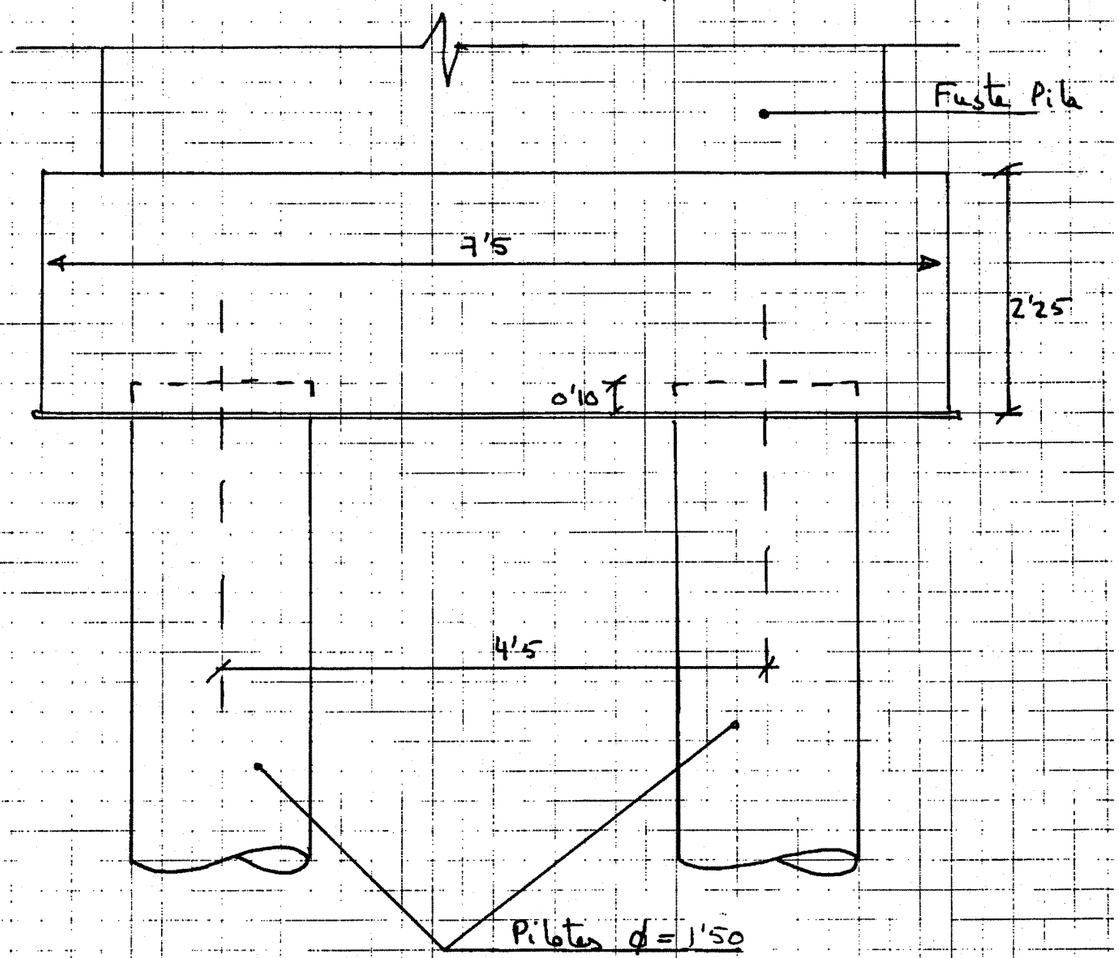
$F_x = 58'8$ T

CASO 10. FRENADO EN PÉRGOLA

$F_y = 43'7$ T

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GEOMETRÍA ENCEPADO 2 PILOTES $\phi = 1'5$ m



**Coordenadas de Nudos**

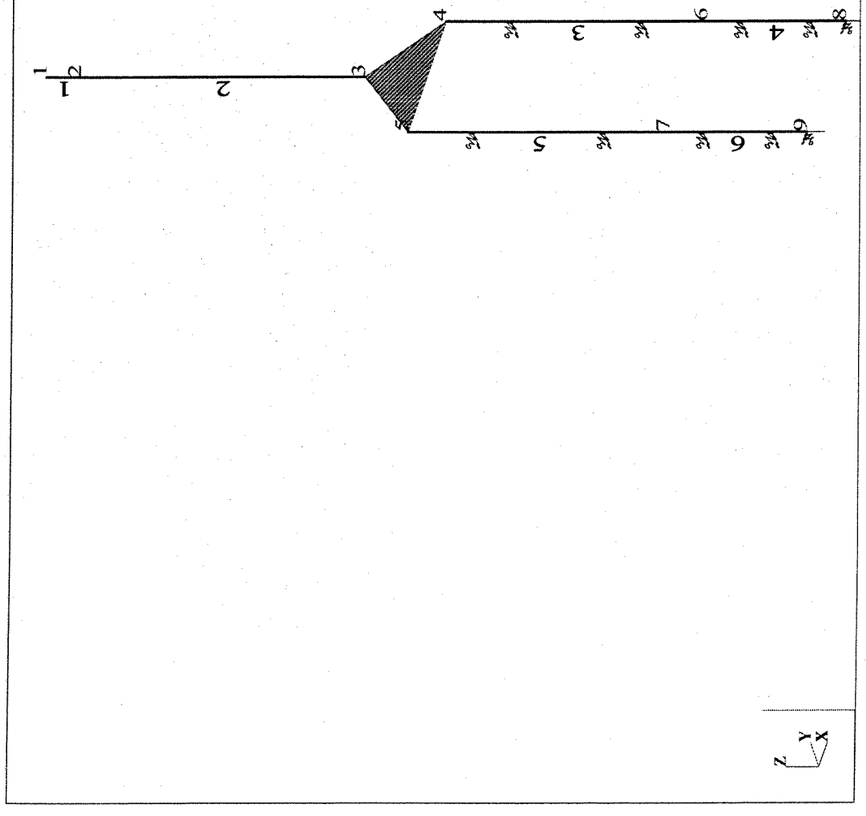
| Filtrar | Nudo |
|---|---|
| Lista compl | 1A9 |
| Selección | 1A9 |
| | |
| Número tot | 9 |
| Número sel | 9 |

| Nudo | X (m) | Y (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.0 | | |
| 2 | 0.0 | 0.0 | -1.050 | | |
| 3 | 0.0 | 0.0 | -9.750 | | |
| 4 | 2.250 | 0.0 | -11.650 | | |
| 5 | -2.250 | 0.0 | -11.650 | | |
| 6 | 2.250 | 0.0 | -19.650 | | |
| 7 | -2.250 | 0.0 | -19.650 | | |
| 8 | 2.250 | 0.0 | -23.850 | eeelll | Apoyo |
| 9 | -2.250 | 0.0 | -23.850 | eeelll | Apoyo |





**Vista - casos: 1 (Peso Propio)**



**Definición de Barras**

| Filtrar | Barra | Elemento |
|---|---|---|
| Lista compl | 1A6 | 1A3 5A7 |
| Selección | 1A6 | 1A3 5A7 |
| | | |
| Número tot | 6 | 6 |
| Número sel | 6 | 6 |

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) | Gama (Deg) | Tipo |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | Fuste1 | HORMIGON | 1.050 | 90.0 | Columna de hormigón armado |
| 2 | 2 | 3 | Fuste2 | HORMIGON | 8.700 | 90.0 | Columna de hormigón armado |
| 3 | 4 | 6 | Pilote150 | HORMIGON | 8.000 | 0.0 | Columna de hormigón armado |
| 4 | 6 | 8 | Pilote150 | HORMIGON | 4.200 | 0.0 | Columna de hormigón armado |
| 5 | 5 | 7 | Pilote150 | HORMIGON | 8.000 | 0.0 | Columna de hormigón armado |
| 6 | 7 | 9 | Pilote150 | HORMIGON | 4.200 | 0.0 | Columna de hormigón armado |





**Características Barras**

| Nombre de la sección | Lista de barras | SX (m^2) | SY (m^2) | SZ (m^2) | IX (m^4) | IY (m^4) | IZ (m^4) |
|---|---|---|---|---|---|---|---|
| Fuste1 | 1 | 6.120 | 5.100 | 5.100 | 1.515 | 0.413 | 23.582 |
| Fuste2 | 2 | 13.600 | 11.333 | 11.333 | 14.772 | 4.533 | 52.405 |
| Pilote150 | 3A6 | 1.767 | 1.491 | 1.491 | 0.497 | 0.249 | 0.249 |

**Definición Cargas - Casos: 1A10**

| Caso | Nombre del caso | Naturaleza | tipo de análisis |
|---|---|---|---|
| 1 | Peso Propio | permanente | Estático lineal |
| 2 | Permanentes Losa | permanente | Estático lineal |
| 3 | Permanentes Pérgola | permanente | Estático lineal |
| 4 | Sobrecargas Losa HIP.1 | explotación | Estático lineal |
| 5 | Sobrecargas Pérgola HIP. 1 | explotación | Estático lineal |
| 6 | Sobrecargas Losa HIP. 2 | explotación | Estático lineal |
| 7 | Sobrecargas Pérgola HIP. 2 | explotación | Estático lineal |
| 8 | Lazo+Centrif.+0.6*Viento | explotación | Estático lineal |
| 9 | 0.8*(Lazo+Centrif.)+Viento | explotación | Estático lineal |
| 10 | Frenado Pérgola | explotación | Estático lineal |

| | Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|---|
| | 1 | Peso Propio | peso propio | 1A6 | PZ Menos |
| | 2 | Permanentes Losa | fuerza nodal | 2 | FY=-12.600(T) FZ=-128.800(T) CX=64.400(Tm) CY=9.000(Tm) |
| | 3 | Permanentes Pérgola | fuerza nodal | 1 | FY=12.000(T) FZ=-77.200(T) CX=-42.500(Tm) CY=124.000(Tm) |
| | 4 | Sobrecargas Losa HIP.1 | fuerza nodal | 2 | FZ=-157.200(T) CX=78.600(Tm) CY=76.700(Tm) |
| | 5 | Sobrecargas Pérgola HIP. 1 | fuerza nodal | 1 | FZ=-70.100(T) CX=-38.600(Tm) |
| | 6 | Sobrecargas Losa HIP. 2 | fuerza nodal | 2 | FZ=-91.500(T) CX=45.800(Tm) CY=181.900(Tm) |
| | 7 | Sobrecargas Pérgola HIP. 2 | fuerza nodal | 1 | FZ=-13.500(T) CX=-7.400(Tm) CY=40.500(Tm) |
| | 8 | Lazo+Centrif.+0.6*Viento | fuerza nodal | 1 | FX=67.400(T) |
| | 9 | 0.8*(Lazo+Centrif.)+Viento | fuerza nodal | 1 | FX=58.800(T) |
| | 10 | Frenado Pérgola | fuerza nodal | 1 | FY=43.700(T) |



ROBOT v 16.1.0
Autor : **PEDELTA**
Dirección :

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Archivo : **Pila 1. Modelo 04.rtd**
Proyecto : Pila 1. Modelo 04

**Combinaciones de casos - Casos: 11A26**

**- Casos: 11A26**

| Filtrar | Combinación |
|---|---|
| Lista completa | 11A26 |
| Selección | 11A26 |
| | |
| Número total | 16 |
| Número seleccionado | 16 |

**- Casos: 11A26**

| Combinación | Nombre | Tipo de análisis | Naturaleza de combinación | Naturaleza de caso | Definición |
|---|---|---|---|---|---|
| 11 (C) | AXIL MÁXIMO 1 | Combinación lineal | ELS | permanente | (1+2+3+4+5)*1.00 |
| 12 (C) | AXIL MÁXIMO 2 | Combinación lineal | ELS | permanente | (1+2+3+4+5+8)*1.00 |
| 13 (C) | AXIL MÁXIMO 3 | Combinación lineal | ELS | permanente | (1+2+3+4+5+9)*1.00 |
| 14 (C) | AXIL MÁXIMO 4 | Combinación lineal | ELS | permanente | (1+2+3+4+5+10)*1.00 |
| 15 (C) | MOM TRANSV MÁX 1 | Combinación lineal | ELS | permanente | (1+2+3+6+7+8)*1.00 |
| 16 (C) | MOM TRANSV MÁX 2 | Combinación lineal | ELS | permanente | (1+2+3+6+7+9)*1.00 |
| 17 (C) | MOM TRANSV MÁX 3 | Combinación lineal | ELS | permanente | (1+2+3+6+7+10)*1.00 |
| 18 (C) | MOM LONG MÁX 1 | Combinación lineal | ELS | permanente | (1+2+3+5+10)*1.00 |
| 19 (C) | AXIL MÁXIMO 1 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5)*1.50 |
| 20 (C) | AXIL MÁXIMO 2 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5+8)*1.50 |
| 21 (C) | AXIL MÁXIMO 3 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5+9)*1.50 |
| 22 (C) | AXIL MÁXIMO 4 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5+10)*1.50 |
| 23 (C) | MOM TRANSV MÁX 1 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(6+7+8)*1.50 |
| 24 (C) | MOM TRANSV MÁX 2 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(6+7+9)*1.50 |
| 25 (C) | MOM TRANSV MÁX 3 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(6+7+10)*1.50 |
| 26 (C) | MOM LONG MÁX 1 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(5+10)*1.50 |

**Reacciones sistema de coordenadas global - Casos: 11A18**
**Valores**
**1**

**sistema de coordenadas global - Casos: 11A18**

| Filtrar | Nudo | Caso |
|---|---|---|
| Lista completa | 1A9 | 1A26 |
| Selección | 8 9 | 11A18 |
| | | |
| Número total | 9 | 26 |
| Número seleccion | 2 | 8 |

**sistema de coordenadas global - Casos: 11A18**

| Nudo/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 8/ 11 (C) | 1.159 | -2.180 | 466.027 | -0.000 | -0.000 | 0.000 |
| 8/ 12 (C) | 13.741 | -2.180 | 688.606 | -0.000 | -0.000 | 0.000 |
| 8/ 13 (C) | 12.135 | -2.180 | 660.206 | -0.000 | 0.000 | 0.000 |
| 8/ 14 (C) | 1.159 | 29.303 | 466.027 | -0.000 | -0.000 | -0.000 |
| 8/ 15 (C) | 14.546 | -2.123 | 654.854 | -0.000 | -0.000 | 0.000 |
| 8/ 16 (C) | 12.940 | -2.123 | 626.453 | -0.000 | 0.000 | 0.000 |
| 8/ 17 (C) | 1.964 | 29.361 | 432.275 | -0.000 | -0.000 | -0.000 |
| 8/ 18 (C) | 0.735 | 32.127 | 373.004 | -0.000 | -0.000 | -0.000 |
| 9/ 11 (C) | 1.159 | -2.180 | 387.163 | 0.000 | -0.000 | 0.000 |
| 9/ 12 (C) | 13.741 | -2.180 | 164.584 | 0.000 | -0.000 | 0.000 |
| 9/ 13 (C) | 12.135 | -2.180 | 192.984 | 0.000 | -0.000 | 0.000 |
| 9/ 14 (C) | 1.159 | 29.303 | 387.163 | 0.000 | -0.000 | -0.000 |
| 9/ 15 (C) | 14.546 | -2.123 | 76.036 | 0.000 | -0.000 | 0.000 |
| 9/ 16 (C) | 12.940 | -2.123 | 104.437 | 0.000 | -0.000 | 0.000 |
| 9/ 17 (C) | 1.964 | 29.361 | 298.615 | 0.000 | -0.000 | -0.000 |
| 9/ 18 (C) | 0.735 | 32.127 | 322.985 | 0.000 | -0.000 | -0.000 |
| | | | | | | |
| Caso 11 (C) | AXIL MÁXIMO 1 | | | | | |
| Suma final | 2.317 | -4.361 | 853.190 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -0.000 | 0.600 | 853.190 | -48.670 | -209.700 | 0.000 |
| Suma de esfuerzo | 0.0 | -0.600 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 4.70217e+000 | 5.11606e-017 | | | | |
| | | | | | | |
| Caso 12 (C) | AXIL MÁXIMO 2 | | | | | |
| Suma final | 27.482 | -4.361 | 853.190 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -67.400 | 0.600 | 853.190 | -48.670 | -209.700 | 0.000 |
| Suma de esfuerzo | 67.400 | -0.600 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 5.00499e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 13 (C) | AXIL MÁXIMO 3 | | | | | |
| Suma final | 24.271 | -4.361 | 853.190 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -58.800 | 0.600 | 853.190 | -48.670 | -209.700 | 0.000 |
| Suma de esfuerzo | 58.800 | -0.600 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 5.70217e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 14 (C) | AXIL MÁXIMO 4 | | | | | |
| Suma final | 2.317 | 58.607 | 853.190 | -0.000 | -0.000 | -0.000 |
| Suma de reaccion | -0.000 | -43.100 | 853.190 | -48.670 | -209.700 | 0.000 |





| Nudo/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| Suma de esfuerzo | 0.0 | 43.100 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | 0.000 | -0.000 | 0.000 | -0.000 | 0.000 |
| Precisión: | 1.44522e+001 | 4.26274e-013 | | | | |
| | | | | | | |
| Caso 15 (C) | MOM TRANSV MÁX 1 | | | | | |
| Suma final | 29.092 | -4.246 | 730.890 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -67.400 | 0.600 | 730.890 | -47.070 | -355.400 | 0.000 |
| Suma de esfuerzo | 67.400 | -0.600 | -730.890 | 47.070 | 355.400 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 6.00499e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 16 (C) | MOM TRANSV MÁX 2 | | | | | |
| Suma final | 25.881 | -4.246 | 730.890 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -58.800 | 0.600 | 730.890 | -47.070 | -355.400 | 0.000 |
| Suma de esfuerzo | 58.800 | -0.600 | -730.890 | 47.070 | 355.400 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 6.70217e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 17 (C) | MOM TRANSV MÁX 3 | | | | | |
| Suma final | 3.927 | 58.722 | 730.890 | -0.000 | -0.000 | -0.000 |
| Suma de reaccion | -0.000 | -43.100 | 730.890 | -47.070 | -355.400 | 0.000 |
| Suma de esfuerzo | 0.0 | 43.100 | -730.890 | 47.070 | 355.400 | 0.0 |
| Verificación | -0.000 | 0.000 | -0.000 | 0.000 | -0.000 | 0.000 |
| Precisión: | 1.54522e+001 | 4.26274e-013 | | | | |
| | | | | | | |
| Caso 18 (C) | MOM LONG MÁX 1 | | | | | |
| Suma final | 1.470 | 64.253 | 695.990 | -0.000 | -0.000 | -0.000 |
| Suma de reaccion | -0.000 | -43.100 | 695.990 | 29.930 | -133.000 | 0.000 |
| Suma de esfuerzo | 0.0 | 43.100 | -695.990 | -29.930 | 133.000 | 0.0 |
| Verificación | -0.000 | 0.000 | -0.000 | 0.000 | -0.000 | 0.000 |
| Precisión: | 1.34522e+001 | 4.26274e-013 | | | | |

**Esfuerzos - Casos: 19A26**
**Envolvente**
**1**

**- Casos: 19A26**

| Filtrar | Barra | Caso |
|---|---|---|
| Lista completa | 1A6 | 1A26 |
| Selección | 3A6 | 19A26 |
| | | |
| Número total | 6 | 26 |
| Número seleccionado | 4 | 8 |

**- Casos: 19A26**

| Barra/Punto/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 3/ 6/ 20 (C) | | 3.815 | 14.017 | 0.000 | 87.586 | 21.894 |
| 3/ 4/ 26 (C) | | 32.370 | 0.000 | 0.000 | 13.809 | -400.208 |
| 3/ 4/ 22 (C) | 575.546 | | 0.000 | 0.000 | 22.657 | -341.258 |
| 3/ 6/ 26 (C) | 483.750 | | -1.301 | 0.000 | 7.020 | -304.982 |
| 3/ 4/ 23 (C) | 858.785 | -0.405 | | 0.000 | -122.831 | 39.370 |
| 3/ 6/ 25 (C) | 572.656 | -31.711 | | 0.000 | 20.062 | -275.625 |
| 3/ 4/ 22 (C) | 575.546 | 32.370 | 0.000 | | 22.657 | -341.258 |
| 3/ 4/ 23 (C) | 858.785 | -0.405 | 50.550 | | -122.831 | 39.370 |
| 3/ 6/ 23 (C) | 906.524 | 3.702 | 12.433 | 0.000 | | 21.284 |
| 3/ 4/ 20 (C) | 909.414 | -0.405 | 50.550 | 0.000 | | 40.570 |
| 3/ 4/ 19 (C) | 575.546 | -0.405 | 0.000 | 0.000 | 22.657 | |
| 3/ 3/9/ 26 (C) | 447.946 | 3.643 | -0.566 | 0.000 | 13.208 | |
| 4/ 8/ 20 (C) | | 3.159 | -20.501 | 0.000 | -0.000 | 0.000 |
| 4/ 6/ 26 (C) | | -37.151 | -1.301 | -0.000 | 7.020 | -304.982 |
| 4/ 5/9/ 19 (C) | 635.816 | | -3.169 | 0.000 | 5.458 | 10.536 |
| 4/ 5/9/ 26 (C) | 496.282 | | -1.931 | -0.000 | 3.326 | -157.355 |
| 4/ 6/ 20 (C) | 957.153 | 3.815 | | 0.000 | 87.586 | 21.894 |
| 4/ 6/9/ 23 (C) | 922.189 | 5.638 | | 0.000 | 48.028 | 7.204 |
| 4/ 6/ 23 (C) | 906.524 | 3.702 | 12.433 | | 96.130 | 21.284 |
| 4/ 6/ 26 (C) | 483.750 | -37.151 | -1.301 | | 7.020 | -304.982 |
| 4/ 2/9/ 23 (C) | 909.657 | 4.772 | -4.088 | 0.000 | | 19.043 |
| 4/ 8/ 24 (C) | 888.987 | 3.073 | -19.300 | 0.000 | | 0.000 |
| 4/ 6/ 19 (C) | 623.285 | 3.815 | -2.134 | 0.000 | 11.517 | |
| 4/ 6/ 26 (C) | 483.750 | -37.151 | -1.301 | -0.000 | 7.020 | |
| 5/ 7/ 19 (C) | | 3.815 | -2.134 | 0.000 | 11.517 | 21.894 |
| 5/ 5/ 23 (C) | | -0.405 | 50.550 | 0.000 | -122.831 | 39.370 |
| 5/ 5/ 22 (C) | 464.752 | | 0.000 | 0.000 | 22.657 | -341.258 |
| 5/ 7/ 26 (C) | 416.225 | | -1.301 | 0.000 | 7.020 | -304.982 |
| 5/ 5/ 23 (C) | -1.938 | -0.405 | | 0.000 | -122.831 | 39.370 |
| 5/ 7/ 25 (C) | 379.670 | -31.711 | | 0.000 | 20.062 | -275.625 |
| 5/ 5/ 22 (C) | 464.752 | 32.370 | 0.000 | | 22.657 | -341.258 |
| 5/ 5/ 23 (C) | -1.938 | -0.405 | 50.550 | | -122.831 | 39.370 |
| 5/ 7/ 23 (C) | 45.801 | 3.702 | 12.433 | 0.000 | | 21.284 |
| 5/ 5/ 20 (C) | 130.884 | -0.405 | 50.550 | 0.000 | | 40.570 |
| 5/ 5/ 19 (C) | 464.752 | -0.405 | 0.000 | 0.000 | 22.657 | |
| 5/ 3/9/ 26 (C) | 380.421 | 3.643 | -0.566 | 0.000 | 13.208 | |
| 6/ 9/ 19 (C) | | 3.159 | -1.628 | 0.000 | 0.000 | -0.000 |
| 6/ 7/ 23 (C) | | 3.702 | 12.433 | 0.000 | 96.130 | 21.284 |
| 6/ 5/9/ 19 (C) | 525.022 | | -3.169 | 0.000 | 5.458 | 10.536 |
| 6/ 5/9/ 26 (C) | 428.756 | | -1.931 | -0.000 | 3.326 | -157.355 |





| Barra/Punto/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 6/ 7/ 20 (C) | 178.622 | 3.815 | | 0.000 | 87.586 | 21.894 |
| 6/ 6/9/ 23 (C) | 61.466 | 5.638 | | 0.000 | 48.028 | 7.204 |
| 6/ 7/ 19 (C) | 512.491 | 3.815 | -2.134 | | 11.517 | 21.894 |
| 6/ 7/ 25 (C) | 379.670 | -31.711 | -3.718 | | 20.062 | -275.625 |
| 6/ 2/9/ 23 (C) | 48.934 | 4.772 | -4.088 | 0.000 | | 19.043 |
| 6/ 9/ 26 (C) | 441.288 | -48.302 | -0.992 | -0.000 | | -0.000 |
| 6/ 7/ 19 (C) | 512.491 | 3.815 | -2.134 | 0.000 | 11.517 | |
| 6/ 7/ 26 (C) | 416.225 | -37.151 | -1.301 | -0.000 | 7.020 | |

**PRONTUARIO INFORMÁTICO DEL HORMIGÓN ESTRUCTURAL 3.0**
**Cátedra de Hormigón Estructural ETSICCPM - IECA**

Obra: General
Fecha: 27/04/2004
Hora: 11:25:13

## Cálculo de secciones a flexión compuesta recta

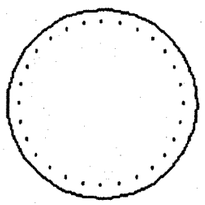
## 1 Datos

- Materiales

Tipo de hormigón : HA-25
Tipo de acero : B-500-S
fck [MPa] = 25.00
fyk [MPa] = 500.00
γc = 1.50
γs = 1.15

- Sección

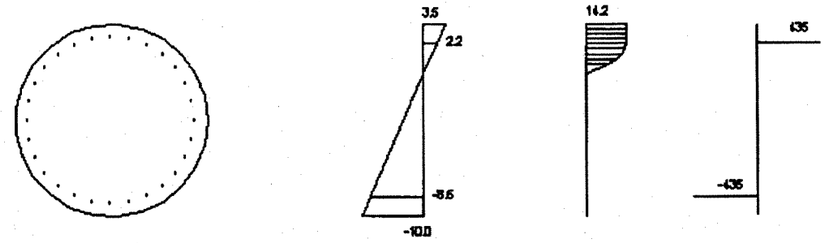
Sección : PIL150
ϕ [m] = 1.50
r [m] = 0.100
nº barras = 28



## 2 Comprobación

ϕ [mm] = 32
Nd [kN] = 0
Md [kN·m] = 4350

Nu [kN] = -0.0
Mu [kN·m] = 5303.7
γ = 1.22




Plano de deformación de agotamiento

x [m] = 0.390
1/r [1/m]·1.E-3 = 9.0
εs ·1.E-3 = 3.5
εi ·1.E-3 = -10.0

Deformación y tensión de armaduras superior e inferior

| Profundidad [m] | Deformación ·1.E-3 | Tensión [MPa] |
|---|---|---|
| 0.147 | 2.2 | -434.8 |
| 1.353 | -8.6 | 434.8 |

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Pilote en pila 1.**

**PILOTE EN PILA 1**

| | |
|---|---|
| D(mm) | 1400 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 750 |
| As(cm2) | 74.7 |
| Vrd(Tn) | 87.50 |
| N(Tn) | -429 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

**COMPROBACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.378 |
| Roele | 0.0071 |
| Sigmaprima (N/mm2) | -4.01 |
| Vu2 (N) | 1084483.0 |

[redacted]

**CÁLCULO DE LA ARMADURA DE CORTANTE**

| | |
|---|---|
| Theta | |
| Vu2 | 377674.58 |
| Vsu,p | 504000.00 |

[redacted]

**VERIFICACIÓN DEL AGOTAMIENTO POR COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 17672 |
| Sigmacd (N/mm2) | 2.42756904 |
| K | 1 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 5250000 |

**Verificada la resistencia del alma a la compresión**

**ARMADURA MÍNIMA DE CORTANTE**

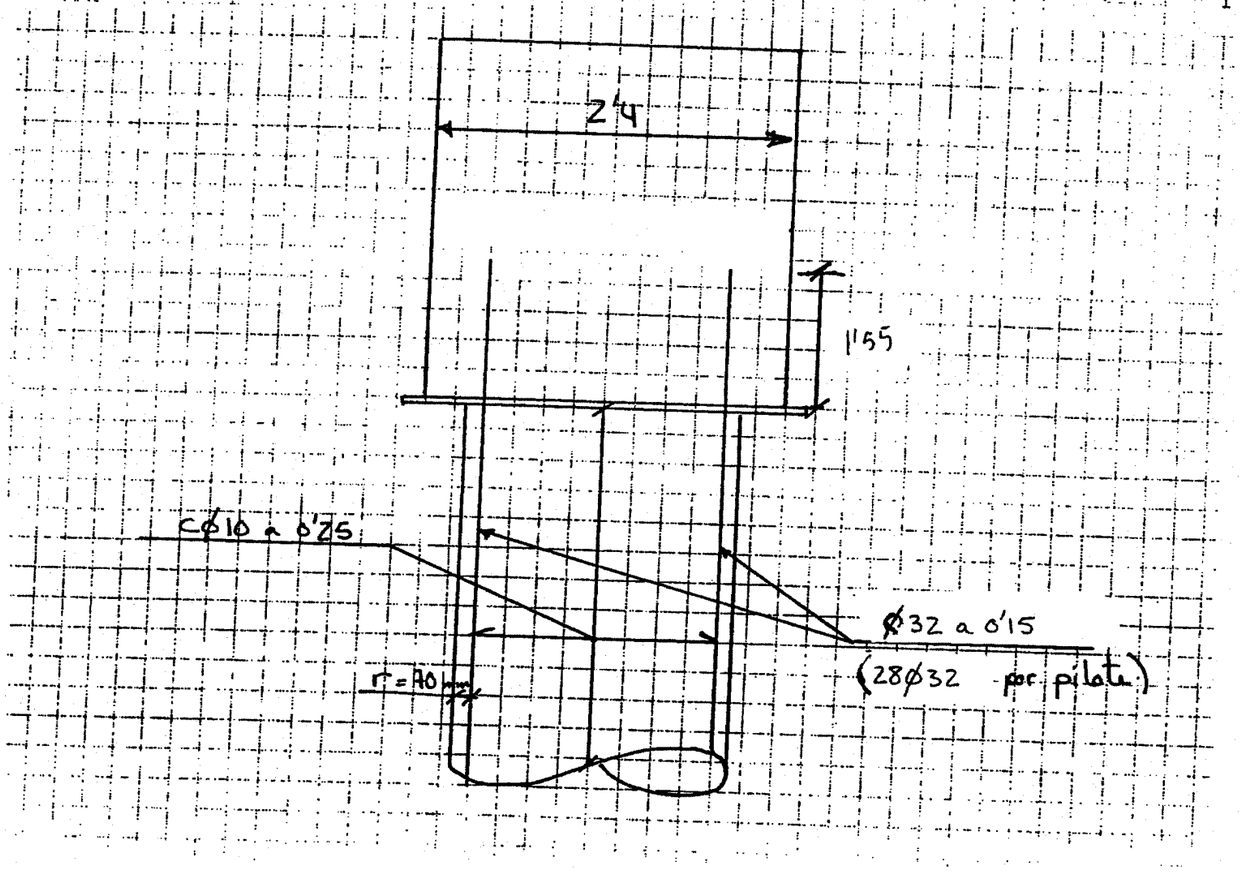
| | | | |
|---|---|---|---|
| α (en grados) = | 90 | As, c mín. (cm2/m) = | [redacted] |

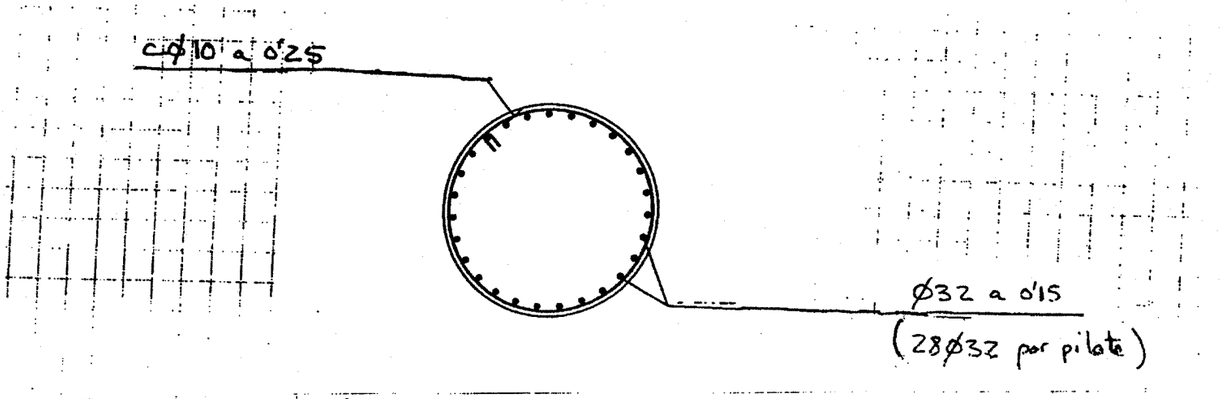
PEDELTA
INGENIERIA CIVIL

FECHA

HOJA

ESQUEMA DE ARMADO



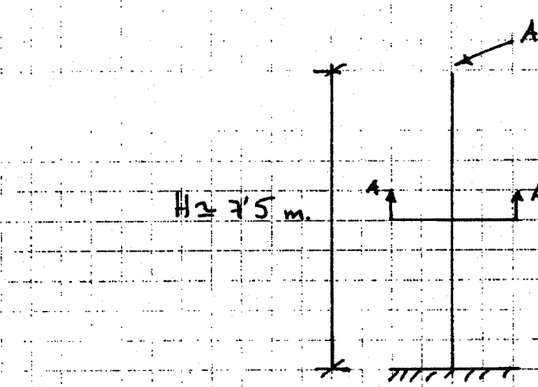

r = recubrimiento nominal = 70 mm

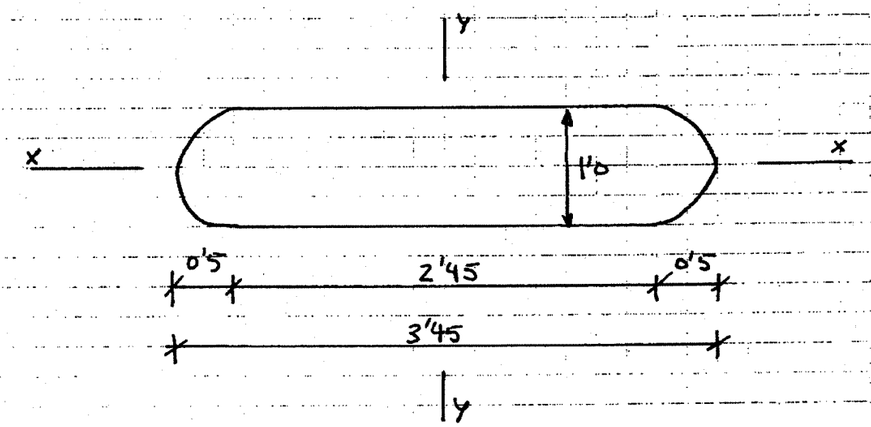
# CÁLCULO CIMENTACIÓN PILA 2

PEDELTA

CÁLCULO DE LA PILA 2.

Fuste:




$A = 3'2354\ m$

$I_x = 0'2533\ m^4$

$I_y = 2'8615\ m^4$

Esbeltez mecánica y efectos de 2º orden:

Longitud de pandeo: $l_p = \beta \cdot H$

$l_p = 2 \cdot 7'5 = 15$ m.

Radio de giro:

$$i_x = \sqrt{\frac{I_x}{A}} = 0'280 \text{ m}$$

$$i_y = \sqrt{\frac{I_y}{A}} = 0'940 \text{ m}$$

Esbeltez mecánica:

$\lambda_x = \frac{l_p}{i_x} = 53'6 > 35 \rightarrow$ Hay que tener en cuenta los efectos de 2º orden.

$\lambda_y = \frac{l_p}{i_y} = 16'0$



Reacciones verticales:

| | 44 | 45 | |
|---|---|---|---|
| $R_{perm}$ | 278'3 | 257'6 | |
| $R_{max}$ | 266'3 | 23'9 | |
| $\Sigma$ | 544'6 | 281'5 | = 826'1 T = N |

Fuerzas debidas al rozamiento:

$F_y = \mu \cdot R_{perm}$

$F_{y,max} = 0'05 \cdot (278'3 + 259'6) = 26'8$ T

Fuerza debida al efecto faja:

$F_x = 5$ T

Fuerza centrífuga:

$F_x = 5$ T

Viento transversal concomitante

$F_x = 1$ T

Viento sobre fuste: $f_w = 0'15$ T/m

Esfuerzos de "1er orden" (en base de fuste)

ELS:

$F_z = N - 826'1 + 60'7 = 886'8$ T

$F_x = 12'1$ T

$F_y = 26'8$ T

$M_x = 26'8 \cdot 7'5 = 201$ mT

$M_y = 12'1 \cdot 7'5 + 289'4 = 380'2$ mT

ELU:

$F_z = 1159$ T

$F_x = 18'2$ T

$F_y = 36'2$ T

$M_x = 271'4$ mT

$M_y = 567'2$ mT

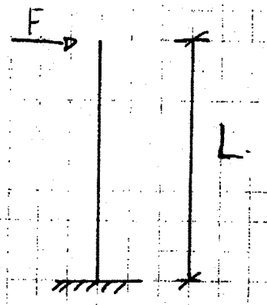
Esfuerzos de "2º orden":

$M_x = 201 + 130'7 = 332$ mT en ELS

$M_x = 271'4 + 175'8 = 447$ mT en ELU



Modelización de la cimentación




$\phi_{pilote} = 1'25$ m $\Rightarrow$ $I_p = 0'120$ m⁴

$K_s = 5$ kp/cm³ = 5000 T/m³

$E_p = 285.000$ kp/cm² = 2.850.000 T/m²

$E = 400$ T/m² $\Rightarrow$ $G = \frac{E}{2(1+\nu)} = \frac{E}{3} =$

$L_e = 1'2 \cdot \sqrt[4]{\frac{E_p I_p}{G}} = 8'5$ m

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

CÁLCULO DE LA CARGA POR PILOTE

$I_x = 0$

$I_y = \sum x_i^2 = 2 \cdot (1'875)^2 = 7'03 \ m^2$

$A = n = 2$ pilotes

Peso encepado:

$g_{enc} = 2'5 \cdot 1'9 \cdot 1'75 \cdot 6'25 = 52 \ T$

($h_{enc}$ $b_{enc}$ $l_{enc}$)

Esfuerzos en la base del encepado

$N = 886'8 + 52 = 938'8 \ T$

$M = M_y + F_x \cdot h_{enc} = 380'2 + 12'1 \cdot 1'9 = 403'2 \ mT$

$$P_d = \frac{N}{1} \pm \frac{M_x}{I_y} = \begin{cases} P_{max} = 577 \ T \\ P_{min} = 362 \ T \end{cases}$$

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

Si $n = 2$ pilotes y $s = 5'0$ m $\Rightarrow$

$\Rightarrow I = 12'5 \ m^2$

$g_{enc} = 2'5 \cdot 1'9 \cdot 1'75 \cdot 7'5 = 62'3 \ T$

$N = 886'8 + 62'3 = 949 \ T$
$M = 403 \ mT$ $\Rightarrow$

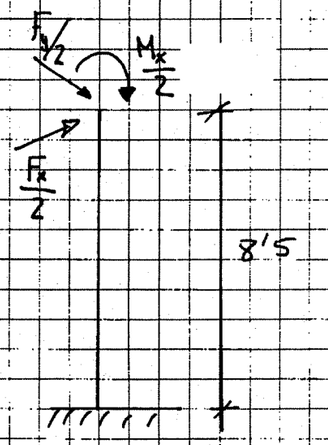
$\Rightarrow$ $P_{max} = 555 \ T$

$P_{min} = 394 \ T$

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

Esfuerzos en el pilote:




$\frac{F_y}{2} = 6'05\ T$

$\frac{F_x}{2} = 13'4\ T$

$\Rightarrow F = \left[F_x^2 + F_y^2\right]^{1/2} = 14'7\ T$

$\frac{M_x}{2} = \frac{332}{2} = 166\ mT$

$M_{x,base} = 166 + 13'4 \cdot (8'5 + 1'9) = 305'4\ mT$

$M_{y,base} = 6'05 \cdot 8'5 = 51'4\ mT$

$\Rightarrow$

$\Rightarrow M_d = \left[M_x^2 + M_y^2\right]^{1/2} \cdot 1'5 = 465\ mT$

**PRONTUARIO INFORMÁTICO DEL HORMIGÓN ESTRUCTURAL 3.0**
**Cátedra de Hormigón Estructural ETSICCPM - IECA**

Obra: General
Fecha: 21/04/2004
Hora: 15:47:28

## Cálculo de secciones a flexión compuesta recta

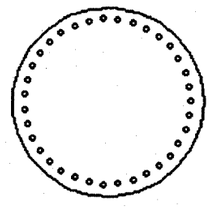
### 1 Datos

- Materiales

Tipo de hormigón : HA-25
Tipo de acero : B-500-S
fck [MPa] = 25.00
fyk [MPa] = 500.00
γc = 1.50
γs = 1.15

- Sección

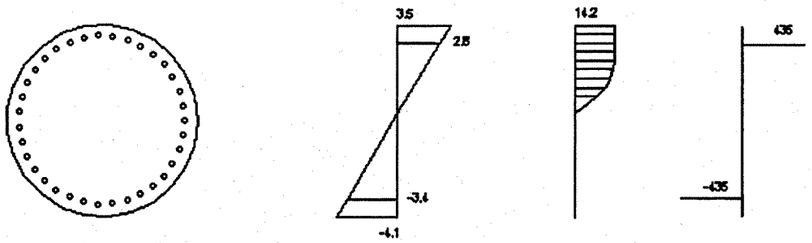
Sección : PIL125
ϕ [m] = 1.25
r [m] = 0.080
nº barras = 35 → ϕ32 a 0'10



### 2 Comprobación

ϕ [mm] = 32
Nd [kN] = 4000
Md [kN·m] = 4650

Nu [kN] = 5074.4
Mu [kN·m] = 5899.0
γ = 1.27




Plano de deformación de agotamiento

x [m] = 0.574

1/r [1/m]·1.E-3 = 6.1

εs ·1.E-3 = 3.5

εi ·1.E-3 = -4.1

Deformación y tensión de armaduras superior e inferior

| Profundidad [m] | Deformación ·1.E-3 | Tensión [MPa] |
|---|---|---|
| 0.119 | 2.8 | -434.8 |
| 1.131 | -3.4 | 434.8 |

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Pilote en pila 2.**

**PILOTE EN PILA 2**

| | |
|---|---|
| D(mm) | 1150 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 680 |
| As(cm2) | 88 |
| Vrd(Tn) | 22.05 |
| N(Tn) | -400 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.417 |
| Roele | 0.0113 |
| Sigmaprima (N/mm2) | -5.02 |
| Vu2 (N) | 993025.6 |

[redacted]

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 337021.35 |
| Vsu,p | 414000.00 |

[redacted]

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 12272 |
| Sigmacd (N/mm2) | 3.25945241 |
| K | 1 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 3910000 |

**Verificada la resistencia del alma a la compresión**

**CÁLCULO DE LA ARMADURA MÍNIMA DE CORTANTE**

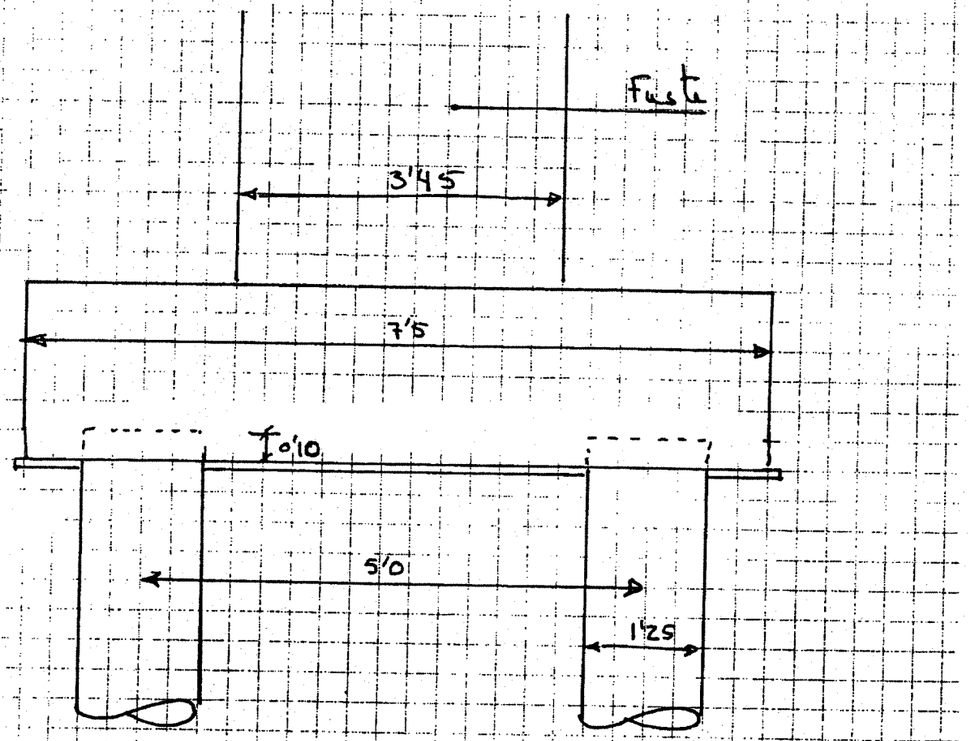
α (en grados) = 90 As, c mín. (cm2/m) = [redacted]

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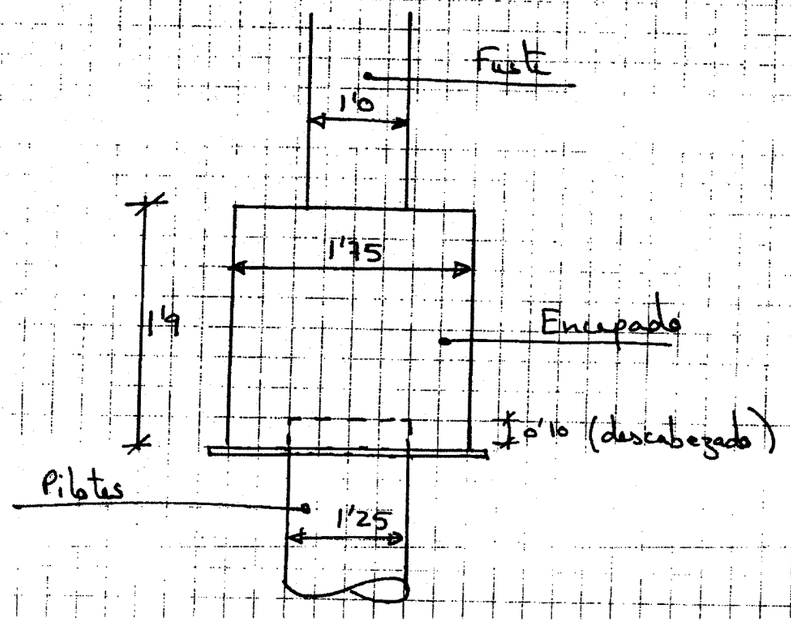
FECHA

HOJA

ALZADO FRONTAL




ALZADO LATERAL

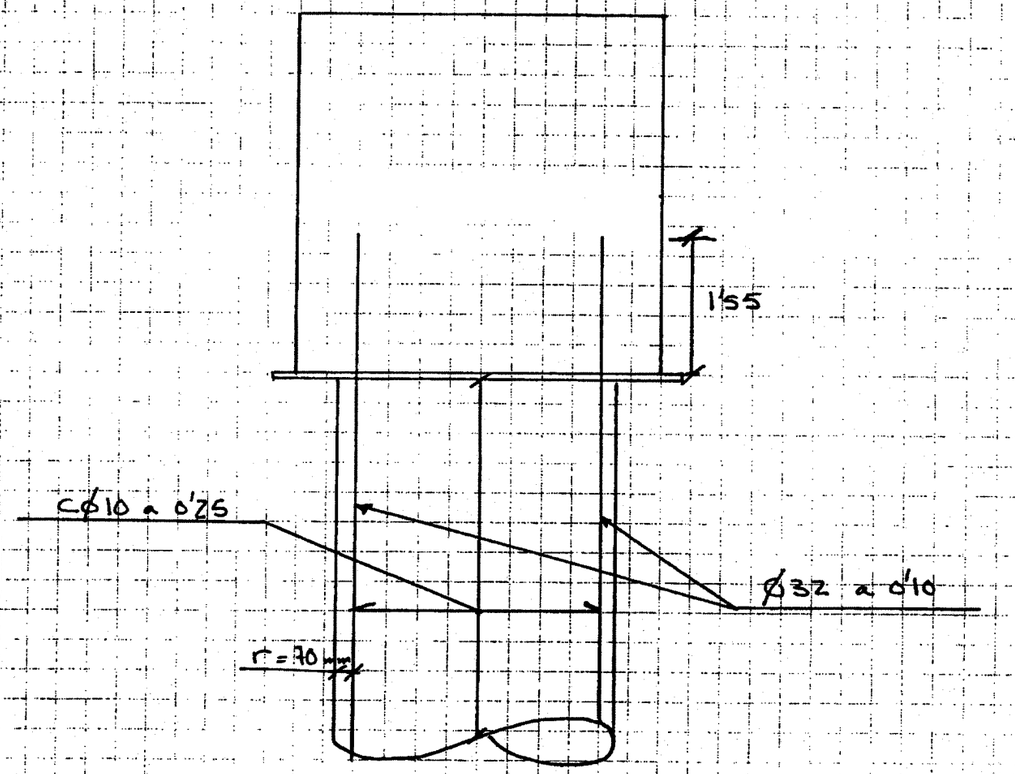


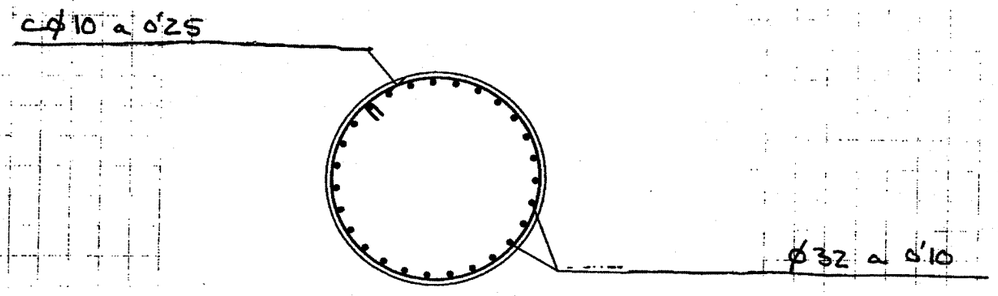

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FECHA

HOJA

ESQUEMA DE ARMADO



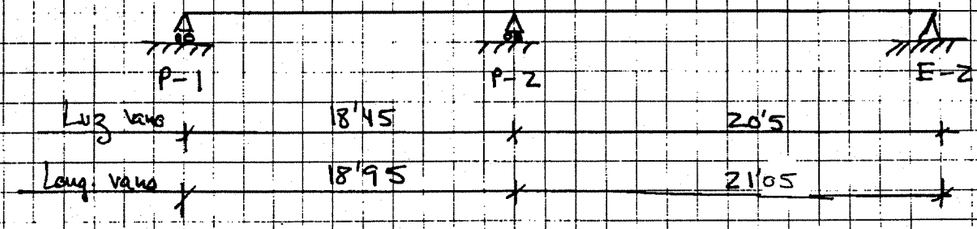

r = recubrimiento nominal = 70 mm

# CÁLCULO CIMENTACIÓN ESTRIBO 2

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FECHA HOJA

DISTRIBUCIÓN DE FUERZAS LONGITUDINALES EN PILAS Y ESTRIBOS.




Long. tablero = 40 m.

Fuerza de frenado IPF-75

$F_{FR,IPF} = \frac{12 \cdot 30 + 10 \cdot 10}{8} = 57'5$ T (valor máximo)

$F_{A,IPF} = \frac{12 \cdot 30}{8} = 45$ T ← fuerza de arranque

Fuerza de frenado EC-1:

$F_{FR,EC-1} = 2 \cdot 40 = 80$ T

$F_{A,EC-1} = 3'3 \cdot 40 = 132 \not< 100$ T

Fuerza de rozamiento en POTs:

$R_{perm,P-1} = 128'8 + 123'2 = 252\ T$

$R_{perm,P-2} = 278'3 + 257'6 = 536\ T$

$F_{R,P-1} = \mu \cdot R_{perm,P-1} = 12'6\ T$ (valor máximo)

$F_{R,P-2} = 26'8\ T$ (valor máximo)

Fuerza total que ejerce el tablero en el punto fijo del estribo 2:

$$F = F_{R,P-1} + F_{R,P-2} + \max\left\{F_{FA} \text{ ó } F_A\right\}$$

Según IPF-75: $F = 97\ T$

Según EC-1: $F = 139\ T$

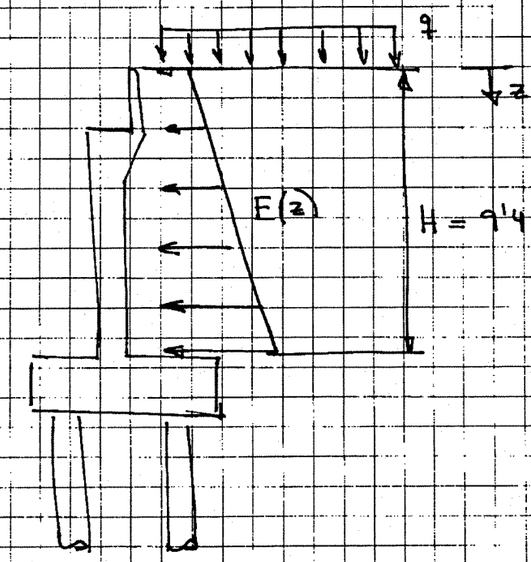
Momento repartido en base de estribo:

$$m = \frac{97 \cdot (9'4 + 1'6)}{8'2} = 92'3\ mT/m$$

$$m = \frac{139\ (9'4 - 1'6)}{8'2} = 132'2\ mT/m$$

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Empuje de tierras en trasdós estribo:




$E(z) = K \cdot (q + \gamma \cdot z)$

$q = 3\ T/m^2$

$\gamma = 2\ T/m^3$

Hipótesis 1: $k = k_0 = 0'5$ $(\phi = 30^\circ \quad c = 0)$

$E(z) = 1'5 + \ldots \cdot z \Rightarrow E(z = 9'4) = 10'9\ T/m^2$

$E_{resultante} = \underbrace{1'5 \cdot 9'4}_{14'1} + \underbrace{\frac{9'4^2}{2}}_{44'18} = 58'28\ T/m$

$M_{result,\ base\ muro} = 14'1 \cdot \frac{9'4}{2} + 44'18 \cdot \frac{9'4}{3} = 204'7\ mT/m$

Hipótesis 2: $K = K_a = 0'33$ $(\phi = 30° \quad c = 0)$

$$E(z) = \frac{1 + 2 \cdot z}{3} \Rightarrow E(z = 9'4) = 7'3 \ T/m^2$$

$$E_{result} = 1 \cdot 9'4 + \frac{9'4 \cdot 6'3}{2} = 9'4 + 29'61 = 39'0 \ T/m$$

$$M_{result,\ base\ muro} = 9'4 \cdot \frac{9'4}{2} + 29'61 \cdot \frac{9'4}{3} = 137'0 \ mT/m$$

Peso de tierras sobre encapado.

$$P(z) = \gamma \cdot z$$

$P_T(z = 9'4) = 18'8 \ T/m^2$ (en trasdós estribo)

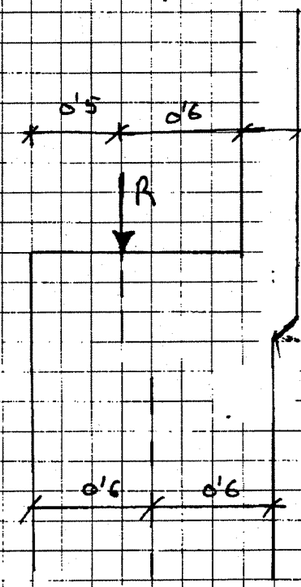
$P_I(z = 1'0) = 2 \ T/m^2$ (en intradós estribo)

$P_I$ sólo se tendrá en cuenta si es desfavorable para la comprobación en cuestión.



Cargas verticales sobre el estribo:

a) Transmitidas por el tablero




$R_{perm} = 143'6 + 136'5 = 280'1 \ T$ $\quad M_{TRANSV} = 1'0 \ mT$

$R_{SAT} = 96'9 + 7'9 = 104'8 \ T$ $\quad M_{TRANSV} = 142'4 \ mT$

$R_{EC-1} = 94'4 + 17'7 = 112'1 \ T$ $\quad M_{TRANSV} = 122'7 \ mT$

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b) Debidas al peso propio del estribo.

$$P_{muro} = 2'5 \cdot 8'2 \cdot (9'4 - 1'8) \cdot 1'2 = 186'96 \text{ T}$$

Por metro de ancho:

$$p_{muro} = \frac{186'96}{8'2} = 22'8 \text{ T/m}$$

Resumen de esfuerzos en base de estribo debidos a cargas verticales:

IPF:

$$p_v = \frac{280'1 + 104'8}{8'2} + 22'8 = 69'7 \text{ T/m}$$

$$m = \frac{(280'1 + 104'8) \cdot 0'10}{8'2} = 4'7 \text{ mT/m}$$

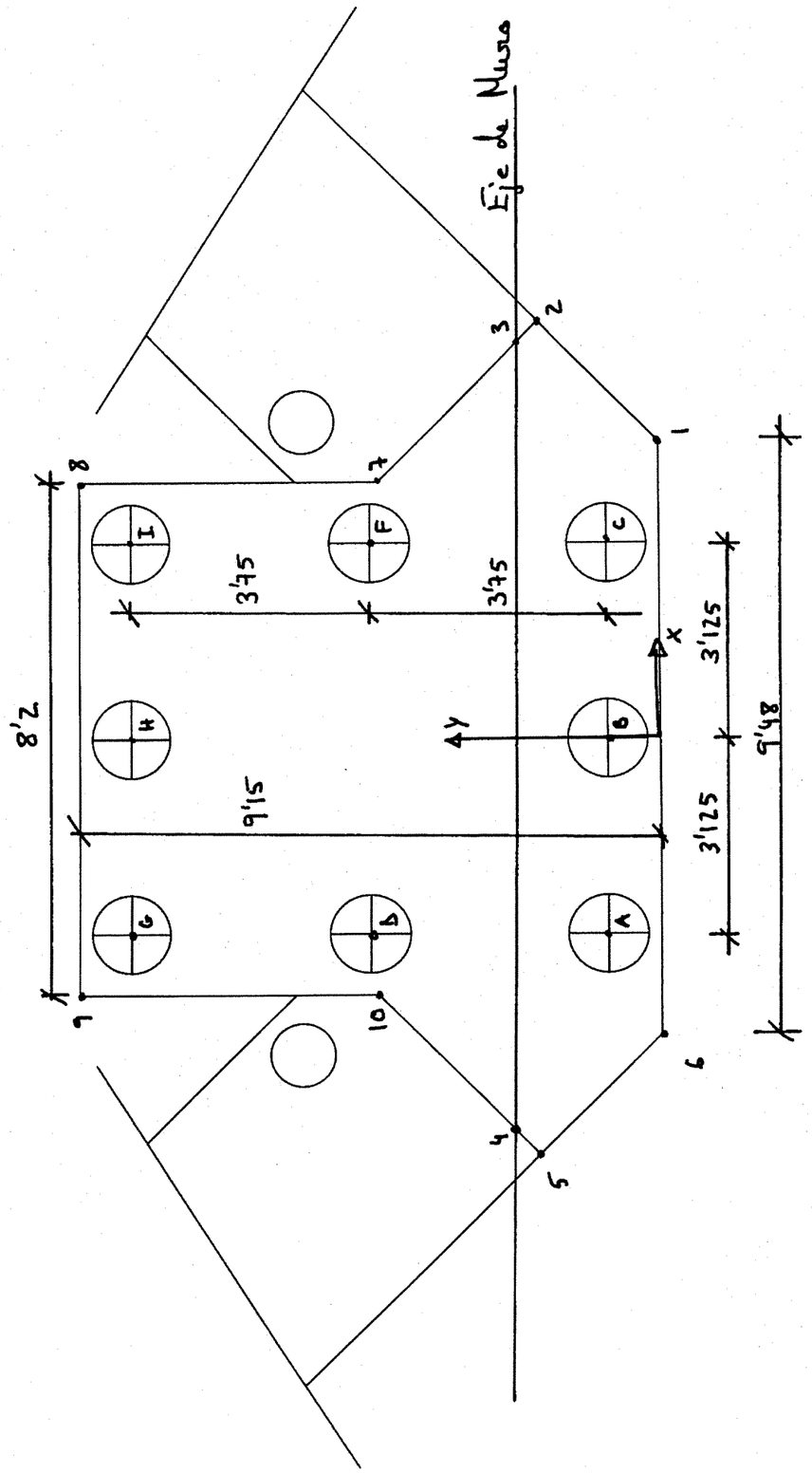
EC-1:

$$p = \frac{280'1 + 112'1}{8'2} + 22'8 = 70'6 \text{ T/m}$$

$$m = \frac{(280'1 + 112'1) \cdot 0'10}{8'2} = 4'8 \text{ mT/m}$$

ENCEPADO DE 8 PILOTES $\phi = 1'25$ m.

PLANTA



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## Encepado de 8 pilotes $\phi = 1'25$ m

### Coordenadas del contorno

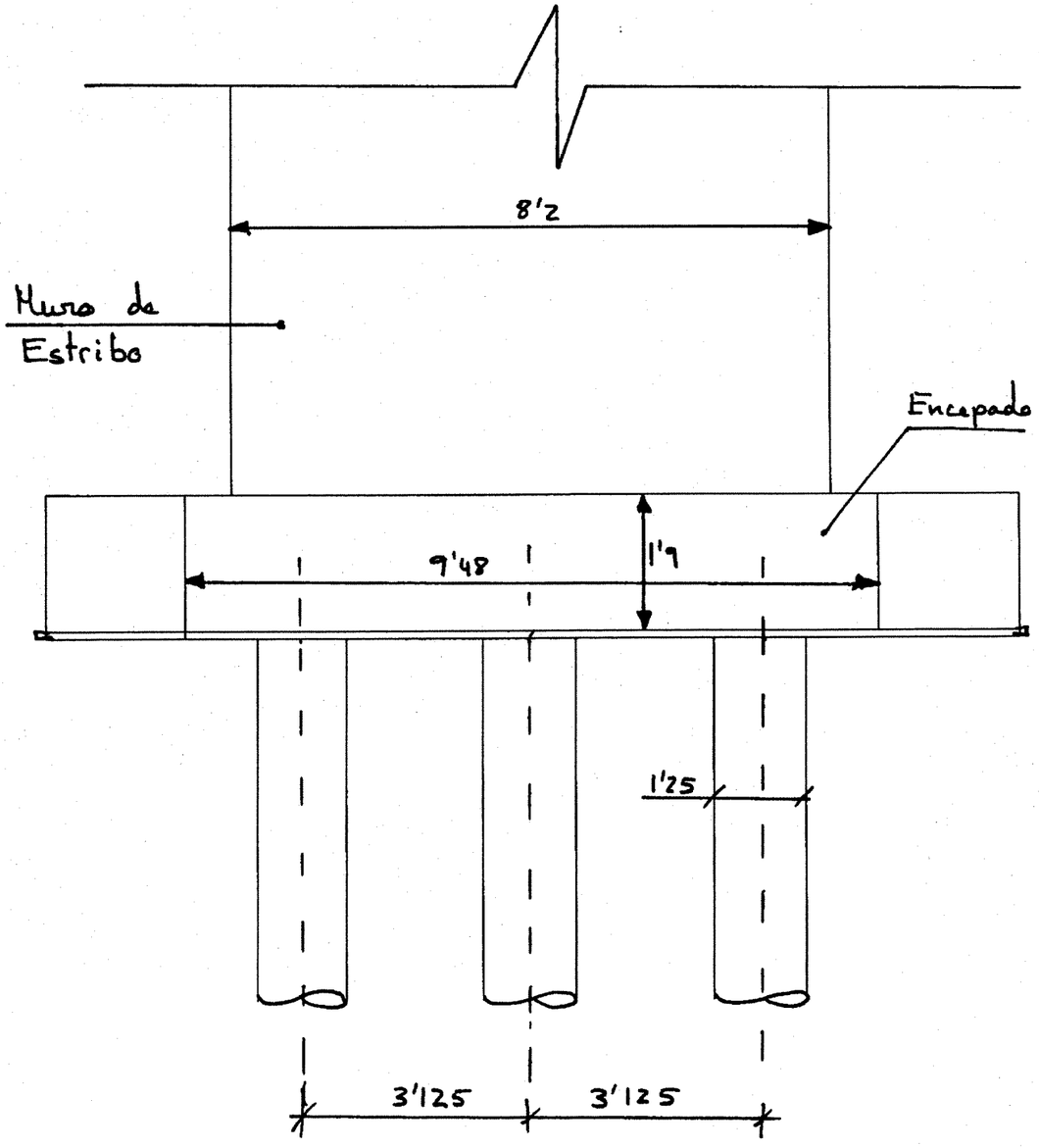
1 → (4'74 ; 0)
2 → (6'644 ; 1'9)
3 → (6'32 ; 2'225)
4 → (-6'32 ; 2'225)
5 → (-6'644 ; 1'9)
6 → (-4'74 ; 0)
7 → (4'10 ; 4'45)
8 → (4'10 ; 9'15)
9 → (-4'10 ; 9'15)
10 → (-4'10 ; 4'45)

### Coordenadas del centro de los pilotes

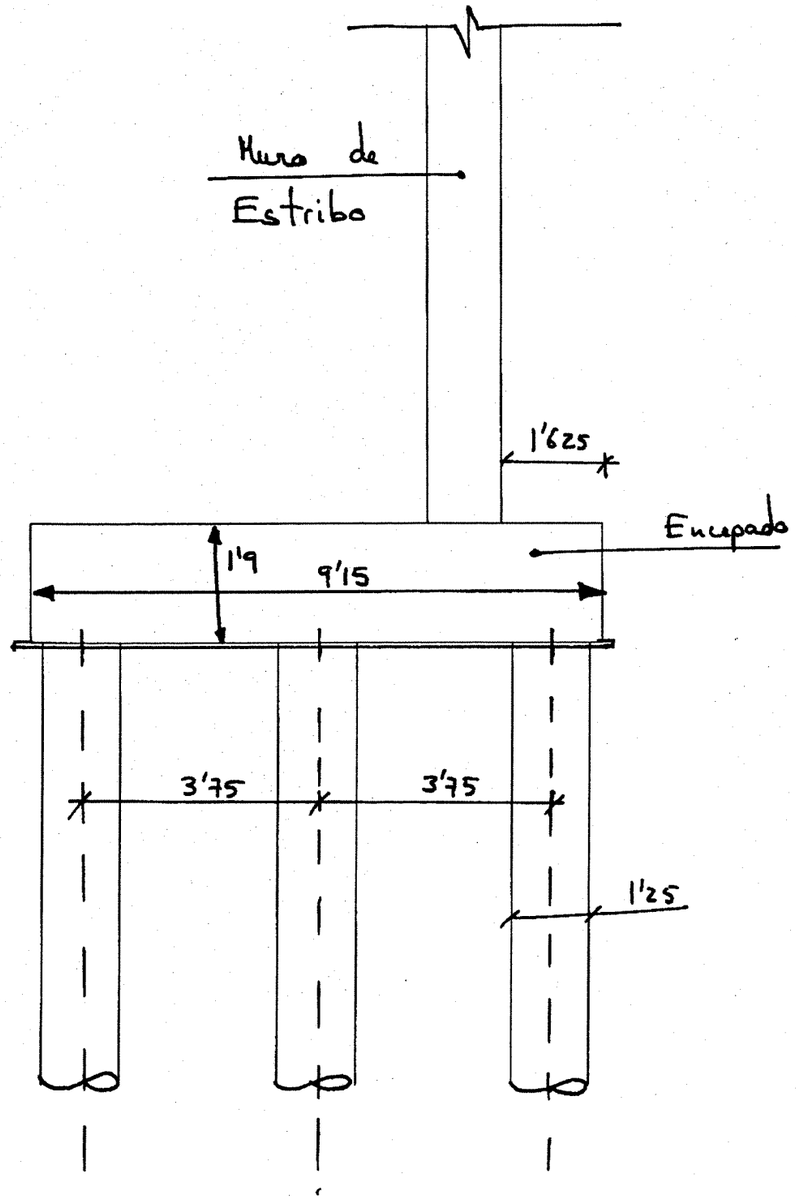
A → (-3'125 ; 0'825)
B → (0'0 ; 0'825)
C → (3'125 ; 0'825)
D → (-3'125 ; 4'575)

F → (3'125 ; 4'575)
G → (-3'125 ; 8'325)
H → (0'0 ; 8'325)
I → (3'125 ; 8'325)

ALZADO FRONTAL



## SECCIÓN TRANSVERSAL

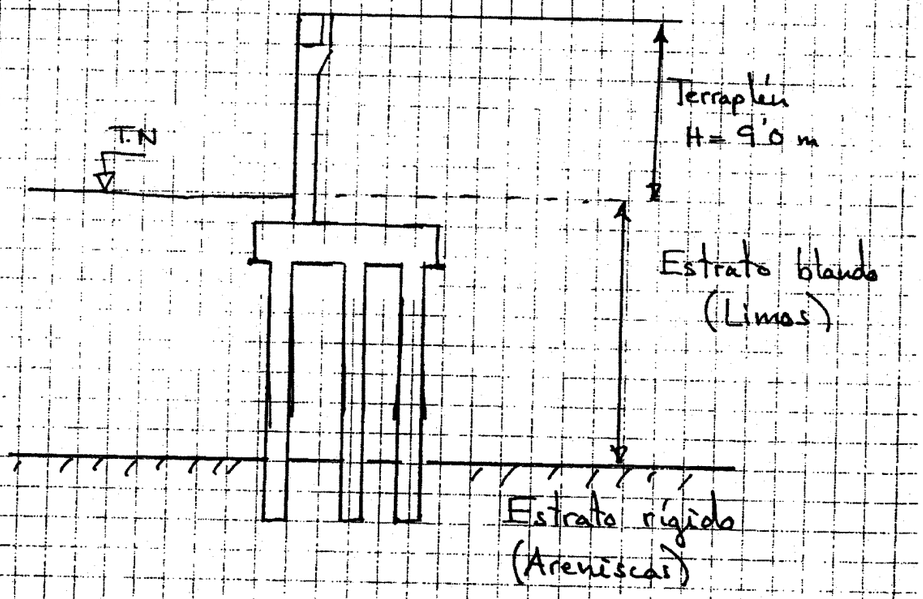



PEDELTA
INGENIERIA CIVIL

FECHA

Nº/A

## Cálculo de la carga horizontal sobre los pilotes.




Datos terreno:

$H = 9'0\ m \Rightarrow p_x = \gamma \cdot H = 18\ T/m^2$

$\gamma = 2\ T/m^3$

$C_u \simeq 0'5\ kp/cm^2 = 5\ T/m^2$ en limos

Datos pilotes:

$\phi = 1'25\ m$

$s = 3 \cdot \phi = 3'75\ m.$ (separación pilotes)

Según Jiménez-Salas:

$p_h = p_H - 2 \cdot G_L = 8 \ T/m^2$

Sobre la 1ª fila de pilotes actúa la siguiente carga:

$$P_1 = p_h \cdot 2\phi = 20 \ T/m$$

Sobre la 2ª fila de pilotes:

$$p_{h,2} = p_h - \frac{P_1}{S} = 2'7 \ T/m^2$$

$$P_2 = p_{h,2} \cdot 2\phi = 6'7 \ T/m$$

Sobre la 3ª fila de pilotes:

$$p_{h,3} = p_{h,2} - \frac{P_2}{S} = 0'92 \ T/m^2$$

$$P_3 = p_{h,3} \cdot 2\phi = 2'3 \ T/m$$

En el pilote central de la 3ª fila:

$$p'_{h,3} = p_H - \frac{P_1}{2 \cdot S} = 5'33 \ T/m^2$$

$$P'_3 = p'_{h,3} \cdot 2\phi = 13'3 \ T/m^2$$



La carga total sobre los pilotes será:

$$P_H = p_h \cdot B = 8 \cdot 8'2 = 65'6 \ T/m$$

(B = Ancho terraplén)

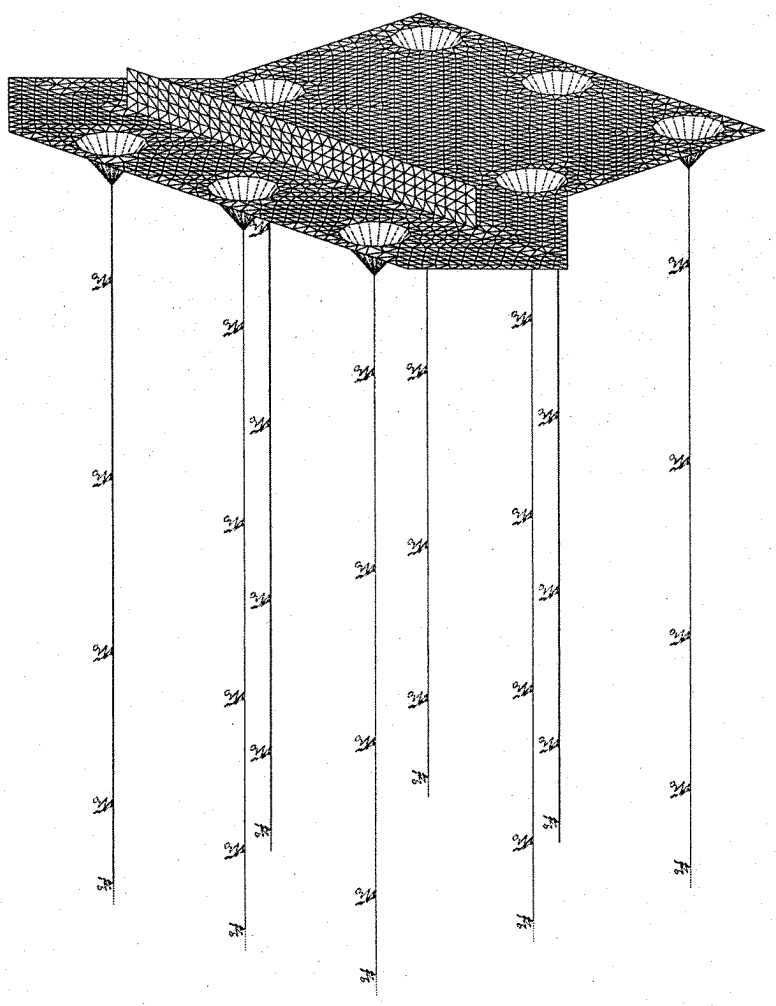
Sin embargo, la carga sobre los pilotes es:

$$\Sigma P_i = 3 \cdot P_1 + 2 \cdot P_2 + 2 \cdot P_3 + P'_3 = 91'3 \ T/m$$

Como $\Sigma P_i$ debe ser menor que $P_H$, se aplica el siguiente coef. reductor:

$$\alpha = \frac{P_H}{\Sigma P_i} = \frac{65'6}{91'3} = 0'72$$

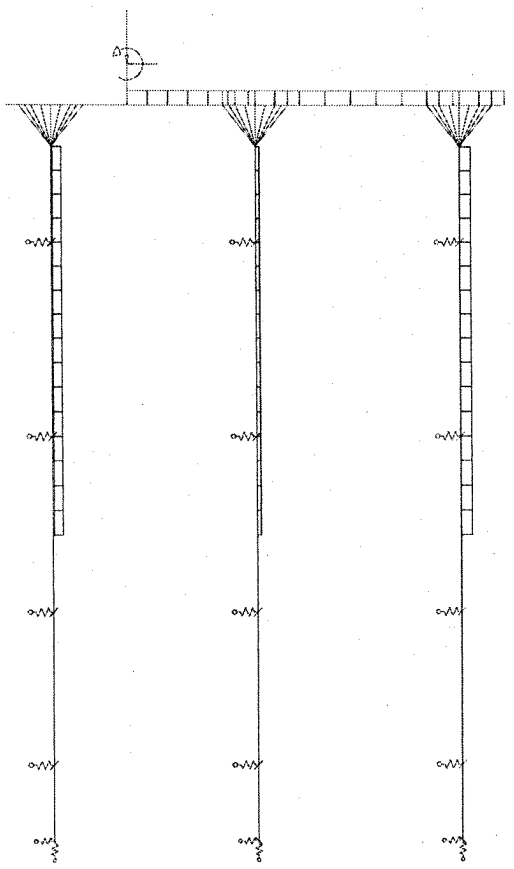
## Vista - casos: 1 (PESO PROPIO)







## Vista - casos: 10 (COMB3)



**Reacciones sistema de coordenadas global - Caso: 10 (COMB3)**

**sistema de coordenadas global - Caso: 10 (COMB3)**

| Filtrar | Nudo | Caso |
|---|---|---|
| Lista completa | 1A671 716A2012 2023 2024 2027A2034 | 1A10 |
| Selección | 1843 1845 1847 2024 2028A2034CA2 | 10 |
| | | |
| Número total | 1978 | 10 |
| Número seleccion | 8 | 1 |

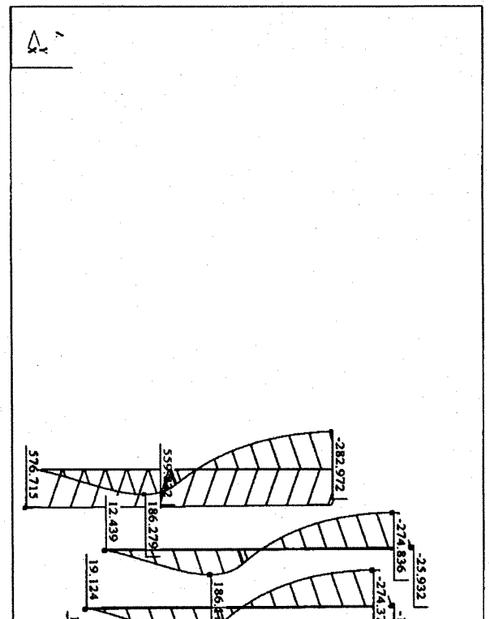
**sistema de coordenadas global - Caso: 10 (COMB3)**

| Caso/Nudo | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| | | | | | | |
| Nombre del caso | COMB3 | | | | | |
| 10 (C)/ 1843 | -0.031 | -34.447 | 575.998 | 0.000 | -0.000 | 0.0 |
| 10 (C)/ 1845 | 0.005 | -37.249 | 576.715 | 0.000 | 0.000 | 0.0 |
| 10 (C)/ 1847 | 0.041 | -34.438 | 575.832 | 0.000 | 0.0 | 0.0 |
| 10 (C)/ 2024 | -0.135 | -35.533 | 280.972 | 0.000 | 0.000 | 0.0 |
| 10 (C)/ 2028 | 0.134 | -35.525 | 280.866 | 0.000 | 0.000 | 0.0 |
| 10 (C)/ 2030 | -0.119 | -37.758 | 12.439 | 0.000 | -0.000 | 0.0 |
| 10 (C)/ 2032 | -0.006 | -37.746 | 19.124 | 0.000 | -0.000 | 0.0 |
| 10 (C)/ 2034 | 0.107 | -37.750 | 12.351 | 0.000 | 0.000 | 0.0 |
| | | | | | | |
| Caso 10 (C) | COMB3 | | | | | |
| Suma final | -0.003 | -290.446 | 2334.296 | 0.000 | -0.000 | 0.0 |
| Suma de reacciones < | -0.000 | 1394.634 | 2334.296 | 11777.064 | 1.205 | -0.844 |
| Suma de esfuerzos | 0.0 | -1394.634 | -2334.296 | -11777.064 | -1.205 | 0.844 |
| Verificación | -0.000 | 0.000 | 0.000 | -0.000 | -0.000 | -0.000 |
| Precisión: | 5.97296e-008 | 2.26993e-017 | | | | |





## Diagramas - FX;MZ; casos: 10 (COMB3)




| | FX (T) | MZ (Tm) |
|---|---|---|
| Tipo (color) de linea | | |
| Escala : (cm) = | 509.9 | 254.929 |
| MAX | 576.715 | 186.279 |
| Barra | 3 | 3 |
| Punto | x = 1.0000 | x = 0.2700 |
| Caso | 10 | 10 |
| MIN | -26.020 | -282.972 |
| Barra | 12 | 4 |
| Punto | x = 0.0000 | x = 0.0000 |
| Caso | 10 | 10 |

**PRONTUARIO INFORMÁTICO DEL HORMIGÓN ESTRUCTURAL 3.0**
**Cátedra de Hormigón Estructural ETSICCPM - IECA**

Obra: General
Fecha: 22/04/2004
Hora: 17:40:39

## Cálculo de secciones a flexión compuesta recta

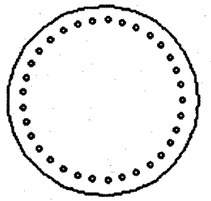
## 1 Datos

- Materiales

Tipo de hormigón : HA-25
Tipo de acero : B-500-S
fck [MPa] = 25.00
fyk [MPa] = 500.00
γc = 1.50
γs = 1.15

- Sección

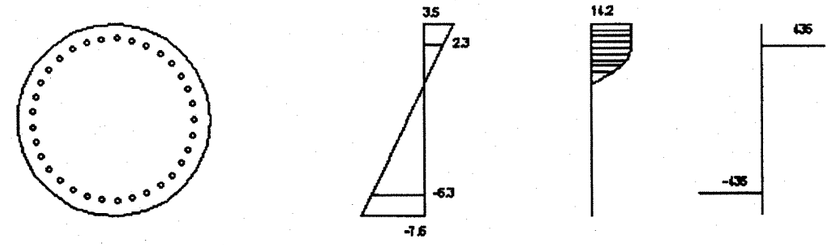
Sección : PIL125
ϕ [m] = 1.25
r [m] = 0.100
nº barras = 33



## 2 Comprobación

ϕ [mm] = 32
Nd [kN] = 0
Md [kN·m] = 4245

Nu [kN] = -0.0
Mu [kN·m] = 4751.4
γ = 1.12



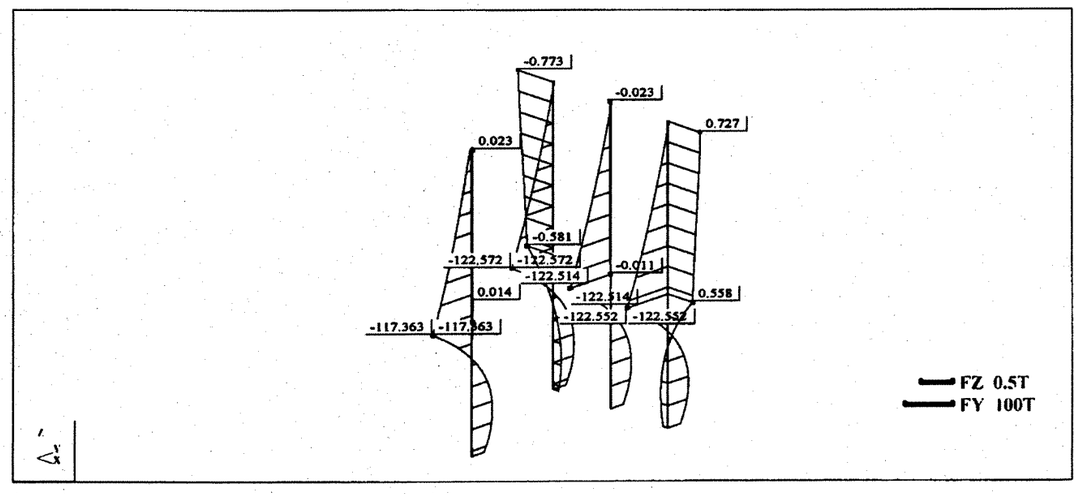

Plano de deformación de agotamiento

x [m] = 0.396
1/r [1/m]·1.E-3 = 8.8
εs ·1.E-3 = 3.5
εi ·1.E-3 = -7.6

Deformación y tensión de armaduras superior e inferior

| Profundidad [m] | Deformación ·1.E-3 | Tensión [MPa] |
|---|---|---|
| 0.139 | 2.3 | -434.8 |
| 1.111 | -6.3 | 434.8 |

## Diagramas - FY;FZ; casos: 10 (COMB3)




| | FY (T) | FZ (T) |
|---|---|---|
| Tipo (color) de línea | | |
| Escala : (cm) = | 102.0 | 0.8 |
| | | |
| MAX | 62.279 | 0.727 |
| Barra | 15 | 12 |
| Punto | x = 0.7100 | x = 0.0000 |
| Caso | 10 | 10 |
| | | |
| MIN | -122.572 | -0.773 |
| Barra | 16 | 16 |
| Punto | x = 1.0000 | x = 0.0000 |
| Caso | 10 | 10 |



## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Pilote trasero en estribo 2.**

**PILOTE EN PILA 2**

| | |
|---|---|
| D(mm) | 1150 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 680 |
| As(cm2) | 88 |
| Vrd(Tn) | 184.00 |
| N(Tn) | 0 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.417 |
| Roele | 0.0113 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 404425.6 |

[redacted]

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 337021.35 |
| Vsu,p | 414000.00 |

[redacted]

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 12272 |
| Sigmacd (N/mm2) | 0 |
| K | 1 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 3910000 |

**Verificada la resistencia del alma a la compresión**

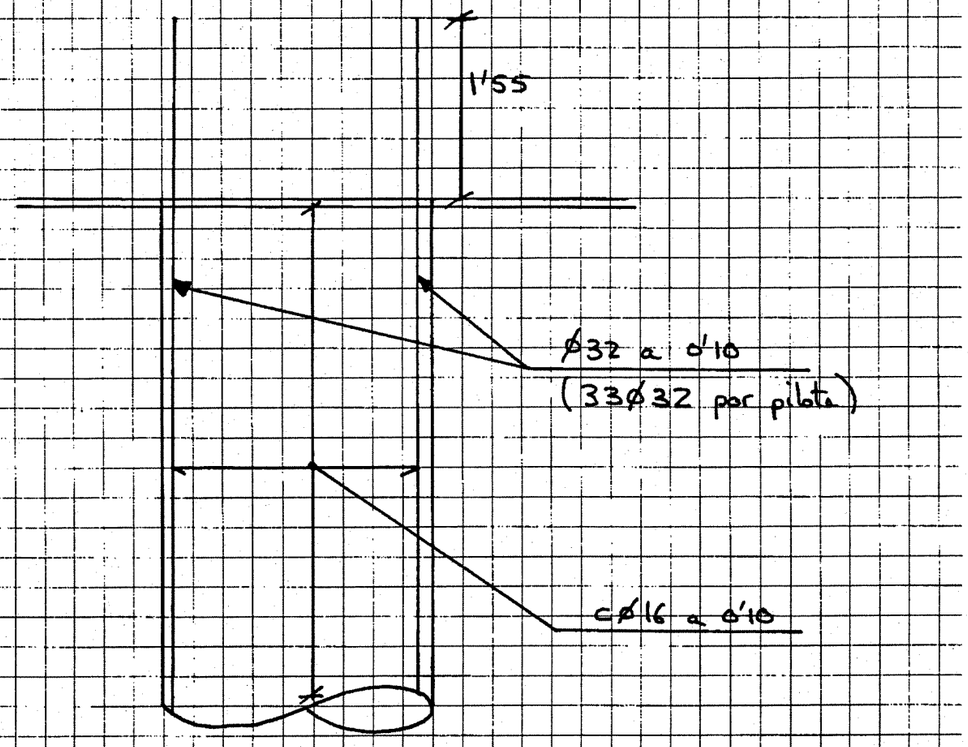
**CÁLCULO DE LA ARMADURA MÍNIMA DE CORTANTE**

α (en grados) = 90 As, c mín. (cm2/m) = [redacted]

**PEDELTA**
INGENIERIA CIVIL

FECHA HOJA

# ESQUEMA DE ARMADO DE UN PILOTE




Recubrimiento nominal = 70 mm.

# CÁLCULO ALETA en MURO del ESTRIBO 1 del VIADUCTO sobre VÍAS de ANCHO IBÉRICO (P-M)

LÍNEA DE ALTA VELOCIDAD
MADRID-ZARAGOZA- BARCELONA-
FRONTERA FRANCESA.

TRAMO: CASTELLBISBAL-PAPIOL

**Junio 2004**

PEDELTA
INGENIERÍA CIVIL



ANEJO DE CÁLCULO
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**2 ALETA VOLADA**
- 2.1 MODELO DE CÁLCULO Y ESFUERZOS
- 2.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

**3 MURO TIPO I**
- 3.1 MODELO DE CÁLCULO Y ESFUERZOS
- 3.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

**4 MURO TIPO II**
- 4.1 MODELO DE CÁLCULO Y ESFUERZOS
- 4.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

**5 MURO TIPO III**
- 5.1 MODELO DE CÁLCULO Y ESFUERZOS
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**6 MURO TIPO IV**
- 6.1 MODELO DE CÁLCULO Y ESFUERZOS
- 6.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

**7 MURO TIPO V**
- 7.1 MODELO DE CÁLCULO Y ESFUERZOS
- 7.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

**8 MURO TIPO VI**
- 8.1 MODELO DE CÁLCULO Y ESFUERZOS
- 8.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

# 1 INTRODUCCIÓN Y GEOMETRÍA

En la presente memoria se adjunta el cálculo de la aleta del estribo 1 del viaducto sobre vías de ancho ibérico, vía Puerto-Martorell, correspondiente al proyecto de la Línea de Alta Velocidad Madrid-Zaragoza-Barcelona-Frontera Francesa, tramo Castellbisbal-Papiol.

En el proyecto original la aleta está planteada como un muro con cimentación superficial. La motivación de los presentes cálculos aparece al no poderse ejecutar la solución original debido a la proximidad de una línea de ferrocarril existente. Es necesario retirar las vías existentes para poder ejecutar la zapata. Es por ello que se plantea una solución de muro pantalla.

Por indicación de la UTE Castellbisbal-Papiol, para reducir la longitud de pantalla necesaria, se ha dimensionado el muro con una bandeja trasera. Con ésta se compensa el momento flector producido por el empuje activo.

En la figura 1 se puede ver la geometría del muro pantalla objeto de cálculo. La nomenclatura expuesta en la figura es la que se usará a lo largo de los cálculos.

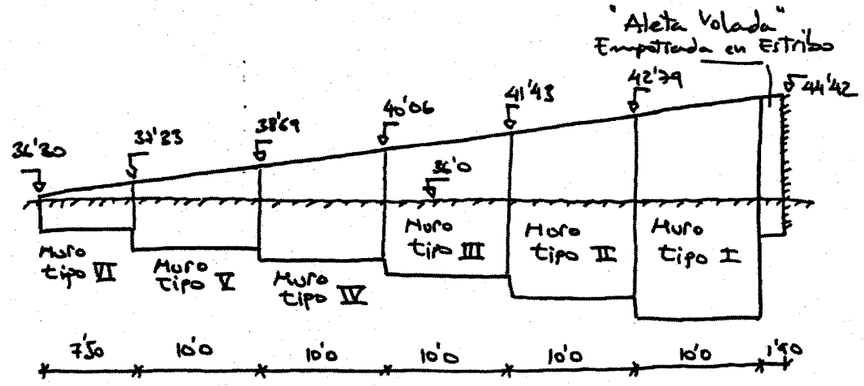



Figura 1: Geometría del muro objeto de cálculo

En las páginas adjuntas se puede ver una sección transversal de cada uno de los muros tipo.

Para obtener los valores de los empujes activos y pasivos se han tomado los datos geotécnicos del proyecto original. Se ha considerado un único terreno con las siguientes características:

| | |
|---|---|
| Densidad: | 2,00 T/m$^3$ |
| Angulo roz: | 30,0º |
| Cohesión: | 0,00 T/m$^2$ |

A más de los empujes, se ha considerado también una carga repartida en el trasdós de 3,0 T/m$^2$. Carga indicada en la normativa vigente (IPF) a aplicar en el trasdós de muros de ferrocarril.

El cálculo de la aleta volada se ha realizado mediante un modelo de elementos finitos. Con éste se han obtenido los esfuerzos que solicitan a la sección y, a partir de estos, se ha armado la aleta siguiendo las disposiciones indicadas en la normativa vigente EHE.

El cálculo de cada uno de los muros tipo se ha realizado mediante un modelo de barras en el que se ha ido variando la longitud de la bandeja hasta obtener momento nulo en la base de la pantalla (condición de estabilidad del muro). Con los esfuerzos obtenidos del modelo de cálculo se ha procedido a dimensionar el muro, siguiendo las especificaciones indicadas en la normativa vigente (EHE).

En los siguientes apartados se incluye, para cada muro tipo, una descripción del modelo de cálculo, los esfuerzos obtenidos con el modelo y, finalmente, las verificaciones seccionales realizadas sobre la estructura. Finalmente se adjunta un croquis con el armado tipo.

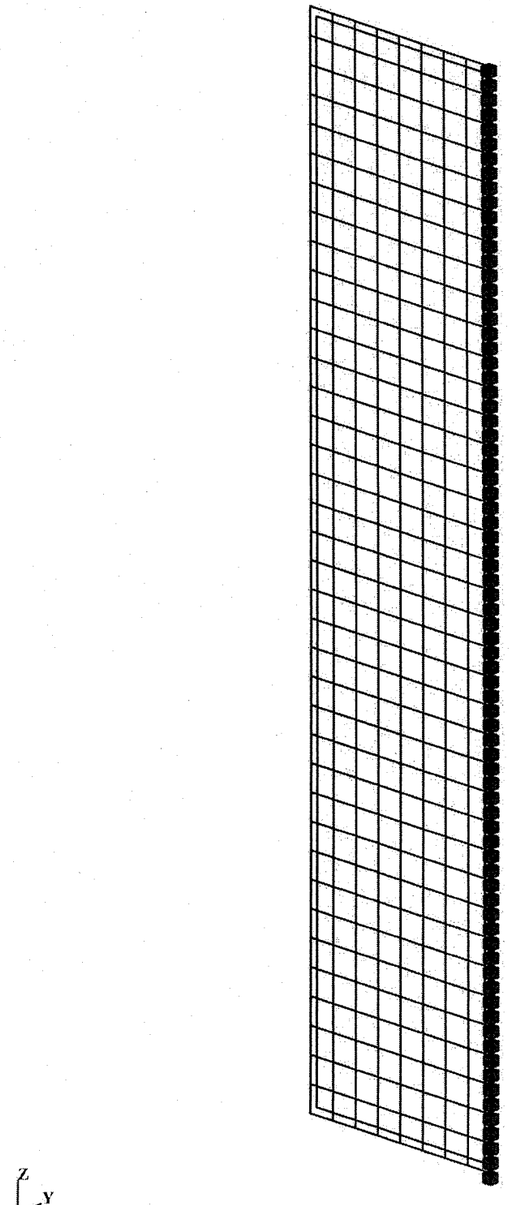
Barcelona, 14 de Junio de 2004

# 2 ALETA VOLADA

## 2.1 MODELO DE CÁLCULO Y ESFUERZOS



### Modelo de Cálculo



## Paneles que Componen la Estructura

| Panel | Espesor | Material | Tipo de malla | Superficie (m2) | Espesor (m) |
|---|---|---|---|---|---|
| 1 | ALETA | HORMIGON | Coons | 16.948 | 0.300 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Empotrado | 2 3 20A94 | UX UY UZ RX RY RZ |

## Cargas Aplicadas a la Estructura

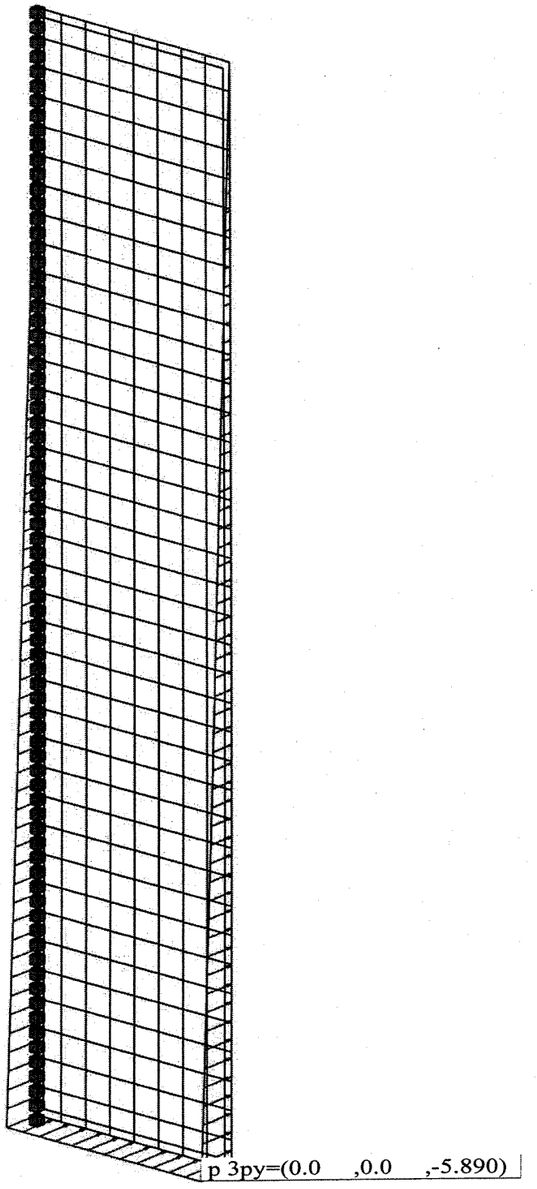
| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1 | PZ Menos Coef=1.0000 |
| 2 | Empuje Tierras | (EF) superficial 3p | 1 | PY3=-5.890(T/m2) N1X=0.0(m) N1Y=0.0(m) N1Z=8.920(m) N2X=1.900(m) N2Y=0.0(m) N2Z=8.920(m) N3X=1.900(m) N3Y=0.0(m) N3Z=0.0(m) |
| 3 | Sobrecarga | (EF) uniforme | 1 | PY=-1.000(T/m2) |

## Combinación de Acciones

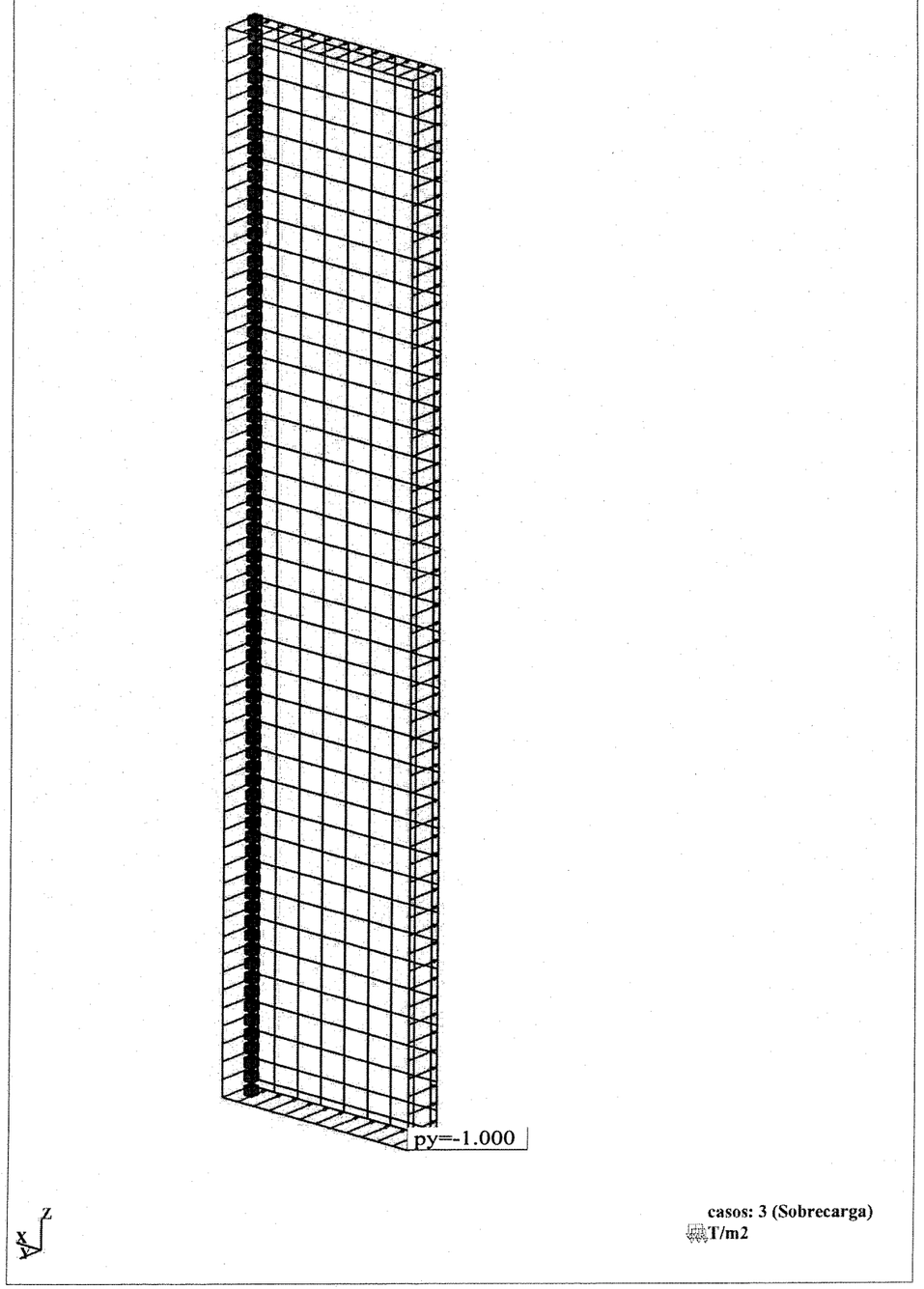
| Combinación | Nombre | Definición |
|---|---|---|
| 4 (C) | ELS | (1+2+3)*1.0000 |
| 5 (C) | ELU | (1+2)*1.3500+3*1.5000 |

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## Cargas Aplicadas: Empuje de Tierras

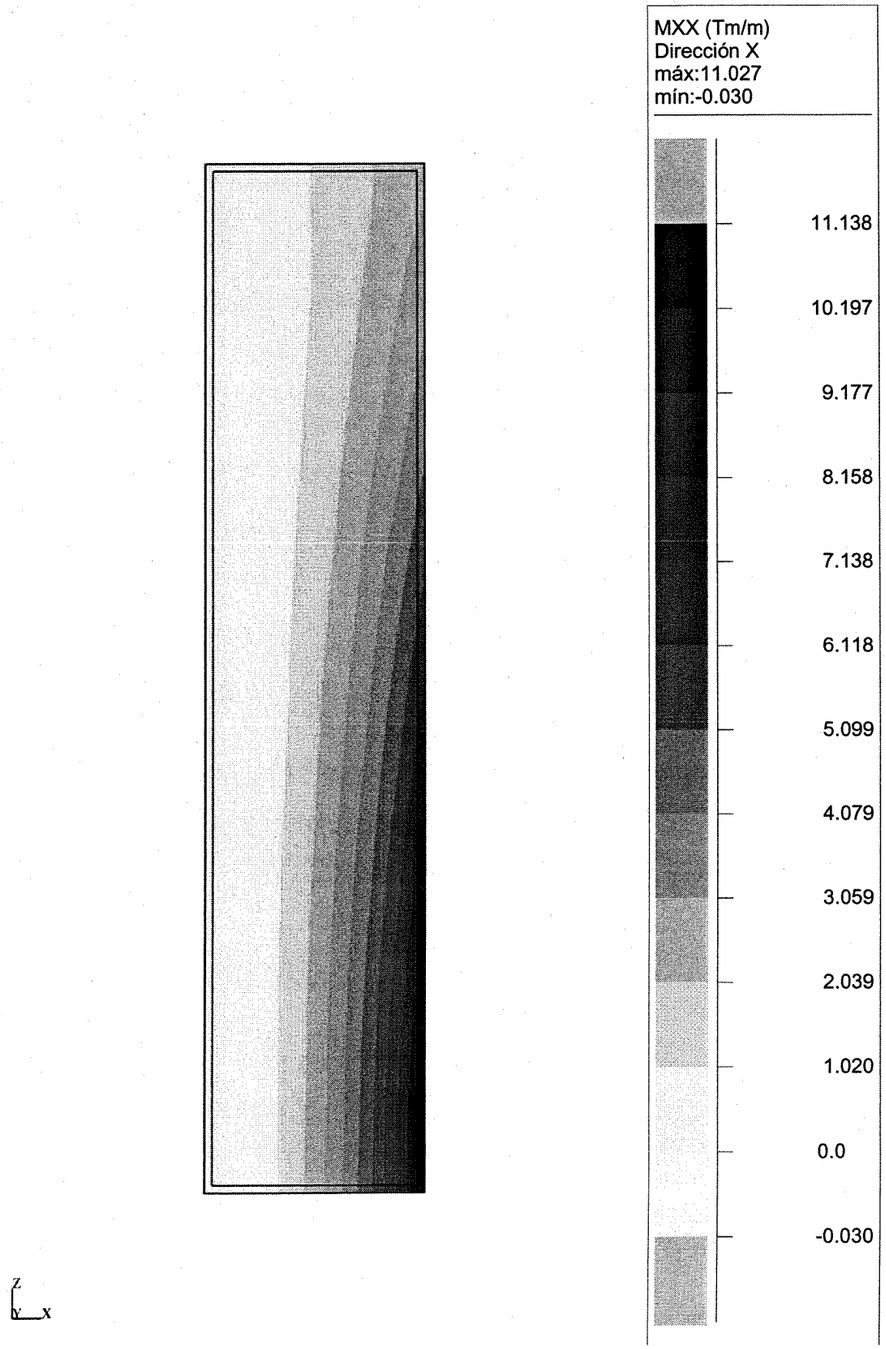


## Cargas Aplicadas: Sobrecargas

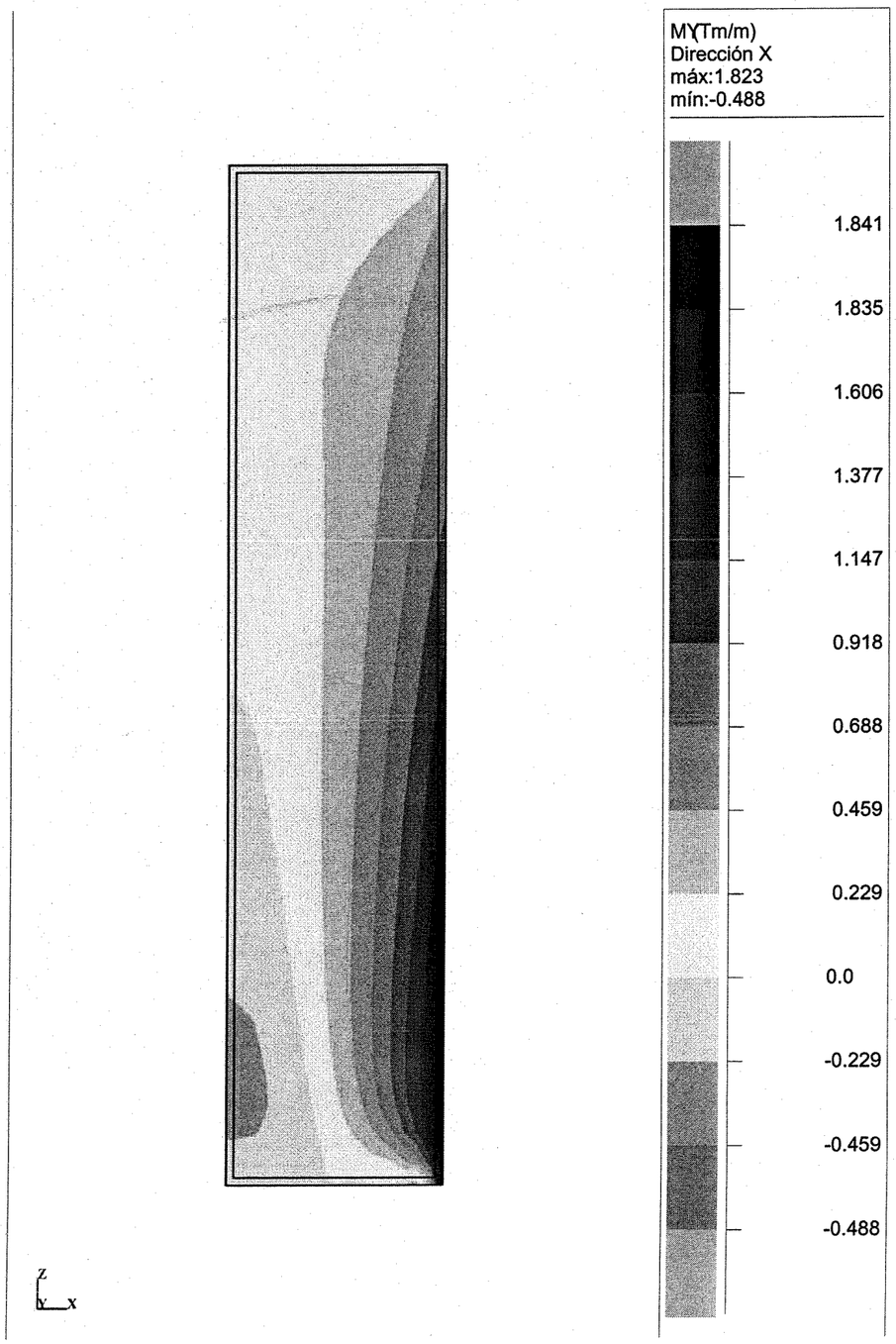





## Momento Horizontal en Aleta - ELS

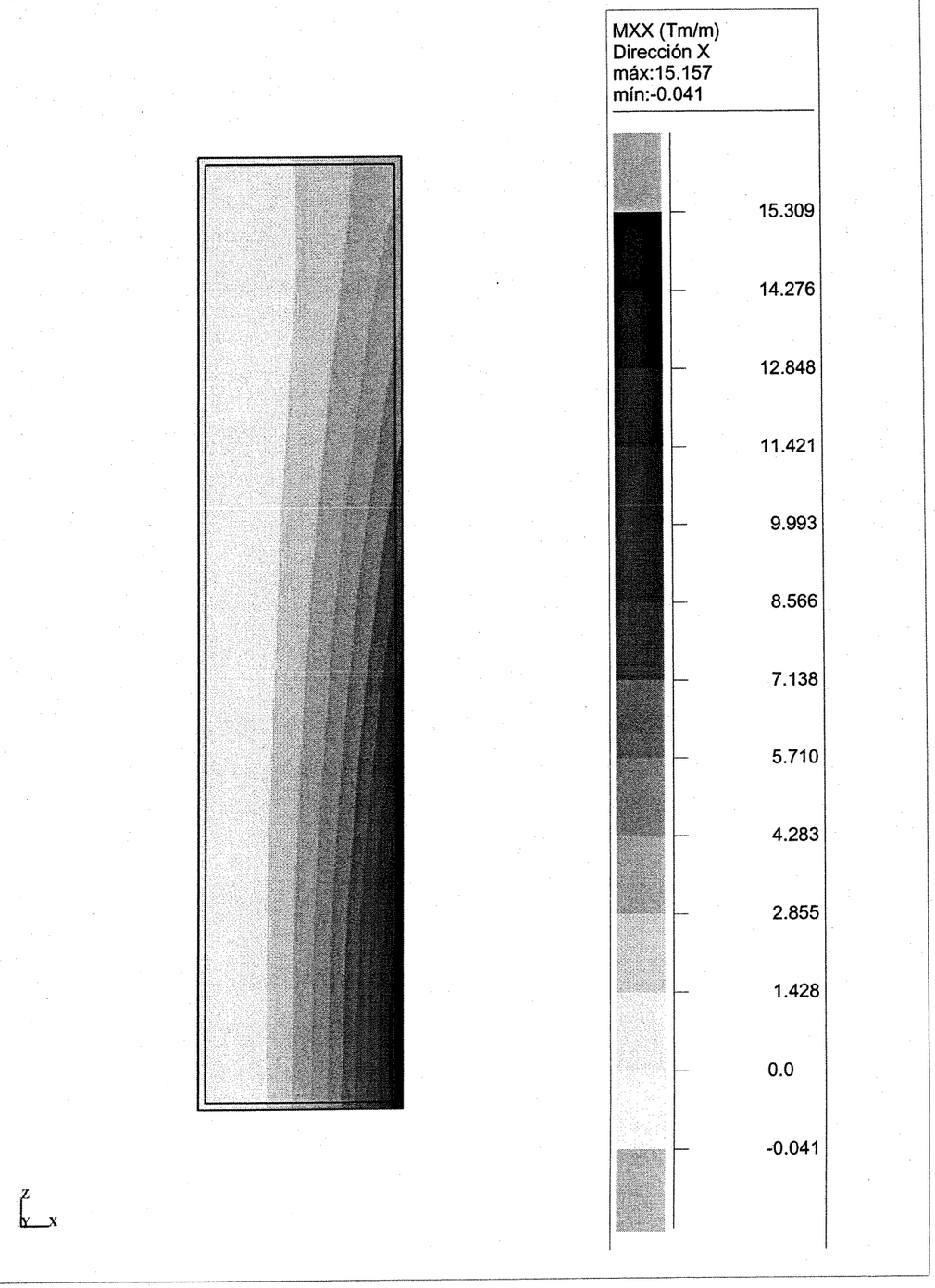


## Momento Vertical en Aleta - ELS

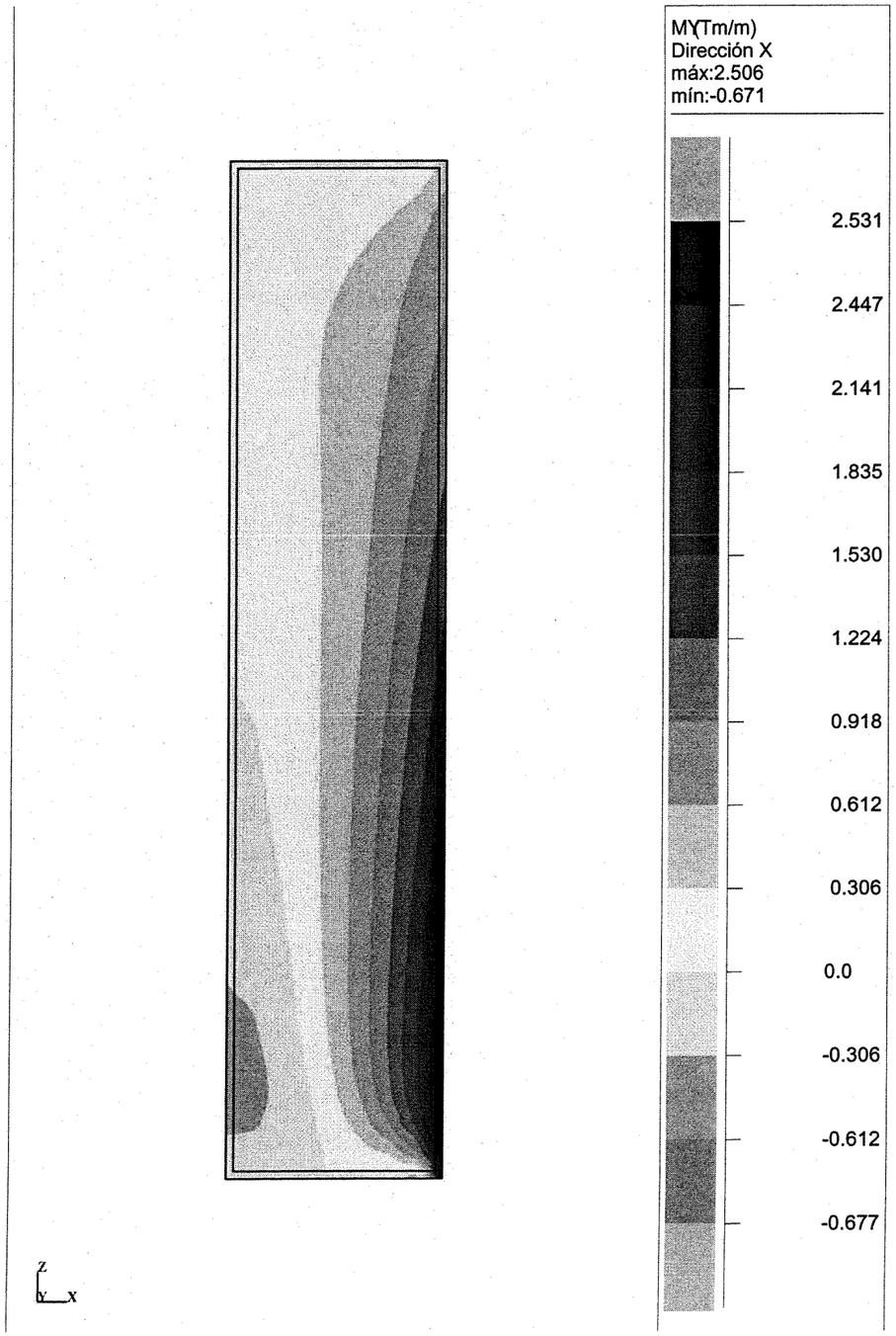



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## Momento Horizontal en Aleta - ELU

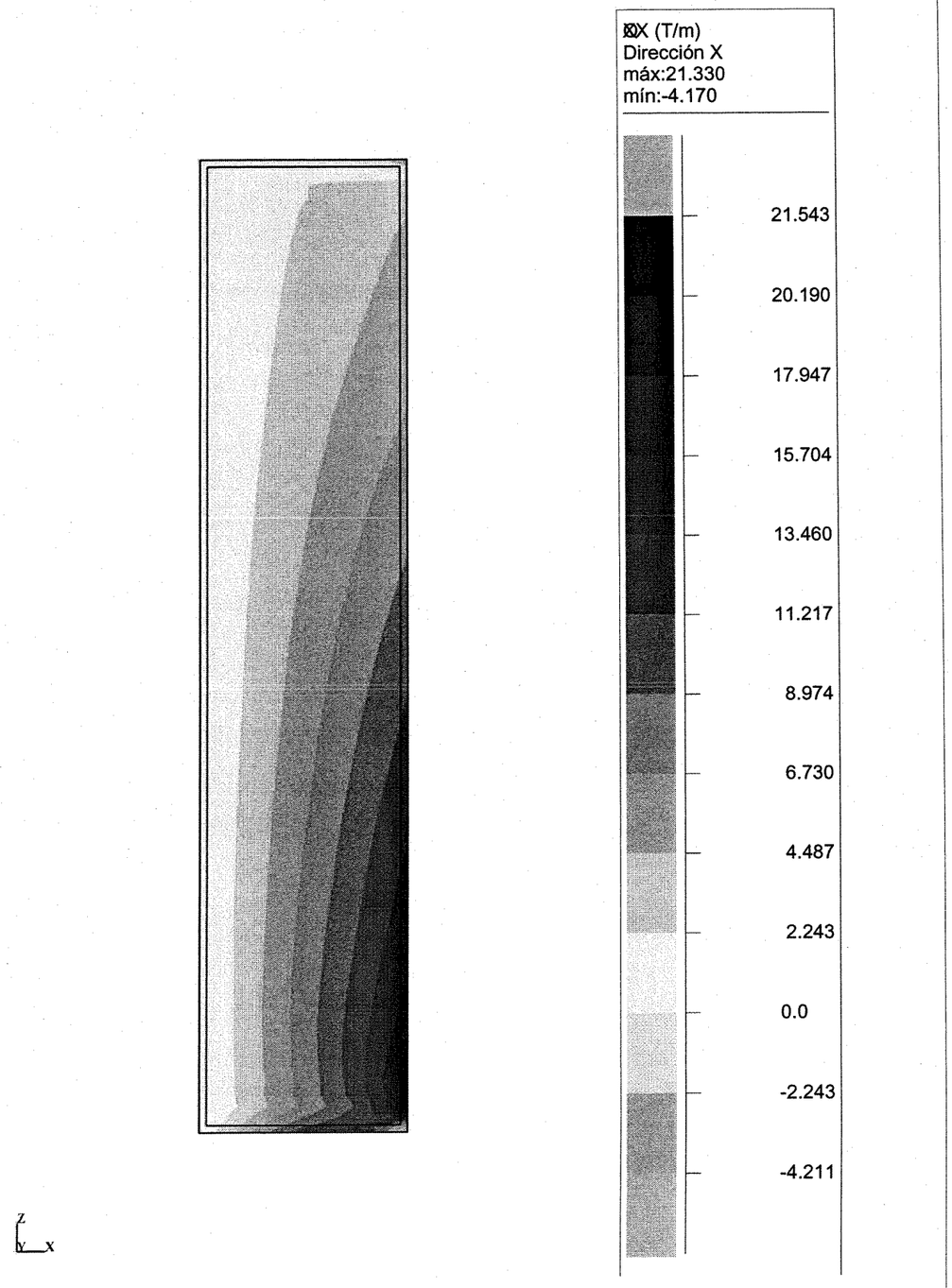


## Momento Vertical en Aleta - ELU

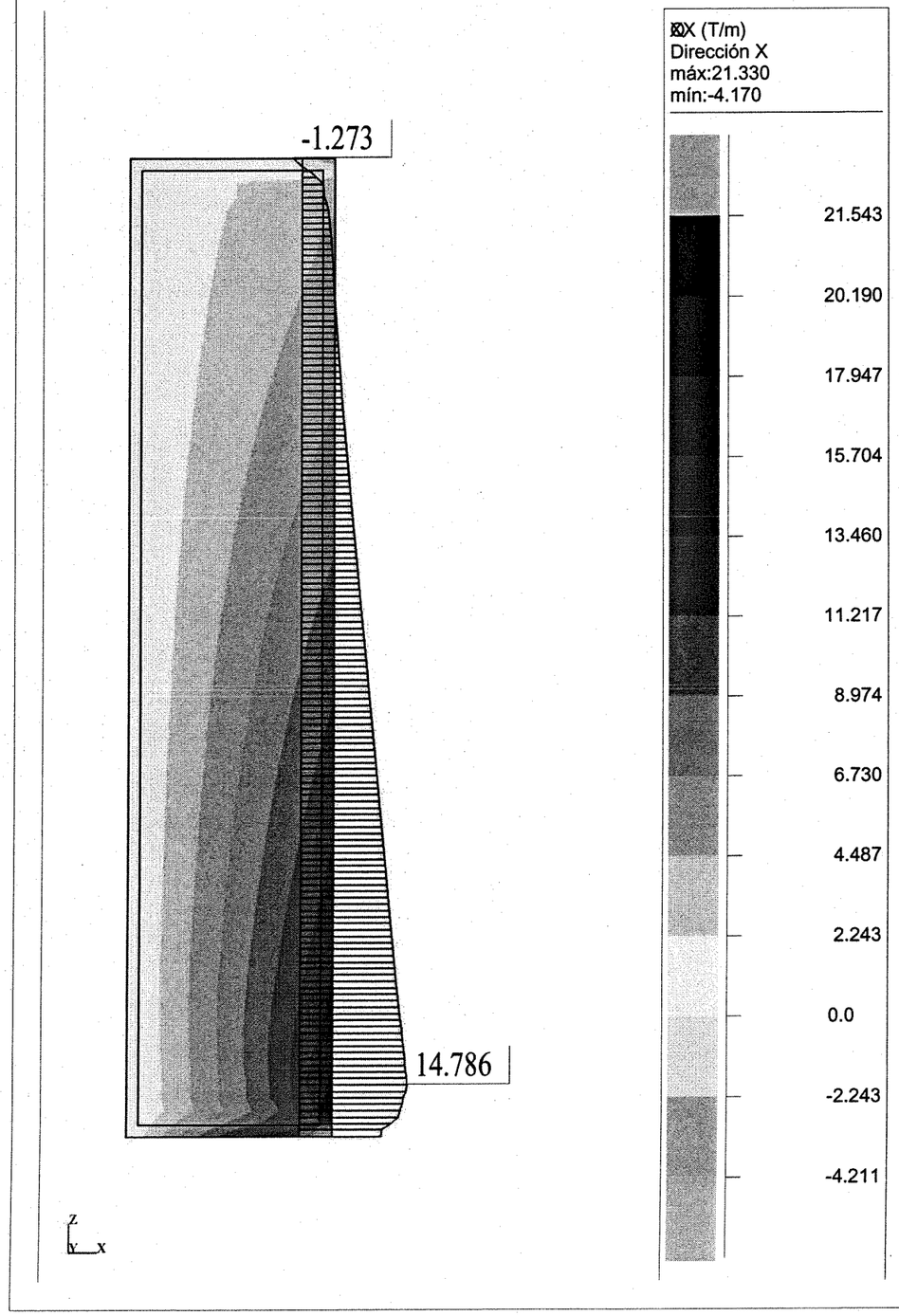



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## Cortante Horizontal en Aleta - ELU



**Esfuerzo Cortante Horizontal a un Canto Útil**




## 2.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Aleta Volada - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: Aleta Volada**

Tipo de elemento Muros

| | |
|---|---|
| Momento flector [Tm] | 15.31 |
| Axil [T] (COMPRESIÓN POSITIVA) | 0.00 |
| Ancho =B [cm] | 100.0 |
| Canto =H [cm] | 30.0 |
| Recubrimiento [cm] | 5.0 |
| fcd [kp/cm2] | 166.7 |
| fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **4.78** |
| **ARMADURA NECESARIA(cm2)** | **15.57** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **2.70** |
| **Cuantía Mínima Horizontal (cm2)** | **9.60** |

Arm Vert:cuantía mínima cara tracción. Arm Horiz:2/3 en cara vista

**Se dispondrá una barra Ø20 cada 0,15m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Aleta Volada - Estribo 1 - Pérgola**

**Aleta Volada**

| | |
|---|---|
| D(mm) | 250 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 18.85 |
| Vrd(Tn) | 14.79 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.894 |
| Roele | 0.0075 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 151252.6 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 126043.87 |
| Vsu,p | 90000.00 |

***As,c =*** ***0.0*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 3000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 1250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Aleta Volada - Estribo 1 - Pérgola**

**Aleta Volada**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 30.00 |
| Arm. Tracción | As1 | cm2 | 18.85 |
| Canto útil | d | cm | 25.00 |
| Arm. Compresión | As2 | cm2 | 12.06 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 3000 |
| Area sec. Homog. | Ah | cm2 | 3238.08 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 15.16 |
| Inercia sec. Homog. | Ih | cm4 | 248723.81 |

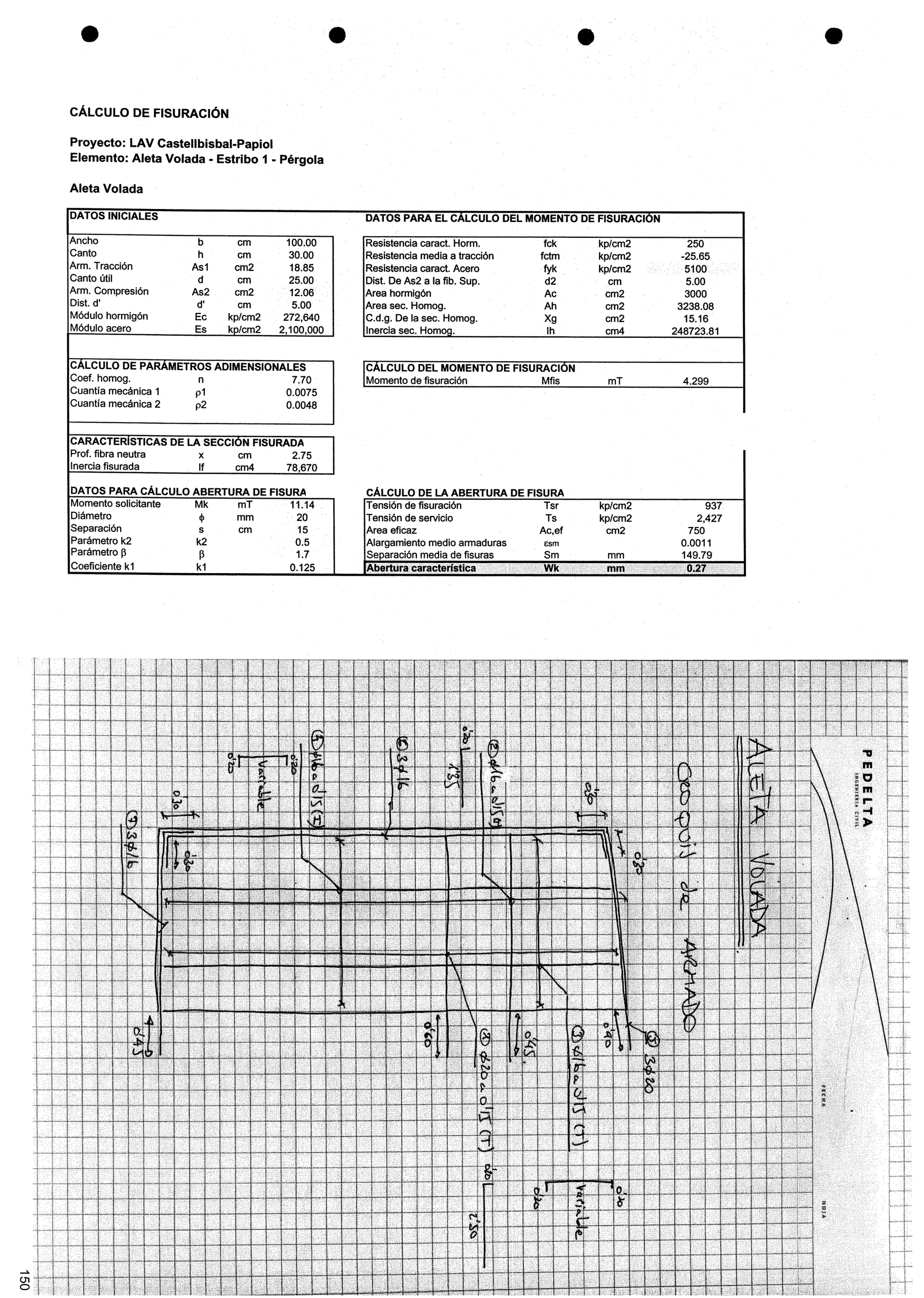
| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | | |
|---|---|---|---|
| Coef. homog. | n | | 7.70 |
| Cuantía mecánica 1 | ρ1 | | 0.0075 |
| Cuantía mecánica 2 | ρ2 | | 0.0048 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 4.299 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 2.75 |
| Inercia fisurada | If | cm4 | 78,670 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 11.14 |
| Diámetro | ϕ | mm | 20 |
| Separación | s | cm | 15 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 937 |
| Tensión de servicio | Ts | kp/cm2 | 2,427 |
| Area eficaz | Ac,ef | cm2 | 750 |
| Alargamiento medio armaduras | εsm | | 0.0011 |
| Separación media de fisuras | Sm | mm | 149.79 |
| **Abertura característica** | **Wk** | **mm** | **0.27** |

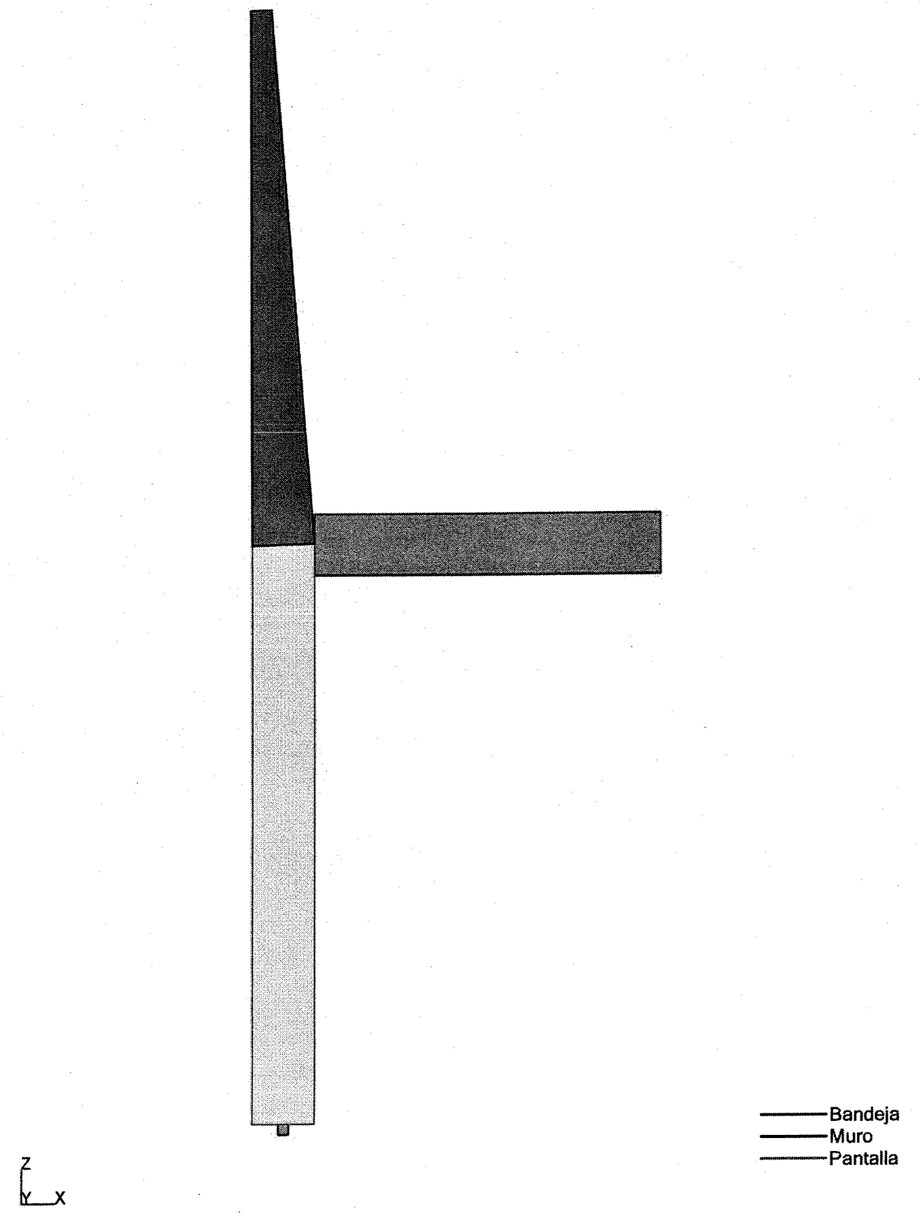


# 3 MURO TIPO I

## 3.1 MODELO DE CÁLCULO Y ESFUERZOS



### Modelo de Cálculo



## Nudos que Componen la Estructura

| Nudo | X (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | | |
| 2 | -0.300 | 7.710 | | |
| 3 | 5.450 | 0.0 | | |
| 4 | 0.450 | 0.0 | | |
| 5 | 0.0 | -8.450 | fff | Apoyo |

## Barras que Componen la Estructura

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) |
|---|---|---|---|---|---|
| 1 | 1 | 2 | Muro | HORMIGON | 7.716 |
| 2 | 5 | 1 | Pantalla | HORM | 8.450 |
| 3 | 4 | 3 | Bandeja | HORM | 5.000 |

## Características de las Barras que Componen la Estructura

| Nombre de la sección | Lista de barras | BB (m) | HH (m) | SX (m2) | SY (m2) | SZ (m2) | IX (m4) | IY (m4) | IZ (m4) |
|---|---|---|---|---|---|---|---|---|---|
| Bandeja | 3 | 1.00 | 0.90 | 0.900 | 0.750 | 0.750 | 0.11329 | 0.06075 | 0.07500 |
| Muro | 1 | 1.00 | 0.90 | 0.600 | 0.500 | 0.500 | 0.04506 | 0.01800 | 0.05000 |
| Pantalla | 2 | 1.00 | 0.90 | 0.900 | 0.750 | 0.750 | 0.11329 | 0.06075 | 0.07500 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Apoyo | 5 | UX UZ RY |

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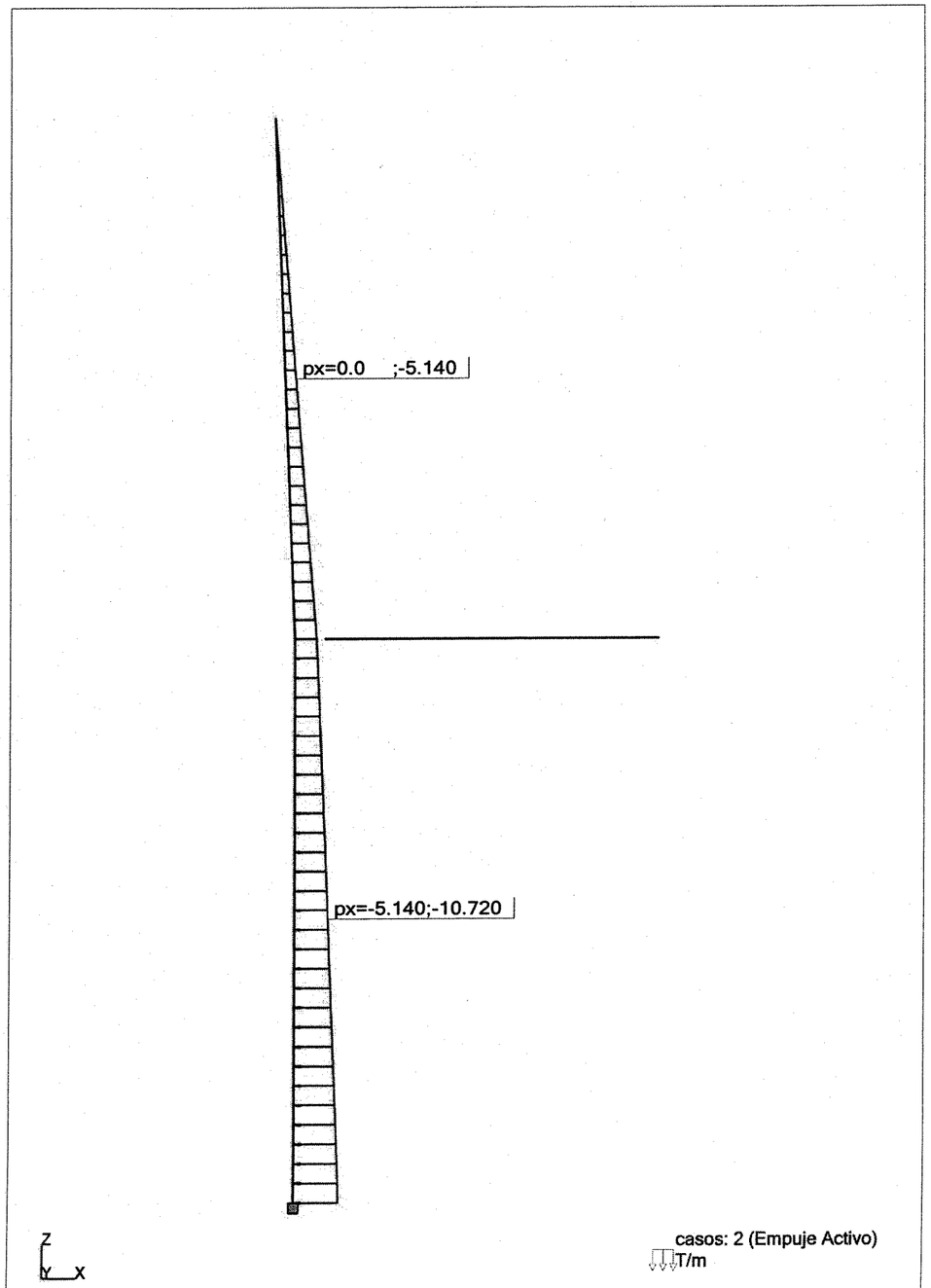
## Cargas Aplicadas a la Estructura

| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1A3 | PZ Menos Coef=1.0000 |
| 2 | Empuje Activo | carga trapezoidal | 1 | PX2=0.0(T/m) PX1=-5.140(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 2 | Empuje Activo | carga trapezoidal | 2 | PX2=-5.140(T/m) PX1=-10.720(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 3 | Empuje Pasivo | carga trapezoidal | 2 | PX2=0.0(T/m) PX1=32.000(T/m) X2=8.000(m) X1=0.0(m) global no proyectadas absolutos |
| 4 | Empuje Sobrecarga | sobrecarga uniforme | 1 2 | PX=-1.083(T/m) |
| 5 | Peso en Bandeja Terreno | sobrecarga uniforme | 3 | PZ=-14.680(T/m) |
| 6 | Peso en Bandeja Sobrecarga | sobrecarga uniforme | 3 | PZ=-3.000(T/m) |

## Combinación de Acciones

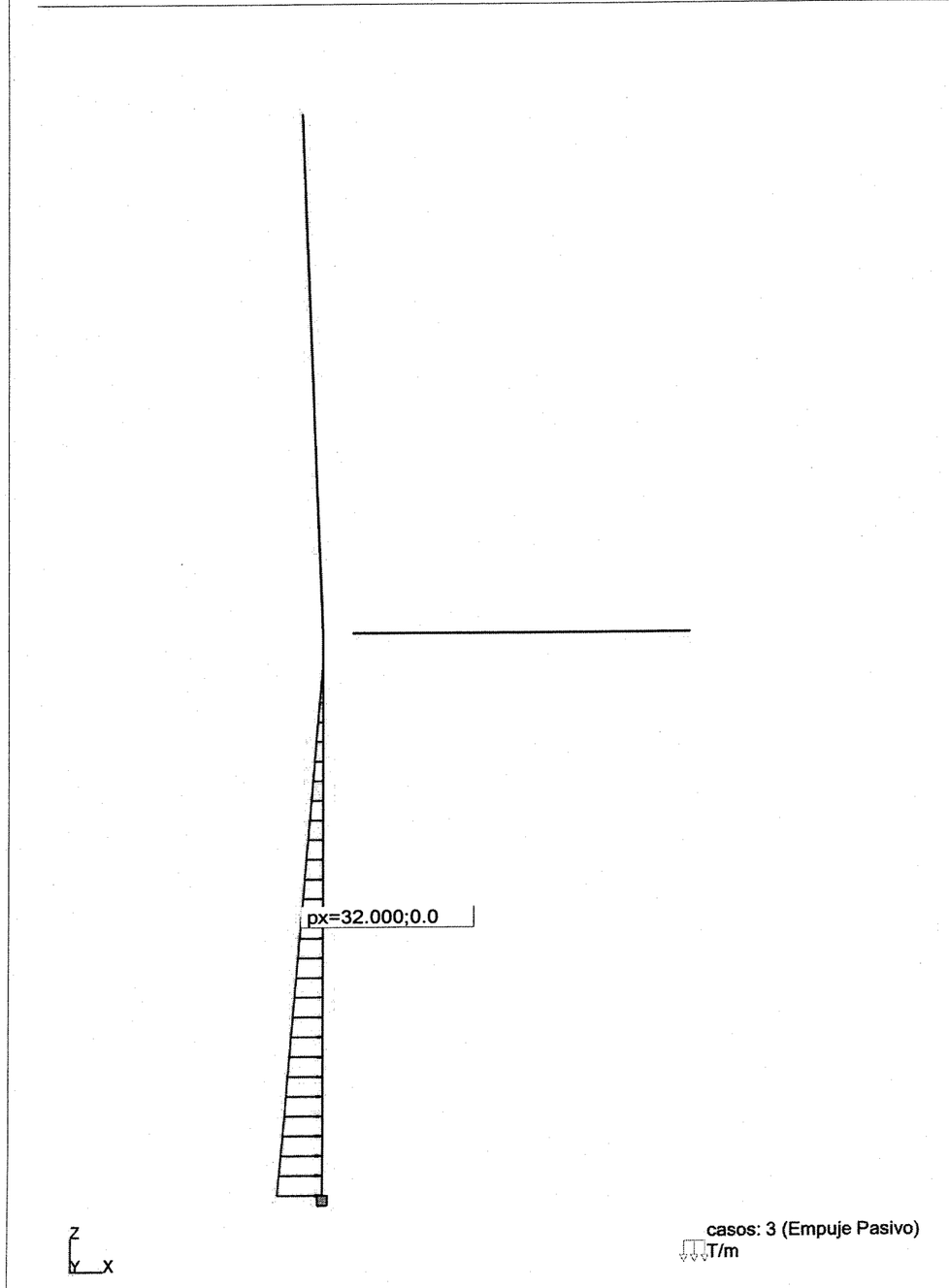
| Combinación | Nombre | Definición |
|---|---|---|
| 11 (C) | ELS (Terreno) | (1+2+3+5)*1.0000 |
| 12 (C) | ELS (Terreno+Sobrecarga) | (1+2+3+4+5+6)*1.0000 |
| 21 (C) | ELU (Terreno) | (1+2+3+5)*1.3500 |
| 22 (C) | ELU (Terreno+Sobrecarga) | (1+2+3+5)*1.3500+(4+6)*1.5000 |

## Cargas Aplicadas: Empuje Activo

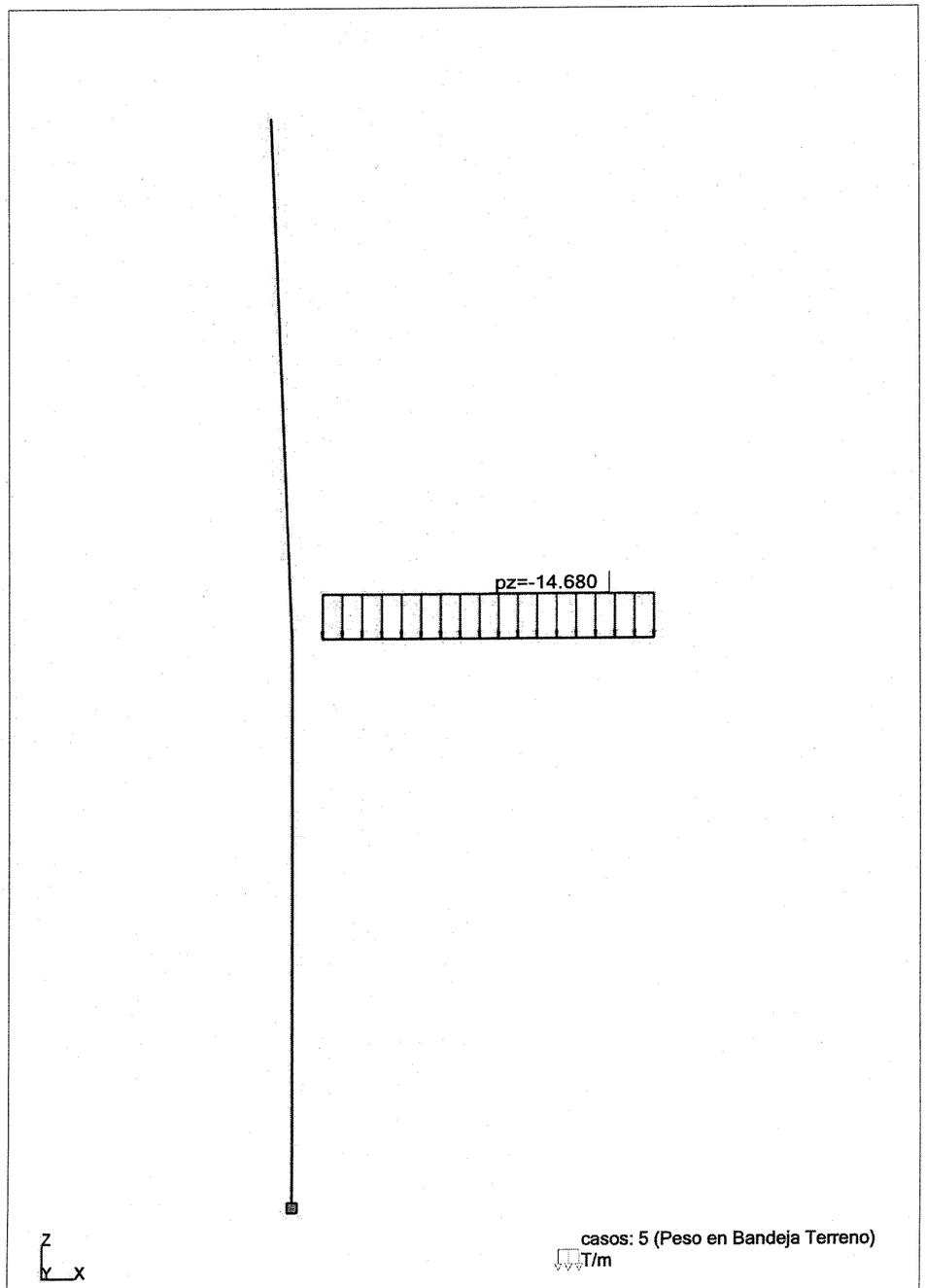



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## Cargas Aplicadas: Empuje Pasivo

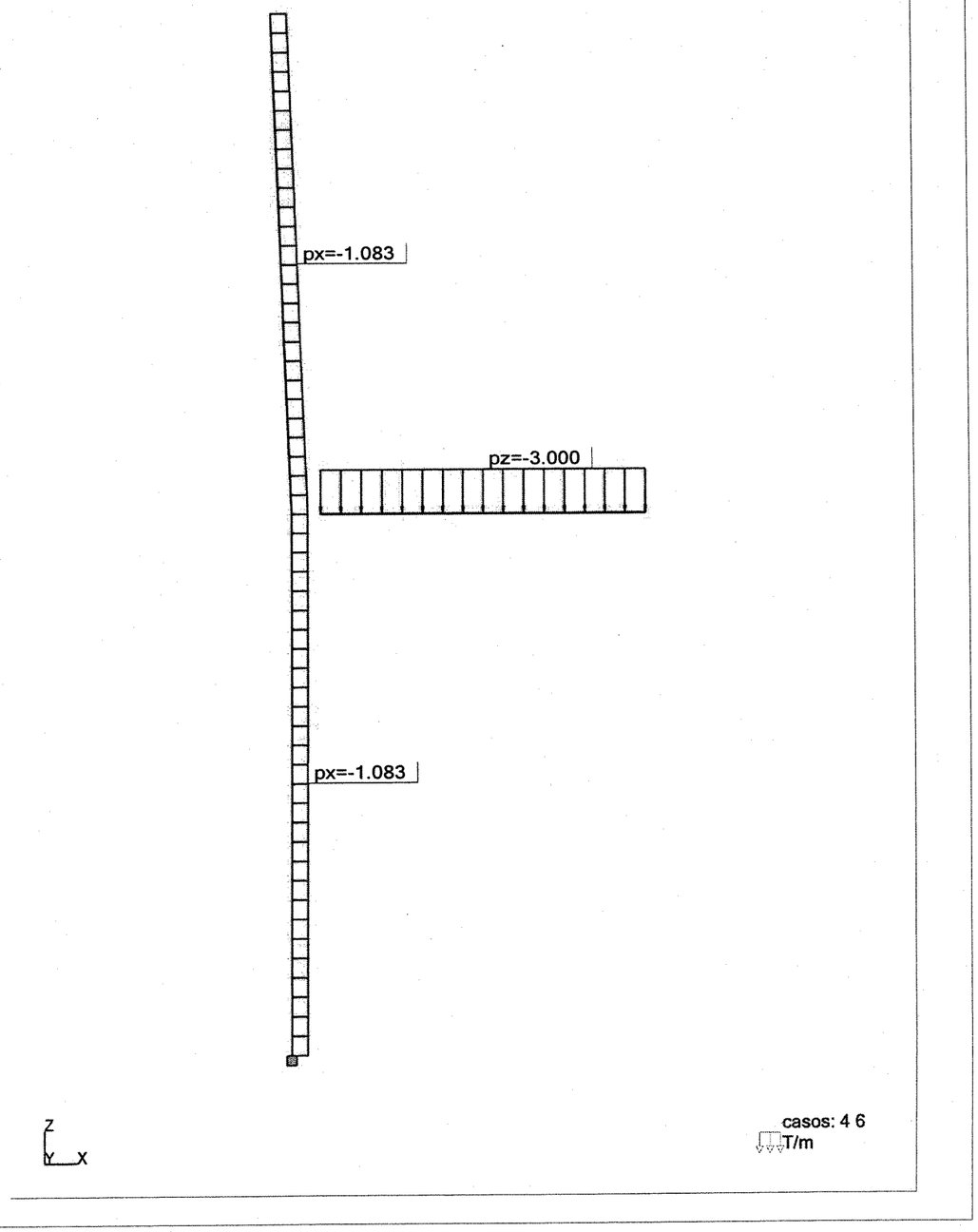


## Cargas Aplicadas: Peso Terreno en Bandeja

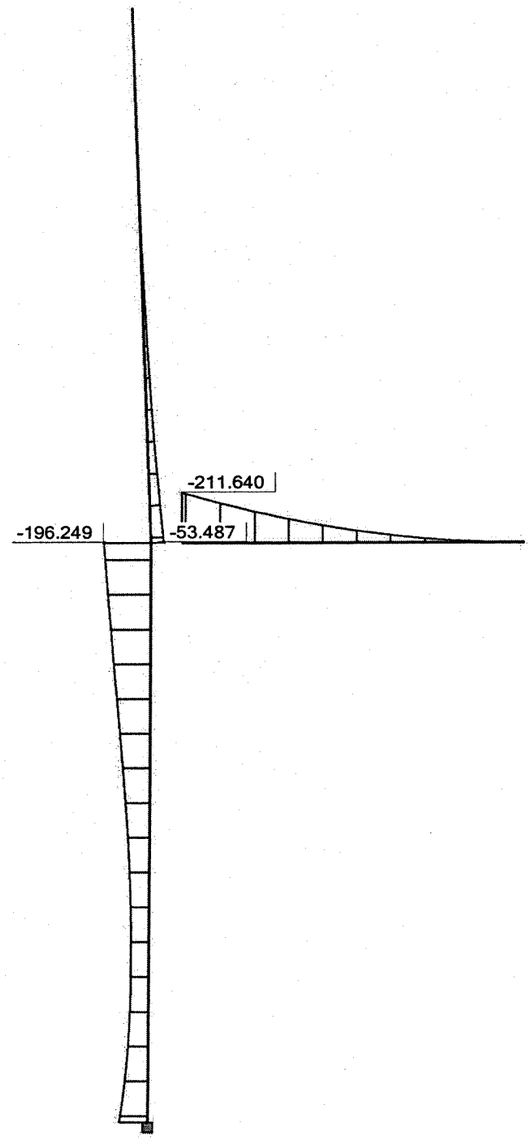



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## Cargas Aplicadas: Sobrecargas

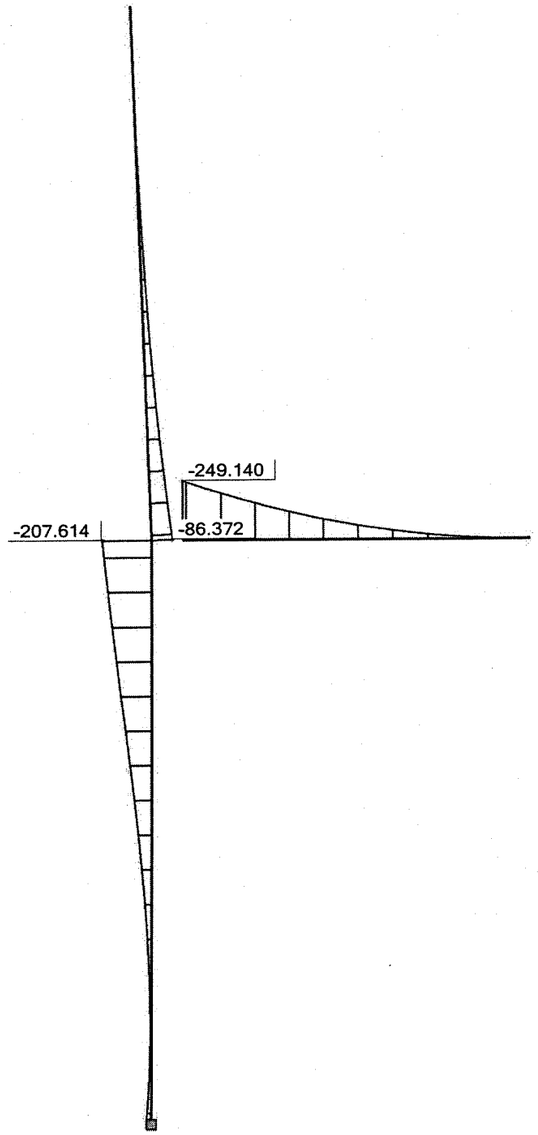


## Momentos Flectores - ELS Terreno

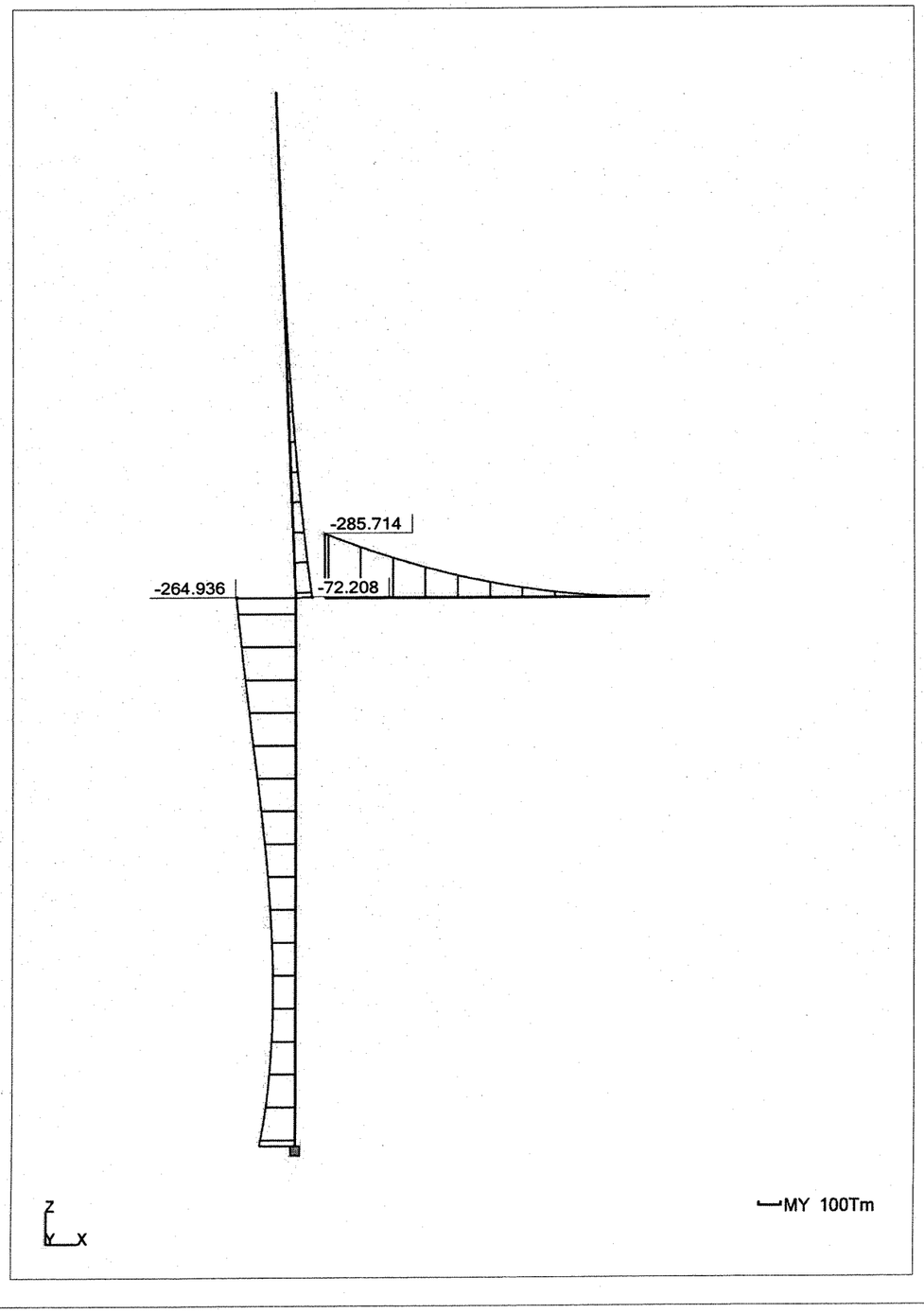



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## Momentos Flectores - ELS Terreno+Sobrecarga

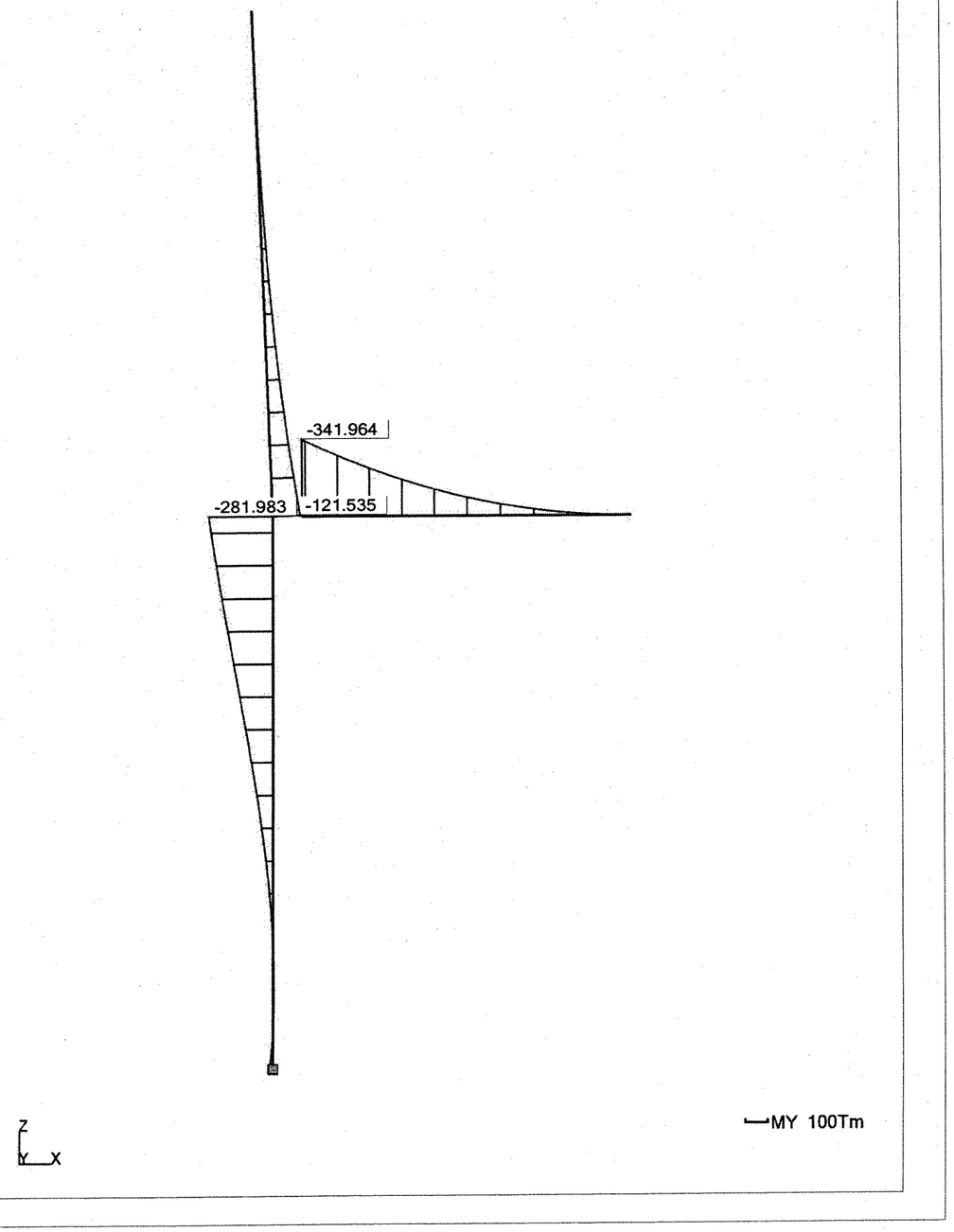


## Momentos Flectores - ELU Terreno

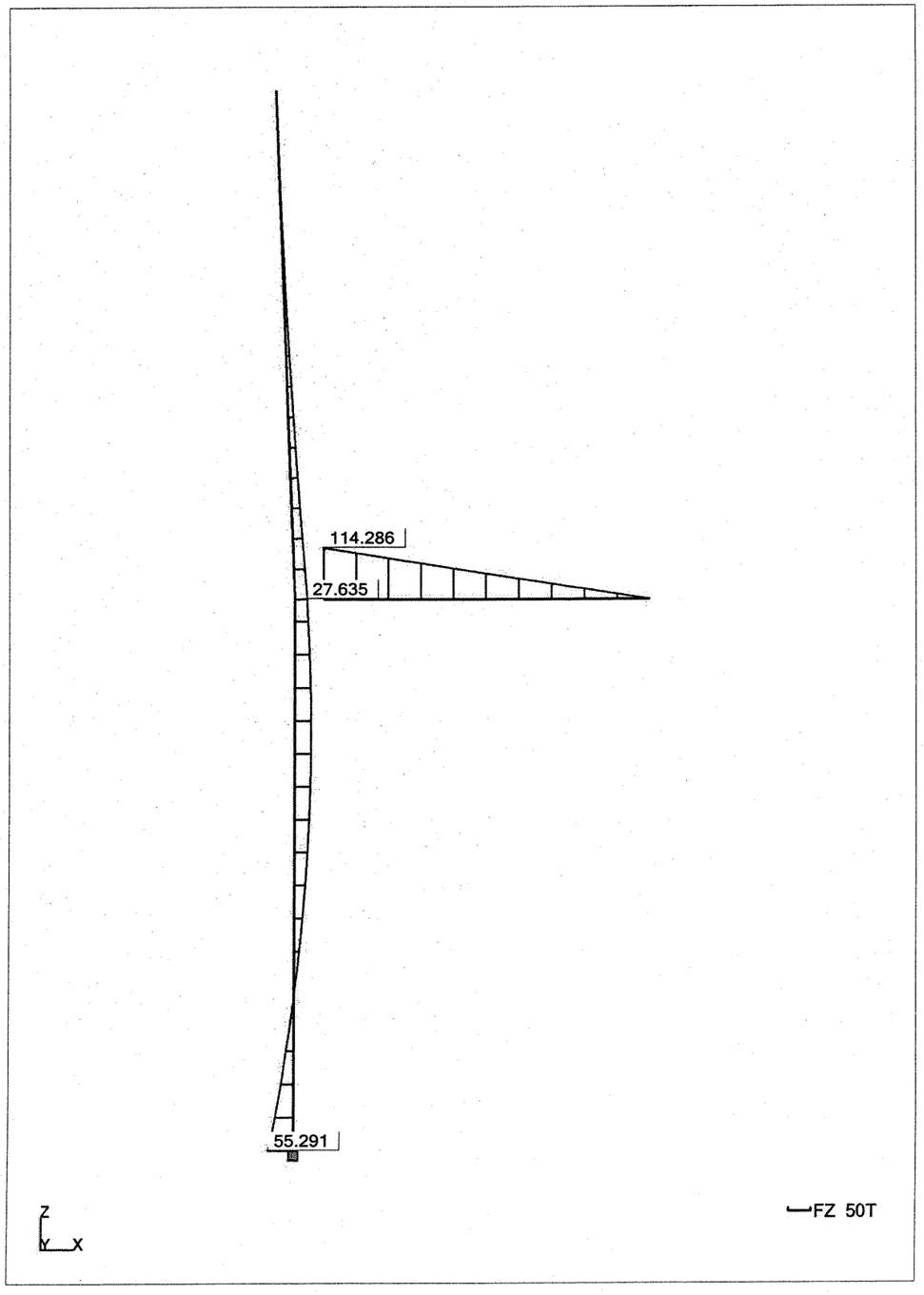



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## Momentos Flectores - ELU Terreno+Sobrecarga

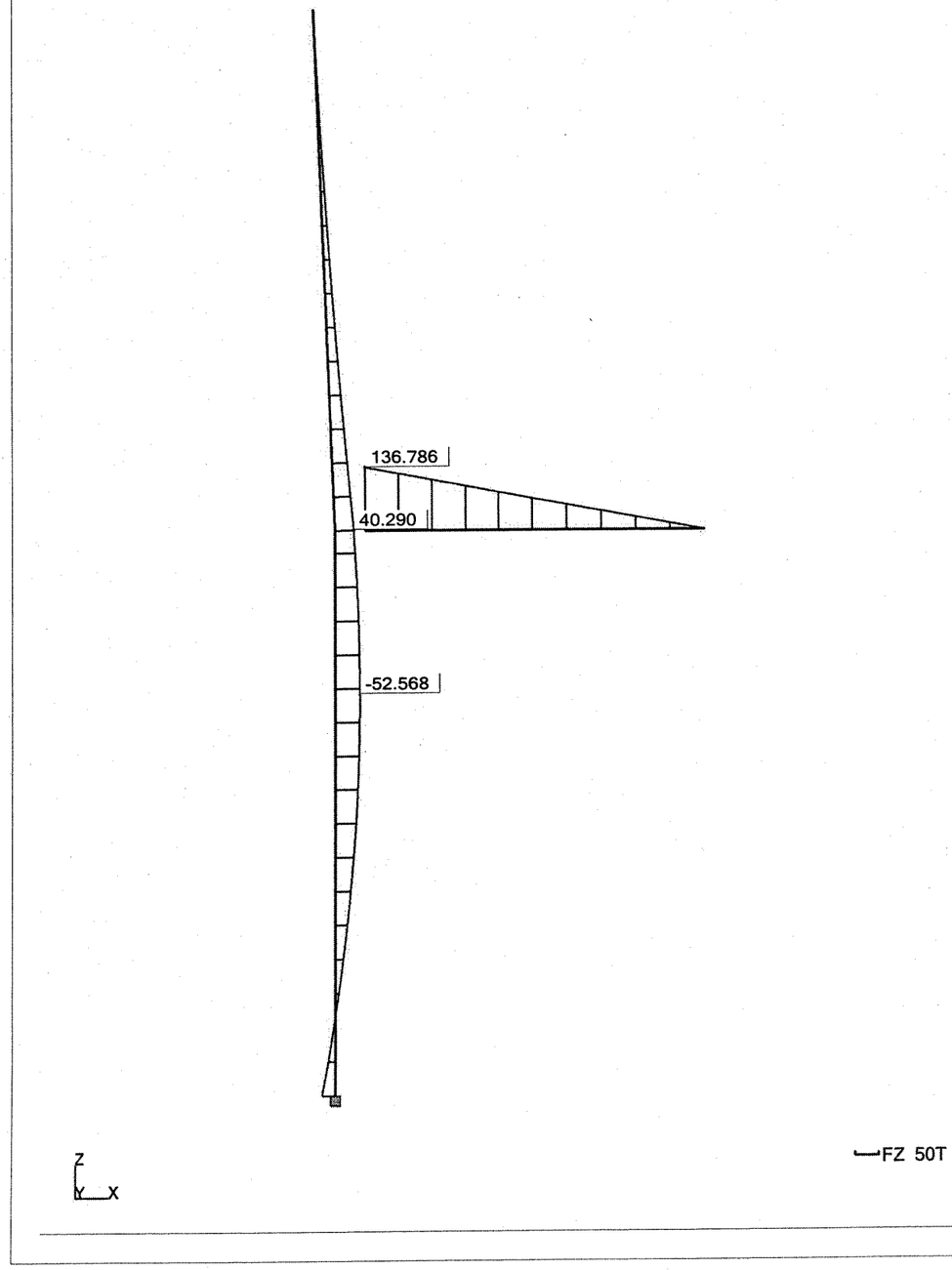


## Esfuerzos Cortantes - ELU Terreno




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## Esfuerzos Cortantes - ELU Terreno+Sobrecarga



## Esfuerzos en Muro

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 1/ 1** | 10.920 | 20.471 | -53.487 |
| **11 (C)/ 1/ 2/10** | 9.206 | 16.196 | -37.643 |
| **11 (C)/ 1/ 3/10** | 7.617 | 12.422 | -25.284 |
| **11 (C)/ 1/ 4/10** | 6.153 | 9.148 | -15.978 |
| **11 (C)/ 1/ 5/10** | 4.814 | 6.374 | -9.292 |
| **11 (C)/ 1/ 6/10** | 3.600 | 4.099 | -4.792 |
| **11 (C)/ 1/ 7/10** | 2.512 | 2.325 | -2.046 |
| **11 (C)/ 1/ 8/10** | 1.550 | 1.050 | -0.621 |
| **11 (C)/ 1/ 9/10** | 0.712 | 0.275 | -0.083 |
| **11 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 1/ 1** | 10.595 | 28.907 | -86.372 |
| **12 (C)/ 1/ 2/10** | 8.917 | 23.696 | -63.626 |
| **12 (C)/ 1/ 3/10** | 7.364 | 18.984 | -45.177 |
| **12 (C)/ 1/ 4/10** | 5.936 | 14.772 | -30.593 |
| **12 (C)/ 1/ 5/10** | 4.633 | 11.061 | -19.441 |
| **12 (C)/ 1/ 6/10** | 3.456 | 7.849 | -11.288 |
| **12 (C)/ 1/ 7/10** | 2.404 | 5.137 | -5.700 |
| **12 (C)/ 1/ 8/10** | 1.477 | 2.925 | -2.245 |
| **12 (C)/ 1/ 9/10** | 0.676 | 1.212 | -0.489 |
| **12 (C)/ 1/ 2** | -0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 1/ 1** | 14.743 | 27.635 | -72.208 |
| **21 (C)/ 1/ 2/10** | 12.428 | 21.865 | -50.818 |
| **21 (C)/ 1/ 3/10** | 10.282 | 16.770 | -34.133 |
| **21 (C)/ 1/ 4/10** | 8.306 | 12.350 | -21.570 |
| **21 (C)/ 1/ 5/10** | 6.499 | 8.604 | -12.544 |
| **21 (C)/ 1/ 6/10** | 4.861 | 5.534 | -6.469 |
| **21 (C)/ 1/ 7/10** | 3.392 | 3.138 | -2.762 |
| **21 (C)/ 1/ 8/10** | 2.092 | 1.417 | -0.838 |
| **21 (C)/ 1/ 9/10** | 0.961 | 0.371 | -0.112 |
| **21 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 1/ 1** | 14.255 | 40.290 | -121.535 |
| **22 (C)/ 1/ 2/10** | 11.995 | 33.114 | -89.792 |
| **22 (C)/ 1/ 3/10** | 9.903 | 26.613 | -63.973 |
| **22 (C)/ 1/ 4/10** | 7.981 | 20.786 | -43.494 |
| **22 (C)/ 1/ 5/10** | 6.228 | 15.635 | -27.768 |
| **22 (C)/ 1/ 6/10** | 4.644 | 11.158 | -16.213 |
| **22 (C)/ 1/ 7/10** | 3.229 | 7.356 | -8.243 |
| **22 (C)/ 1/ 8/10** | 1.984 | 4.229 | -3.274 |
| **22 (C)/ 1/ 9/10** | 0.907 | 1.777 | -0.721 |
| **22 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |

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## Esfuerzos en Pantalla

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 2/ 5** | 115.379 | 40.956 | -118.376 |
| **11 (C)/ 2/ 2/10** | 113.265 | 22.449 | -88.841 |
| **11 (C)/ 2/ 3/10** | 111.152 | 6.885 | -75.301 |
| **11 (C)/ 2/ 4/10** | 109.038 | -5.735 | -74.991 |
| **11 (C)/ 2/ 5/10** | 106.924 | -15.410 | -85.148 |
| **11 (C)/ 2/ 6/10** | 104.811 | -22.142 | -103.007 |
| **11 (C)/ 2/ 7/10** | 102.697 | -25.930 | -125.805 |
| **11 (C)/ 2/ 8/10** | 100.583 | -26.774 | -150.777 |
| **11 (C)/ 2/ 9/10** | 98.470 | -24.674 | -175.159 |
| **11 (C)/ 2/ 1** | 96.356 | -20.035 | -196.249 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 2/ 5** | 130.379 | 23.362 | -19.735 |
| **12 (C)/ 2/ 2/10** | 128.265 | 5.871 | -6.242 |
| **12 (C)/ 2/ 3/10** | 126.152 | -8.675 | -7.788 |
| **12 (C)/ 2/ 4/10** | 124.038 | -20.278 | -21.611 |
| **12 (C)/ 2/ 5/10** | 121.924 | -28.937 | -44.945 |
| **12 (C)/ 2/ 6/10** | 119.811 | -34.652 | -75.027 |
| **12 (C)/ 2/ 7/10** | 117.697 | -37.423 | -109.093 |
| **12 (C)/ 2/ 8/10** | 115.583 | -37.250 | -144.379 |
| **12 (C)/ 2/ 9/10** | 113.470 | -34.134 | -178.120 |
| **12 (C)/ 2/ 1** | 111.356 | -28.478 | -207.614 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 2/ 5** | 155.762 | 55.291 | -159.808 |
| **21 (C)/ 2/ 2/10** | 152.908 | 30.306 | -119.936 |
| **21 (C)/ 2/ 3/10** | 150.055 | 9.295 | -101.656 |
| **21 (C)/ 2/ 4/10** | 147.201 | -7.742 | -101.238 |
| **21 (C)/ 2/ 5/10** | 144.348 | -20.804 | -114.950 |
| **21 (C)/ 2/ 6/10** | 141.495 | -29.892 | -139.060 |
| **21 (C)/ 2/ 7/10** | 138.641 | -35.006 | -169.836 |
| **21 (C)/ 2/ 8/10** | 135.788 | -36.145 | -203.549 |
| **21 (C)/ 2/ 9/10** | 132.934 | -33.310 | -236.465 |
| **21 (C)/ 2/ 1** | 130.081 | -27.047 | -264.936 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 2/ 5** | 178.262 | 28.900 | -11.846 |
| **22 (C)/ 2/ 2/10** | 175.408 | 5.440 | 3.963 |
| **22 (C)/ 2/ 3/10** | 172.555 | -14.046 | -0.388 |
| **22 (C)/ 2/ 4/10** | 169.701 | -29.557 | -21.168 |
| **22 (C)/ 2/ 5/10** | 166.848 | -41.094 | -54.646 |
| **22 (C)/ 2/ 6/10** | 163.995 | -48.657 | -97.090 |
| **22 (C)/ 2/ 7/10** | 161.141 | -52.246 | -144.769 |
| **22 (C)/ 2/ 8/10** | 158.288 | -51.860 | -193.952 |
| **22 (C)/ 2/ 9/10** | 155.434 | -47.499 | -240.906 |
| **22 (C)/ 2/ 1** | 152.581 | -39.712 | -281.983 |

## Esfuerzos en Bandeja

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 3/ 4** | 0.000 | 84.656 | -211.640 |
| **11 (C)/ 3/ 2/10** | 0.000 | 75.250 | -167.222 |
| **11 (C)/ 3/ 3/10** | 0.000 | 65.844 | -128.029 |
| **11 (C)/ 3/ 4/10** | 0.000 | 56.437 | -94.062 |
| **11 (C)/ 3/ 5/10** | 0.000 | 47.031 | -65.321 |
| **11 (C)/ 3/ 6/10** | 0.000 | 37.625 | -41.805 |
| **11 (C)/ 3/ 7/10** | 0.000 | 28.219 | -23.516 |
| **11 (C)/ 3/ 8/10** | 0.000 | 18.812 | -10.451 |
| **11 (C)/ 3/ 9/10** | 0.000 | 9.406 | -2.613 |
| **11 (C)/ 3/ 3** | 0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 3/ 4** | 0.0 | 99.656 | -249.140 |
| **12 (C)/ 3/ 2/10** | 0.0 | 88.583 | -196.852 |
| **12 (C)/ 3/ 3/10** | 0.0 | 77.510 | -150.715 |
| **12 (C)/ 3/ 4/10** | 0.0 | 66.437 | -110.729 |
| **12 (C)/ 3/ 5/10** | 0.0 | 55.365 | -76.895 |
| **12 (C)/ 3/ 6/10** | 0.0 | 44.292 | -49.213 |
| **12 (C)/ 3/ 7/10** | 0.0 | 33.219 | -27.682 |
| **12 (C)/ 3/ 8/10** | 0.0 | 22.146 | -12.303 |
| **12 (C)/ 3/ 9/10** | 0.0 | 11.073 | -3.076 |
| **12 (C)/ 3/ 3** | 0.0 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 3/ 4** | 0.000 | 114.286 | -285.714 |
| **21 (C)/ 3/ 2/10** | 0.000 | 101.587 | -225.750 |
| **21 (C)/ 3/ 3/10** | 0.000 | 88.889 | -172.840 |
| **21 (C)/ 3/ 4/10** | 0.000 | 76.191 | -126.984 |
| **21 (C)/ 3/ 5/10** | 0.000 | 63.492 | -88.183 |
| **21 (C)/ 3/ 6/10** | 0.000 | 50.794 | -56.437 |
| **21 (C)/ 3/ 7/10** | 0.000 | 38.095 | -31.746 |
| **21 (C)/ 3/ 8/10** | 0.000 | 25.397 | -14.109 |
| **21 (C)/ 3/ 9/10** | 0.000 | 12.698 | -3.527 |
| **21 (C)/ 3/ 3** | 0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 3/ 4** | -0.000 | 136.786 | -341.964 |
| **22 (C)/ 3/ 2/10** | -0.000 | 121.587 | -270.194 |
| **22 (C)/ 3/ 3/10** | -0.000 | 106.389 | -206.867 |
| **22 (C)/ 3/ 4/10** | -0.000 | 91.191 | -151.984 |
| **22 (C)/ 3/ 5/10** | -0.000 | 75.992 | -105.545 |
| **22 (C)/ 3/ 6/10** | -0.000 | 60.794 | -67.549 |
| **22 (C)/ 3/ 7/10** | -0.000 | 45.595 | -37.996 |
| **22 (C)/ 3/ 8/10** | -0.000 | 30.397 | -16.887 |
| **22 (C)/ 3/ 9/10** | -0.000 | 15.198 | -4.222 |
| **22 (C)/ 3/ 3** | -0.000 | -0.000 | -0.000 |

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## Reacciones en Apoyo

| Nudo/Caso | Nombre del caso | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|---|
| **5/ 11 (C)** | ELS (Terreno) | -40.956 | 115.379 | -118.376 |
| **5/ 12 (C)** | ELS (Terreno+Sobrecarga) | -23.362 | 130.379 | -19.735 |
| **5/ 21 (C)** | ELU (Terreno) | -55.291 | 155.762 | -159.808 |
| **5/ 22 (C)** | ELU (Terreno+Sobrecarga) | -28.900 | 178.262 | -11.846 |

La estabilidad del muro se obtiene cuando los empujes pasivos son capaces de compensar los empujes activos. Para que se de este criterio, el momento de reacción en el apoyo de la pantalla deba ser cero.

En caso de tener un momento negativo, éste nos indica que el momento producido por los empujes pasivos es mayor que el producido por los empujes activos y, por tanto, la pantalla es capaz de generar mecanismos resistentes.

En las reacciones adjuntas se puede ver que los momentos en el apoyo de pantalla son siempre menores o iguales a cero. De este modo, podemos asegurar la estabilidad de la pantalla.

## 3.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: MURO**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 121.54 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 90.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **10.78** |
| **ARMADURA NECESARIA(cm2)** | **35.11** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **8.10** |
| **Cuantía Mínima Horizontal (cm2)** | **28.80** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø25 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**MURO**

| | |
|---|---|
| D(mm) | 850 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 39.27 |
| Vrd(Tn) | 33.11 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.485 |
| Roele | 0.0046 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 342406.1 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 285338.39 |
| Vsu,p | 306000.00 |

***As,c =*** ***0.0*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 9000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 4250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**MURO**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 90.00 |
| Arm. Tracción | As1 | cm2 | 39.27 |
| Canto útil | d | cm | 85.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0046 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 5.78 |
| Inercia fisurada | If | cm4 | 1,989,743 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 75.00 |
| Diámetro | ϕ | mm | 25 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 9000 |
| Area sec. Homog. | Ah | cm2 | 9604.95 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 45.00 |
| Inercia sec. Homog. | Ih | cm4 | 7042921.05 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 40.144 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,231 |
| Tensión de servicio | Ts | kp/cm2 | 2,300 |
| Area eficaz | Ac,ef | cm2 | 2250 |
| Alargamiento medio armaduras | εsm | | 0.0009 |
| Separación media de fisuras | Sm | mm | 171.62 |
| **Abertura característica** | **Wk** | **mm** | **0.27** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: PANTALLA**

Tipo de elemento Muros

| | |
|---|---|
| Momento Flector [T·m] | 281.98 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 90.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **28.04** |
| **ARMADURA NECESARIA(cm2)** | **91.37** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **8.10** |
| **Cuantía Mínima Horizontal (cm2)** | **28.80** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø32 y una barra Ø25 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**PANTALLA**

| | |
|---|---|
| D(mm) | 850 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 103.61 |
| Vrd(Tn) | 55.29 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.485 |
| Roele | 0.0122 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 473138.6 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 394282.17 |
| Vsu,p | 306000.00 |

| | | |
|---|---|---|
| ***As,c =*** | ***5.2*** | **$cm^2/m$** |
| ***As,min=*** | ***8.3*** | **$cm^2/m$** |

**Se dispondrá un cerco Ø12 cada 0,20m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 9000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 4250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

### PANTALLA

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 90.00 |
| Arm. Tracción | As1 | cm2 | 103.61 |
| Canto útil | d | cm | 85.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 9000 |
| Area sec. Homog. | Ah | cm2 | 10100.53 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 46.96 |
| Inercia sec. Homog. | Ih | cm4 | 7796938.20 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0122 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 46.469 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 8.83 |
| Inercia fisurada | If | cm4 | 4,985,301 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 207.61 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 547 |
| Tensión de servicio | Ts | kp/cm2 | 2,443 |
| Area eficaz | Ac,ef | cm2 | 2250 |
| Alargamiento medio armaduras | εsm | | 0.0011 |
| Separación media de fisuras | Sm | mm | 127.75 |
| **Abertura característica** | **Wk** | **mm** | **0.25** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: BANDEJA**

Tipo de elemento: Losas

| | |
|---|---|
| Momento Flector [T·m] | 341.96 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 90.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **36.04** |
| **ARMADURA NECESARIA(cm2)** | **117.42** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **16.20** |
| **Cuantía Mínima Horizontal (cm2)** | |

La cuantía mínima corresponde a la cara de tracción

**Se dispondrán dos barras Ø32 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**BANDEJA**

| | |
|---|---|
| D(mm) | 850 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 128.68 |
| Vrd(Tn) | 136.79 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.485 |
| Roele | 0.0151 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 508578.7 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 423815.59 |
| Vsu,p | 306000.00 |

***As,c =*** ***30.9*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m** **Se dispondrán dos cercos Ø16 cada 0,15m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 9000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 4250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro I - Estribo 1 - Pérgola**

**BANDEJA**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 90.00 |
| Arm. Tracción | As1 | cm2 | 128.68 |
| Canto útil | d | cm | 85.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0151 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 10.14 |
| Inercia fisurada | If | cm4 | 6,054,006 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 249.14 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 9000 |
| Area sec. Homog. | Ah | cm2 | 10293.63 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 47.68 |
| Inercia sec. Homog. | Ih | cm4 | 8071083.75 |

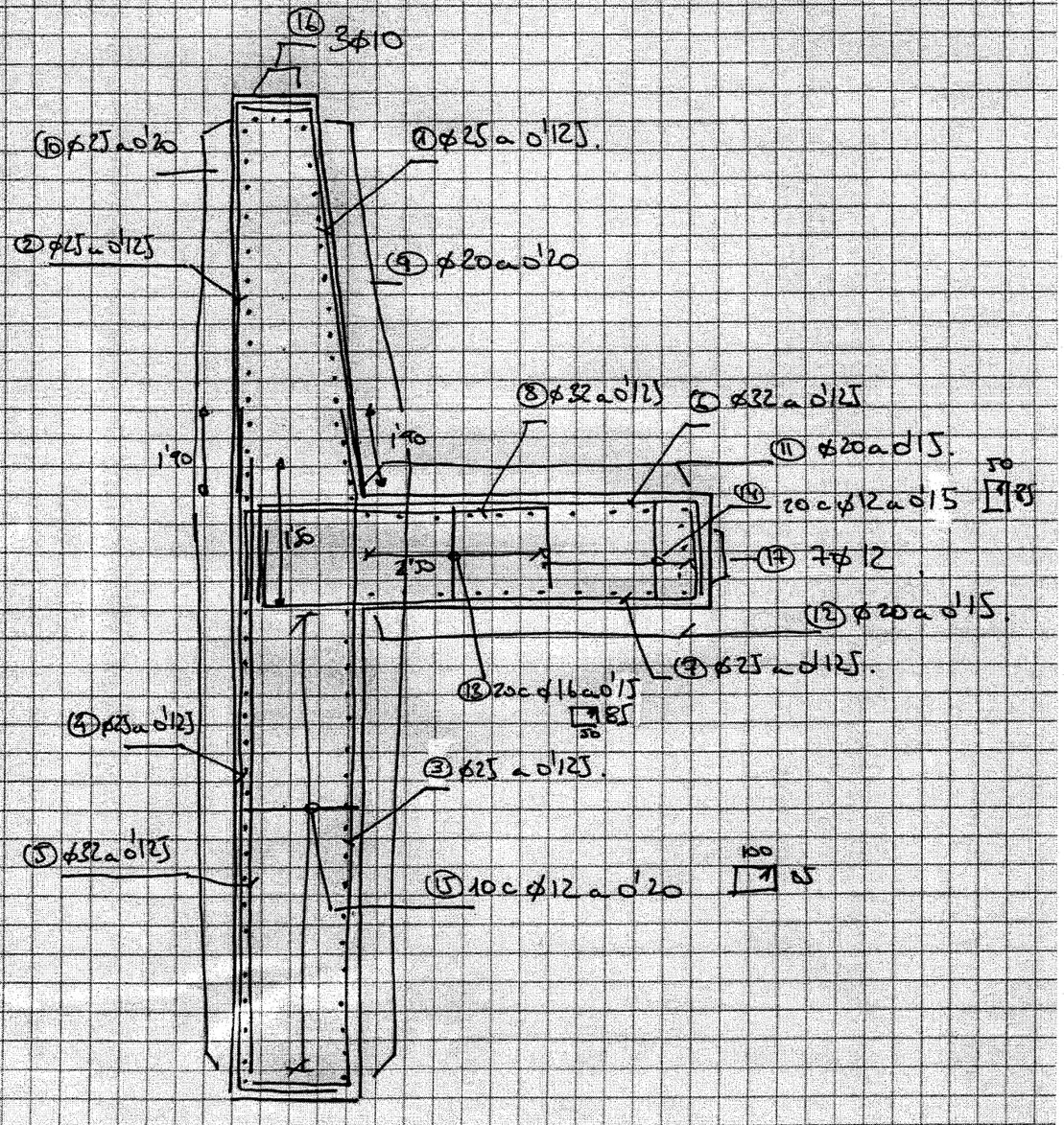
| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 48.913 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 466 |
| Tensión de servicio | Ts | kp/cm2 | 2,373 |
| Area eficaz | Ac,ef | cm2 | 2250 |
| Alargamiento medio armaduras | εsm | | 0.0011 |
| Separación media de fisuras | Sm | mm | 120.98 |
| **Abertura característica** | **Wk** | **mm** | **0.23** |

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

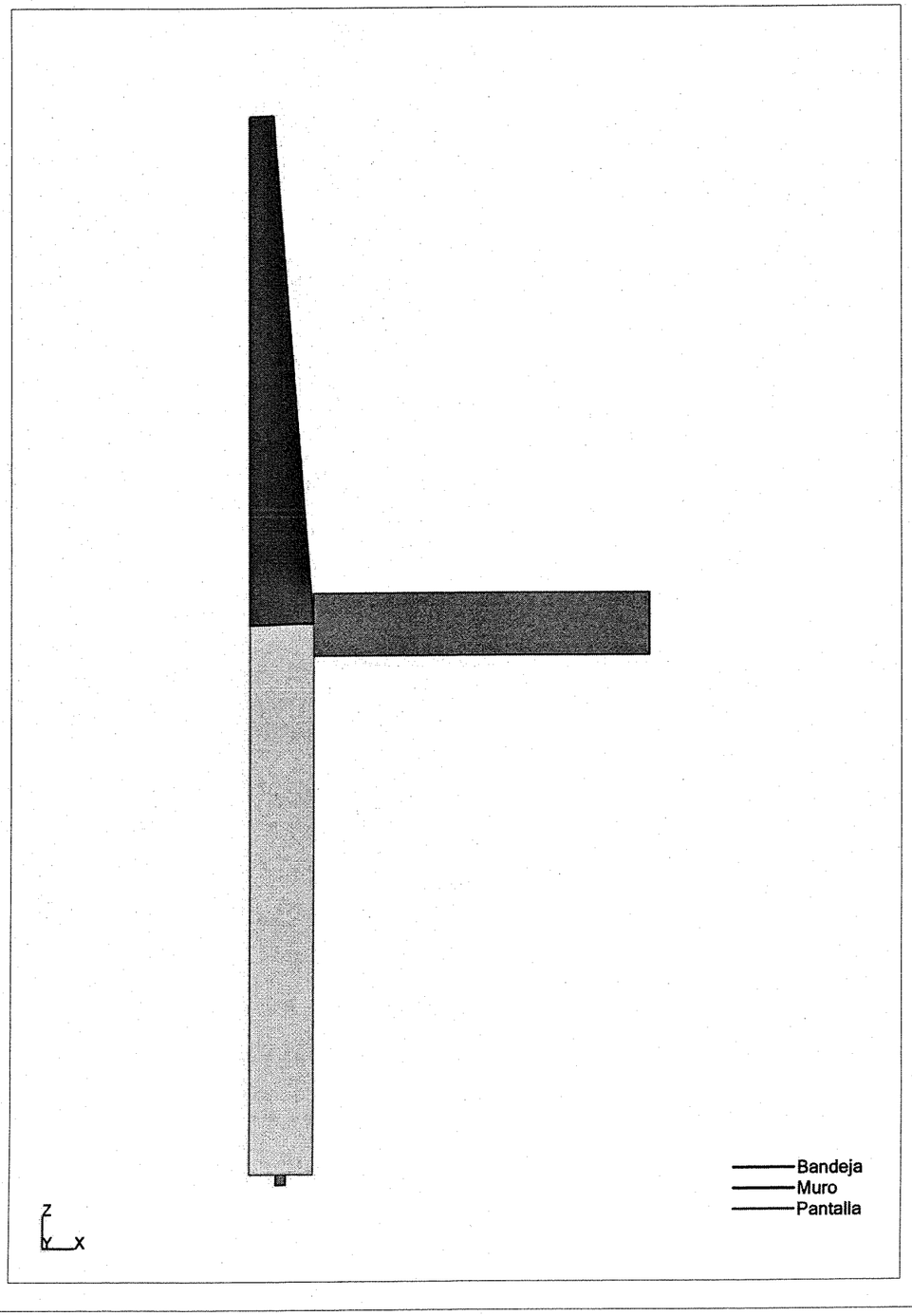
ARMADO MURO TIPO I




# 4 MURO TIPO II

## 4.1 MODELO DE CÁLCULO Y ESFUERZOS

## Modelo de Cálculo




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## Nudos que Componen la Estructura

| Nudo | X (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | | |
| 2 | -0.250 | 6.390 | | |
| 3 | 4.700 | 0.0 | | |
| 4 | 0.400 | 0.0 | | |
| 5 | 0.0 | -7.000 | fff | Apoyo |

## Barras que Componen la Estructura

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) |
|---|---|---|---|---|---|
| 1 | 1 | 2 | Muro | HORMIGON | 6.395 |
| 2 | 5 | 1 | Pantalla | HORM | 7.000 |
| 3 | 4 | 3 | Bandeja | HORM | 4.300 |

## Características de las Barras que Componen la Estructura

| Nombre de la sección | Lista de barras | BB (m) | HH (m) | SX (m2) | SY (m2) | SZ (m2) | IX (m4) | IY (m4) | IZ (m4) |
|---|---|---|---|---|---|---|---|---|---|
| Bandeja | 3 | 1.00 | 0.80 | 0.80000 | 0.66667 | 0.66667 | 0.08793 | 0.04267 | 0.06667 |
| Muro | 1 | 1.00 | 0.80 | 0.55000 | 0.45833 | 0.45833 | 0.03636 | 0.01386 | 0.04583 |
| Pantalla | 2 | 1.00 | 0.80 | 0.80000 | 0.66667 | 0.66667 | 0.08793 | 0.04267 | 0.06667 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Apoyo | 5 | UX UZ RY |

## Cargas Aplicadas a la Estructura

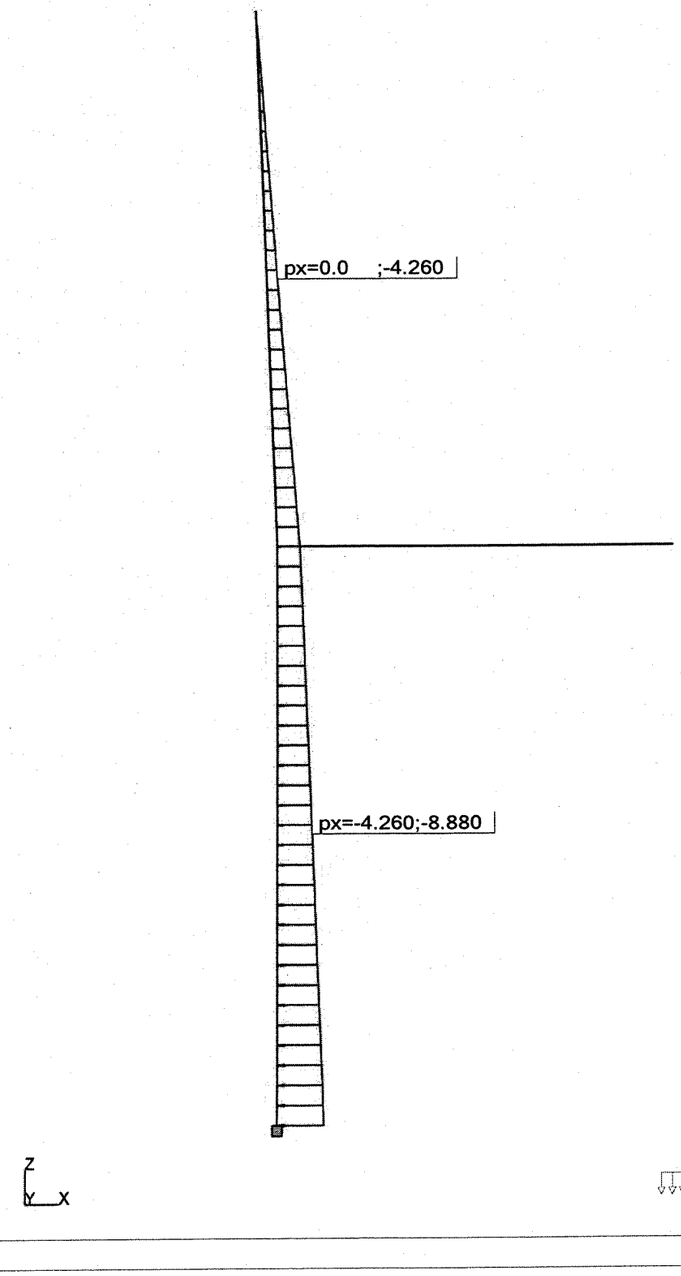
| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1A3 | PZ Menos Coef=1.0000 |
| 2 | Empuje Activo | carga trapezoidal | 1 | PX2=0.0(T/m) PX1=-4.260(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 2 | Empuje Activo | carga trapezoidal | 2 | PX2=-4.260(T/m) PX1=-8.880(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 3 | Empuje Pasivo | carga trapezoidal | 2 | PX2=0.0(T/m) PX1=26.400(T/m) X2=6.600(m) X1=0.0(m) global no proyectadas absolutos |
| 4 | Empuje Sobrecarga | sobrecarga uniforme | 1 2 | PX=-1.083(T/m) |
| 5 | Peso en Bandeja Terreno | sobrecarga uniforme | 3 | PZ=-12.120(T/m) |
| 6 | Peso en Bandeja Sobrecarga | sobrecarga uniforme | 3 | PZ=-3.000(T/m) |

## Combinación de Acciones

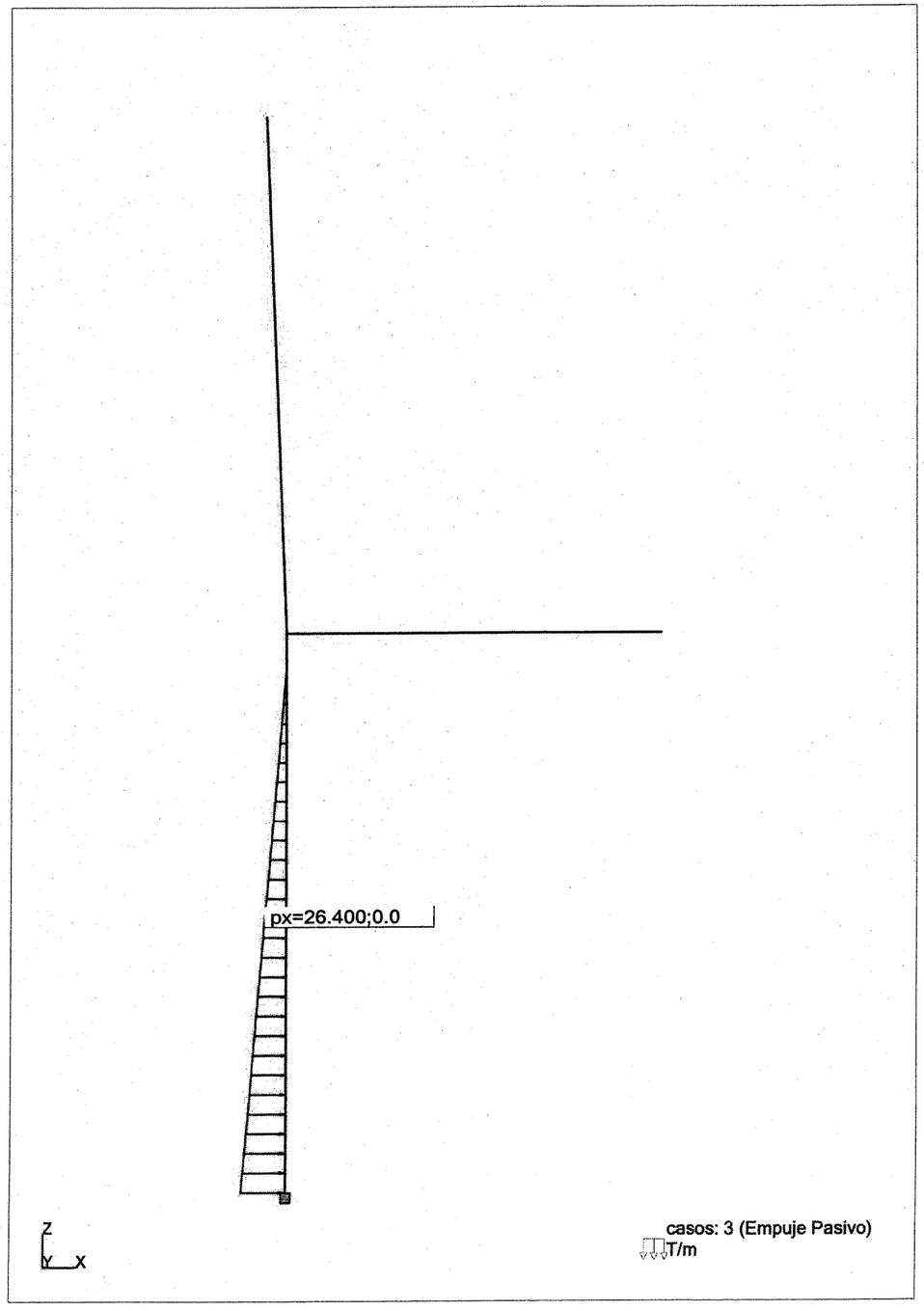
| Combinación | Nombre | Definición |
|---|---|---|
| 11 (C) | ELS (Terreno) | (1+2+3+5)*1.0000 |
| 12 (C) | ELS (Terreno+Sobrecarga) | (1+2+3+4+5+6)*1.0000 |
| 21 (C) | ELU (Terreno) | (1+2+3+5)*1.3500 |
| 22 (C) | ELU (Terreno+Sobrecarga) | (1+2+3+5)*1.3500+(4+6)*1.5000 |

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## Cargas Aplicadas: Empuje Activo

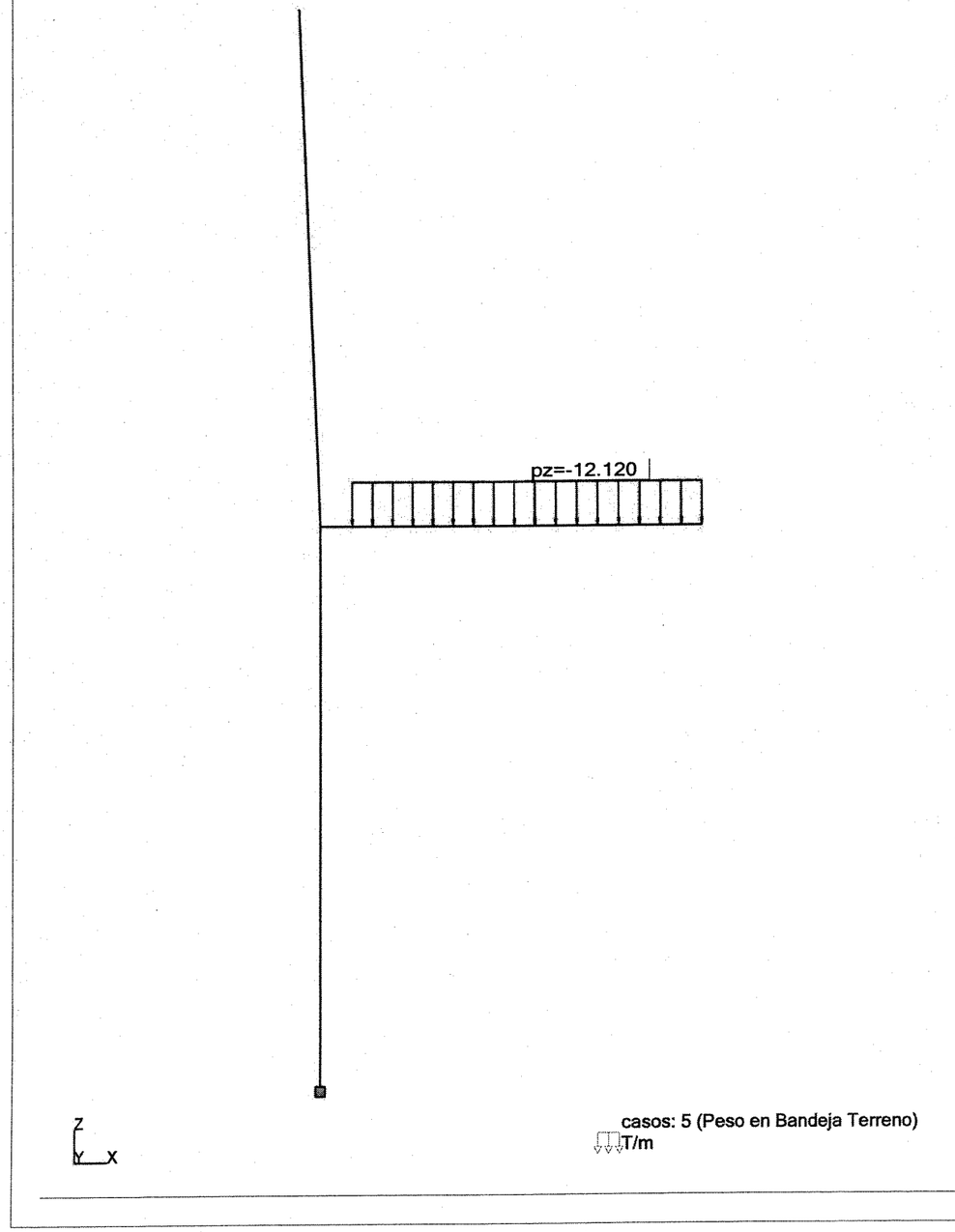


## Cargas Aplicadas: Empuje Pasivo

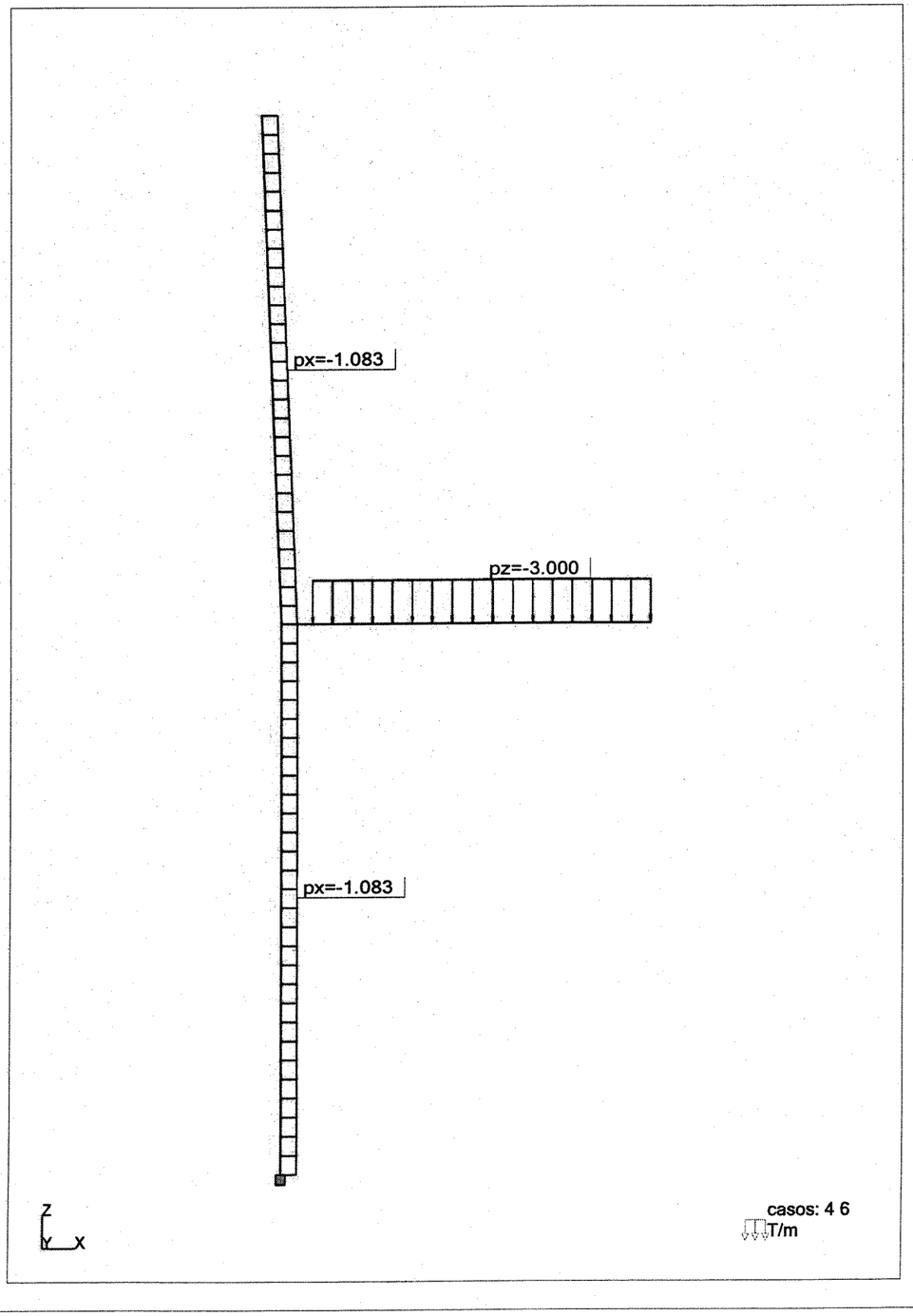





## Cargas Aplicadas: Peso Terreno en Bandeja

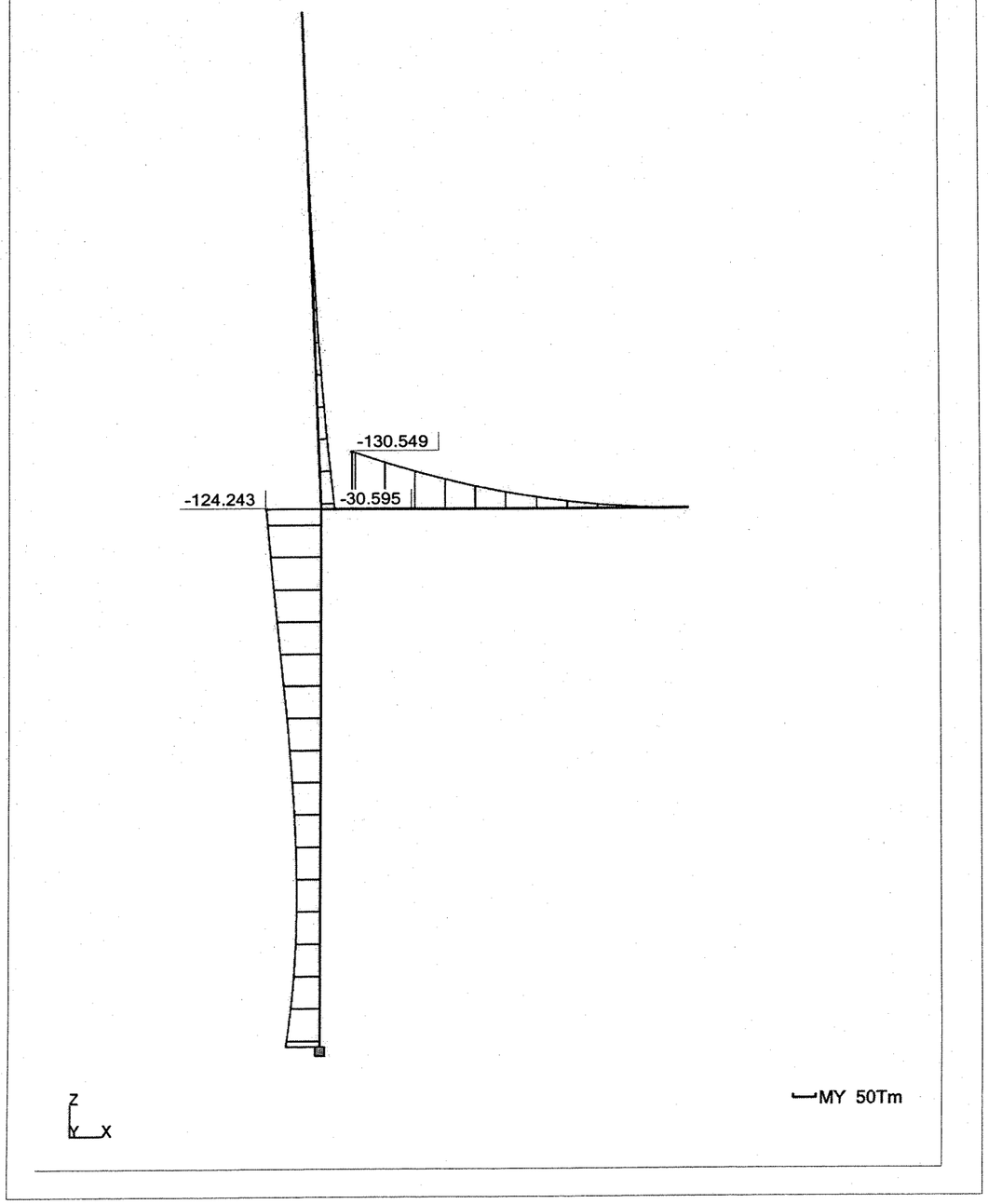


## Cargas Aplicadas: Sobrecargas

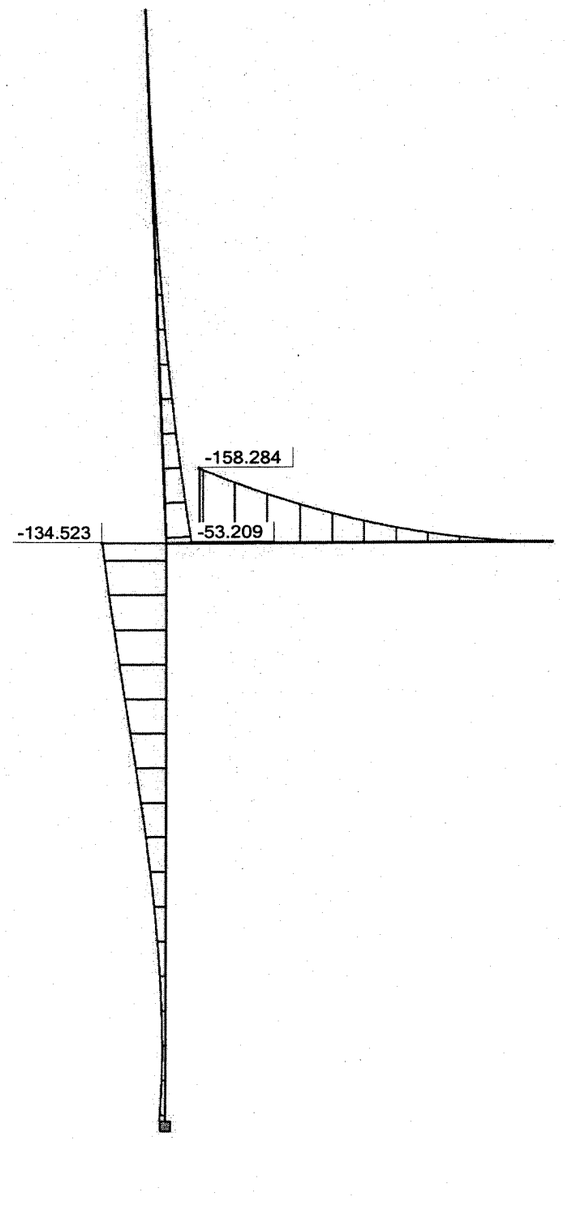



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## Momentos Flectores - ELS Terreno

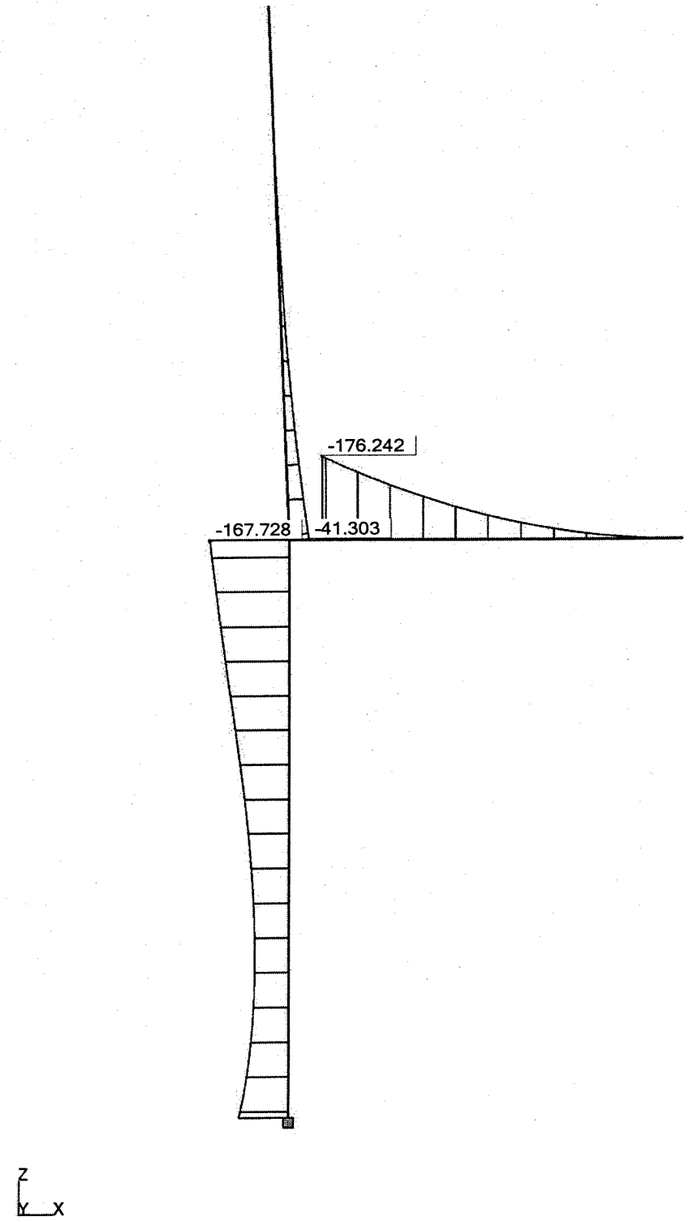


## Momentos Flectores - ELS Terreno+Sobrecarga

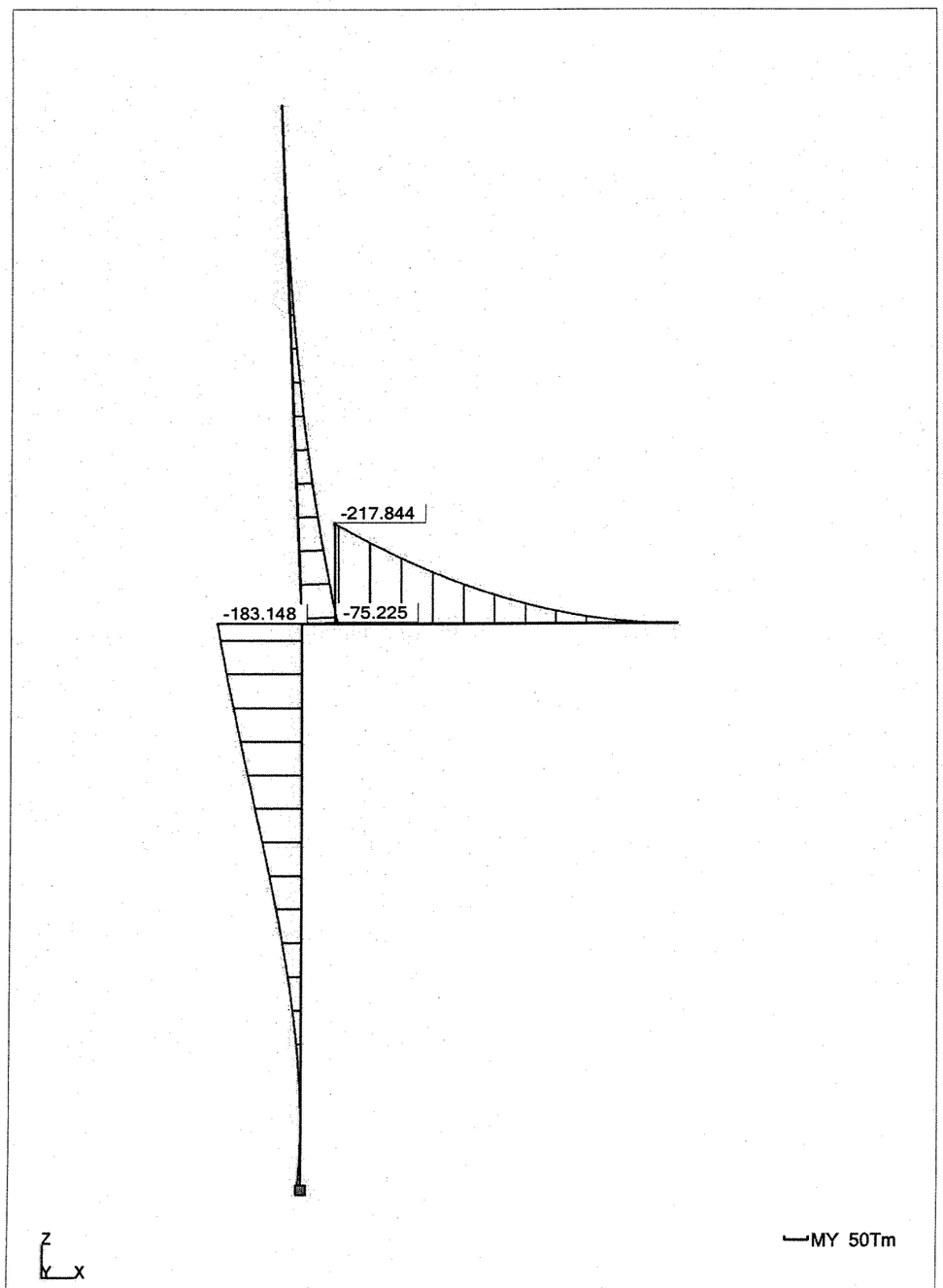



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## Momentos Flectores - ELU Terreno

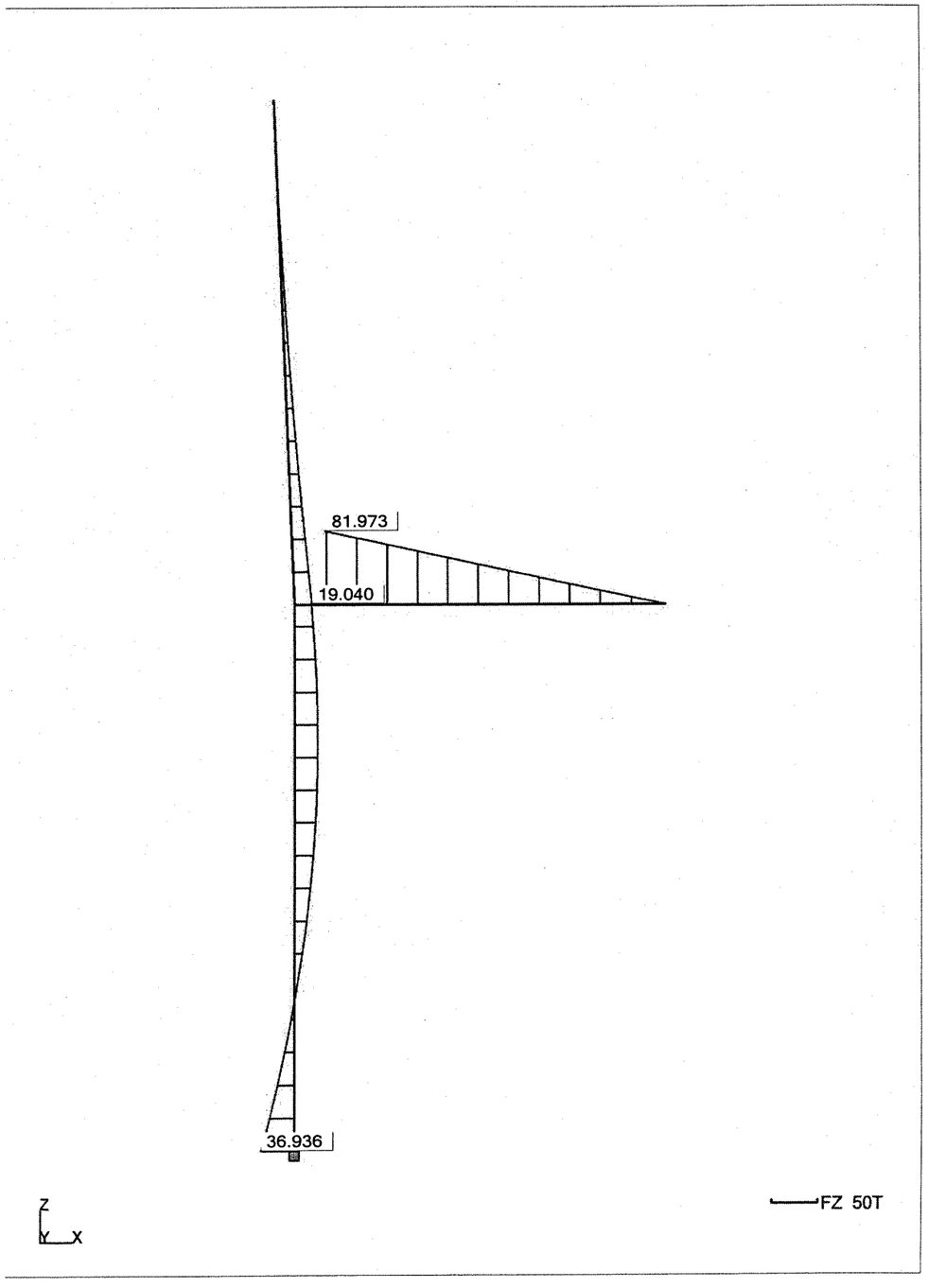


## Momentos Flectores - ELU Terreno+Sobrecarga

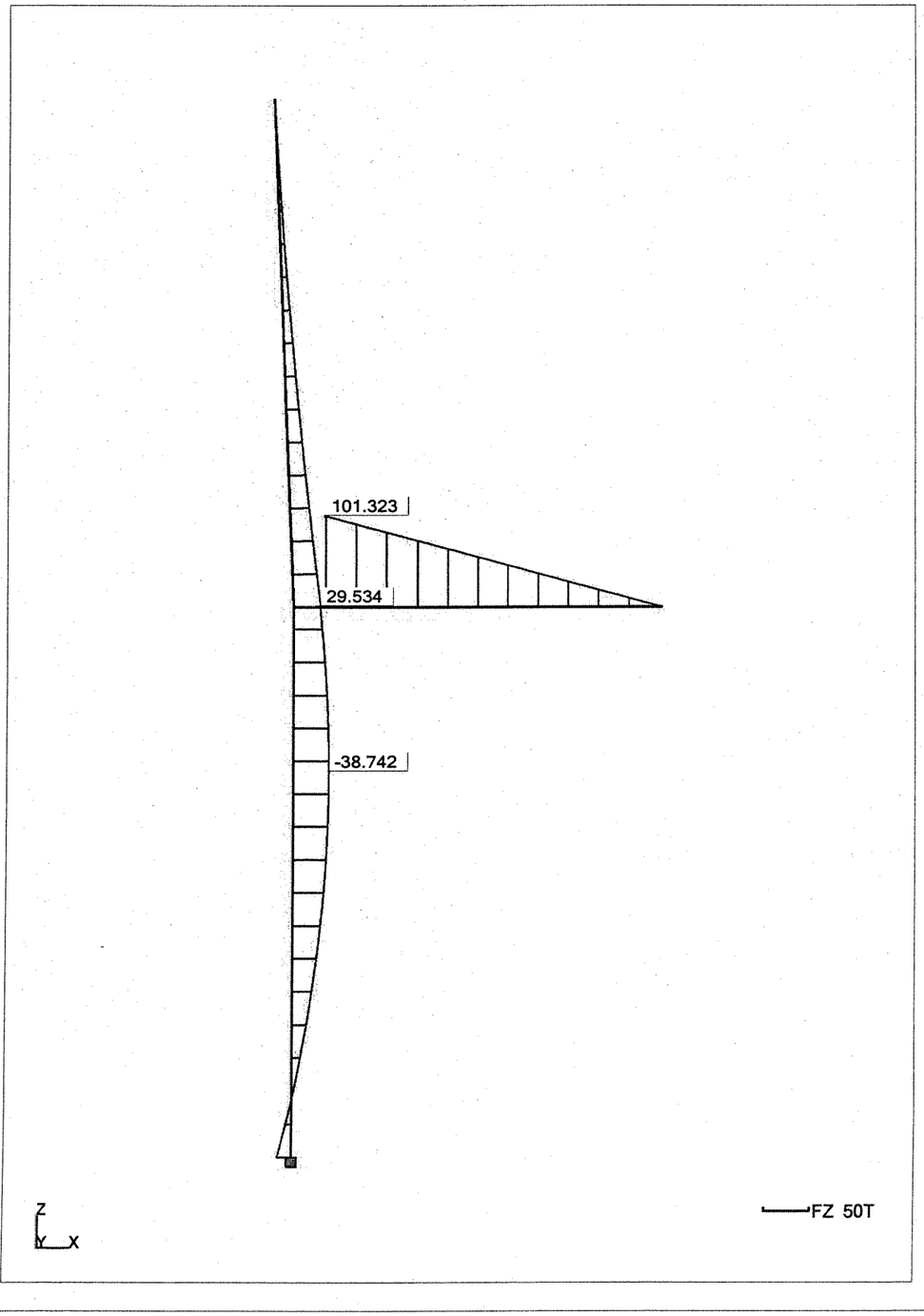



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## Esfuerzos Cortantes - ELU Terreno



## Esfuerzos Cortantes - ELU Terreno+Sobrecarga




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## Esfuerzos en Muro

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 1/ 1** | 8.355 | 14.104 | -30.595 |
| **11 (C)/ 1/ 2/10** | 7.080 | 11.162 | -21.541 |
| **11 (C)/ 1/ 3/10** | 5.892 | 8.564 | -14.477 |
| **11 (C)/ 1/ 4/10** | 4.791 | 6.310 | -9.155 |
| **11 (C)/ 1/ 5/10** | 3.776 | 4.399 | -5.329 |
| **11 (C)/ 1/ 6/10** | 2.847 | 2.832 | -2.753 |
| **11 (C)/ 1/ 7/10** | 2.006 | 1.609 | -1.178 |
| **11 (C)/ 1/ 8/10** | 1.250 | 0.729 | -0.359 |
| **11 (C)/ 1/ 9/10** | 0.582 | 0.193 | -0.049 |
| **11 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 1/ 1** | 8.084 | 21.100 | -53.209 |
| **12 (C)/ 1/ 2/10** | 6.839 | 17.381 | -39.409 |
| **12 (C)/ 1/ 3/10** | 5.681 | 14.006 | -28.157 |
| **12 (C)/ 1/ 4/10** | 4.610 | 10.974 | -19.206 |
| **12 (C)/ 1/ 5/10** | 3.625 | 8.286 | -12.309 |
| **12 (C)/ 1/ 6/10** | 2.727 | 5.942 | -7.220 |
| **12 (C)/ 1/ 7/10** | 1.915 | 3.941 | -3.691 |
| **12 (C)/ 1/ 8/10** | 1.190 | 2.284 | -1.476 |
| **12 (C)/ 1/ 9/10** | 0.552 | 0.970 | -0.328 |
| **12 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 1/ 1** | 11.279 | 19.040 | -41.303 |
| **21 (C)/ 1/ 2/10** | 9.558 | 15.069 | -29.080 |
| **21 (C)/ 1/ 3/10** | 7.954 | 11.562 | -19.543 |
| **21 (C)/ 1/ 4/10** | 6.467 | 8.519 | -12.359 |
| **21 (C)/ 1/ 5/10** | 5.097 | 5.939 | -7.194 |
| **21 (C)/ 1/ 6/10** | 3.844 | 3.824 | -3.716 |
| **21 (C)/ 1/ 7/10** | 2.708 | 2.172 | -1.590 |
| **21 (C)/ 1/ 8/10** | 1.688 | 0.984 | -0.485 |
| **21 (C)/ 1/ 9/10** | 0.786 | 0.260 | -0.066 |
| **21 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 1/ 1** | 10.873 | 29.534 | -75.225 |
| **22 (C)/ 1/ 2/10** | 9.197 | 24.397 | -55.883 |
| **22 (C)/ 1/ 3/10** | 7.638 | 19.724 | -40.064 |
| **22 (C)/ 1/ 4/10** | 6.196 | 15.515 | -27.436 |
| **22 (C)/ 1/ 5/10** | 4.871 | 11.769 | -17.664 |
| **22 (C)/ 1/ 6/10** | 3.663 | 8.488 | -10.417 |
| **22 (C)/ 1/ 7/10** | 2.572 | 5.670 | -5.359 |
| **22 (C)/ 1/ 8/10** | 1.598 | 3.316 | -2.160 |
| **22 (C)/ 1/ 9/10** | 0.740 | 1.426 | -0.484 |
| **22 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |

## Esfuerzos en Pantalla

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 2/ 5** | 83.622 | 27.360 | -77.416 |
| **11 (C)/ 2/ 2/10** | 82.066 | 14.743 | -61.174 |
| **11 (C)/ 2/ 3/10** | 80.510 | 4.148 | -53.958 |
| **11 (C)/ 2/ 4/10** | 78.953 | -4.428 | -54.198 |
| **11 (C)/ 2/ 5/10** | 77.397 | -10.983 | -60.322 |
| **11 (C)/ 2/ 6/10** | 75.840 | -15.517 | -70.759 |
| **11 (C)/ 2/ 7/10** | 74.284 | -18.031 | -83.936 |
| **11 (C)/ 2/ 8/10** | 72.727 | -18.525 | -98.283 |
| **11 (C)/ 2/ 9/10** | 71.171 | -16.998 | -112.228 |
| **11 (C)/ 2/ 1** | 69.615 | -13.770 | -124.243 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 2/ 5** | 96.522 | 12.777 | -12.153 |
| **12 (C)/ 2/ 2/10** | 94.966 | 1.003 | -6.925 |
| **12 (C)/ 2/ 3/10** | 93.410 | -8.750 | -10.068 |
| **12 (C)/ 2/ 4/10** | 91.853 | -16.483 | -20.012 |
| **12 (C)/ 2/ 5/10** | 90.297 | -22.196 | -35.185 |
| **12 (C)/ 2/ 6/10** | 88.740 | -25.888 | -54.016 |
| **12 (C)/ 2/ 7/10** | 87.184 | -27.560 | -74.932 |
| **12 (C)/ 2/ 8/10** | 85.627 | -27.211 | -96.362 |
| **12 (C)/ 2/ 9/10** | 84.071 | -24.841 | -116.736 |
| **12 (C)/ 2/ 1** | 82.515 | -20.772 | -134.523 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 2/ 5** | 112.890 | 36.936 | -104.512 |
| **21 (C)/ 2/ 2/10** | 110.789 | 19.904 | -82.584 |
| **21 (C)/ 2/ 3/10** | 108.688 | 5.599 | -72.843 |
| **21 (C)/ 2/ 4/10** | 106.587 | -5.978 | -73.167 |
| **21 (C)/ 2/ 5/10** | 104.486 | -14.827 | -81.435 |
| **21 (C)/ 2/ 6/10** | 102.384 | -20.948 | -95.524 |
| **21 (C)/ 2/ 7/10** | 100.283 | -24.342 | -113.314 |
| **21 (C)/ 2/ 8/10** | 98.182 | -25.008 | -132.682 |
| **21 (C)/ 2/ 9/10** | 96.081 | -22.947 | -151.508 |
| **21 (C)/ 2/ 1** | 93.980 | -18.590 | -167.728 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 2/ 5** | 132.240 | 15.062 | -6.617 |
| **22 (C)/ 2/ 2/10** | 130.139 | -0.706 | -1.211 |
| **22 (C)/ 2/ 3/10** | 128.038 | -13.747 | -7.009 |
| **22 (C)/ 2/ 4/10** | 125.937 | -24.061 | -21.889 |
| **22 (C)/ 2/ 5/10** | 123.836 | -31.646 | -43.730 |
| **22 (C)/ 2/ 6/10** | 121.734 | -36.504 | -70.410 |
| **22 (C)/ 2/ 7/10** | 119.633 | -38.635 | -99.807 |
| **22 (C)/ 2/ 8/10** | 117.532 | -38.037 | -129.801 |
| **22 (C)/ 2/ 9/10** | 115.431 | -34.712 | -158.269 |
| **22 (C)/ 2/ 1** | 113.330 | -29.092 | -183.148 |

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## Esfuerzos en Bandeja

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 3/ 4** | -0.000 | 60.721 | -130.549 |
| **11 (C)/ 3/ 2/10** | -0.000 | 53.974 | -103.150 |
| **11 (C)/ 3/ 3/10** | -0.000 | 47.227 | -78.974 |
| **11 (C)/ 3/ 4/10** | -0.000 | 40.480 | -58.022 |
| **11 (C)/ 3/ 5/10** | -0.000 | 33.734 | -40.293 |
| **11 (C)/ 3/ 6/10** | -0.000 | 26.987 | -25.788 |
| **11 (C)/ 3/ 7/10** | -0.000 | 20.240 | -14.505 |
| **11 (C)/ 3/ 8/10** | -0.000 | 13.493 | -6.447 |
| **11 (C)/ 3/ 9/10** | -0.000 | 6.747 | -1.612 |
| **11 (C)/ 3/ 3** | -0.000 | -0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 3/ 4** | -0.000 | 73.621 | -158.284 |
| **12 (C)/ 3/ 2/10** | -0.000 | 65.441 | -125.064 |
| **12 (C)/ 3/ 3/10** | -0.000 | 57.261 | -95.752 |
| **12 (C)/ 3/ 4/10** | -0.000 | 49.080 | -70.349 |
| **12 (C)/ 3/ 5/10** | -0.000 | 40.900 | -48.853 |
| **12 (C)/ 3/ 6/10** | -0.000 | 32.720 | -31.266 |
| **12 (C)/ 3/ 7/10** | -0.000 | 24.540 | -17.587 |
| **12 (C)/ 3/ 8/10** | -0.000 | 16.360 | -7.817 |
| **12 (C)/ 3/ 9/10** | -0.000 | 8.180 | -1.954 |
| **12 (C)/ 3/ 3** | -0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 3/ 4** | -0.000 | 81.973 | -176.242 |
| **21 (C)/ 3/ 2/10** | -0.000 | 72.865 | -139.253 |
| **21 (C)/ 3/ 3/10** | -0.000 | 63.757 | -106.615 |
| **21 (C)/ 3/ 4/10** | -0.000 | 54.649 | -78.330 |
| **21 (C)/ 3/ 5/10** | -0.000 | 45.541 | -54.396 |
| **21 (C)/ 3/ 6/10** | -0.000 | 36.432 | -34.813 |
| **21 (C)/ 3/ 7/10** | -0.000 | 27.324 | -19.582 |
| **21 (C)/ 3/ 8/10** | -0.000 | 18.216 | -8.703 |
| **21 (C)/ 3/ 9/10** | -0.000 | 9.108 | -2.176 |
| **21 (C)/ 3/ 3** | -0.000 | -0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 3/ 4** | -0.000 | 101.323 | -217.844 |
| **22 (C)/ 3/ 2/10** | -0.000 | 90.065 | -172.124 |
| **22 (C)/ 3/ 3/10** | -0.000 | 78.807 | -131.782 |
| **22 (C)/ 3/ 4/10** | -0.000 | 67.549 | -96.820 |
| **22 (C)/ 3/ 5/10** | -0.000 | 56.291 | -67.236 |
| **22 (C)/ 3/ 6/10** | -0.000 | 45.032 | -43.031 |
| **22 (C)/ 3/ 7/10** | -0.000 | 33.774 | -24.205 |
| **22 (C)/ 3/ 8/10** | -0.000 | 22.516 | -10.758 |
| **22 (C)/ 3/ 9/10** | -0.000 | 11.258 | -2.689 |
| **22 (C)/ 3/ 3** | -0.000 | -0.000 | -0.000 |

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## Reacciones en Apoyo

| Nudo/Caso | Nombre del caso | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|---|
| 5/ 11 (C) | ELS (Terreno) | -27.360 | 83.622 | -77.416 |
| 5/ 12 (C) | ELS (Terreno+Sobrecarga) | -12.777 | 96.522 | -12.153 |
| 5/ 21 (C) | ELU (Terreno) | -36.936 | 112.890 | -104.512 |
| 5/ 22 (C) | ELU (Terreno+Sobrecarga) | -15.062 | 132.240 | -6.617 |

La estabilidad del muro se obtiene cuando los empujes pasivos son capaces de compensar los empujes activos. Para que se de este criterio, el momento de reacción en el apoyo de la pantalla deba ser cero.

En caso de tener un momento negativo, éste nos indica que el momento producido por los empujes pasivos es mayor que el producido por los empujes activos y, por tanto, la pantalla es capaz de generar mecanismos resistentes.

En las reacciones adjuntas se puede ver que los momentos en el apoyo de pantalla son siempre menores o iguales a cero. De este modo, podemos asegurar la estabilidad de la pantalla.

## 4.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: MURO**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 75.23 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 80.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **7.45** |
| **ARMADURA NECESARIA(cm2)** | **24.27** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **7.20** |
| **Cuantía Mínima Horizontal (cm2)** | **25.60** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø25 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**MURO**

| | |
|---|---|
| D(mm) | 750 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 39.27 |
| Vrd(Tn) | 29.53 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.516 |
| Roele | 0.0052 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 321639.1 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 268032.60 |
| Vsu,p | 270000.00 |

***As,c =*** ***0.0*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 8000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 3750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

### MURO

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 80.00 |
| Arm. Tracción | As1 | cm2 | 39.27 |
| Canto útil | d | cm | 75.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0052 |
| Cuantía mecánica 2 | ρ2 | 0.0052 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 5.78 |
| Inercia fisurada | If | cm4 | 1,529,110 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 53.21 |
| Diámetro | ϕ | mm | 25 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 8000 |
| Area sec. Homog. | Ah | cm2 | 8604.95 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 40.00 |
| Inercia sec. Homog. | Ih | cm4 | 5007731.22 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 32.112 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,120 |
| Tensión de servicio | Ts | kp/cm2 | 1,855 |
| Area eficaz | Ac,ef | cm2 | 2000 |
| Alargamiento medio armaduras | εsm | | 0.0007 |
| Separación media de fisuras | Sm | mm | 163.66 |
| **Abertura característica** | **Wk** | **mm** | **0.20** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: PANTALLA**

Tipo de elemento Muros

| | |
|---|---|
| Momento Flector [T·m] | 170.71 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 80.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **18.30** |
| **ARMADURA NECESARIA(cm2)** | **59.63** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **7.20** |
| **Cuantía Mínima Horizontal (cm2)** | **25.60** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø32 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**PANTALLA**

| | |
|---|---|
| D(mm) | 750 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 64.34 |
| Vrd(Tn) | 38.74 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.516 |
| Roele | 0.0086 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 379177.2 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 315981.03 |
| Vsu,p | 270000.00 |

***As,c =*** ***2.6*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m** **Se dispondrá un cerco Ø12 cada 0,20m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 8000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 3750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**PANTALLA**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 80.00 |
| Arm. Tracción | As1 | cm2 | 64.34 |
| Canto útil | d | cm | 75.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0086 |
| Cuantía mecánica 2 | ρ2 | 0.0052 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 6.90 |
| Inercia fisurada | If | cm4 | 2,452,167 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 125.63 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 8000 |
| Area sec. Homog. | Ah | cm2 | 8798.05 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 40.77 |
| Inercia sec. Homog. | Ih | cm4 | 5239087.55 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 34.253 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 733 |
| Tensión de servicio | Ts | kp/cm2 | 2.687 |
| Area eficaz | Ac,ef | cm2 | 2000 |
| Alargamiento medio armaduras | εsm | | 0.0012 |
| Separación media de fisuras | Sm | mm | 142.74 |
| **Abertura característica** | **Wk** | **mm** | **0.30** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: BANDEJA**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 217.84 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 80.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **24.51** |
| **ARMADURA NECESARIA(cm2)** | **79.85** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **7.20** |
| **Cuantía Mínima Horizontal (cm2)** | **25.60** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø32 y una barra Ø20 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

**BANDEJA**

| | |
|---|---|
| D(mm) | 750 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 89.47 |
| Vrd(Tn) | 101.32 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.516 |
| Roele | 0.0119 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 423228.0 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 352689.99 |
| Vsu,p | 270000.00 |

***As,c =*** ***24.5*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**Se dispondrán dos cercos Ø12 cada 0,15m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 8000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 3750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro II - Estribo 1 - Pérgola**

## BANDEJA

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 80.00 |
| Arm. Tracción | As1 | cm2 | 89.47 |
| Canto útil | d | cm | 75.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0119 |
| Cuantía mecánica 2 | ρ2 | 0.0052 |

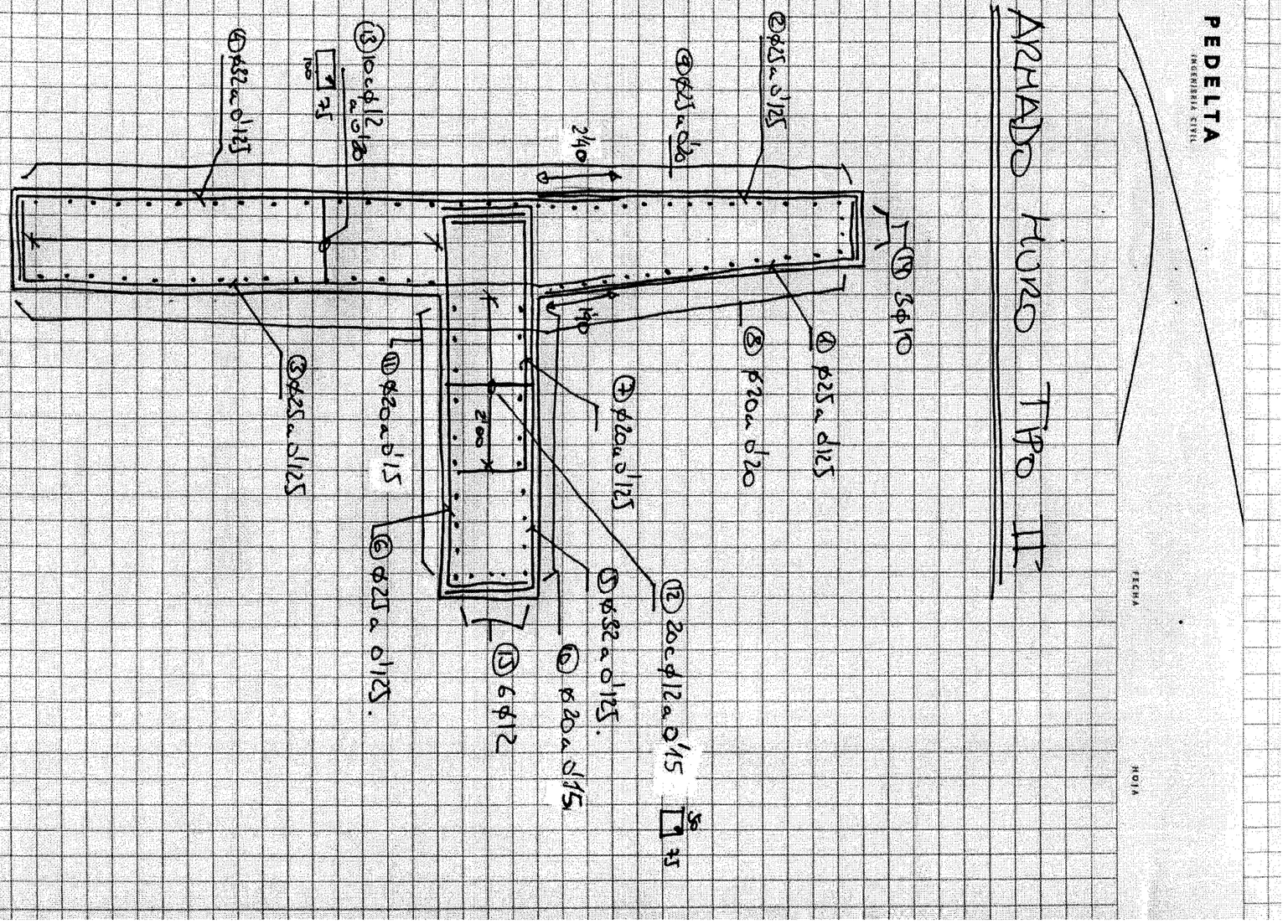
| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 8.12 |
| Inercia fisurada | If | cm4 | 3,329,924 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 158.28 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 8000 |
| Area sec. Homog. | Ah | cm2 | 8991.61 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 41.51 |
| Inercia sec. Homog. | Ih | cm4 | 5461024.84 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 36.387 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 563 |
| Tensión de servicio | Ts | kp/cm2 | 2,449 |
| Area eficaz | Ac,ef | cm2 | 2000 |
| Alargamiento medio armaduras | εsm | | 0.0011 |
| Separación media de fisuras | Sm | mm | 128.77 |
| **Abertura característica** | **Wk** | **mm** | **0.25** |

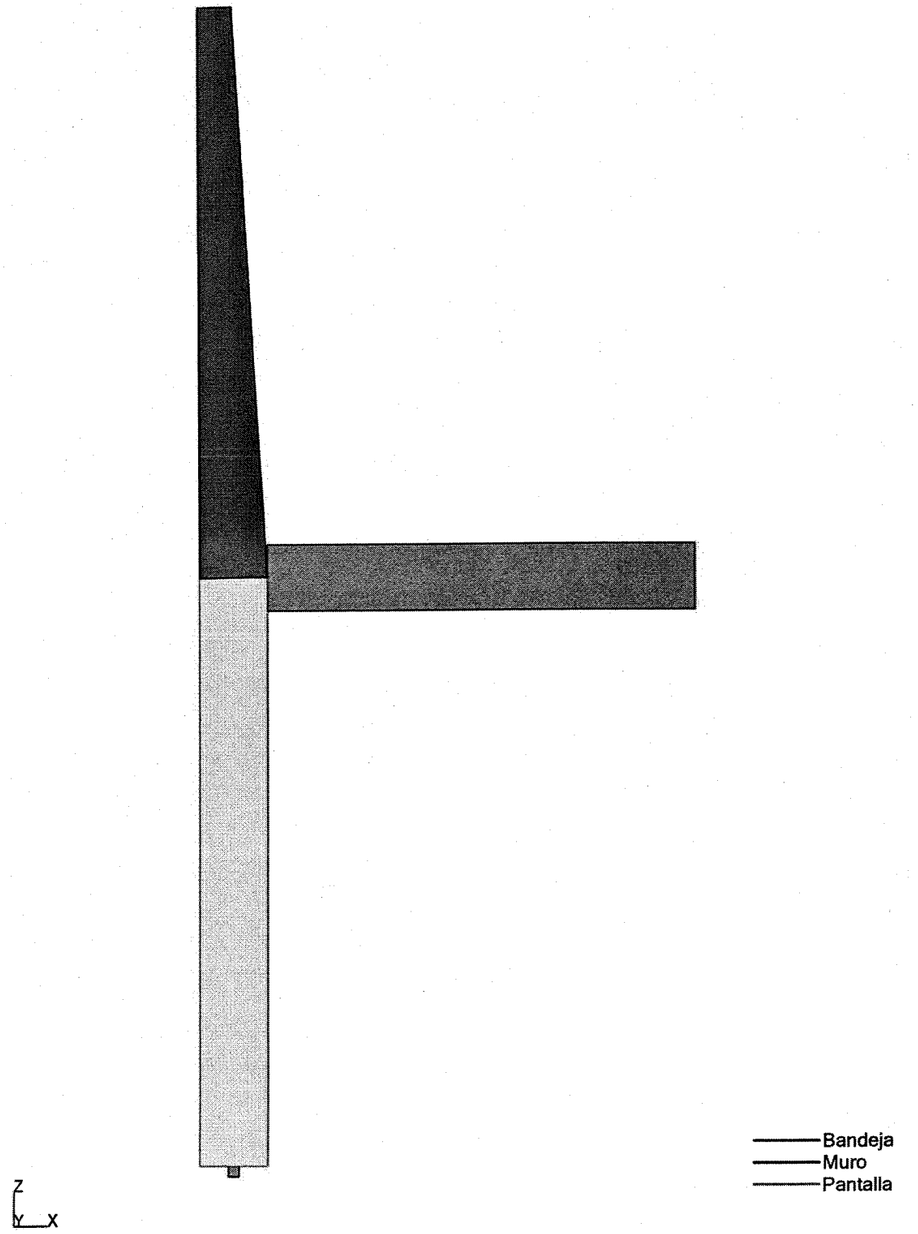


# 5 MURO TIPO III

## 5.1 MODELO DE CÁLCULO Y ESFUERZOS



### Modelo de Cálculo



## Nudos que Componen la Estructura

| Nudo | X (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | | |
| 2 | -0.150 | 5.130 | | |
| 3 | 4.100 | 0.0 | | |
| 4 | 0.300 | 0.0 | | |
| 5 | 0.0 | -5.300 | fff | Apoyo |

## Barras que Componen la Estructura

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) |
|---|---|---|---|---|---|
| 1 | 1 | 2 | Muro | HORMIGON | 5.132 |
| 2 | 5 | 1 | Pantalla | HORM | 5.300 |
| 3 | 4 | 3 | Bandeja | HORM | 3.800 |

## Características de las Barras que Componen la Estructura

| Nombre de la sección | Lista de barras | BB (m) | HH (m) | SX (m2) | SY (m2) | SZ (m2) | IX (m4) | IY (m4) | IZ (m4) |
|---|---|---|---|---|---|---|---|---|---|
| Bandeja | 3 | 1.00 | 0.60 | 0.60000 | 0.50000 | 0.50000 | 0.04506 | 0.01800 | 0.05000 |
| Muro | 1 | 1.00 | 0.60 | 0.45000 | 0.37500 | 0.37500 | 0.02178 | 0.00759 | 0.03750 |
| Pantalla | 2 | 1.00 | 0.60 | 0.60000 | 0.50000 | 0.50000 | 0.04506 | 0.01800 | 0.05000 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Apoyo | 5 | UX UZ RY |

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Autor :

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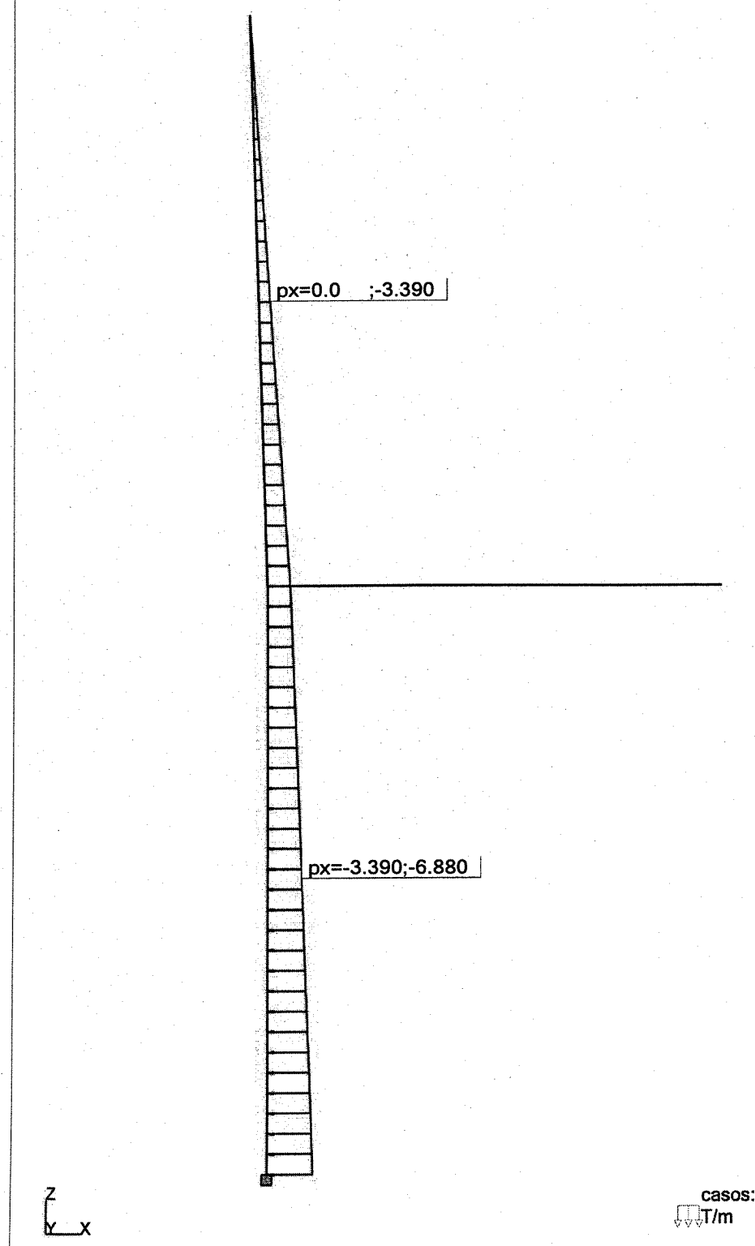
## Cargas Aplicadas a la Estructura

| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1A3 | PZ Menos Coef=1.0000 |
| 2 | Empuje Activo | carga trapezoidal | 1 | PX2=0.0(T/m) PX1=-3.390(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 2 | Empuje Activo | carga trapezoidal | 2 | PX2=-3.390(T/m) PX1=-6.880(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 3 | Empuje Pasivo | carga trapezoidal | 2 | PX2=0.0(T/m) PX1=20.000(T/m) X2=5.000(m) X1=0.0(m) global no proyectadas absolutos |
| 4 | Empuje Sobrecarga | sobrecarga uniforme | 1 2 | PX=-1.083(T/m) |
| 5 | Peso en Bandeja Terreno | sobrecarga uniforme | 3 | PZ=-9.660(T/m) |
| 6 | Peso en Bandeja Sobrecarga | sobrecarga uniforme | 3 | PZ=-3.000(T/m) |

## Combinación de Acciones

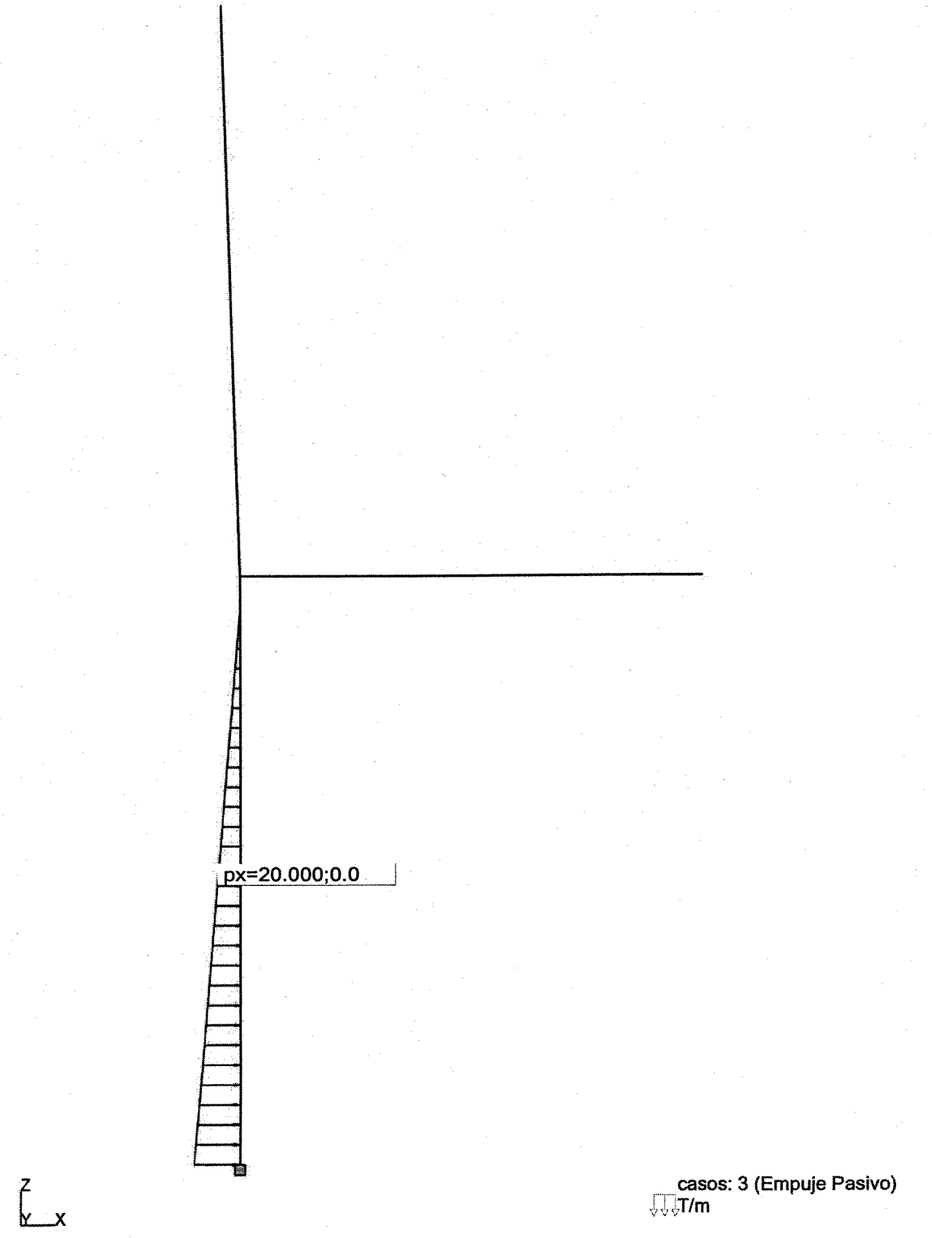
| Combinación | Nombre | Definición |
|---|---|---|
| 11 (C) | ELS (Terreno) | (1+2+3+5)*1.0000 |
| 12 (C) | ELS (Terreno+Sobrecarga) | (1+2+3+4+5+6)*1.0000 |
| 21 (C) | ELU (Terreno) | (1+2+3+5)*1.3500 |
| 22 (C) | ELU (Terreno+Sobrecarga) | (1+2+3+5)*1.3500+(4+6)*1.5000 |

## Cargas Aplicadas: Empuje Activo

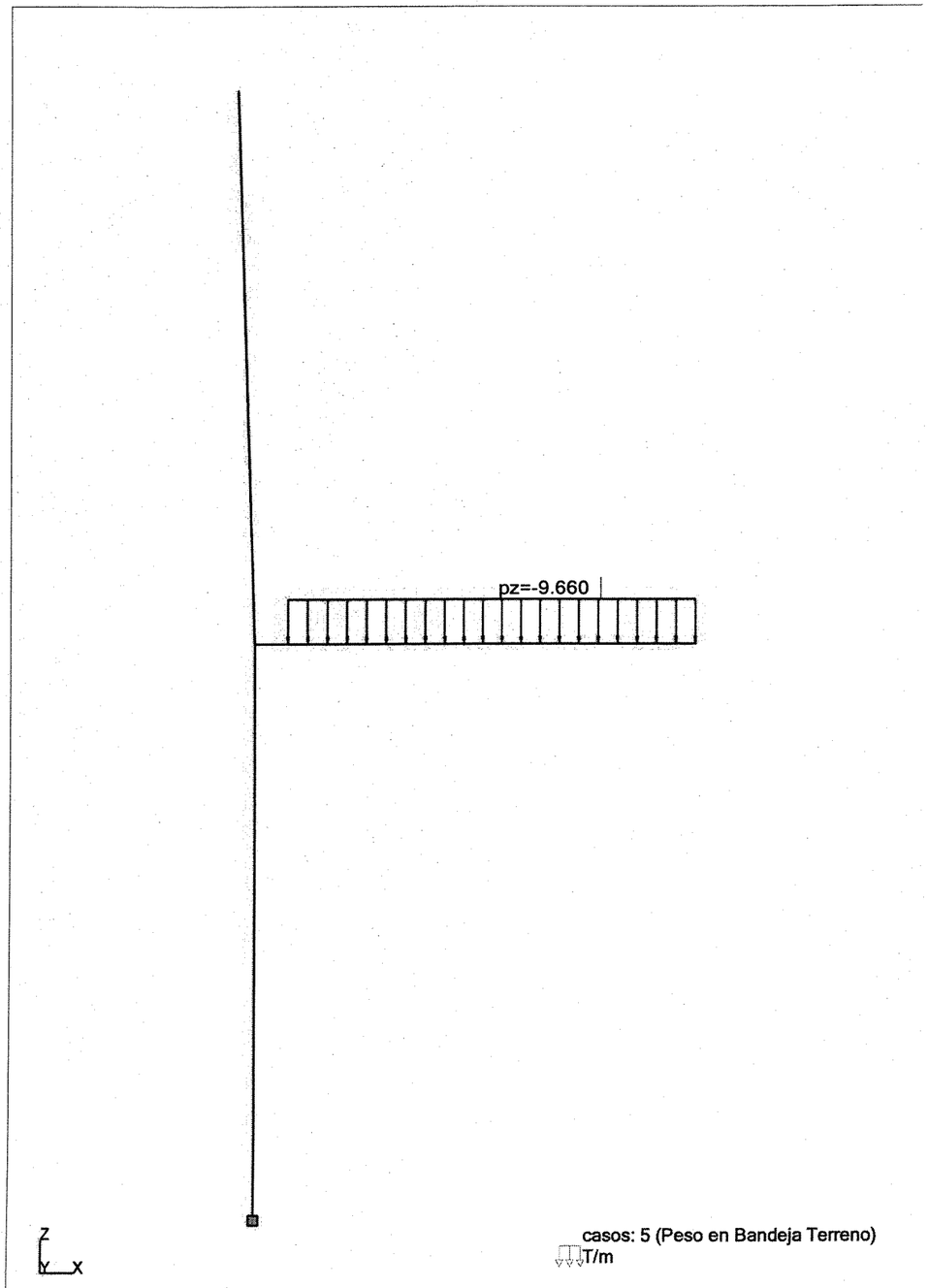



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## Cargas Aplicadas: Empuje Pasivo

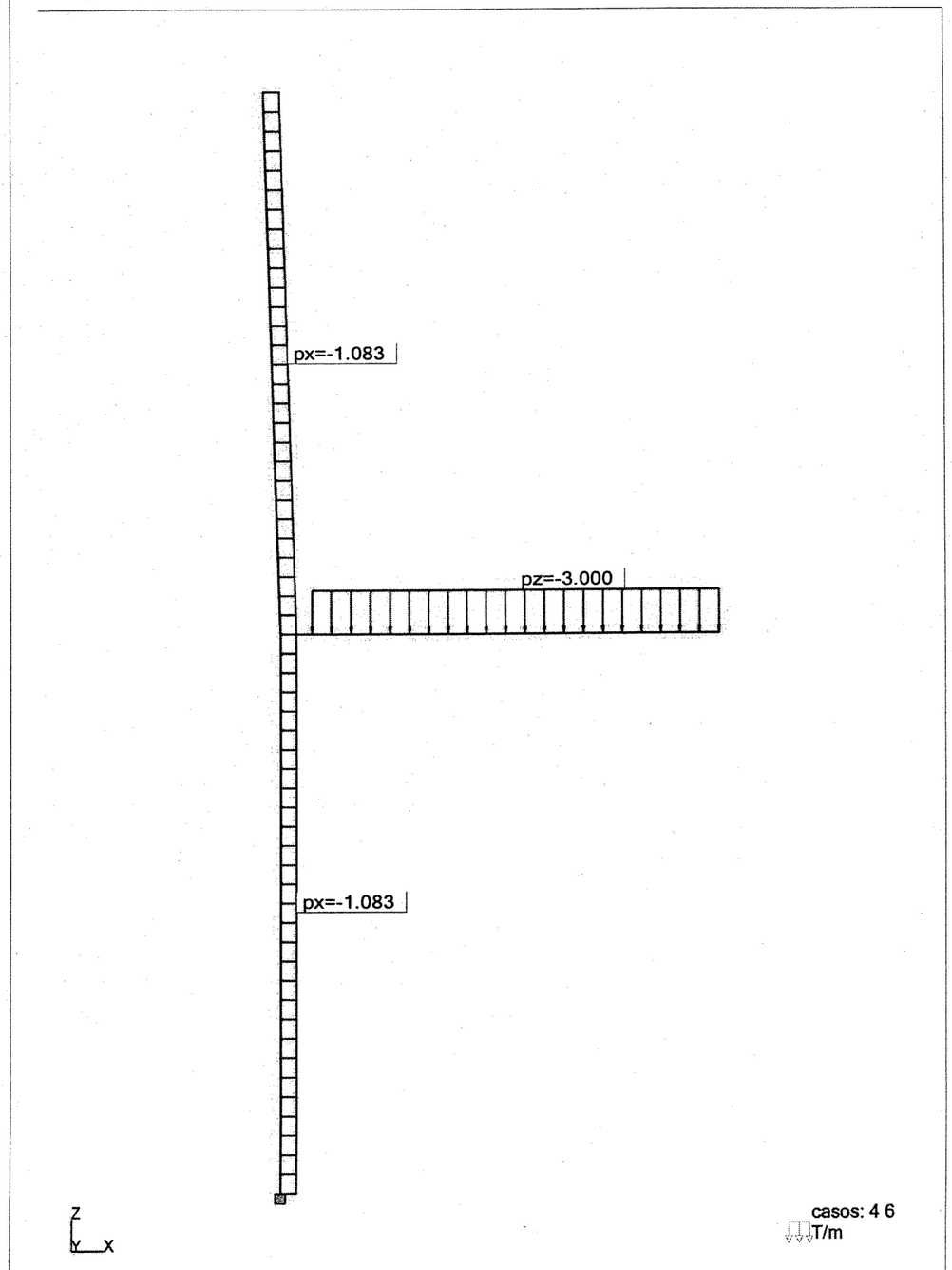


## Cargas Aplicadas: Peso Terreno en Bandeja

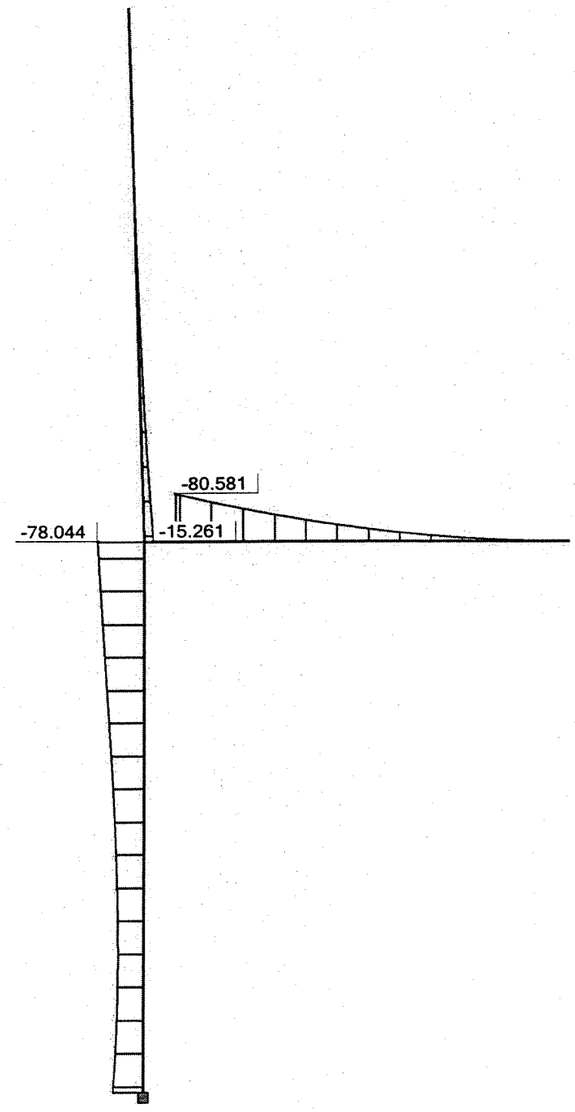



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## Cargas Aplicadas: Sobrecargas

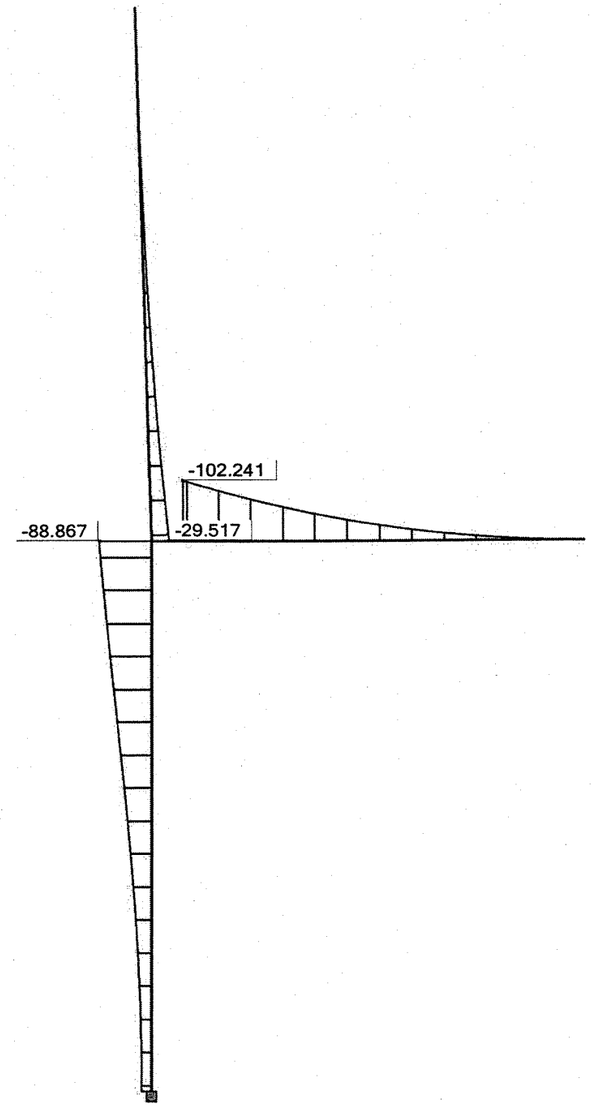


## Momentos Flectores - ELS Terreno

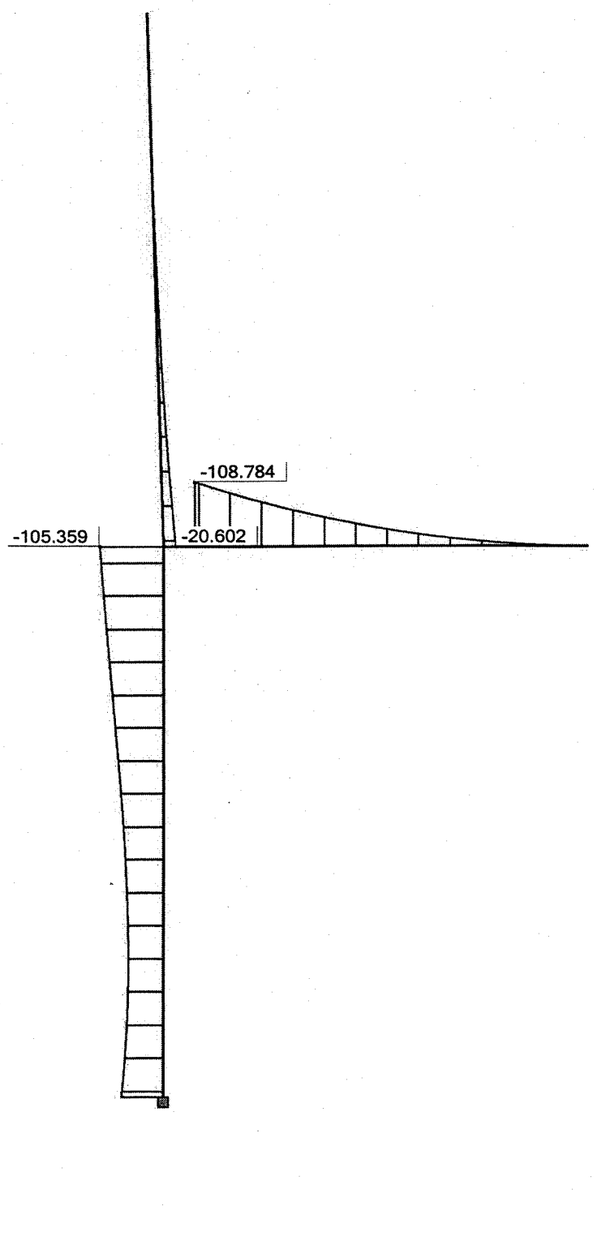



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## Momentos Flectores - ELS Terreno+Sobrecarga

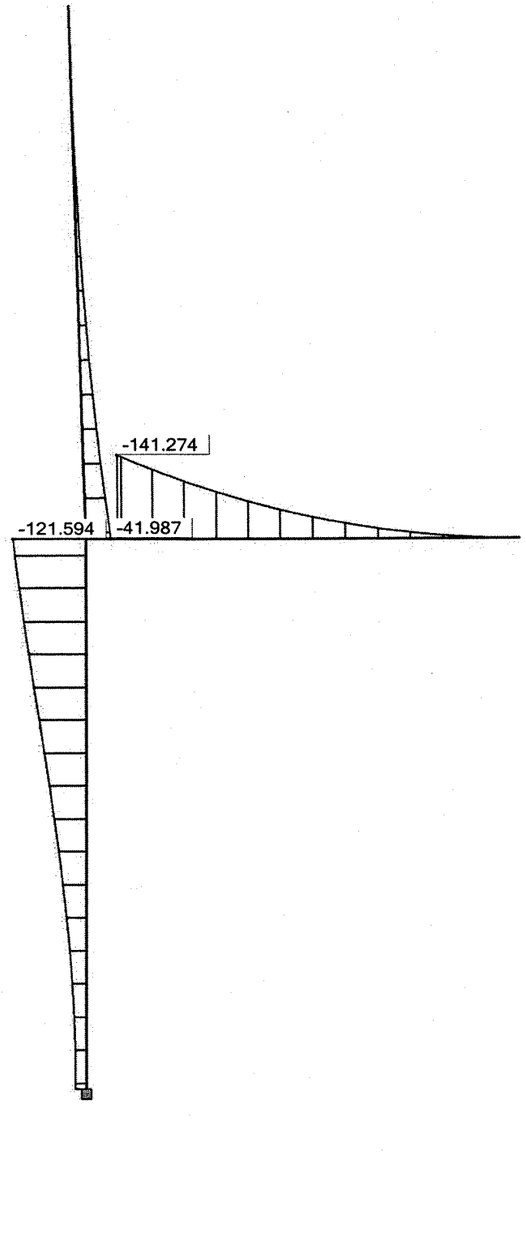


## Momentos Flectores - ELU Terreno

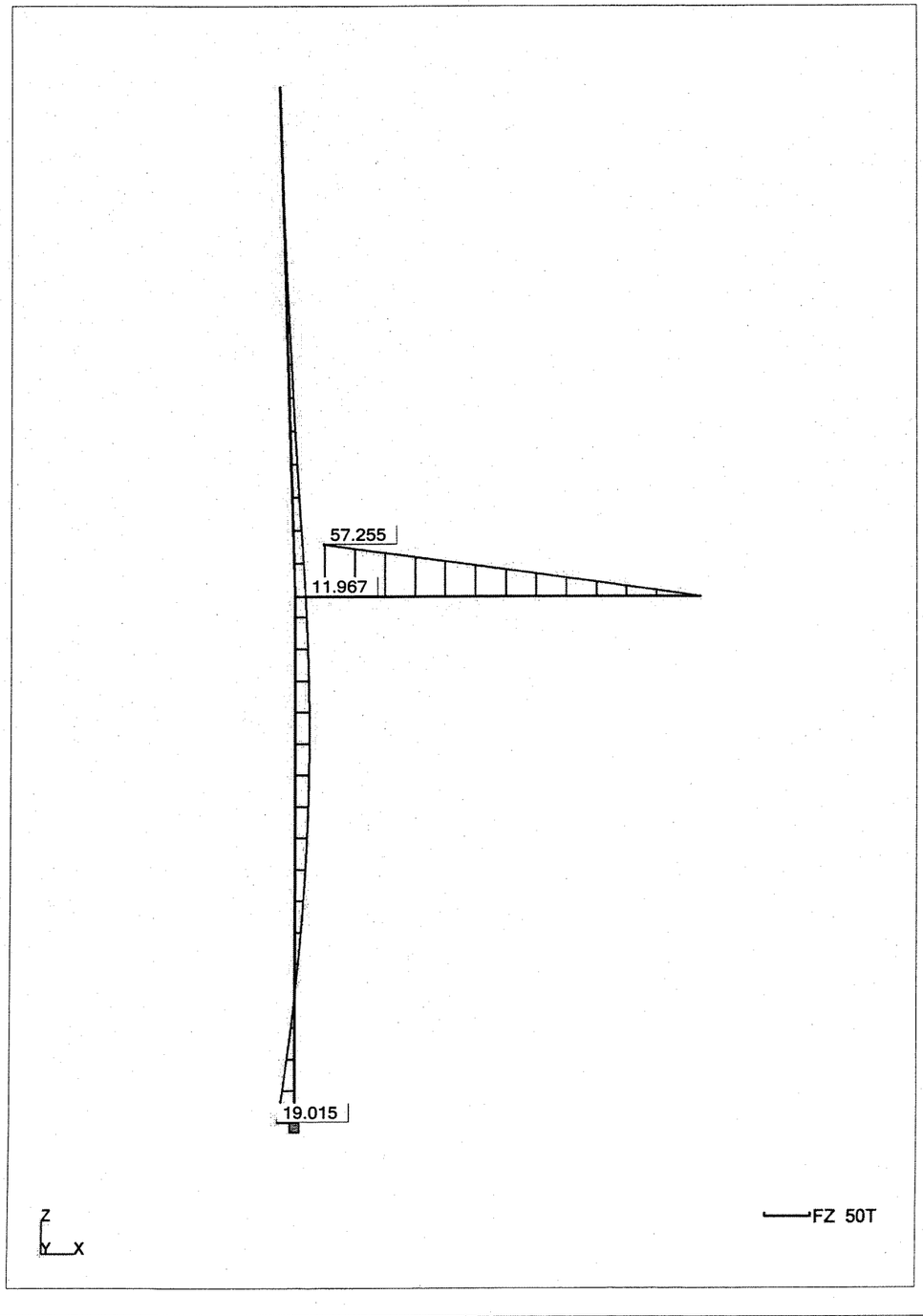



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## Momentos Flectores - ELU Terreno+Sobrecarga

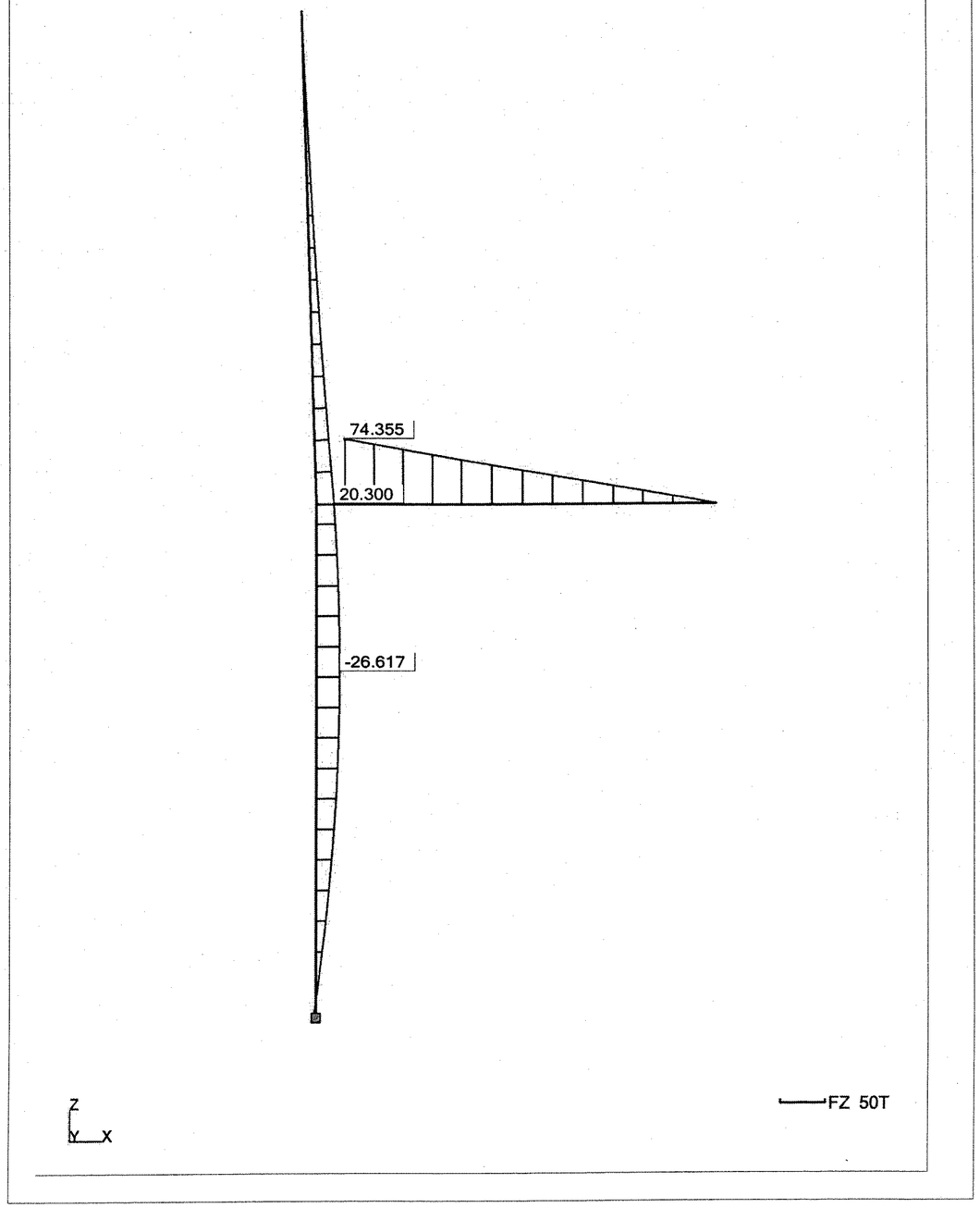


## Esfuerzos Cortantes - ELU Terreno




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## Esfuerzos Cortantes - ELU Terreno+Sobrecarga



## Esfuerzos en Muro

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 1/ 1** | 5.520 | 8.864 | -15.261 |
| **11 (C)/ 1/ 2/10** | 4.742 | 7.015 | -10.743 |
| **11 (C)/ 1/ 3/10** | 4.005 | 5.382 | -7.219 |
| **11 (C)/ 1/ 4/10** | 3.309 | 3.965 | -4.564 |
| **11 (C)/ 1/ 5/10** | 2.654 | 2.764 | -2.656 |
| **11 (C)/ 1/ 6/10** | 2.041 | 1.779 | -1.371 |
| **11 (C)/ 1/ 7/10** | 1.469 | 1.010 | -0.587 |
| **11 (C)/ 1/ 8/10** | 0.938 | 0.457 | -0.179 |
| **11 (C)/ 1/ 9/10** | 0.448 | 0.121 | -0.024 |
| **11 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 1/ 1** | 5.358 | 14.420 | -29.517 |
| **12 (C)/ 1/ 2/10** | 4.597 | 11.953 | -22.008 |
| **12 (C)/ 1/ 3/10** | 3.878 | 9.703 | -15.843 |
| **12 (C)/ 1/ 4/10** | 3.201 | 7.669 | -10.901 |
| **12 (C)/ 1/ 5/10** | 2.564 | 5.850 | -7.057 |
| **12 (C)/ 1/ 6/10** | 1.969 | 4.248 | -4.188 |
| **12 (C)/ 1/ 7/10** | 1.415 | 2.862 | -2.171 |
| **12 (C)/ 1/ 8/10** | 0.902 | 1.692 | -0.883 |
| **12 (C)/ 1/ 9/10** | 0.430 | 0.738 | -0.200 |
| **12 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 1/ 1** | 7.452 | 11.967 | -20.602 |
| **21 (C)/ 1/ 2/10** | 6.401 | 9.470 | -14.503 |
| **21 (C)/ 1/ 3/10** | 5.406 | 7.265 | -9.746 |
| **21 (C)/ 1/ 4/10** | 4.467 | 5.352 | -6.162 |
| **21 (C)/ 1/ 5/10** | 3.583 | 3.731 | -3.586 |
| **21 (C)/ 1/ 6/10** | 2.755 | 2.401 | -1.851 |
| **21 (C)/ 1/ 7/10** | 1.983 | 1.363 | -0.792 |
| **21 (C)/ 1/ 8/10** | 1.266 | 0.617 | -0.241 |
| **21 (C)/ 1/ 9/10** | 0.605 | 0.163 | -0.033 |
| **21 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 1/ 1** | 7.209 | 20.300 | -41.987 |
| **22 (C)/ 1/ 2/10** | 6.185 | 16.878 | -31.400 |
| **22 (C)/ 1/ 3/10** | 5.217 | 13.747 | -22.682 |
| **22 (C)/ 1/ 4/10** | 4.305 | 10.908 | -15.666 |
| **22 (C)/ 1/ 5/10** | 3.448 | 8.361 | -10.186 |
| **22 (C)/ 1/ 6/10** | 2.647 | 6.105 | -6.076 |
| **22 (C)/ 1/ 7/10** | 1.902 | 4.141 | -3.168 |
| **22 (C)/ 1/ 8/10** | 1.212 | 2.469 | -1.297 |
| **22 (C)/ 1/ 9/10** | 0.578 | 1.089 | -0.297 |
| **22 (C)/ 1/ 2** | -0.000 | 0.000 | -0.000 |

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## Esfuerzos en Pantalla

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 2/ 5** | 56.142 | 14.085 | -51.321 |
| **11 (C)/ 2/ 2/10** | 55.258 | 6.939 | -45.187 |
| **11 (C)/ 2/ 3/10** | 54.375 | 0.951 | -42.921 |
| **11 (C)/ 2/ 4/10** | 53.491 | -3.879 | -43.840 |
| **11 (C)/ 2/ 5/10** | 52.607 | -7.549 | -47.262 |
| **11 (C)/ 2/ 6/10** | 51.723 | -10.061 | -52.504 |
| **11 (C)/ 2/ 7/10** | 50.839 | -11.413 | -58.883 |
| **11 (C)/ 2/ 8/10** | 49.956 | -11.607 | -65.719 |
| **11 (C)/ 2/ 9/10** | 49.072 | -10.643 | -72.327 |
| **11 (C)/ 2/ 1** | 48.188 | -8.699 | -78.044 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 2/ 5** | 67.542 | 2.787 | -17.475 |
| **12 (C)/ 2/ 2/10** | 66.658 | -3.722 | -17.807 |
| **12 (C)/ 2/ 3/10** | 65.775 | -9.072 | -21.631 |
| **12 (C)/ 2/ 4/10** | 64.891 | -13.263 | -28.264 |
| **12 (C)/ 2/ 5/10** | 64.007 | -16.296 | -37.025 |
| **12 (C)/ 2/ 6/10** | 63.123 | -18.170 | -47.230 |
| **12 (C)/ 2/ 7/10** | 62.239 | -18.885 | -58.197 |
| **12 (C)/ 2/ 8/10** | 61.356 | -18.441 | -69.245 |
| **12 (C)/ 2/ 9/10** | 60.472 | -16.839 | -79.689 |
| **12 (C)/ 2/ 1** | 59.588 | -14.257 | -88.867 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 2/ 5** | 75.792 | 19.015 | -69.283 |
| **21 (C)/ 2/ 2/10** | 74.599 | 9.367 | -61.003 |
| **21 (C)/ 2/ 3/10** | 73.406 | 1.283 | -57.943 |
| **21 (C)/ 2/ 4/10** | 72.213 | -5.236 | -59.184 |
| **21 (C)/ 2/ 5/10** | 71.020 | -10.191 | -63.803 |
| **21 (C)/ 2/ 6/10** | 69.826 | -13.582 | -70.880 |
| **21 (C)/ 2/ 7/10** | 68.633 | -15.408 | -79.493 |
| **21 (C)/ 2/ 8/10** | 67.440 | -15.670 | -88.720 |
| **21 (C)/ 2/ 9/10** | 66.247 | -14.368 | -97.641 |
| **21 (C)/ 2/ 1** | 65.054 | -11.744 | -105.359 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 2/ 5** | 92.892 | 2.068 | -18.514 |
| **22 (C)/ 2/ 2/10** | 91.699 | -6.623 | -19.932 |
| **22 (C)/ 2/ 3/10** | 90.506 | -13.750 | -26.008 |
| **22 (C)/ 2/ 4/10** | 89.313 | -19.313 | -35.820 |
| **22 (C)/ 2/ 5/10** | 88.120 | -23.312 | -48.448 |
| **22 (C)/ 2/ 6/10** | 86.926 | -25.746 | -62.969 |
| **22 (C)/ 2/ 7/10** | 85.733 | -26.615 | -78.463 |
| **22 (C)/ 2/ 8/10** | 84.540 | -25.921 | -94.009 |
| **22 (C)/ 2/ 9/10** | 83.347 | -23.661 | -108.685 |
| **22 (C)/ 2/ 1** | 82.154 | -20.081 | -121.594 |

## Esfuerzos en Bandeja

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 3/ 4** | -0.000 | 42.411 | -80.581 |
| **11 (C)/ 3/ 2/10** | -0.000 | 37.699 | -63.669 |
| **11 (C)/ 3/ 3/10** | -0.000 | 32.986 | -48.747 |
| **11 (C)/ 3/ 4/10** | -0.000 | 28.274 | -35.814 |
| **11 (C)/ 3/ 5/10** | -0.000 | 23.562 | -24.871 |
| **11 (C)/ 3/ 6/10** | -0.000 | 18.849 | -15.917 |
| **11 (C)/ 3/ 7/10** | -0.000 | 14.137 | -8.953 |
| **11 (C)/ 3/ 8/10** | -0.000 | 9.425 | -3.979 |
| **11 (C)/ 3/ 9/10** | -0.000 | 4.712 | -0.995 |
| **11 (C)/ 3/ 3** | -0.000 | 0.000 | 0.0 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 3/ 4** | -0.000 | 53.811 | -102.241 |
| **12 (C)/ 3/ 2/10** | -0.000 | 47.832 | -80.783 |
| **12 (C)/ 3/ 3/10** | -0.000 | 41.853 | -61.850 |
| **12 (C)/ 3/ 4/10** | -0.000 | 35.874 | -45.440 |
| **12 (C)/ 3/ 5/10** | -0.000 | 29.895 | -31.556 |
| **12 (C)/ 3/ 6/10** | -0.000 | 23.916 | -20.196 |
| **12 (C)/ 3/ 7/10** | -0.000 | 17.937 | -11.360 |
| **12 (C)/ 3/ 8/10** | -0.000 | 11.958 | -5.049 |
| **12 (C)/ 3/ 9/10** | -0.000 | 5.979 | -1.262 |
| **12 (C)/ 3/ 3** | -0.000 | 0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 3/ 4** | -0.000 | 57.255 | -108.784 |
| **21 (C)/ 3/ 2/10** | -0.000 | 50.893 | -85.953 |
| **21 (C)/ 3/ 3/10** | -0.000 | 44.532 | -65.808 |
| **21 (C)/ 3/ 4/10** | -0.000 | 38.170 | -48.349 |
| **21 (C)/ 3/ 5/10** | -0.000 | 31.808 | -33.575 |
| **21 (C)/ 3/ 6/10** | -0.000 | 25.447 | -21.488 |
| **21 (C)/ 3/ 7/10** | -0.000 | 19.085 | -12.087 |
| **21 (C)/ 3/ 8/10** | -0.000 | 12.723 | -5.372 |
| **21 (C)/ 3/ 9/10** | -0.000 | 6.362 | -1.343 |
| **21 (C)/ 3/ 3** | -0.000 | 0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 3/ 4** | -0.000 | 74.355 | -141.274 |
| **22 (C)/ 3/ 2/10** | -0.000 | 66.093 | -111.624 |
| **22 (C)/ 3/ 3/10** | -0.000 | 57.832 | -85.462 |
| **22 (C)/ 3/ 4/10** | -0.000 | 49.570 | -62.789 |
| **22 (C)/ 3/ 5/10** | -0.000 | 41.308 | -43.603 |
| **22 (C)/ 3/ 6/10** | -0.000 | 33.047 | -27.906 |
| **22 (C)/ 3/ 7/10** | -0.000 | 24.785 | -15.697 |
| **22 (C)/ 3/ 8/10** | -0.000 | 16.523 | -6.977 |
| **22 (C)/ 3/ 9/10** | -0.000 | 8.262 | -1.744 |
| **22 (C)/ 3/ 3** | -0.000 | 0.000 | 0.000 |

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## Reacciones en Apoyo

| Nudo/Caso | Nombre del caso | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|---|
| **5/ 11 (C)** | ELS (Terreno) | -14.085 | 56.142 | -51.321 |
| **5/ 12 (C)** | ELS (Terreno+Sobrecarga) | -2.787 | 67.542 | -17.475 |
| **5/ 21 (C)** | ELU (Terreno) | -19.015 | 75.792 | -69.283 |
| **5/ 22 (C)** | ELU (Terreno+Sobrecarga) | -2.068 | 92.892 | -18.514 |

La estabilidad del muro se obtiene cuando los empujes pasivos son capaces de compensar los empujes activos. Para que se de este criterio, el momento de reacción en el apoyo de la pantalla deba ser cero.

En caso de tener un momento negativo, éste nos indica que el momento producido por los empujes pasivos es mayor que el producido por los empujes activos y, por tanto, la pantalla es capaz de generar mecanismos resistentes.

En las reacciones adjuntas se puede ver que los momentos en el apoyo de pantalla son siempre menores o iguales a cero. De este modo, podemos asegurar la estabilidad de la pantalla.

## 5.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

### CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: MURO**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 41.99 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 60.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **5.68** |
| **ARMADURA NECESARIA(cm2)** | **18.51** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **5.40** |
| **Cuantía Mínima Horizontal (cm2)** | **19.20** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrán una barra Ø25 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**MURO**

| | |
|---|---|
| D(mm) | 550 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 39.27 |
| Vrd(Tn) | 20.30 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.603 |
| Roele | 0.0071 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 276500.8 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 230417.31 |
| Vsu,p | 198000.00 |

***As,c =*** ***0.0*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 6000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 2750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**MURO**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 60.00 |
| Arm. Tracción | As1 | cm2 | 39.27 |
| Canto útil | d | cm | 55.00 |
| Arm. Compresión | As2 | cm2 | 25.13 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0071 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 4.69 |
| Inercia fisurada | If | cm4 | 813,332 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 29.57 |
| Diámetro | ϕ | mm | 25 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 6000 |
| Area sec. Homog. | Ah | cm2 | 6496.04 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 30.42 |
| Inercia sec. Homog. | Ih | cm4 | 2108882.46 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 18.286 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 871 |
| Tensión de servicio | Ts | kp/cm2 | 1,409 |
| Area eficaz | Ac,ef | cm2 | 1500 |
| Alargamiento medio armaduras | εsm | | 0.0005 |
| Separación media de fisuras | Sm | mm | 147.75 |
| **Abertura característica** | **Wk** | **mm** | **0.14** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: PANTALLA**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 121.59 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 60.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **18.83** |
| **ARMADURA NECESARIA(cm2)** | **61.35** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **5.40** |
| **Cuantía Mínima Horizontal (cm2)** | **19.20** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø32 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**PANTALLA**

| | |
|---|---|
| D(mm) | 550 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 64.34 |
| Vrd(Tn) | 26.62 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.603 |
| Roele | 0.0117 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 325964.1 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 271636.72 |
| Vsu,p | 198000.00 |

***As,c =*** ***0.0*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 6000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 2750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

### PANTALLA

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 60.00 |
| Arm. Tracción | As1 | cm2 | 64.34 |
| Canto útil | d | cm | 55.00 |
| Arm. Compresión | As2 | cm2 | 39.27 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 6000 |
| Area sec. Homog. | Ah | cm2 | 6798.05 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 30.71 |
| Inercia sec. Homog. | Ih | cm4 | 2295353.80 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0117 |
| Cuantía mecánica 2 | ρ2 | 0.0071 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 20.101 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 6.90 |
| Inercia fisurada | If | cm4 | 1,254,804 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 88.87 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 594 |
| Tensión de servicio | Ts | kp/cm2 | 2,624 |
| Area eficaz | Ac,ef | cm2 | 1500 |
| Alargamiento medio armaduras | εsm | | 0.0012 |
| Separación media de fisuras | Sm | mm | 130.30 |
| **Abertura característica** | **Wk** | **mm** | **0.27** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: BANDEJA**

Tipo de elemento Losas

| Momento Flector [T·m] | | 141.27 |
|---|---|---|
| Axil [T] (COMPRESION POSITIVA) | | 0.00 |
| Ancho = B [cm] | | 100.0 |
| Canto = H [cm] | | 60.0 |
| Recubrimiento [cm] | | 5.0 |
| Fcd [kp/cm2] | | 166.7 |
| Fyd [kp/cm2] | | 4347.8 |

| **POSICION FIBRA NEUTRA(cm)** | | **22.90** |
|---|---|---|
| **ARMADURA NECESARIA(cm2)** | | **74.61** |

| **Cuantía Mínima Vertical (cm2)** | | **10.80** |
|---|---|---|
| **Cuantía Mínima Horizontal (cm2)** | | |

La cuantía mínima corresponde a la cara de tracción

**Se dispondrán dos barras Ø25 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**BANDEJA**

| | |
|---|---|
| D(mm) | 550 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 78.54 |
| Vrd(Tn) | 66.09 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.603 |
| Roele | 0.0143 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 348369.1 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 290307.62 |
| Vsu,p | 198000.00 |

***As,c =*** ***18.7*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m** **Se dispondrán dos cercos Ø12 cada 0,20m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 6000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 2750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro III - Estribo 1 - Pérgola**

**BANDEJA**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 60.00 |
| Arm. Tracción | As1 | cm2 | 78.54 |
| Canto útil | d | cm | 55.00 |
| Arm. Compresión | As2 | cm2 | 25.13 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0143 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 6.53 |
| Inercia fisurada | If | cm4 | 1,548,114 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 102.24 |
| Diámetro | ϕ | mm | 25 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 6000 |
| Area sec. Homog. | Ah | cm2 | 6798.51 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 31.51 |
| Inercia sec. Homog. | Ih | cm4 | 2283512.26 |

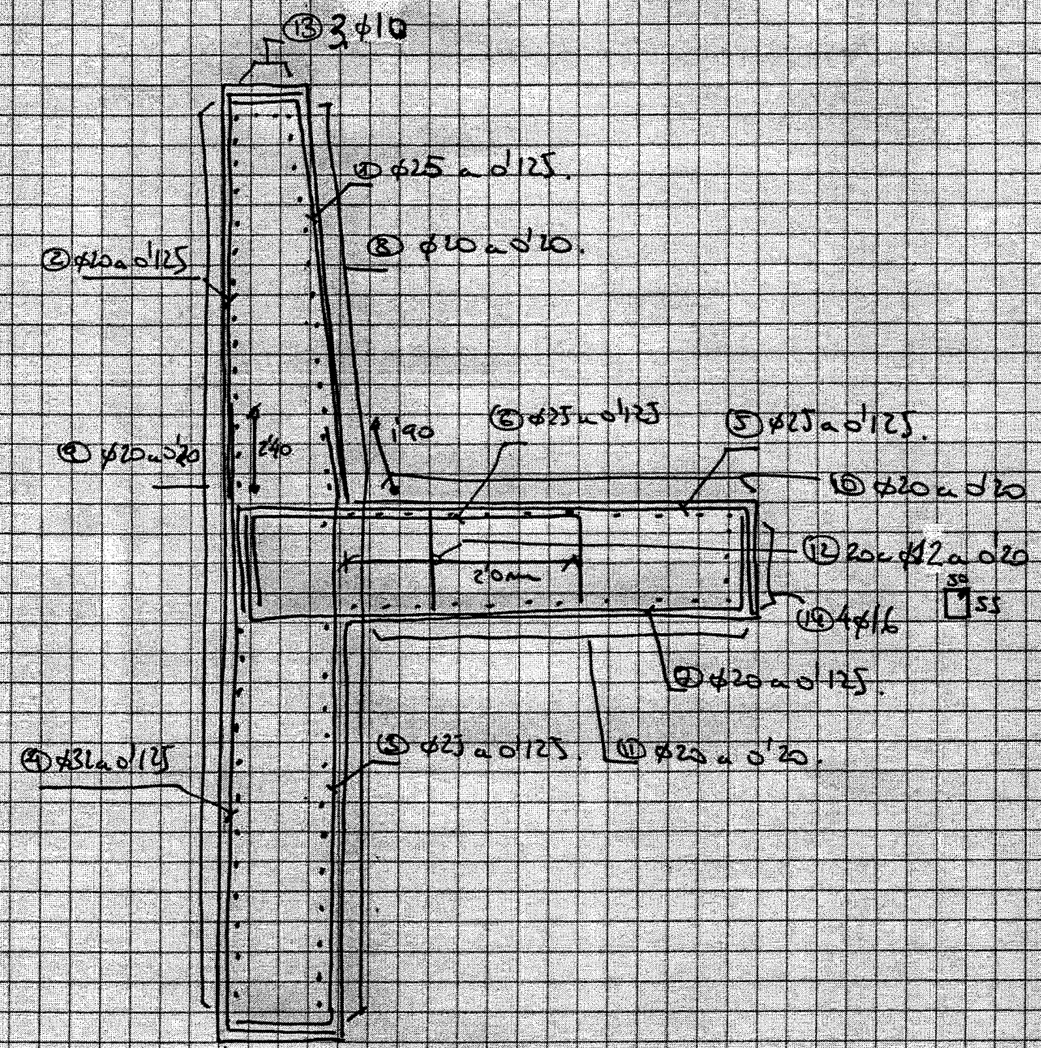
| CÁLCULO DEL MOMENTO DE FISURACIÓN | | |
|---|---|---|
| Momento de fisuración | Mfis | mT 20.561 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 496 |
| Tensión de servicio | Ts | kp/cm2 | 2,466 |
| Area eficaz | Ac,ef | cm2 | 1500 |
| Alargamiento medio armaduras | εsm | | 0.0012 |
| Separación media de fisuras | Sm | mm | 123.87 |
| **Abertura característica** | **Wk** | **mm** | **0.24** |

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

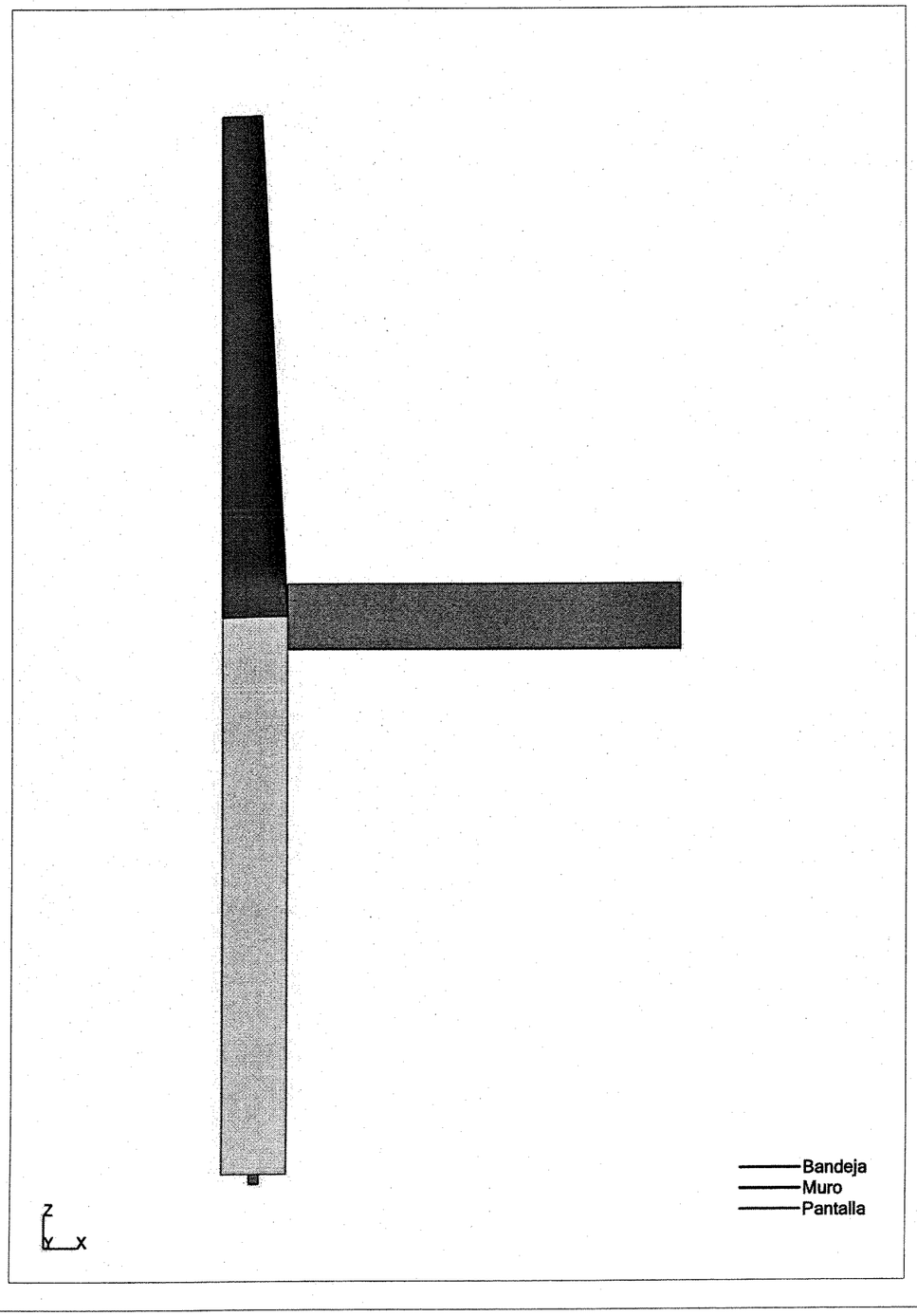
ARMADO MURO TIPO III




# 6 MURO TIPO IV

## 6.1 MODELO DE CÁLCULO Y ESFUERZOS

## Modelo de Cálculo




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## Nudos que Componen la Estructura

| Nudo | X (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | | |
| 2 | -0.100 | 3.810 | | |
| 3 | 3.250 | 0.0 | | |
| 4 | 0.250 | 0.0 | | |
| 5 | 0.0 | -4.250 | fff | Apoyo |

## Barras que Componen la Estructura

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) |
|---|---|---|---|---|---|
| 1 | 1 | 2 | Muro | HORMIGON | 3.811 |
| 2 | 5 | 1 | Pantalla | HORM | 4.250 |
| 3 | 4 | 3 | Bandeja | HORM | 3.000 |

## Características de las Barras que Componen la Estructura

| Nombre de la sección | Lista de barras | BB (m) | HH (m) | SX (m2) | SY (m2) | SZ (m2) | IX (m4) | IY (m4) | IZ (m4) |
|---|---|---|---|---|---|---|---|---|---|
| Bandeja | 3 | 1.00 | 0.50 | 0.50000 | 0.41667 | 0.41667 | 0.02859 | 0.01042 | 0.04167 |
| Muro | 1 | 1.00 | 0.50 | 0.40000 | 0.33333 | 0.33333 | 0.01596 | 0.00533 | 0.03333 |
| Pantalla | 2 | 1.00 | 0.50 | 0.50000 | 0.41667 | 0.41667 | 0.02859 | 0.01042 | 0.04167 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Apoyo | 5 | UX UZ RY |

## Cargas Aplicadas a la Estructura

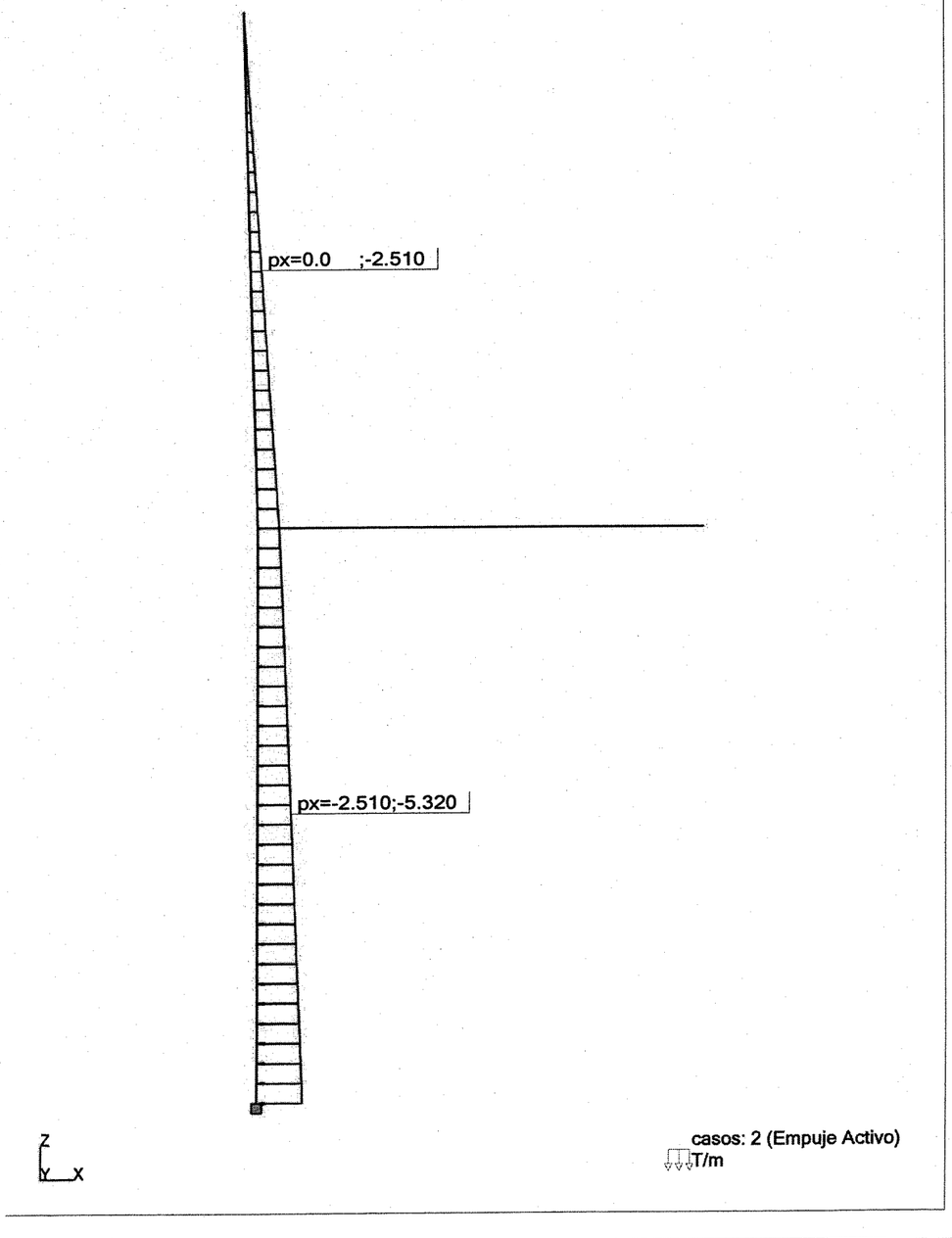
| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1A3 | PZ Menos Coef=1.0000 |
| 2 | Empuje Activo | carga trapezoidal | 1 | PX2=0.0(T/m) PX1=-2.510(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 2 | Empuje Activo | carga trapezoidal | 2 | PX2=-2.510(T/m) PX1=-5.320(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 3 | Empuje Pasivo | carga trapezoidal | 2 | PX2=0.0(T/m) PX1=16.000(T/m) X2=4.000(m) X1=0.0(m) global no proyectadas absolutos |
| 4 | Empuje Sobrecarga | sobrecarga uniforme | 1 2 | PX=-1.083(T/m) |
| 5 | Peso en Bandeja Terreno | sobrecarga uniforme | 3 | PZ=-7.120(T/m) |
| 6 | Peso en Bandeja Sobrecarga | sobrecarga uniforme | 3 | PZ=-3.000(T/m) |

## Combinación de Acciones

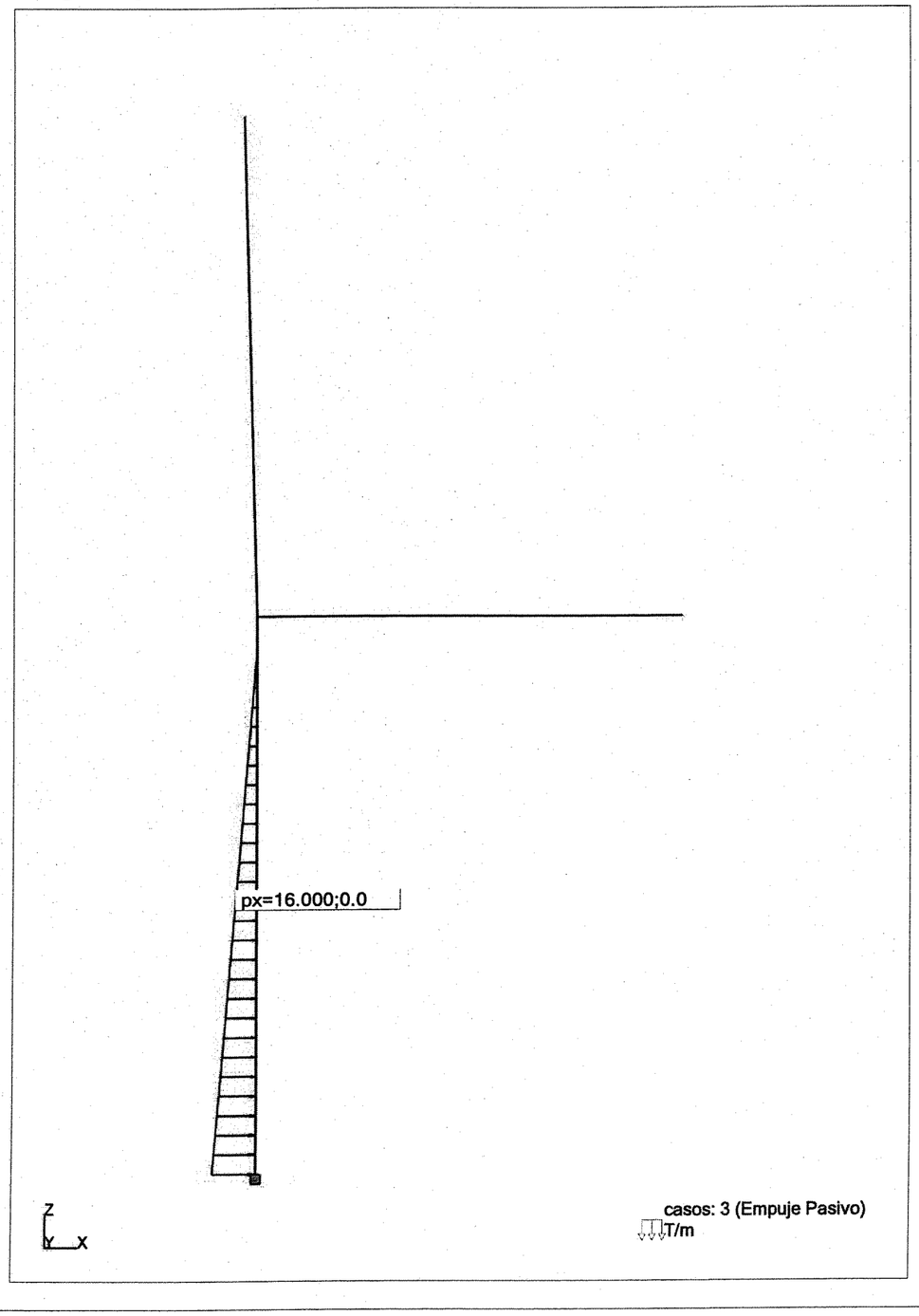
| Combinación | Nombre | Definición |
|---|---|---|
| 11 (C) | ELS (Terreno) | (1+2+3+5)*1.0000 |
| 12 (C) | ELS (Terreno+Sobrecarga) | (1+2+3+4+5+6)*1.0000 |
| 21 (C) | ELU (Terreno) | (1+2+3+5)*1.3500 |
| 22 (C) | ELU (Terreno+Sobrecarga) | (1+2+3+5)*1.3500+(4+6)*1.5000 |

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## Cargas Aplicadas: Empuje Activo

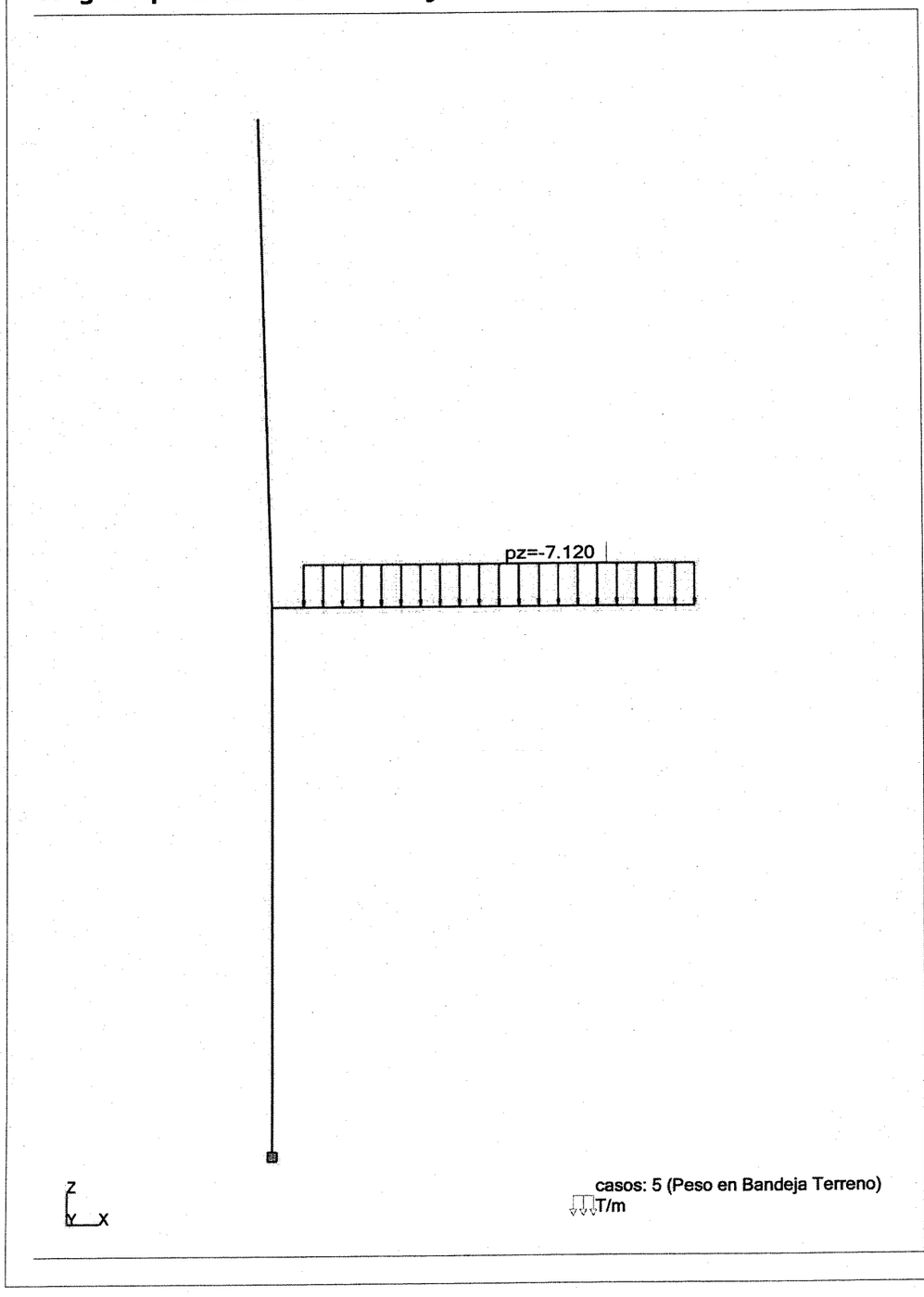


## Cargas Aplicadas: Empuje Pasivo

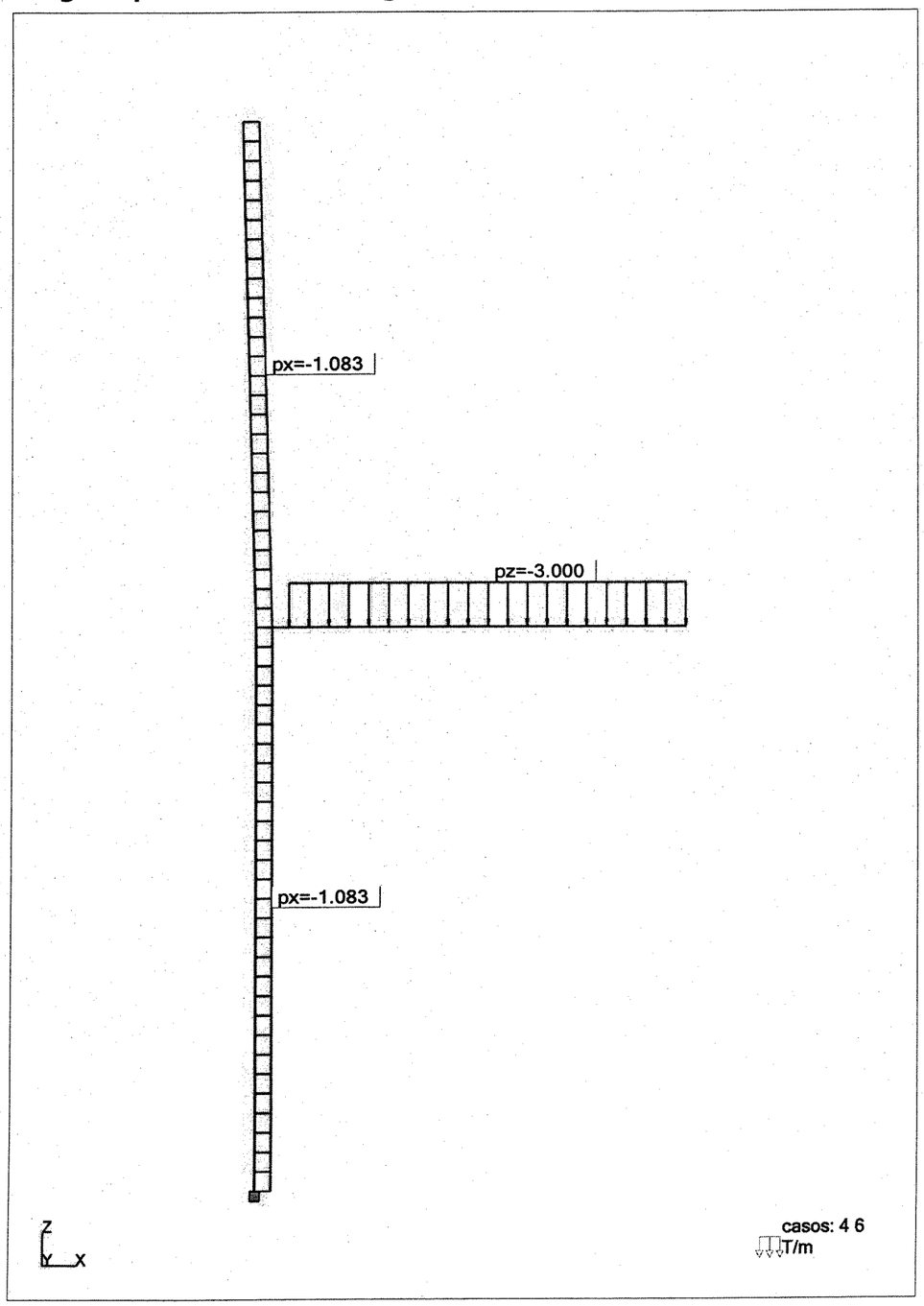





## Cargas Aplicadas: Peso Bandeja en Terreno

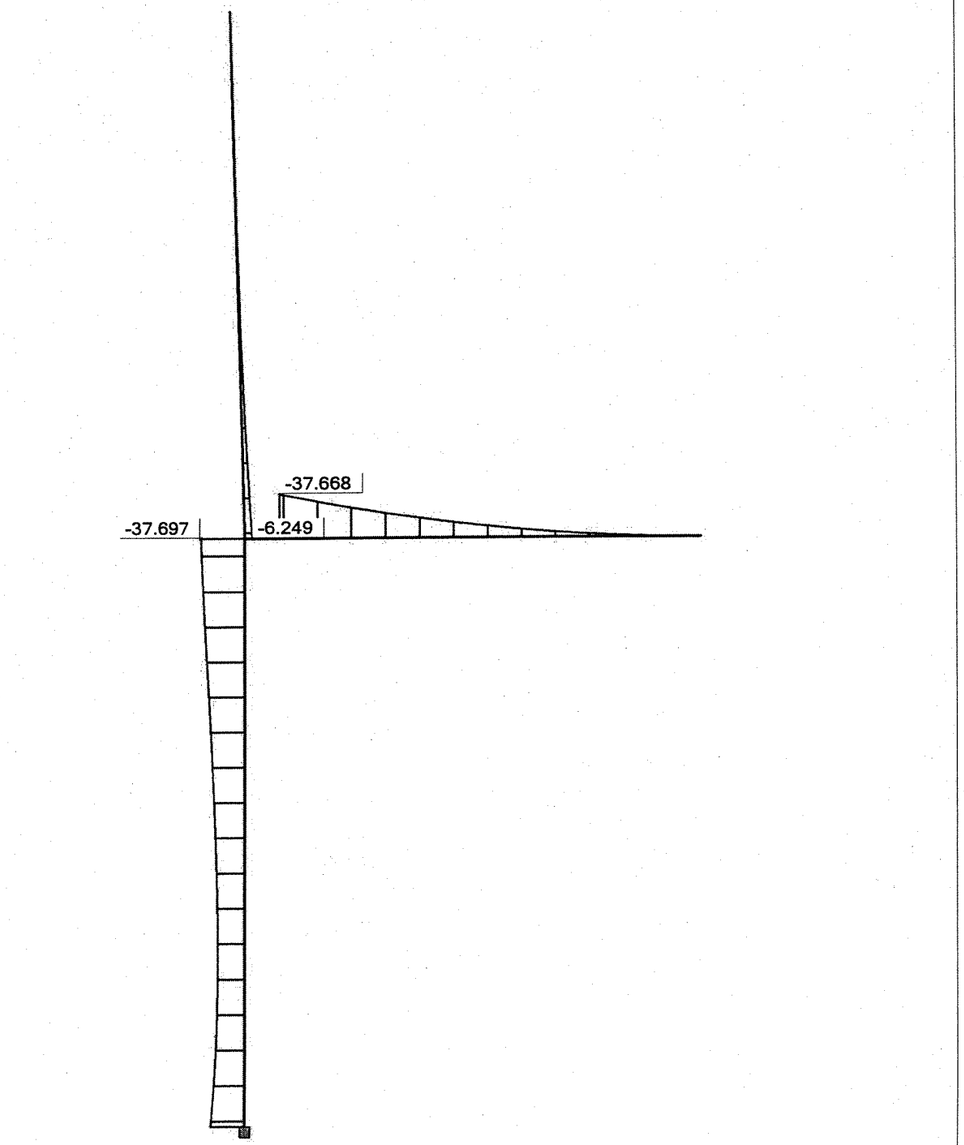


## Cargas Aplicadas: Sobrecargas

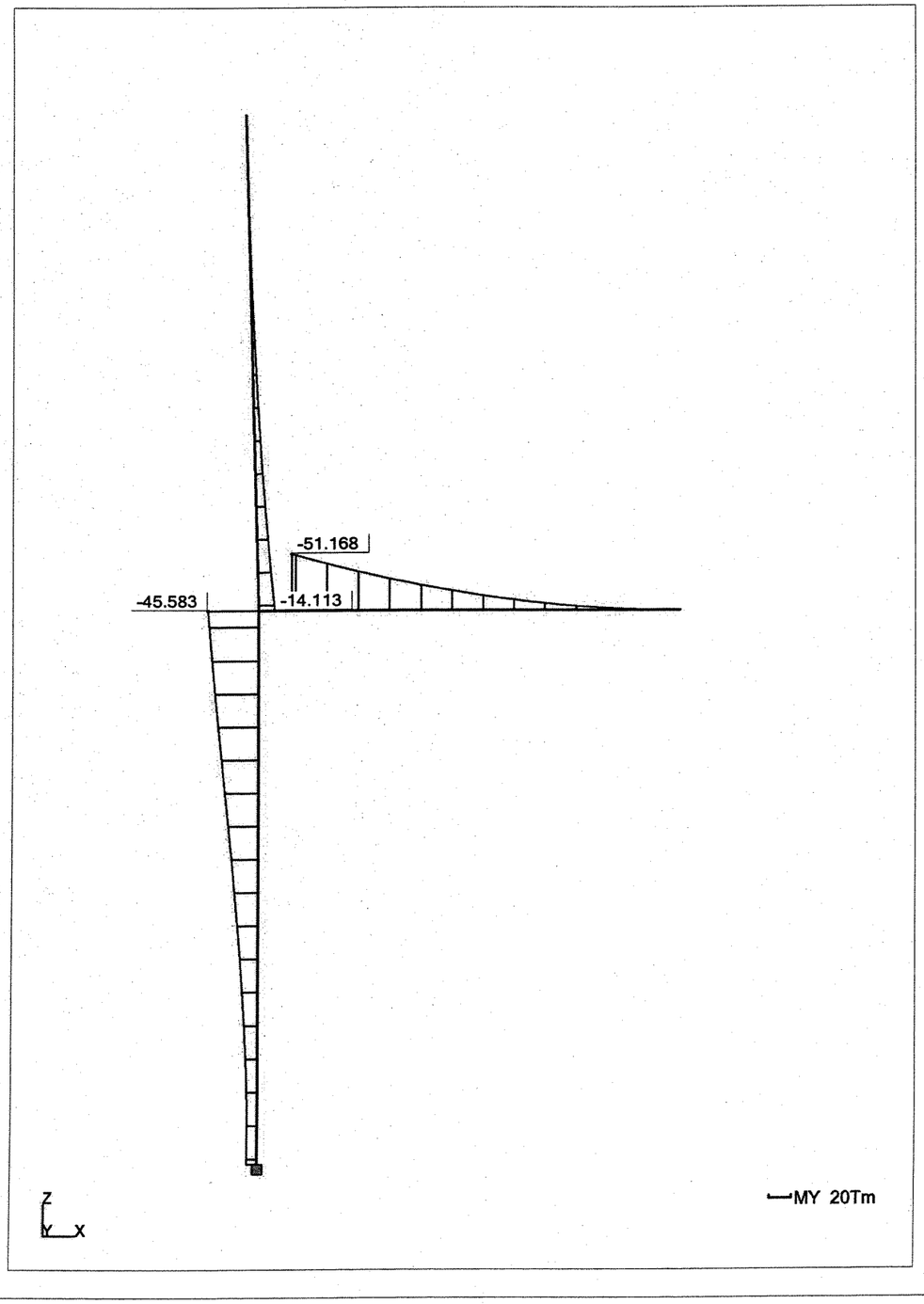





## Momentos Flectores - ELS Terreno

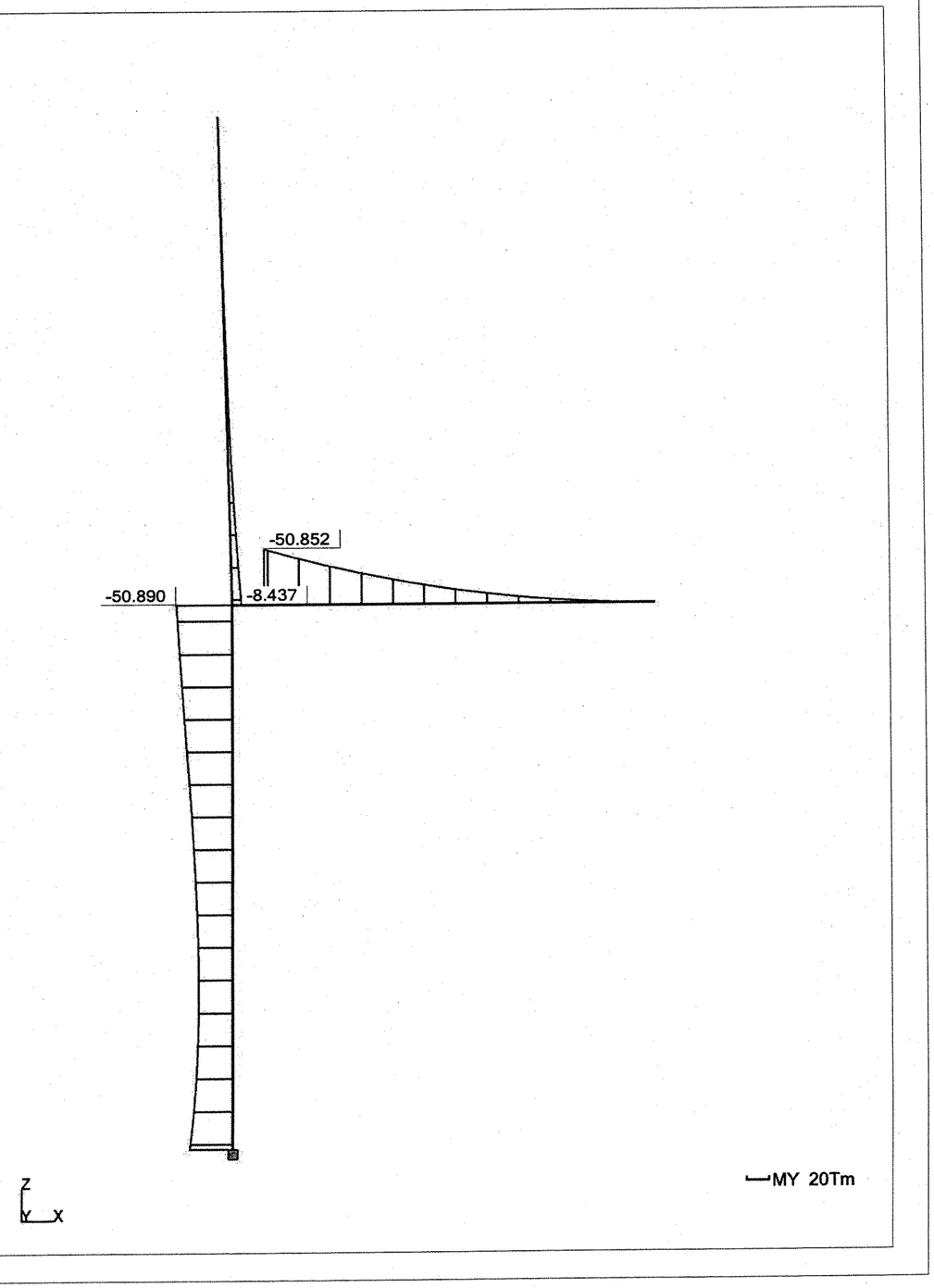


## Momentos Flectores - ELS Terreno+Sobrecarga

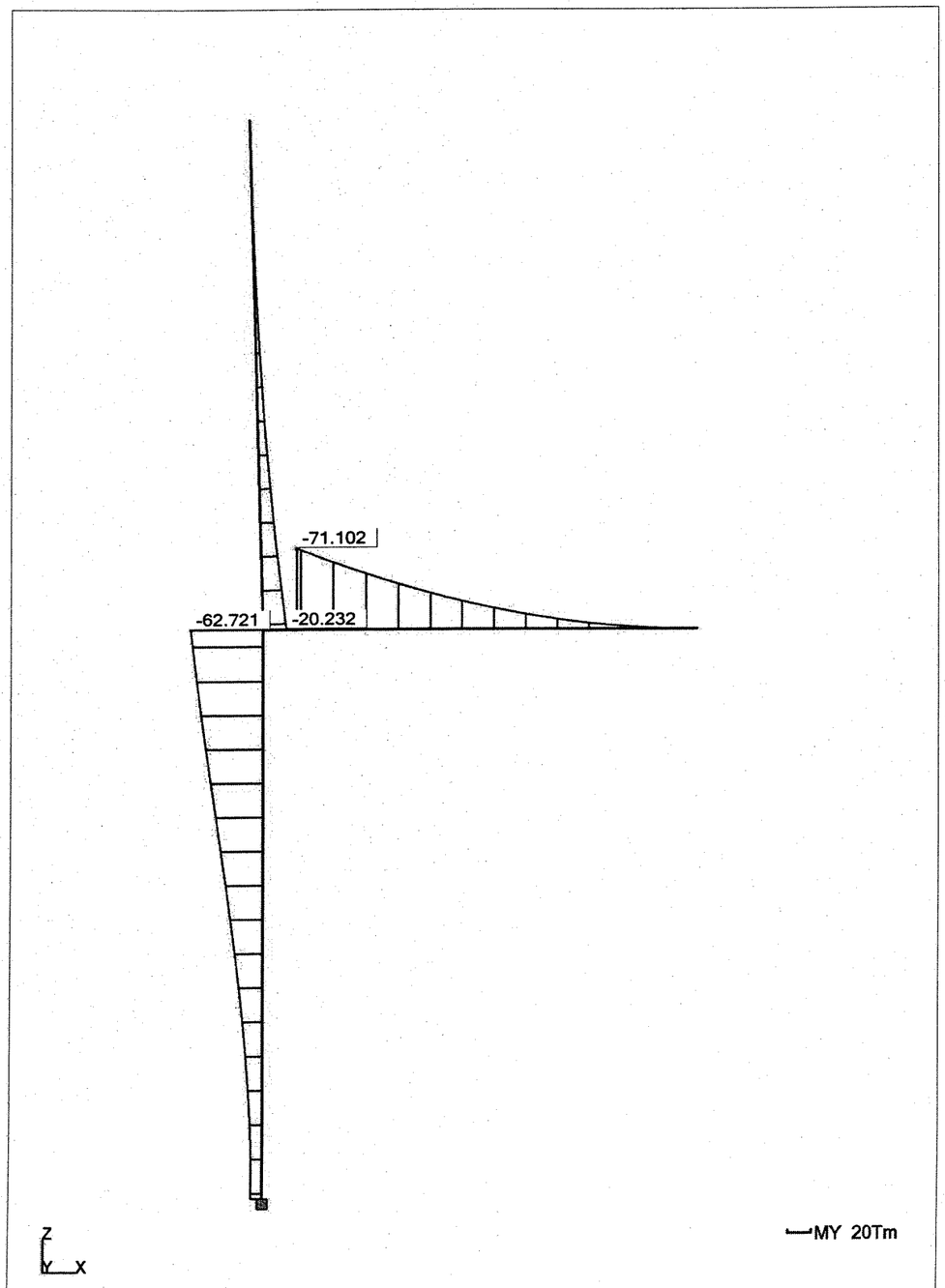



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## Momentos Flectores - ELU Terreno

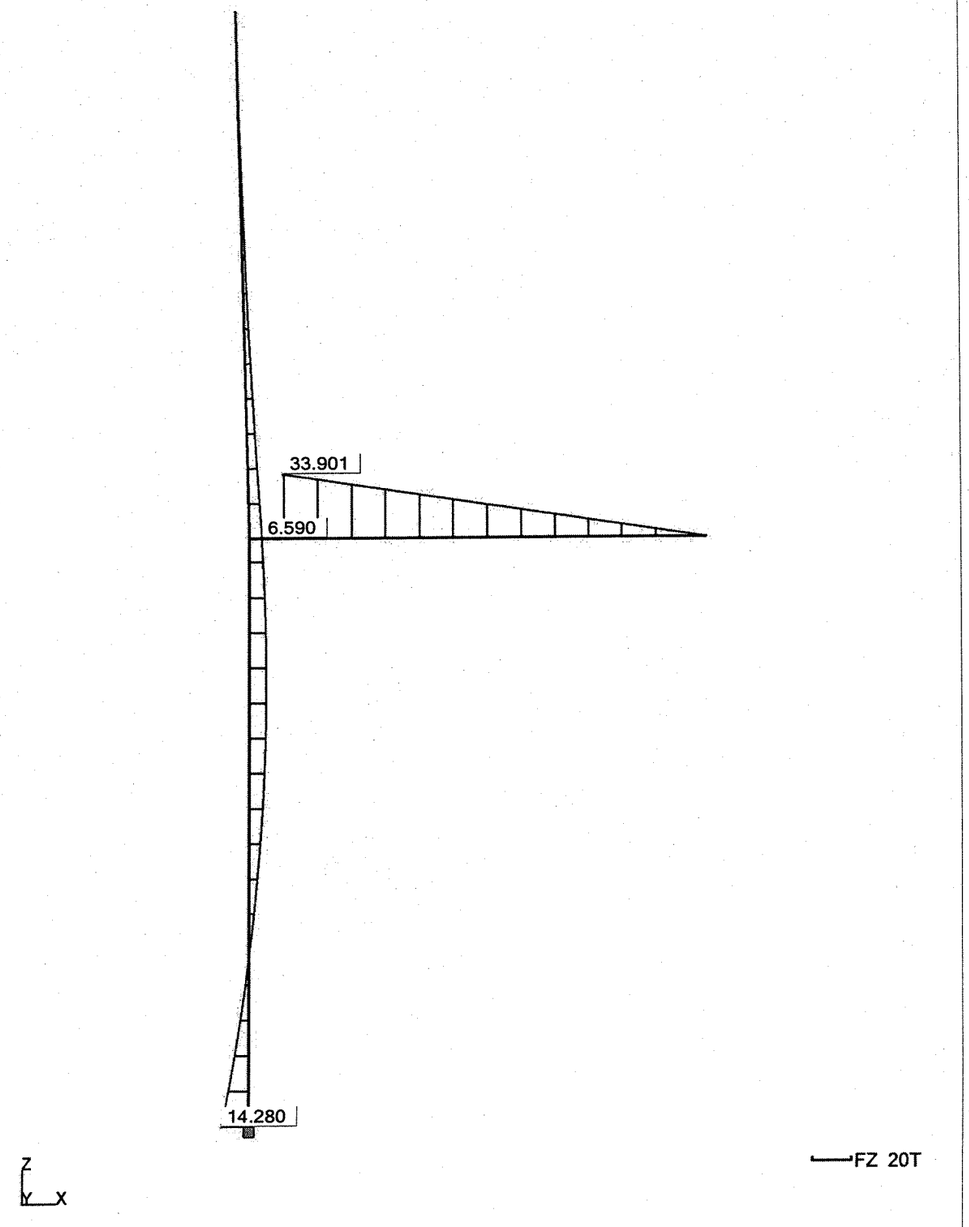


## Momentos Flectores - ELU Terreno+Sobrecarga

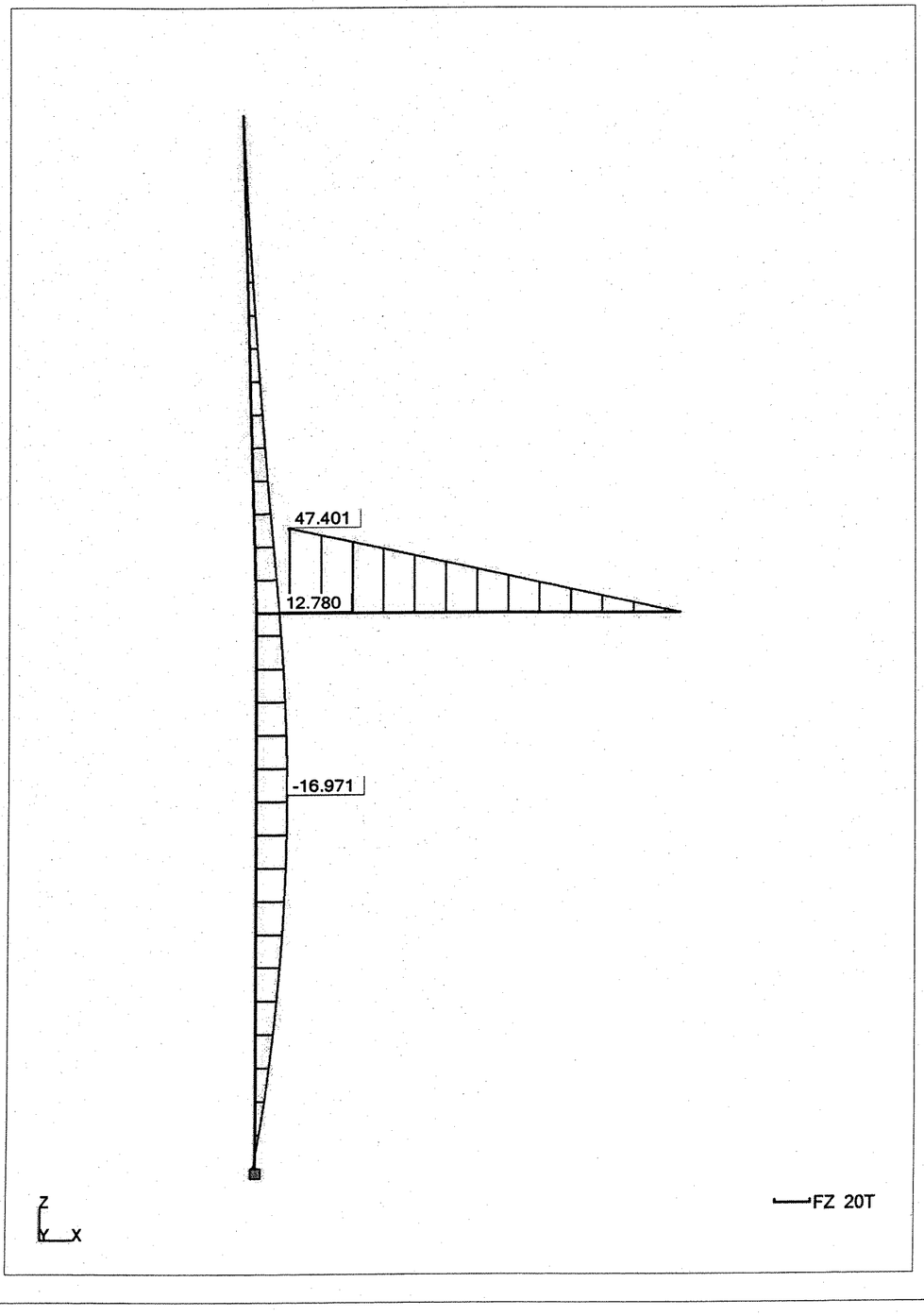



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## Esfuerzos Cortantes - ELU Terreno



## Esfuerzos Cortantes - ELU Terreno+Sobrecarga




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## Esfuerzos en Muro

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 1/ 1** | 3.687 | 4.882 | -6.249 |
| **11 (C)/ 1/ 2/10** | 3.195 | 3.864 | -4.402 |
| **11 (C)/ 1/ 3/10** | 2.724 | 2.966 | -2.960 |
| **11 (C)/ 1/ 4/10** | 2.274 | 2.186 | -1.873 |
| **11 (C)/ 1/ 5/10** | 1.844 | 1.525 | -1.091 |
| **11 (C)/ 1/ 6/10** | 1.434 | 0.983 | -0.564 |
| **11 (C)/ 1/ 7/10** | 1.045 | 0.559 | -0.242 |
| **11 (C)/ 1/ 8/10** | 0.676 | 0.254 | -0.074 |
| **11 (C)/ 1/ 9/10** | 0.328 | 0.068 | -0.010 |
| **11 (C)/ 1/ 2** | -0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 1/ 1** | 3.578 | 9.008 | -14.113 |
| **12 (C)/ 1/ 2/10** | 3.099 | 7.532 | -10.615 |
| **12 (C)/ 1/ 3/10** | 2.640 | 6.175 | -7.716 |
| **12 (C)/ 1/ 4/10** | 2.202 | 4.937 | -5.368 |
| **12 (C)/ 1/ 5/10** | 1.784 | 3.818 | -3.518 |
| **12 (C)/ 1/ 6/10** | 1.386 | 2.817 | -2.118 |
| **12 (C)/ 1/ 7/10** | 1.009 | 1.934 | -1.116 |
| **12 (C)/ 1/ 8/10** | 0.652 | 1.171 | -0.462 |
| **12 (C)/ 1/ 9/10** | 0.316 | 0.526 | -0.107 |
| **12 (C)/ 1/ 2** | -0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 1/ 1** | 4.977 | 6.590 | -8.437 |
| **21 (C)/ 1/ 2/10** | 4.314 | 5.217 | -5.942 |
| **21 (C)/ 1/ 3/10** | 3.678 | 4.004 | -3.996 |
| **21 (C)/ 1/ 4/10** | 3.070 | 2.951 | -2.528 |
| **21 (C)/ 1/ 5/10** | 2.489 | 2.059 | -1.473 |
| **21 (C)/ 1/ 6/10** | 1.936 | 1.327 | -0.762 |
| **21 (C)/ 1/ 7/10** | 1.411 | 0.755 | -0.327 |
| **21 (C)/ 1/ 8/10** | 0.913 | 0.343 | -0.100 |
| **21 (C)/ 1/ 9/10** | 0.443 | 0.091 | -0.014 |
| **21 (C)/ 1/ 2** | -0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 1/ 1** | 4.814 | 12.780 | -20.232 |
| **22 (C)/ 1/ 2/10** | 4.169 | 10.719 | -15.262 |
| **22 (C)/ 1/ 3/10** | 3.551 | 8.818 | -11.131 |
| **22 (C)/ 1/ 4/10** | 2.961 | 7.078 | -7.770 |
| **22 (C)/ 1/ 5/10** | 2.399 | 5.498 | -5.113 |
| **22 (C)/ 1/ 6/10** | 1.864 | 4.078 | -3.092 |
| **22 (C)/ 1/ 7/10** | 1.357 | 2.818 | -1.637 |
| **22 (C)/ 1/ 8/10** | 0.877 | 1.718 | -0.682 |
| **22 (C)/ 1/ 9/10** | 0.425 | 0.779 | -0.159 |
| **22 (C)/ 1/ 2** | -0.000 | -0.000 | -0.000 |

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## Reacciones en Apoyo

| Nudo/Caso | Nombre del caso | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|---|
| 5/ 11 (C) | ELS (Terreno) | -10.578 | 34.241 | -28.907 |
| 5/ 12 (C) | ELS (Terreno+Sobrecarga) | -1.848 | 43.241 | -9.470 |
| 5/ 21 (C) | ELU (Terreno) | -14.280 | 46.225 | -39.024 |
| 5/ 22 (C) | ELU (Terreno+Sobrecarga) | -1.185 | 59.725 | -9.870 |

La estabilidad del muro se obtiene cuando los empujes pasivos son capaces de compensar los empujes activos. Para que se de este criterio, el momento de reacción en el apoyo de la pantalla deba ser cero.

En caso de tener un momento negativo, éste nos indica que el momento producido por los empujes pasivos es mayor que el producido por los empujes activos y, por tanto, la pantalla es capaz de generar mecanismos resistentes.

En las reacciones adjuntas se puede ver que los momentos en el apoyo de pantalla son siempre menores o iguales a cero. De este modo, podemos asegurar la estabilidad de la pantalla.

## 6.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: MURO**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 20.23 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 50.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **3.29** |
| **ARMADURA NECESARIA(cm2)** | **10.73** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **4.50** |
| **Cuantía Mínima Horizontal (cm2)** | **16.00** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrán una barra Ø20 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**MURO**

| | |
|---|---|
| D(mm) | 450 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 25.13 |
| Vrd(Tn) | 12.78 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.667 |
| Roele | 0.0056 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 216711.8 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 180593.14 |
| Vsu,p | 162000.00 |

| | |
|---|---|
| ***As,c =*** | ***0.0*** $cm^2/m$ |
| ***As,min=*** | ***8.3*** $cm^2/m$ |

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 5000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 2250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**MURO**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 50.00 |
| Arm. Tracción | As1 | cm2 | 25.13 |
| Canto útil | d | cm | 45.00 |
| Arm. Compresión | As2 | cm2 | 16.08 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0056 |
| Cuantía mecánica 2 | ρ2 | 0.0036 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 3.35 |
| Inercia fisurada | If | cm4 | 354,534 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 14.13 |
| Diámetro | ϕ | mm | 20 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 5000 |
| Area sec. Homog. | Ah | cm2 | 5317.42 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 25.26 |
| Inercia sec. Homog. | Ih | cm4 | 1168268.38 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 12.113 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,096 |
| Tensión de servicio | Ts | kp/cm2 | 1,278 |
| Area eficaz | Ac,ef | cm2 | 1250 |
| Alargamiento medio armaduras | εsm | | 0.0004 |
| Separación media de fisuras | Sm | mm | 154.74 |
| **Abertura característica** | **Wk** | **mm** | **0.10** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: PANTALLA**

Tipo de elemento Muros

| | |
|---|---|
| Momento Flector [T·m] | 62.72 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 50.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **11.24** |
| **ARMADURA NECESARIA(cm2)** | **36.63** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **4.50** |
| **Cuantía Mínima Horizontal (cm2)** | **16.00** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrán una barra Ø25 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**PANTALLA**

| | |
|---|---|
| D(mm) | 450 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 39.27 |
| Vrd(Tn) | 16.97 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.667 |
| Roele | 0.0087 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 251481.1 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | 209567.56 |
| Vu2 | 162000.00 |
| Vsu,p | |

$As,c$ = **0.0 cm²/m**

$As,min$ = **8.3 cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 5000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 2250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**PANTALLA**

**DATOS INICIALES**

| | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 50.00 |
| Arm. Tracción | As1 | cm2 | 39.27 |
| Canto útil | d | cm | 45.00 |
| Arm. Compresión | As2 | cm2 | 25.13 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

**CÁLCULO DE PARÁMETROS ADIMENSIONALES**

| | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0087 |
| Cuantía mecánica 2 | ρ2 | 0.0056 |

**CARACTERÍSTICAS DE LA SECCIÓN FISURADA**

| | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 4.69 |
| Inercia fisurada | If | cm4 | 529,781 |

**DATOS PARA CÁLCULO ABERTURA DE FISURA**

| | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 45.58 |
| Diámetro | ϕ | mm | 25 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

**DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN**

| | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 5000 |
| Area sec. Homog. | Ah | cm2 | 5496.04 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 25.40 |
| Inercia sec. Homog. | Ih | cm4 | 1239218.54 |

**CÁLCULO DEL MOMENTO DE FISURACIÓN**

| | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 12.919 |

**CÁLCULO DE LA ABERTURA DE FISURA**

| | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 757 |
| Tensión de servicio | Ts | kp/cm2 | 2,671 |
| Area eficaz | Ac,ef | cm2 | 1250 |
| Alargamiento medio armaduras | εsm | | 0.0012 |
| Separación media de fisuras | Sm | mm | 139.79 |
| **Abertura característica** | **Wk** | **mm** | **0.29** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: BANDEJA**

| Tipo de elemento | Losas |
|---|---|
| Momento Flector [T·m] | 71.10 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 50.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **13.04** |
| **ARMADURA NECESARIA(cm2)** | **42.50** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **9.00** |
| **Cuantía Mínima Horizontal (cm2)** | |

La cuantía mínima corresponde a la cara de tracción

**Se dispondrán una barra Ø32 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

**BANDEJA**

| | |
|---|---|
| D(mm) | 450 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 64.34 |
| Vrd(Tn) | 47.40 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.667 |
| Roele | 0.0143 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 296468.6 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 247057.16 |
| Vsu,p | 162000.00 |

| | | |
|---|---|---|
| ***As,c =*** | ***14.0*** | **$cm^2/m$** |
| ***As,min=*** | ***8.3*** | **$cm^2/m$** |

**Se dispondrán dos cercos Ø10 cada 0,20m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 5000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 2250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro IV - Estribo 1 - Pérgola**

### BANDEJA

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 50.00 |
| Arm. Tracción | As1 | cm2 | 64.34 |
| Canto útil | d | cm | 45.00 |
| Arm. Compresión | As2 | cm2 | 25.13 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0143 |
| Cuantía mecánica 2 | ρ2 | 0.0056 |

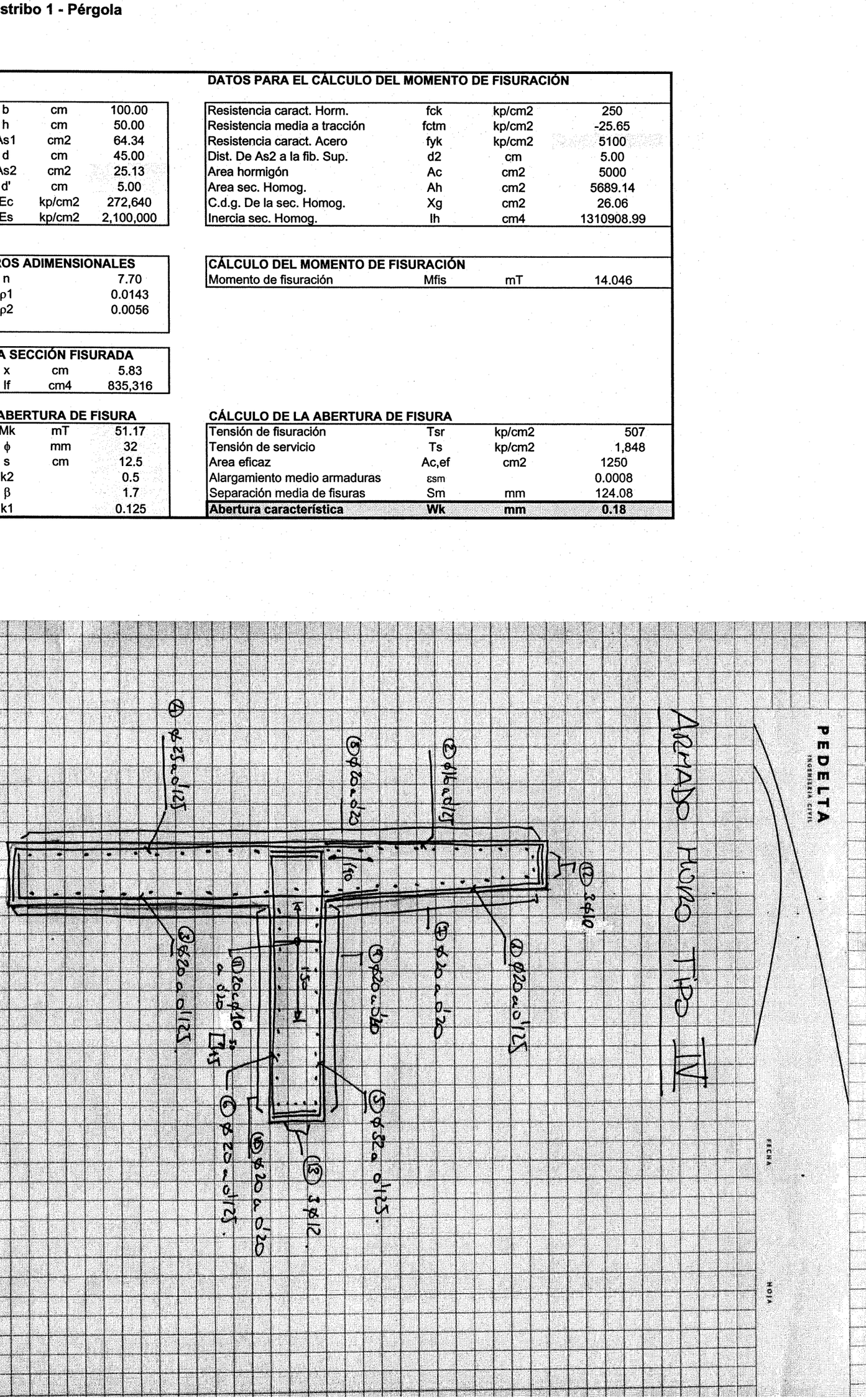
| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 5.83 |
| Inercia fisurada | If | cm4 | 835,316 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 51.17 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 5000 |
| Area sec. Homog. | Ah | cm2 | 5689.14 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 26.06 |
| Inercia sec. Homog. | Ih | cm4 | 1310908.99 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 14.046 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 507 |
| Tensión de servicio | Ts | kp/cm2 | 1,848 |
| Area eficaz | Ac,ef | cm2 | 1250 |
| Alargamiento medio armaduras | εsm | | 0.0008 |
| Separación media de fisuras | Sm | mm | 124.08 |
| **Abertura característica** | **Wk** | **mm** | **0.18** |

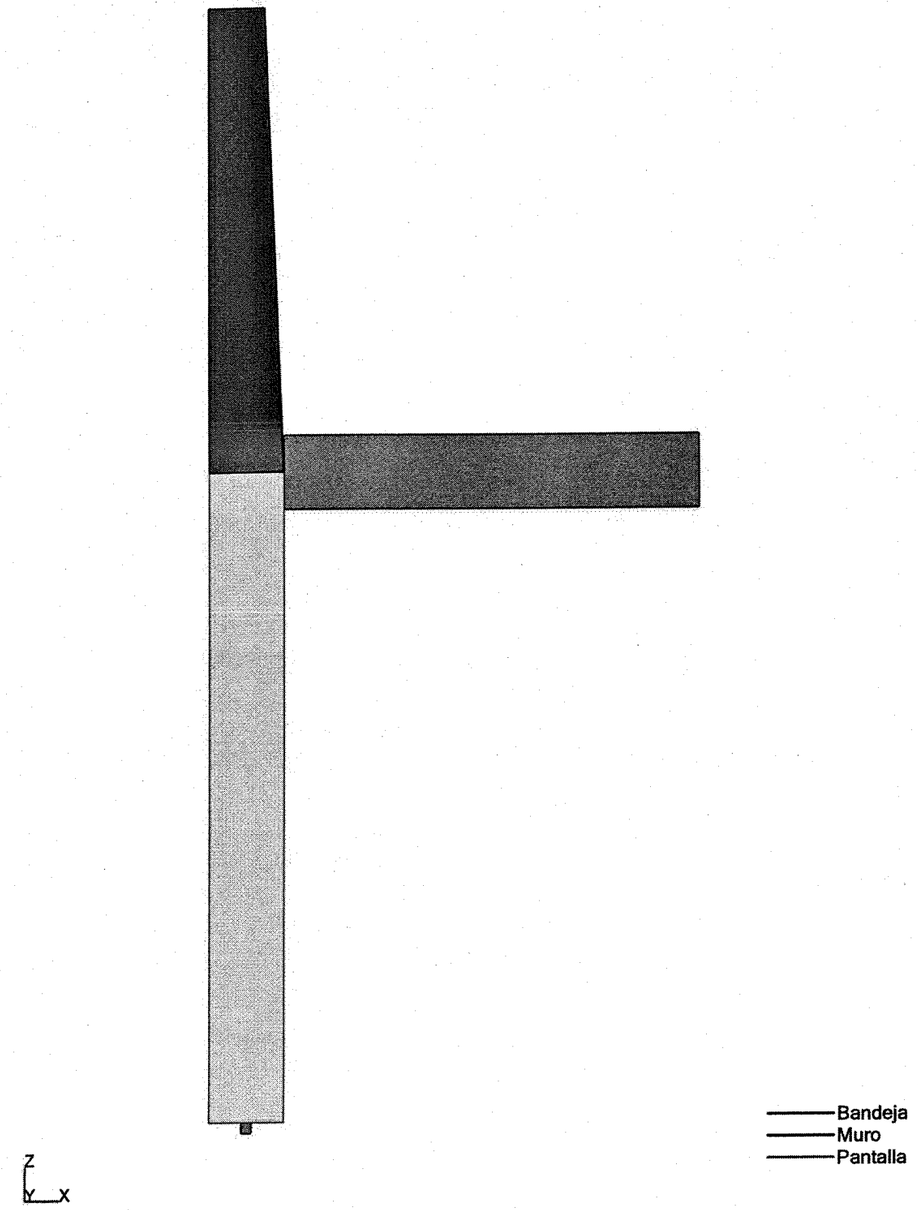


# 7 MURO TIPO V

## 7.1 MODELO DE CÁLCULO Y ESFUERZOS



### Modelo de Cálculo



## Nudos que Componen la Estructura

| Nudo | X (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | | |
| 2 | -0.050 | 2.490 | | |
| 3 | 2.400 | 0.0 | | |
| 4 | 0.200 | 0.0 | | |
| 5 | 0.0 | -3.500 | fff | Apoyo |

## Barras que Componen la Estructura

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) |
|---|---|---|---|---|---|
| 1 | 1 | 2 | Muro | HORMIGON | 2.491 |
| 2 | 5 | 1 | Pantalla | HORM | 3.500 |
| 3 | 4 | 3 | Bandeja | HORM | 2.200 |

## Características de las Barras que Componen la Estructura

| Nombre de la sección | Lista de barras | BB (m) | HH (m) | SX (m2) | SY (m2) | SZ (m2) | IX (m4) | IY (m4) | IZ (m4) |
|---|---|---|---|---|---|---|---|---|---|
| Pantalla | 2 | 1.00 | 0.40 | 0.40000 | 0.33333 | 0.33333 | 0.01596 | 0.00533 | 0.03333 |
| Muro | 1 | 1.00 | 0.40 | 0.35000 | 0.29167 | 0.29167 | 0.01114 | 0.00357 | 0.02917 |
| Bandeja | 3 | 1.00 | 0.40 | 0.40000 | 0.33333 | 0.33333 | 0.01596 | 0.00533 | 0.03333 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Apoyo | 5 | UX UZ RY |

ROBOT v 17.0.1
Autor :

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Archivo : **Muro Tipo V.rtd**

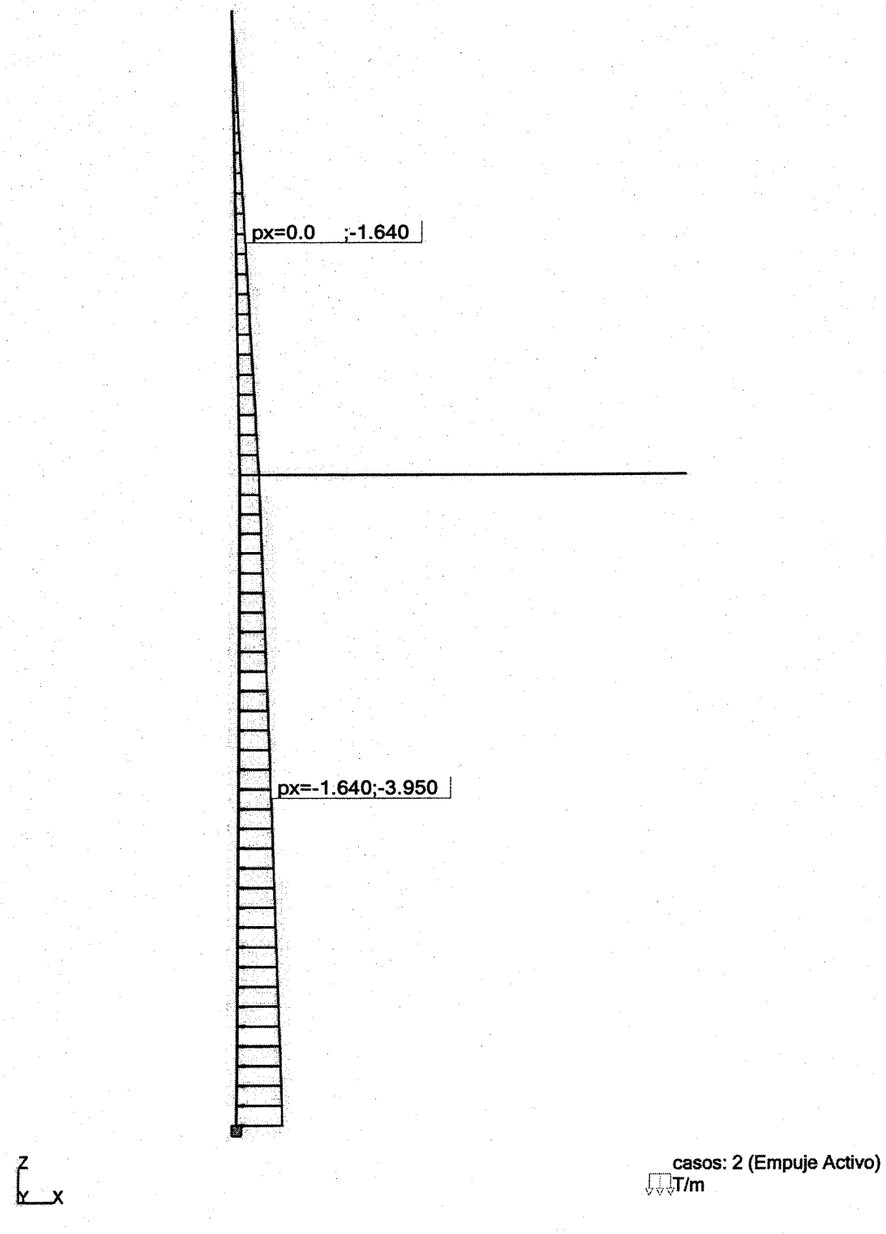
## Cargas Aplicadas a la Estructura

| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1A3 | PZ Menos Coef=1.0000 |
| 2 | Empuje Activo | carga trapezoidal | 1 | PX2=0.0(T/m) PX1=-1.640(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 2 | Empuje Activo | carga trapezoidal | 2 | PX2=-1.640(T/m) PX1=-3.950(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 3 | Empuje Pasivo | carga trapezoidal | 2 | PX2=0.0(T/m) PX1=13.200(T/m) X2=3.300(m) X1=0.0(m) global no proyectadas absolutos |
| 4 | Empuje Sobrecarga | sobrecarga uniforme | 1 2 | PX=-1.083(T/m) |
| 5 | Peso en Bandeja Terreno | sobrecarga uniforme | 3 | PZ=-4.580(T/m) |
| 6 | Peso en Bandeja Sobrecarga | sobrecarga uniforme | 3 | PZ=-3.000(T/m) |

## Combinación de Acciones

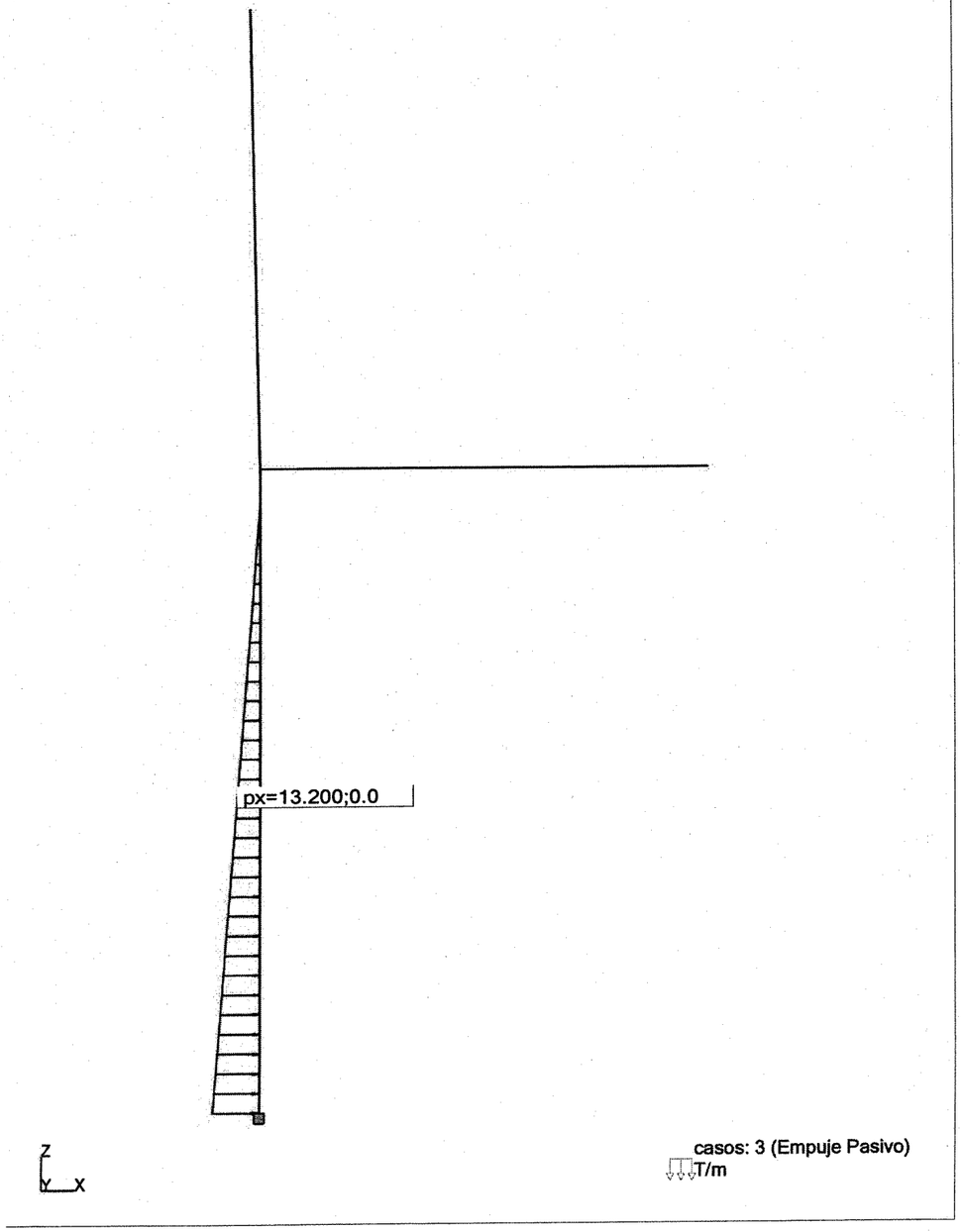
| Combinación | Nombre | Definición |
|---|---|---|
| 11 (C) | ELS (Terreno) | (1+2+3+5)*1.0000 |
| 12 (C) | ELS (Terreno+Sobrecarga) | (1+2+3+4+5+6)*1.0000 |
| 21 (C) | ELU (Terreno) | (1+2+3+5)*1.3500 |
| 22 (C) | ELU (Terreno+Sobrecarga) | (1+2+3+5)*1.3500+(4+6)*1.5000 |

## Cargas Aplicadas: Empuje Activo

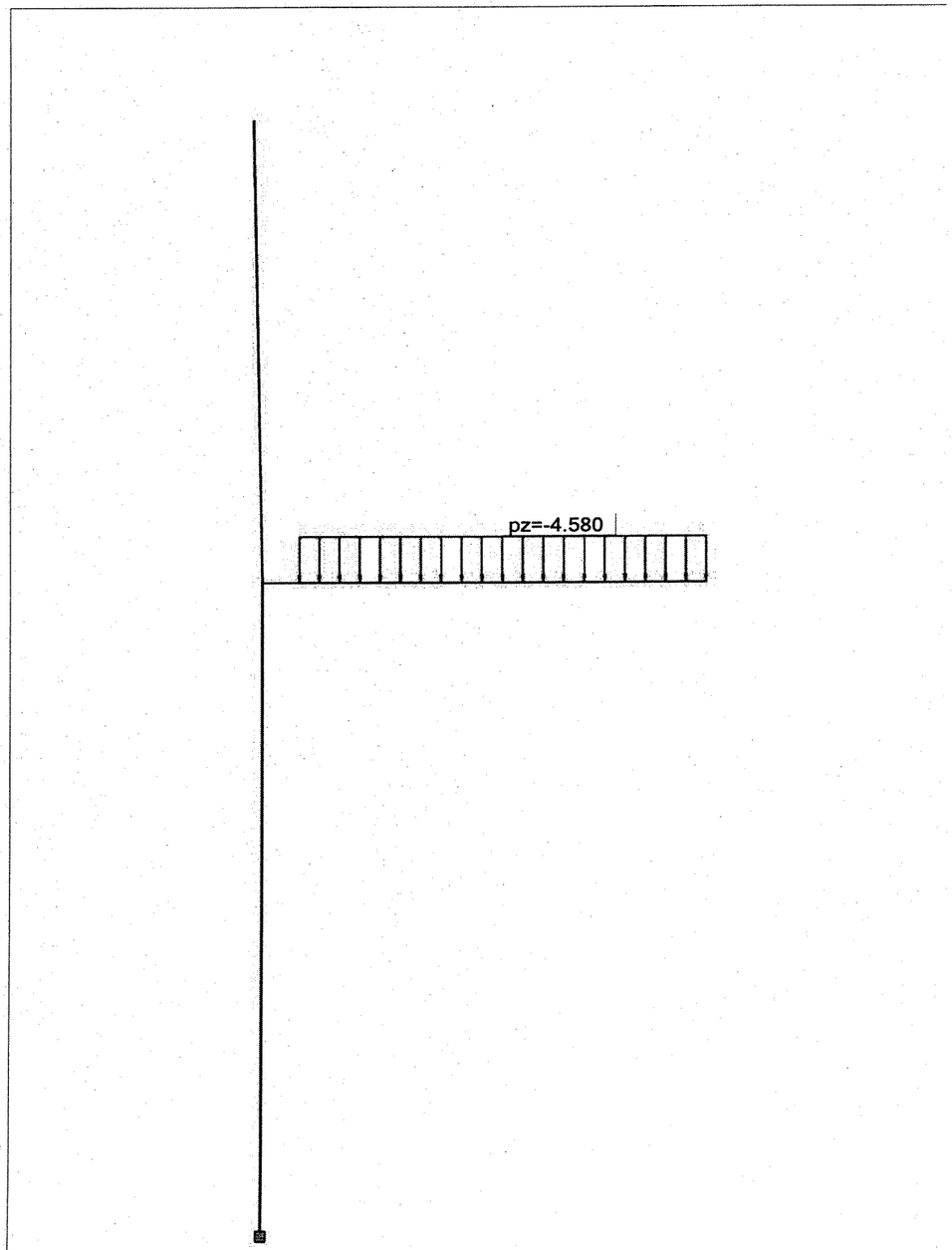



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## Cargas Aplicadas: Empuje Pasivo

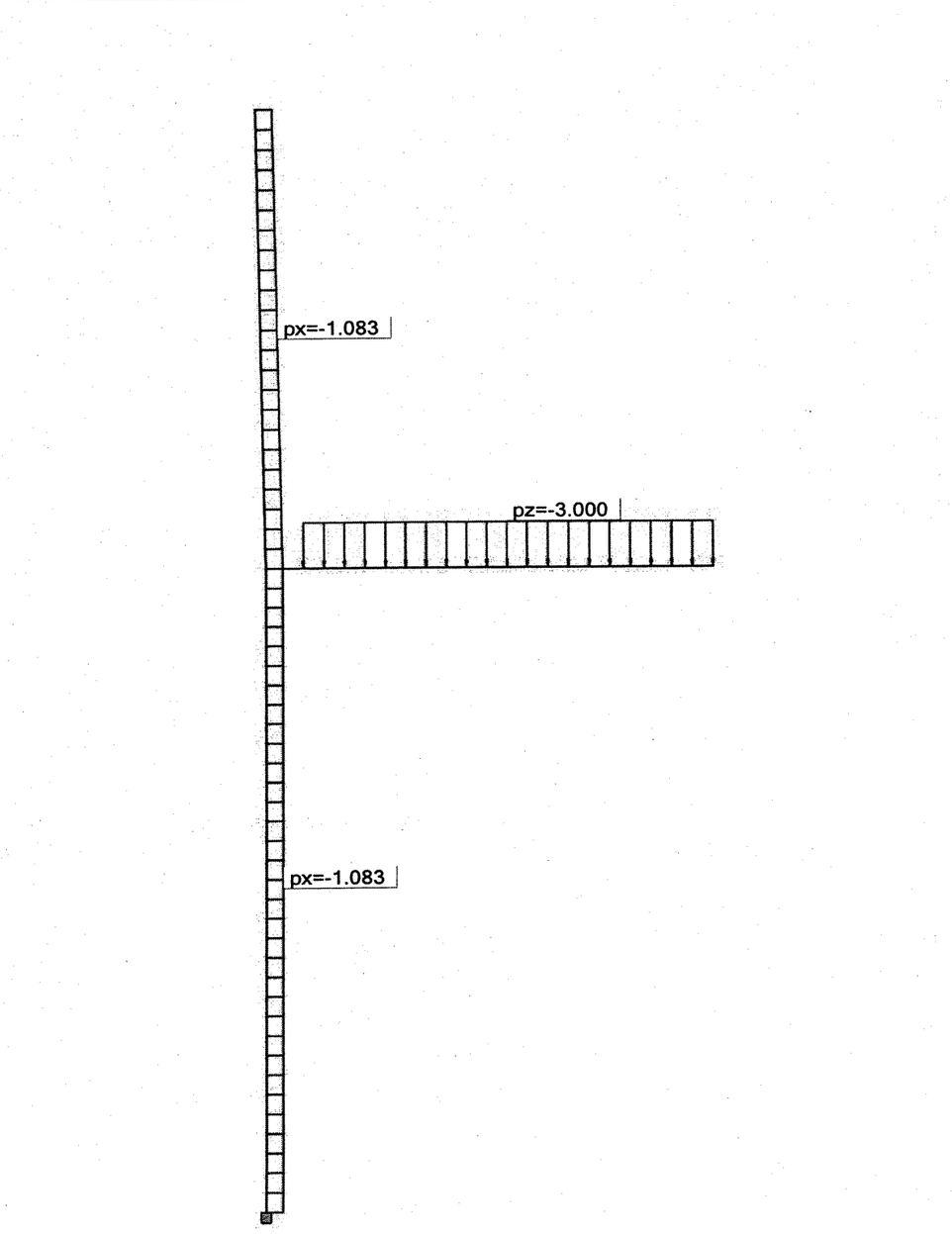


## Cargas Aplicadas: Peso Terreno en Bandeja

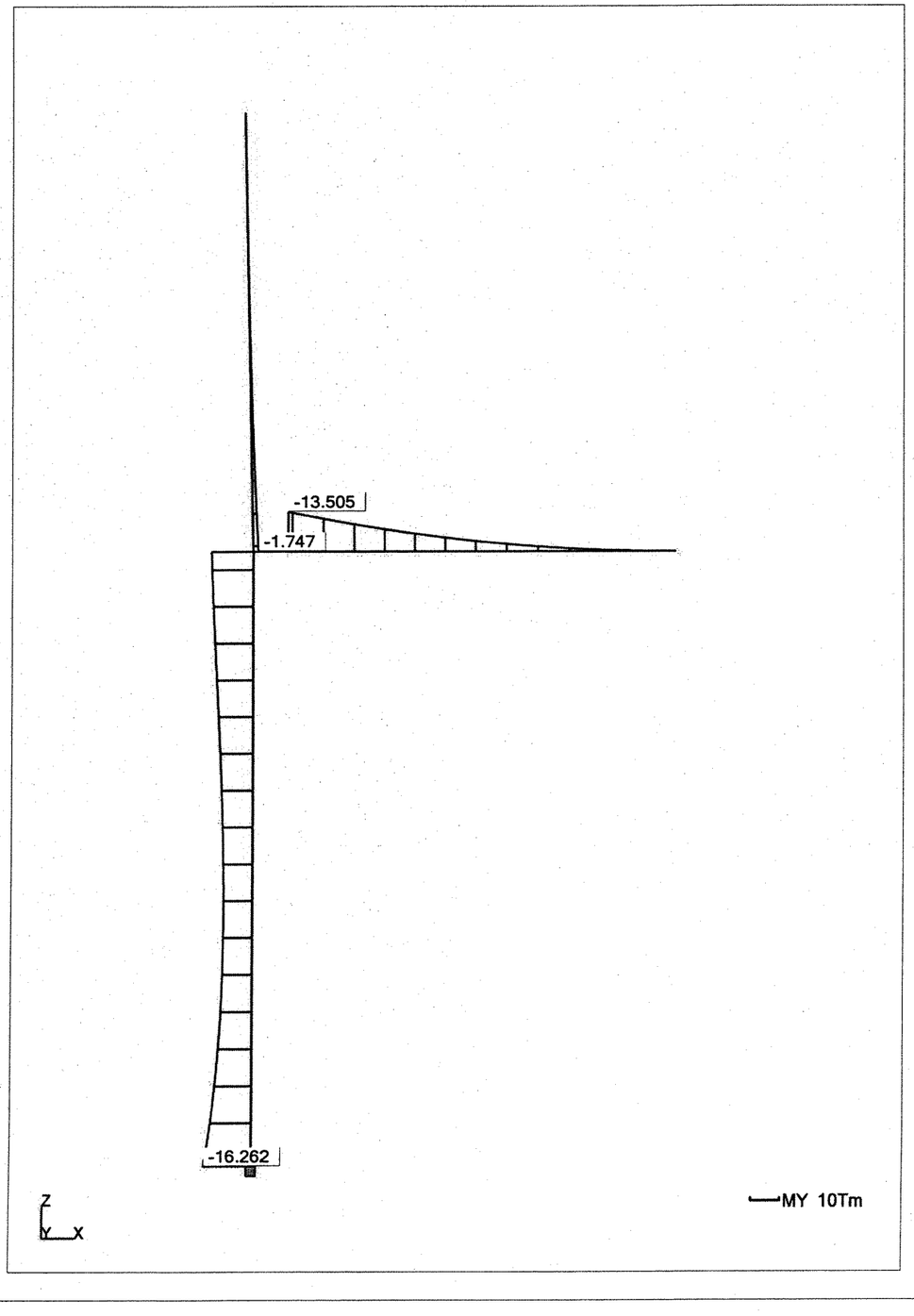



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## Cargas Aplicadas: Sobrecargas

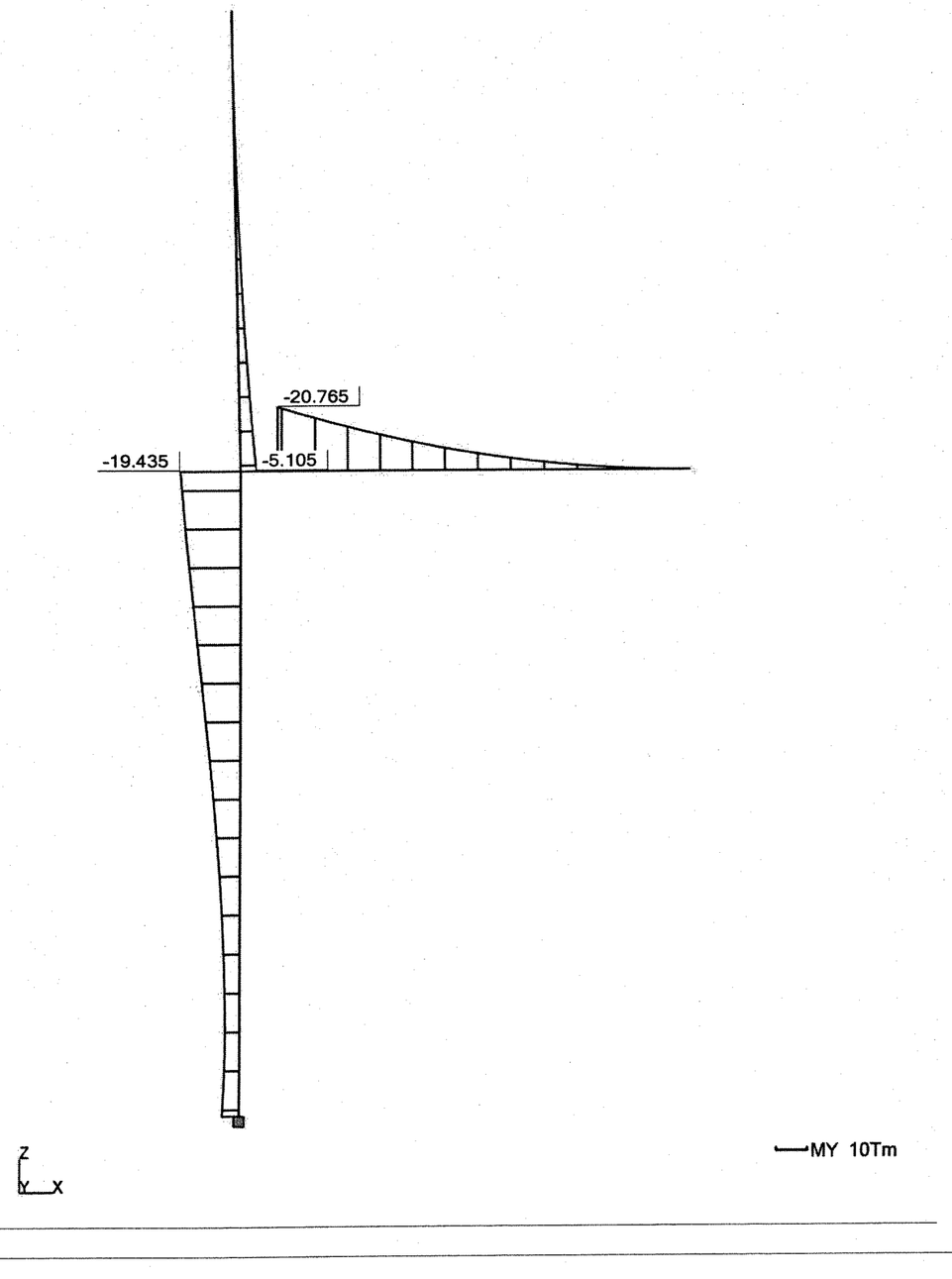


## Momentos Flectores - ELS Terreno

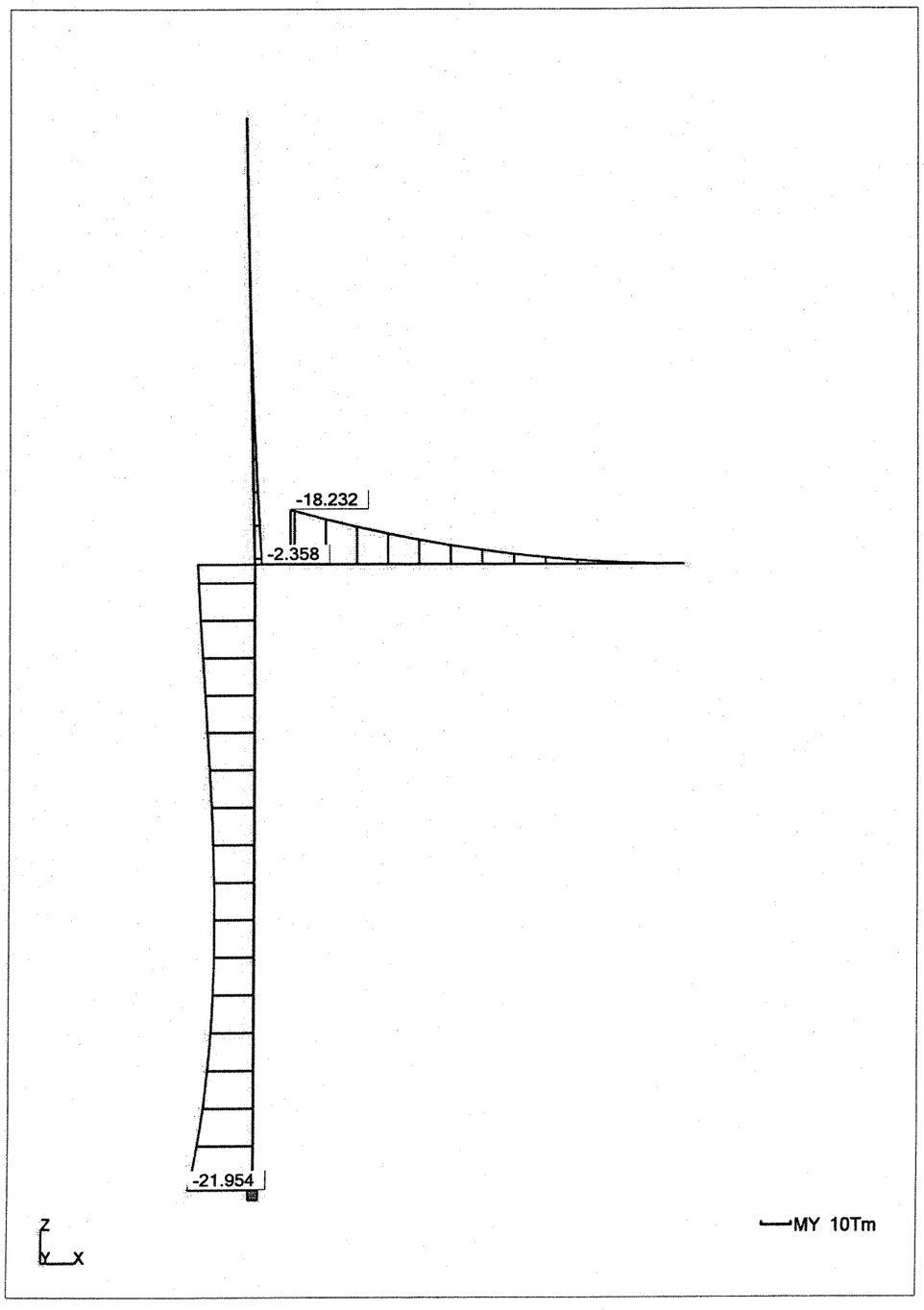



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## Momentos Flectores - ELS Terreno+Sobrecarga

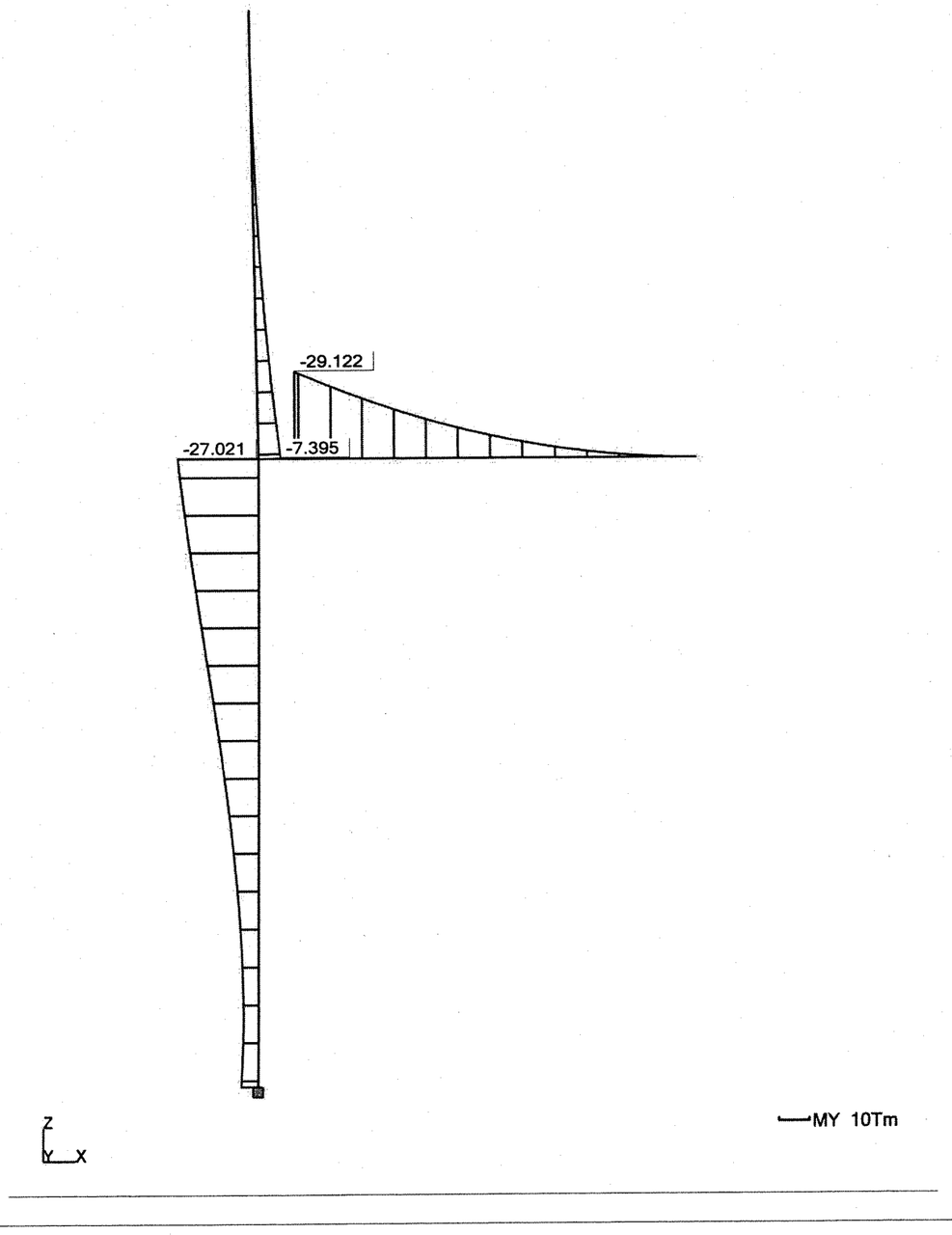


## Momentos Flectores - ELU Terreno

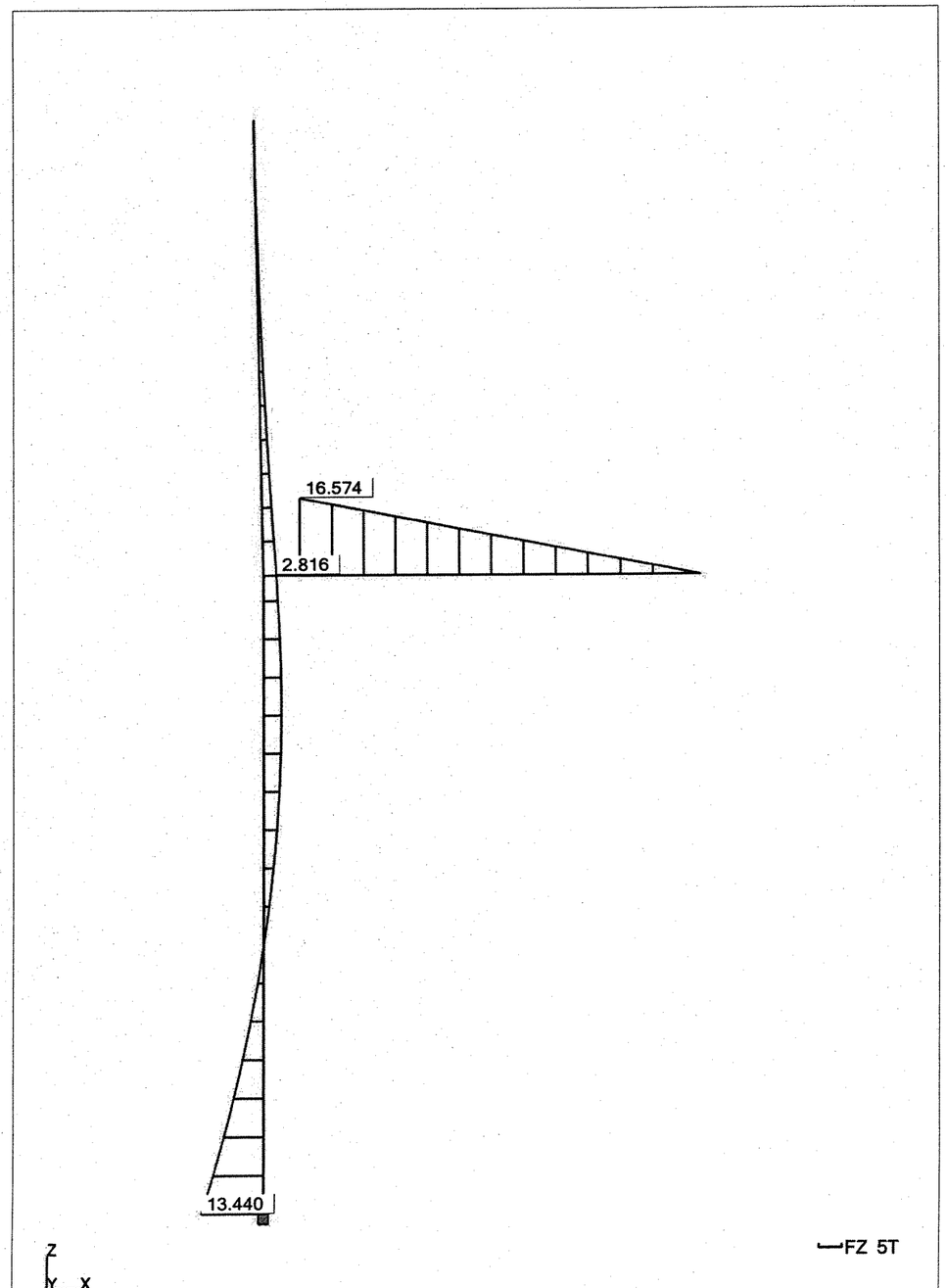



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## Momentos Flectores - ELU Terreno+Sobrecarga

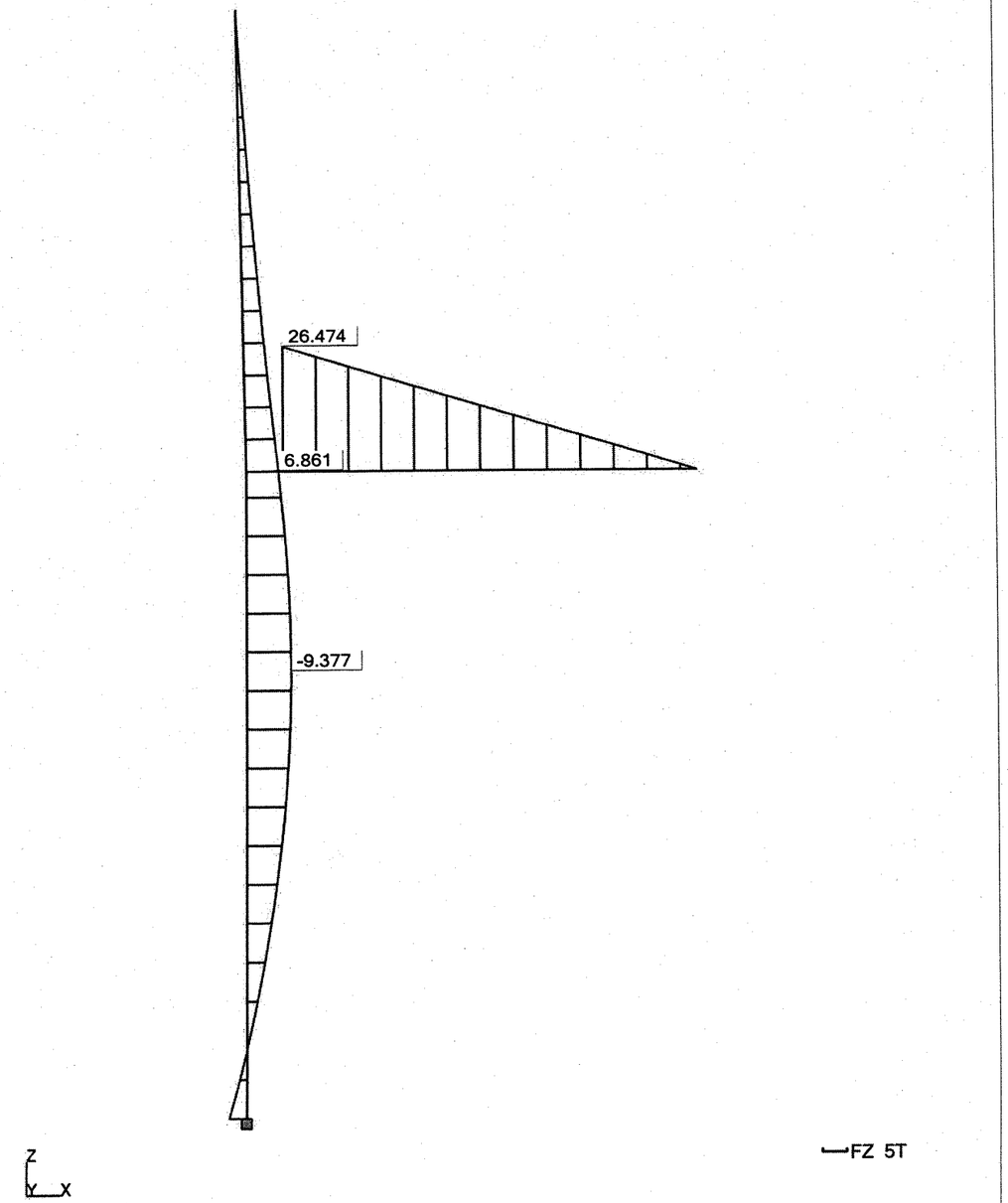


## Esfuerzos Cortantes - ELU Terreno




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## Esfuerzos Cortantes - ELU Terreno+Sobrecarga



## Esfuerzos en Muro

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 1/ 1** | 2.139 | 2.086 | -1.747 |
| **11 (C)/ 1/ 2/10** | 1.875 | 1.652 | -1.231 |
| **11 (C)/ 1/ 3/10** | 1.617 | 1.268 | -0.828 |
| **11 (C)/ 1/ 4/10** | 1.366 | 0.935 | -0.525 |
| **11 (C)/ 1/ 5/10** | 1.122 | 0.653 | -0.306 |
| **11 (C)/ 1/ 6/10** | 0.884 | 0.421 | -0.158 |
| **11 (C)/ 1/ 7/10** | 0.653 | 0.240 | -0.068 |
| **11 (C)/ 1/ 8/10** | 0.429 | 0.109 | -0.021 |
| **11 (C)/ 1/ 9/10** | 0.211 | 0.029 | -0.003 |
| **11 (C)/ 1/ 2** | 0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 1/ 1** | 2.085 | 4.782 | -5.105 |
| **12 (C)/ 1/ 2/10** | 1.826 | 4.049 | -3.884 |
| **12 (C)/ 1/ 3/10** | 1.575 | 3.366 | -2.860 |
| **12 (C)/ 1/ 4/10** | 1.330 | 2.733 | -2.017 |
| **12 (C)/ 1/ 5/10** | 1.091 | 2.151 | -1.342 |
| **12 (C)/ 1/ 6/10** | 0.860 | 1.620 | -0.822 |
| **12 (C)/ 1/ 7/10** | 0.635 | 1.139 | -0.441 |
| **12 (C)/ 1/ 8/10** | 0.417 | 0.709 | -0.187 |
| **12 (C)/ 1/ 9/10** | 0.205 | 0.329 | -0.044 |
| **12 (C)/ 1/ 2** | 0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 1/ 1** | 2.888 | 2.816 | -2.358 |
| **21 (C)/ 1/ 2/10** | 2.531 | 2.230 | -1.662 |
| **21 (C)/ 1/ 3/10** | 2.183 | 1.712 | -1.118 |
| **21 (C)/ 1/ 4/10** | 1.844 | 1.263 | -0.708 |
| **21 (C)/ 1/ 5/10** | 1.514 | 0.881 | -0.413 |
| **21 (C)/ 1/ 6/10** | 1.193 | 0.569 | -0.214 |
| **21 (C)/ 1/ 7/10** | 0.881 | 0.324 | -0.092 |
| **21 (C)/ 1/ 8/10** | 0.579 | 0.148 | -0.028 |
| **21 (C)/ 1/ 9/10** | 0.285 | 0.040 | -0.004 |
| **21 (C)/ 1/ 2** | 0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 1/ 1** | 2.806 | 6.861 | -7.395 |
| **22 (C)/ 1/ 2/10** | 2.458 | 5.825 | -5.642 |
| **22 (C)/ 1/ 3/10** | 2.120 | 4.858 | -4.165 |
| **22 (C)/ 1/ 4/10** | 1.790 | 3.959 | -2.947 |
| **22 (C)/ 1/ 5/10** | 1.469 | 3.129 | -1.968 |
| **22 (C)/ 1/ 6/10** | 1.157 | 2.366 | -1.209 |
| **22 (C)/ 1/ 7/10** | 0.854 | 1.672 | -0.652 |
| **22 (C)/ 1/ 8/10** | 0.561 | 1.047 | -0.277 |
| **22 (C)/ 1/ 9/10** | 0.276 | 0.489 | -0.066 |
| **22 (C)/ 1/ 2** | 0.000 | -0.000 | -0.000 |

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## Esfuerzos en Pantalla

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 2/ 5** | 17.959 | 9.955 | -16.262 |
| **11 (C)/ 2/ 2/10** | 17.570 | 6.611 | -13.058 |
| **11 (C)/ 2/ 3/10** | 17.181 | 3.771 | -11.055 |
| **11 (C)/ 2/ 4/10** | 16.792 | 1.437 | -10.059 |
| **11 (C)/ 2/ 5/10** | 16.403 | -0.393 | -9.872 |
| **11 (C)/ 2/ 6/10** | 16.014 | -1.717 | -10.299 |
| **11 (C)/ 2/ 7/10** | 15.625 | -2.536 | -11.142 |
| **11 (C)/ 2/ 8/10** | 15.236 | -2.850 | -12.206 |
| **11 (C)/ 2/ 9/10** | 14.847 | -2.659 | -13.293 |
| **11 (C)/ 2/ 1** | 14.458 | -2.042 | -14.213 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 2/ 5** | 24.559 | 3.468 | -5.411 |
| **12 (C)/ 2/ 2/10** | 24.170 | 0.544 | -4.647 |
| **12 (C)/ 2/ 3/10** | 23.781 | -1.874 | -4.922 |
| **12 (C)/ 2/ 4/10** | 23.392 | -3.788 | -6.039 |
| **12 (C)/ 2/ 5/10** | 23.003 | -5.196 | -7.802 |
| **12 (C)/ 2/ 6/10** | 22.614 | -6.099 | -10.015 |
| **12 (C)/ 2/ 7/10** | 22.225 | -6.497 | -12.480 |
| **12 (C)/ 2/ 8/10** | 21.836 | -6.389 | -15.002 |
| **12 (C)/ 2/ 9/10** | 21.447 | -5.777 | -17.384 |
| **12 (C)/ 2/ 1** | 21.058 | -4.739 | -19.435 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 2/ 5** | 24.245 | 13.440 | -21.954 |
| **21 (C)/ 2/ 2/10** | 23.720 | 8.924 | -17.628 |
| **21 (C)/ 2/ 3/10** | 23.195 | 5.091 | -14.925 |
| **21 (C)/ 2/ 4/10** | 22.669 | 1.940 | -13.580 |
| **21 (C)/ 2/ 5/10** | 22.144 | -0.530 | -13.328 |
| **21 (C)/ 2/ 6/10** | 21.619 | -2.318 | -13.904 |
| **21 (C)/ 2/ 7/10** | 21.094 | -3.423 | -15.042 |
| **21 (C)/ 2/ 8/10** | 20.568 | -3.847 | -16.478 |
| **21 (C)/ 2/ 9/10** | 20.043 | -3.589 | -17.946 |
| **21 (C)/ 2/ 1** | 19.518 | -2.757 | -19.188 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 2/ 5** | 34.145 | 3.708 | -5.677 |
| **22 (C)/ 2/ 2/10** | 33.620 | -0.175 | -5.012 |
| **22 (C)/ 2/ 3/10** | 33.095 | -3.377 | -5.725 |
| **22 (C)/ 2/ 4/10** | 32.569 | -5.897 | -7.550 |
| **22 (C)/ 2/ 5/10** | 32.044 | -7.735 | -10.223 |
| **22 (C)/ 2/ 6/10** | 31.519 | -8.890 | -13.478 |
| **22 (C)/ 2/ 7/10** | 30.994 | -9.364 | -17.049 |
| **22 (C)/ 2/ 8/10** | 30.468 | -9.156 | -20.673 |
| **22 (C)/ 2/ 9/10** | 29.943 | -8.267 | -24.083 |
| **22 (C)/ 2/ 1** | 29.418 | -6.803 | -27.021 |

## Esfuerzos en Bandeja

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 3/ 4** | -0.000 | 12.277 | -13.505 |
| **11 (C)/ 3/ 2/10** | -0.000 | 10.913 | -10.671 |
| **11 (C)/ 3/ 3/10** | -0.000 | 9.549 | -8.170 |
| **11 (C)/ 3/ 4/10** | -0.000 | 8.185 | -6.002 |
| **11 (C)/ 3/ 5/10** | -0.000 | 6.821 | -4.168 |
| **11 (C)/ 3/ 6/10** | -0.000 | 5.457 | -2.668 |
| **11 (C)/ 3/ 7/10** | -0.000 | 4.092 | -1.501 |
| **11 (C)/ 3/ 8/10** | -0.000 | 2.728 | -0.667 |
| **11 (C)/ 3/ 9/10** | -0.000 | 1.364 | -0.167 |
| **11 (C)/ 3/ 3** | -0.000 | -0.000 | -0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 3/ 4** | 0.0 | 18.877 | -20.765 |
| **12 (C)/ 3/ 2/10** | 0.0 | 16.780 | -16.407 |
| **12 (C)/ 3/ 3/10** | 0.0 | 14.682 | -12.561 |
| **12 (C)/ 3/ 4/10** | 0.0 | 12.585 | -9.229 |
| **12 (C)/ 3/ 5/10** | 0.0 | 10.487 | -6.409 |
| **12 (C)/ 3/ 6/10** | 0.0 | 8.390 | -4.102 |
| **12 (C)/ 3/ 7/10** | 0.0 | 6.292 | -2.307 |
| **12 (C)/ 3/ 8/10** | 0.0 | 4.195 | -1.025 |
| **12 (C)/ 3/ 9/10** | 0.0 | 2.097 | -0.256 |
| **12 (C)/ 3/ 3** | 0.0 | 0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 3/ 4** | -0.000 | 16.574 | -18.232 |
| **21 (C)/ 3/ 2/10** | -0.000 | 14.733 | -14.405 |
| **21 (C)/ 3/ 3/10** | -0.000 | 12.891 | -11.029 |
| **21 (C)/ 3/ 4/10** | -0.000 | 11.049 | -8.103 |
| **21 (C)/ 3/ 5/10** | -0.000 | 9.208 | -5.627 |
| **21 (C)/ 3/ 6/10** | -0.000 | 7.366 | -3.601 |
| **21 (C)/ 3/ 7/10** | -0.000 | 5.525 | -2.026 |
| **21 (C)/ 3/ 8/10** | -0.000 | 3.683 | -0.900 |
| **21 (C)/ 3/ 9/10** | -0.000 | 1.842 | -0.225 |
| **21 (C)/ 3/ 3** | -0.000 | -0.000 | 0.0 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 3/ 4** | 0.000 | 26.474 | -29.122 |
| **22 (C)/ 3/ 2/10** | 0.000 | 23.533 | -23.010 |
| **22 (C)/ 3/ 3/10** | 0.000 | 20.591 | -17.617 |
| **22 (C)/ 3/ 4/10** | 0.000 | 17.649 | -12.943 |
| **22 (C)/ 3/ 5/10** | 0.000 | 14.708 | -8.988 |
| **22 (C)/ 3/ 6/10** | 0.000 | 11.766 | -5.752 |
| **22 (C)/ 3/ 7/10** | 0.000 | 8.825 | -3.236 |
| **22 (C)/ 3/ 8/10** | 0.000 | 5.883 | -1.438 |
| **22 (C)/ 3/ 9/10** | 0.000 | 2.942 | -0.360 |
| **22 (C)/ 3/ 3** | 0.000 | 0.000 | 0.000 |

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## Reacciones en Apoyo

| Nudo/Caso | Nombre del caso | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|---|
| **5/ 11 (C)** | ELS (Terreno) | -9.955 | 17.959 | -16.262 |
| **5/ 12 (C)** | ELS (Terreno+Sobrecarga) | -3.468 | 24.559 | -5.411 |
| **5/ 21 (C)** | ELU (Terreno) | -13.440 | 24.245 | -21.954 |
| **5/ 22 (C)** | ELU (Terreno+Sobrecarga) | -3.708 | 34.145 | -5.677 |

La estabilidad del muro se obtiene cuando los empujes pasivos son capaces de compensar los empujes activos. Para que se de este criterio, el momento de reacción en el apoyo de la pantalla deba ser cero.

En caso de tener un momento negativo, éste nos indica que el momento producido por los empujes pasivos es mayor que el producido por los empujes activos y, por tanto, la pantalla es capaz de generar mecanismos resistentes.

En las reacciones adjuntas se puede ver que los momentos en el apoyo de pantalla son siempre menores o iguales a cero. De este modo, podemos asegurar la estabilidad de la pantalla.

## 7.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: MURO**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 7.40 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 40.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **1.52** |
| **ARMADURA NECESARIA(cm2)** | **4.97** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **3.60** |
| **Cuantía Mínima Horizontal (cm2)** | **12.80** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrá una barra Ø16 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**MURO**

| | |
|---|---|
| D(mm) | 350 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 16.08 |
| Vrd(Tn) | 6.86 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.756 |
| Roele | 0.0046 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 166395.8 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 138663.13 |
| Vsu,p | 126000.00 |

***As,c =*** ***0.0*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 4000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 1750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**MURO**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 40.00 |
| Arm. Tracción | As1 | cm2 | 16.08 |
| Canto útil | d | cm | 35.00 |
| Arm. Compresión | As2 | cm2 | 9.05 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0046 |
| Cuantía mecánica 2 | ρ2 | 0.0026 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 2.33 |
| Inercia fisurada | If | cm4 | 139,255 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 5.11 |
| Diámetro | ϕ | mm | 16 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

**DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN**

| | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 4000 |
| Area sec. Homog. | Ah | cm2 | 4193.56 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 20.19 |
| Inercia sec. Homog. | Ih | cm4 | 576727.61 |

**CÁLCULO DEL MOMENTO DE FISURACIÓN**

| | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 7.469 |

**CÁLCULO DE LA ABERTURA DE FISURA**

| | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,350 |
| Tensión de servicio | Ts | kp/cm2 | 922 |
| Area eficaz | Ac,ef | cm2 | 1000 |
| Alargamiento medio armaduras | εsm | | 0.0002 |
| Separación media de fisuras | Sm | mm | 158.75 |
| **Abertura característica** | **Wk** | **mm** | **0.00** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: PANTALLA**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 27.02 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 40.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **5.96** |
| **ARMADURA NECESARIA(cm2)** | **19.41** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **3.60** |
| **Cuantía Mínima Horizontal (cm2)** | **12.80** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrán una barra Ø20 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**PANTALLA**

| | |
|---|---|
| D(mm) | 350 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 25.13 |
| Vrd(Tn) | 13.44 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.756 |
| Roele | 0.0072 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 193098.0 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 160914.98 |
| Vsu,p | 126000.00 |

| | |
|---|---|
| ***As,c =*** | ***0.0*** $cm^2/m$ |
| ***As,min=*** | ***8.3*** $cm^2/m$ |

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 4000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 1750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

### PANTALLA

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 40.00 |
| Arm. Tracción | As1 | cm2 | 25.13 |
| Canto útil | d | cm | 35.00 |
| Arm. Compresión | As2 | cm2 | 16.08 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 4000 |
| Area sec. Homog. | Ah | cm2 | 4317.42 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 20.24 |
| Inercia sec. Homog. | Ih | cm4 | 604499.17 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0072 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 7.848 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 3.35 |
| Inercia fisurada | If | cm4 | 208,339 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 19.44 |
| Diámetro | ϕ | mm | 20 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 918 |
| Tensión de servicio | Ts | kp/cm2 | 2,274 |
| Area eficaz | Ac,ef | cm2 | 1000 |
| Alargamiento medio armaduras | εsm | | 0.0010 |
| Separación media de fisuras | Sm | mm | 144.79 |
| **Abertura característica** | **Wk** | **mm** | **0.24** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: BANDEJA**

Tipo de elemento Losas

| | |
|---|---|
| Momento Flector [T·m] | 29.12 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 40.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **6.47** |
| **ARMADURA NECESARIA(cm2)** | **21.09** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **7.20** |
| **Cuantía Mínima Horizontal (cm2)** | |

La cuantía mínima corresponde a la cara de tracción

**Se dispondrán una barra Ø20 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**BANDEJA**

| | |
|---|---|
| D(mm) | 350 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 25.13 |
| Vrd(Tn) | 26.47 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.756 |
| Roele | 0.0072 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 193098.0 |

**Necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 160914.98 |
| Vsu,p | 126000.00 |

***As,c =*** ***8.2*** **cm²/m**
***As,min=*** ***8.3*** **cm²/m** **Se dispondrá un cerco Ø12 cada 0,20m**

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 4000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 1750000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro V - Estribo 1 - Pérgola**

**BANDEJA**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 40.00 |
| Arm. Tracción | As1 | cm2 | 25.13 |
| Canto útil | d | cm | 35.00 |
| Arm. Compresión | As2 | cm2 | 16.08 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0072 |
| Cuantía mecánica 2 | ρ2 | 0.0046 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 3.35 |
| Inercia fisurada | If | cm4 | 208,339 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 20.76 |
| Diámetro | ϕ | mm | 20 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 4000 |
| Area sec. Homog. | Ah | cm2 | 4317.42 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 20.24 |
| Inercia sec. Homog. | Ih | cm4 | 604499.17 |

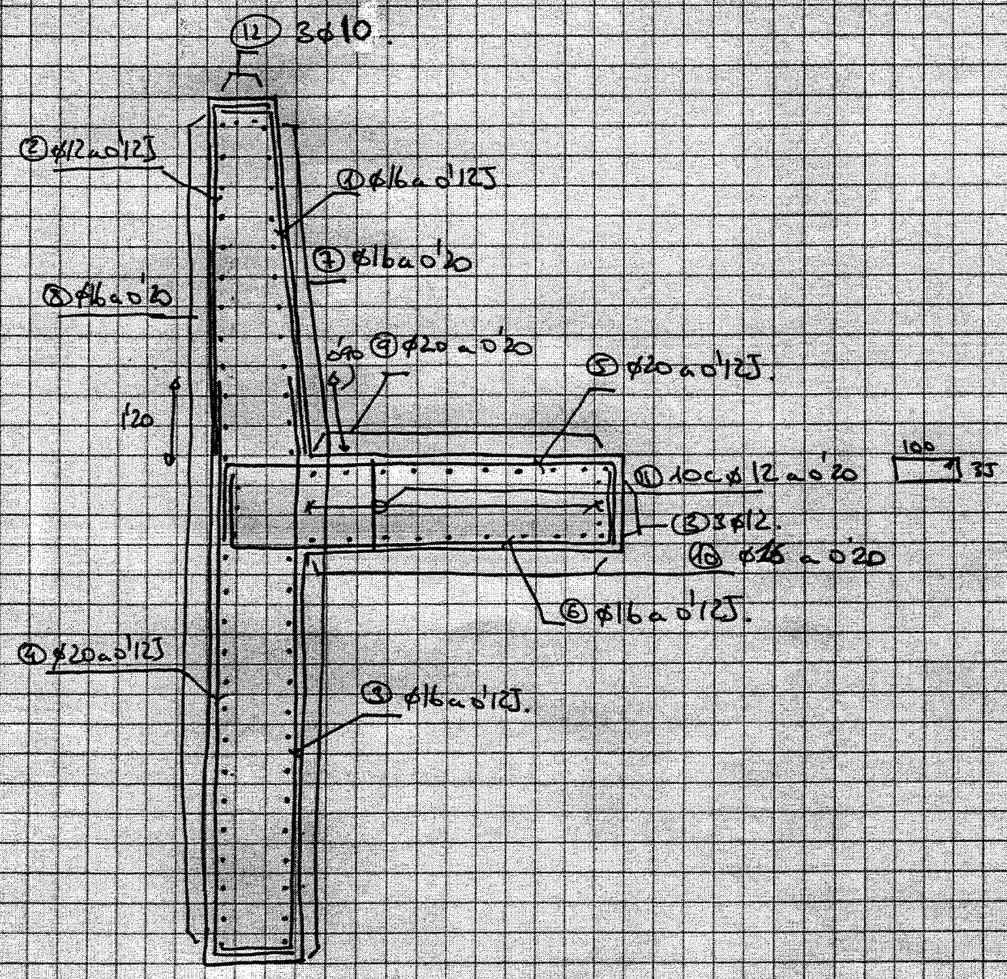
| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 7.848 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 918 |
| Tensión de servicio | Ts | kp/cm2 | 2,429 |
| Area eficaz | Ac,ef | cm2 | 1000 |
| Alargamiento medio armaduras | εsm | | 0.0011 |
| Separación media de fisuras | Sm | mm | 144.79 |
| **Abertura característica** | **Wk** | **mm** | **0.26** |

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

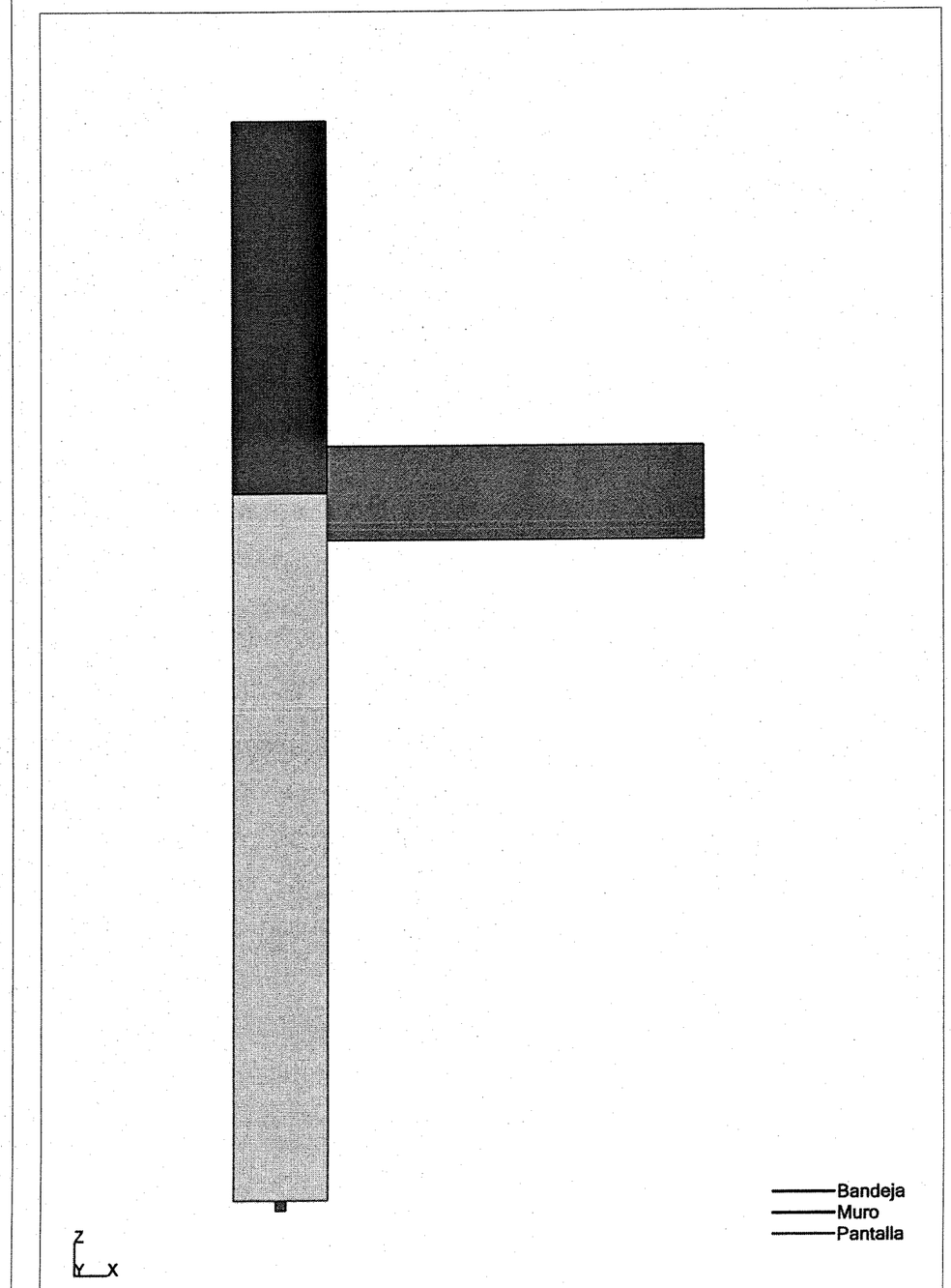
ARMADO MURO tipo V.




## 8 MURO TIPO VI

### 8.1 MODELO DE CÁLCULO Y ESFUERZOS

## Modelo de Cálculo




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## Nudos que Componen la Estructura

| Nudo | X (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|
| 1 | 0.0 | 0.0 | | |
| 2 | 0.0 | 1.180 | | |
| 3 | 1.350 | 0.0 | | |
| 4 | 0.150 | 0.0 | | |
| 5 | 0.0 | -2.250 | fff | Apoyo |

## Barras que Componen la Estructura

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) |
|---|---|---|---|---|---|
| 1 | 1 | 2 | Muro | HORMIGON | 1.180 |
| 2 | 5 | 1 | Pantalla | HORM | 2.250 |
| 3 | 4 | 3 | Bandeja | HORM | 1.200 |

## Características de las Barras que Componen la Estructura

| Nombre de la sección | Lista de barras | BB (m) | HH (m) | SX (m2) | SY (m2) | SZ (m2) | IX (m4) | IY (m4) | IZ (m4) |
|---|---|---|---|---|---|---|---|---|---|
| Bandeja | 3 | 1.00 | 0.30 | 0.30000 | 0.25000 | 0.25000 | 0.00730 | 0.00225 | 0.02500 |
| Muro | 1 | 1.00 | 0.30 | 0.30000 | 0.25000 | 0.25000 | 0.00730 | 0.00225 | 0.02500 |
| Pantalla | 2 | 1.00 | 0.30 | 0.30000 | 0.25000 | 0.25000 | 0.00730 | 0.00225 | 0.02500 |

## Apoyos Aplicados a la Estructura

| Nombre del apoyo | Lista de nudos | Condiciones de apoyo |
|---|---|---|
| Apoyo | 5 | UX UZ RY |

## Cargas Aplicadas a la Estructura

| Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|
| 1 | Peso Propio | peso propio | 1A3 | PZ Menos Coef=1.0000 |
| 2 | Empuje Activo | carga trapezoidal | 1 | PX2=0.0(T/m) PX1=-0.780(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 2 | Empuje Activo | carga trapezoidal | 2 | PX2=-0.760(T/m) PX1=-2.260(T/m) X2=1.000 X1=0.0 global no proyectadas relativa |
| 3 | Empuje Pasivo | carga trapezoidal | 2 | PX2=0.0(T/m) PX1=8.400(T/m) X2=2.100(m) X1=0.0(m) global no proyectadas absolutos |
| 4 | Empuje Sobrecarga | sobrecarga uniforme | 1 2 | PX=-1.083(T/m) |
| 5 | Peso en Bandeja Terreno | sobrecarga uniforme | 3 | PZ=-2.060(T/m) |
| 6 | Peso en Bandeja Sobrecarga | sobrecarga uniforme | 3 | PZ=-3.000(T/m) |

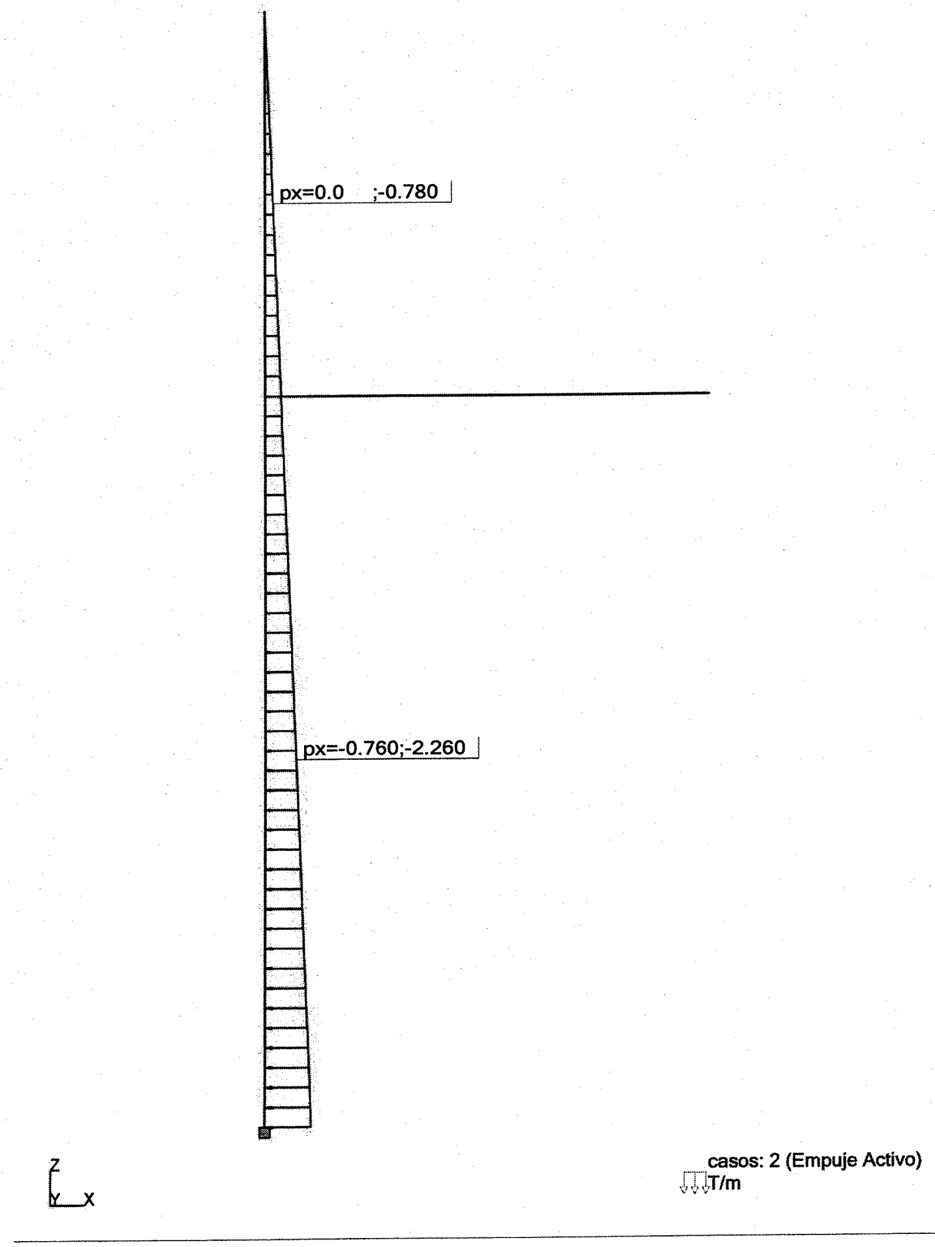
## Combinación de Acciones

| Combinación | Nombre | Definición |
|---|---|---|
| 11 (C) | ELS (Terreno) | (1+2+3+5)*1.0000 |
| 12 (C) | ELS (Terreno+Sobrecarga) | (1+2+3+4+5+6)*1.0000 |
| 21 (C) | ELU (Terreno) | (1+2+3+5)*1.3500 |
| 22 (C) | ELU (Terreno+Sobrecarga) | (1+2+3+5)*1.3500+(4+6)*1.5000 |

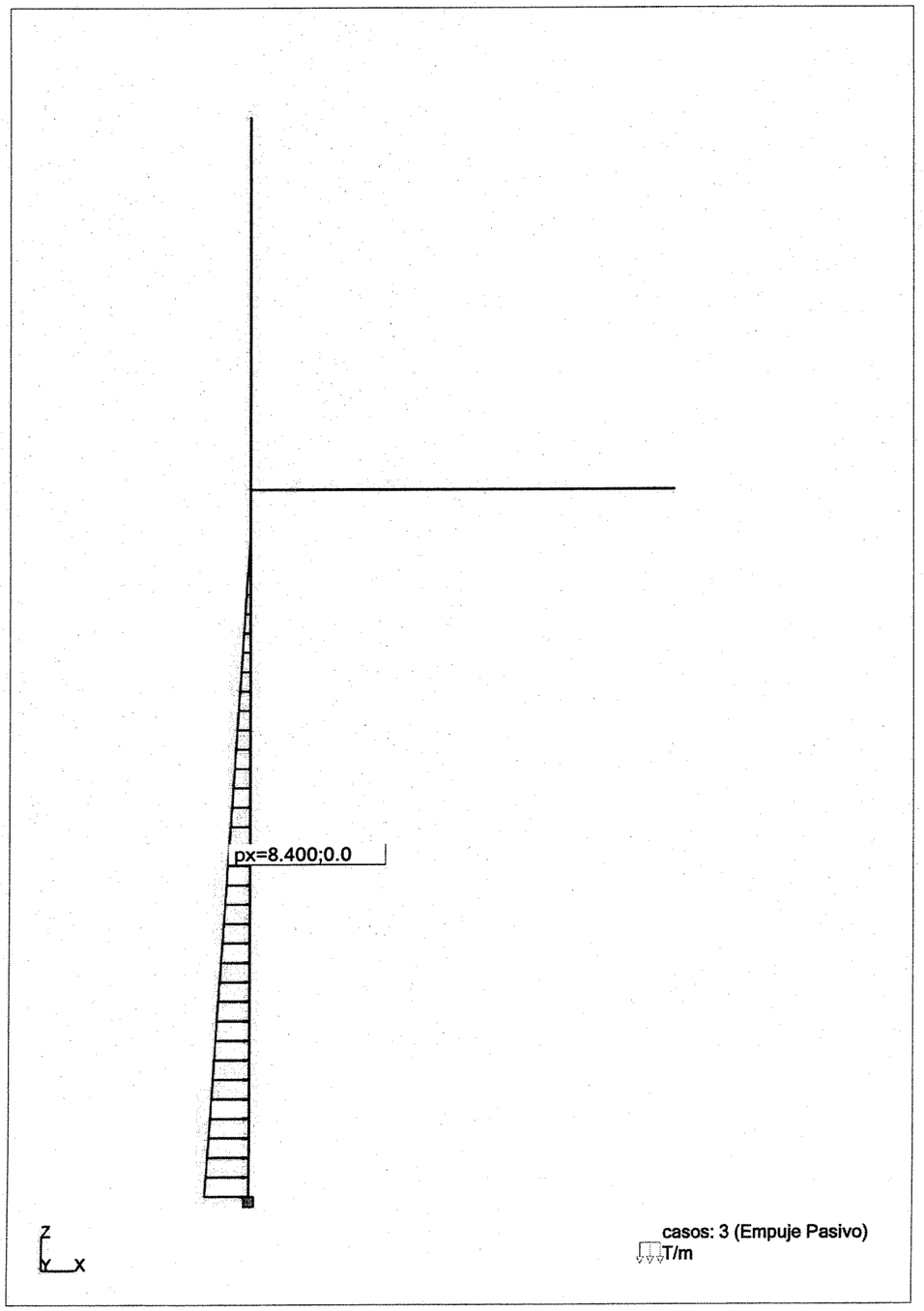
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## Cargas Aplicadas: Empuje Activo

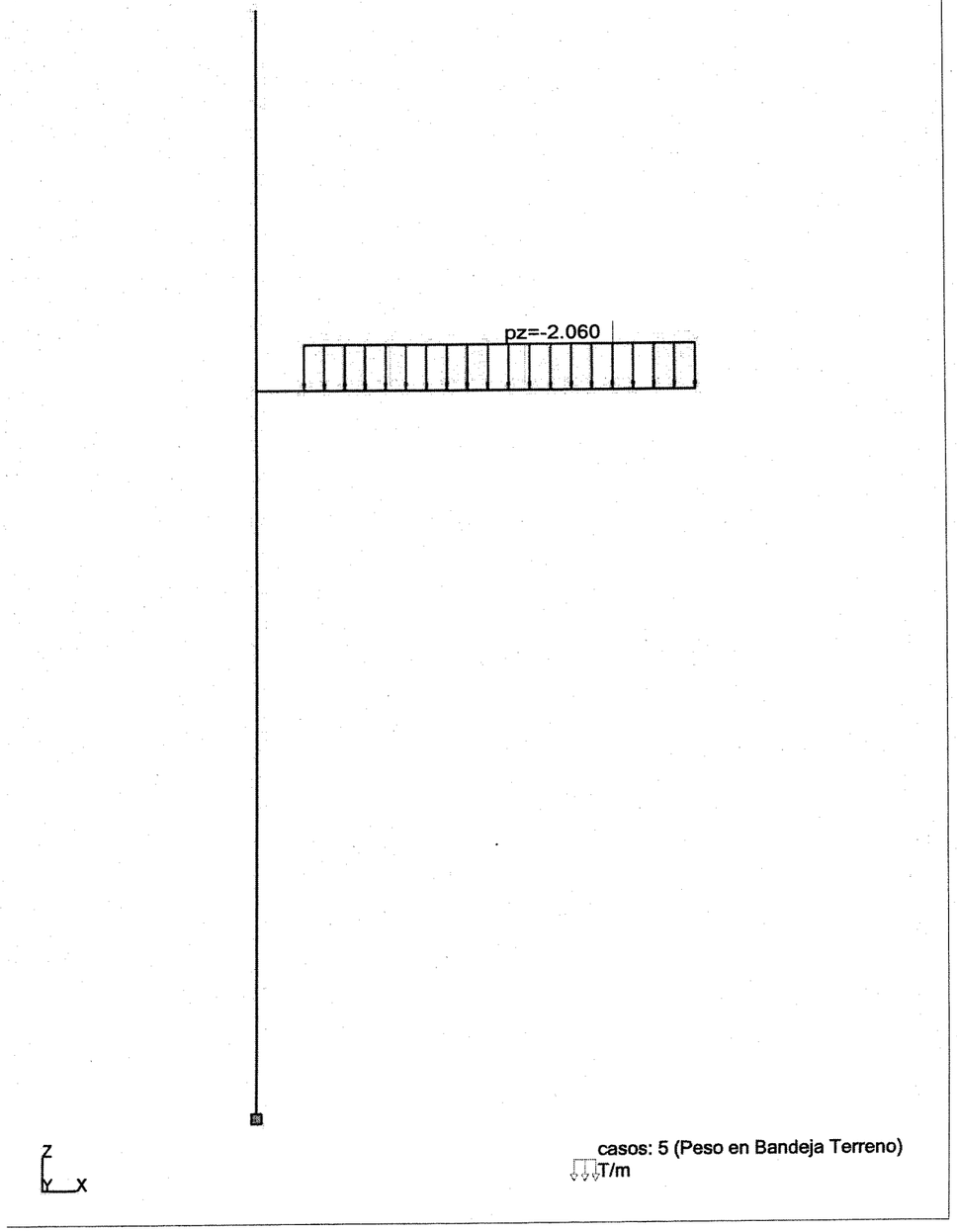


## Cargas Aplicadas: Empuje Pasivo

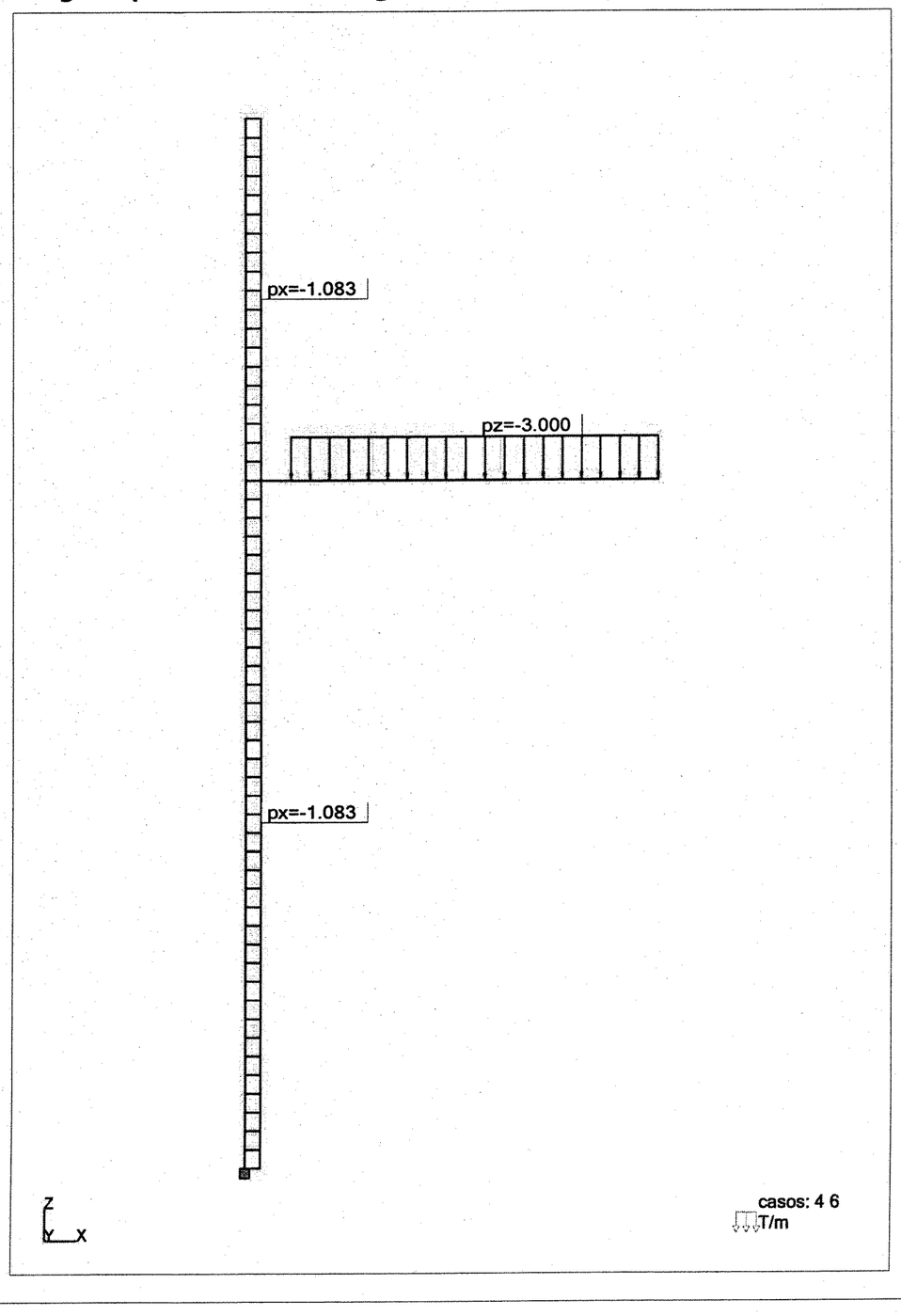





## Cargas Aplicadas: Peso Terreno en Bandeja

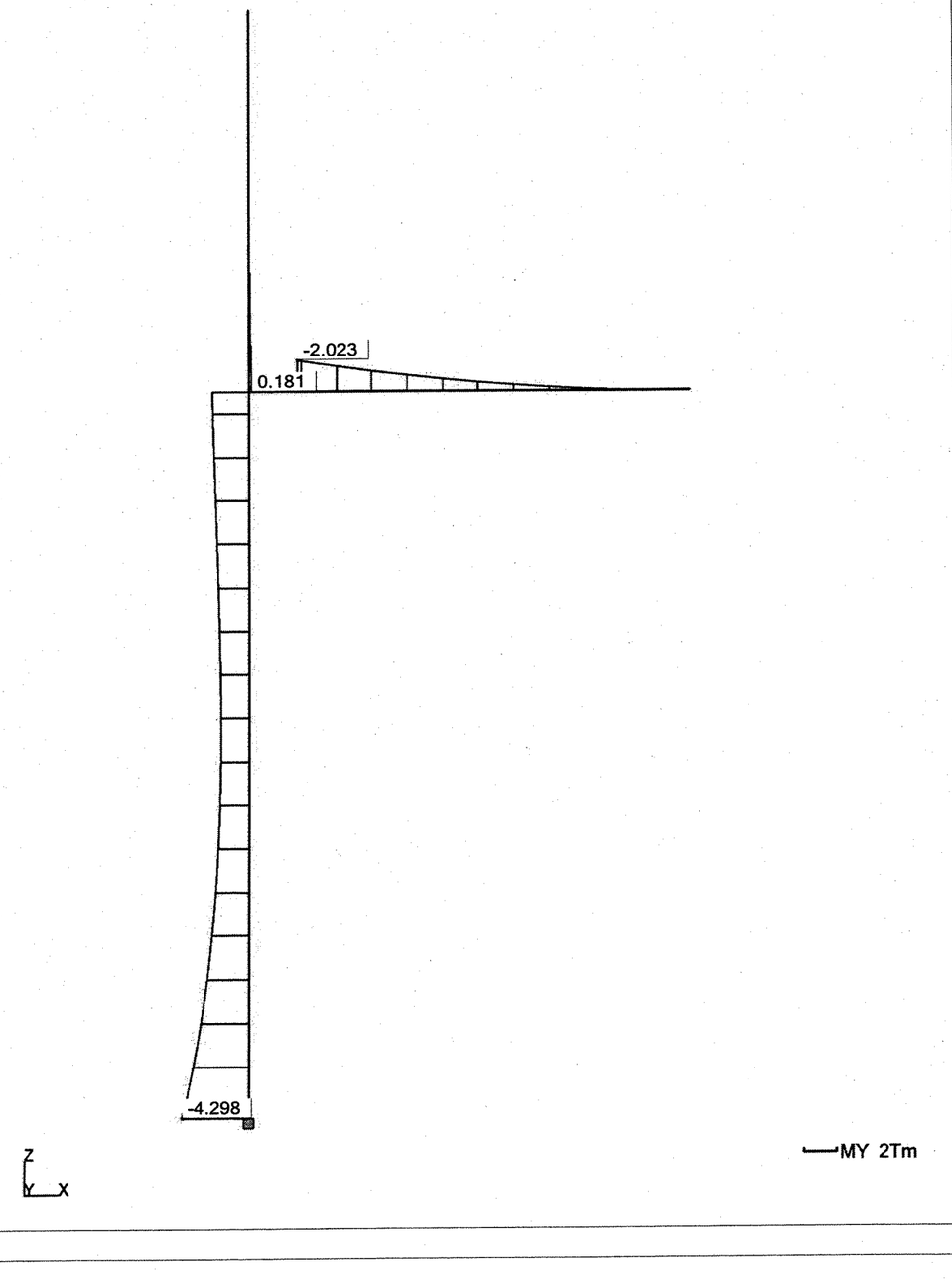


## Cargas Aplicadas: Sobrecargas

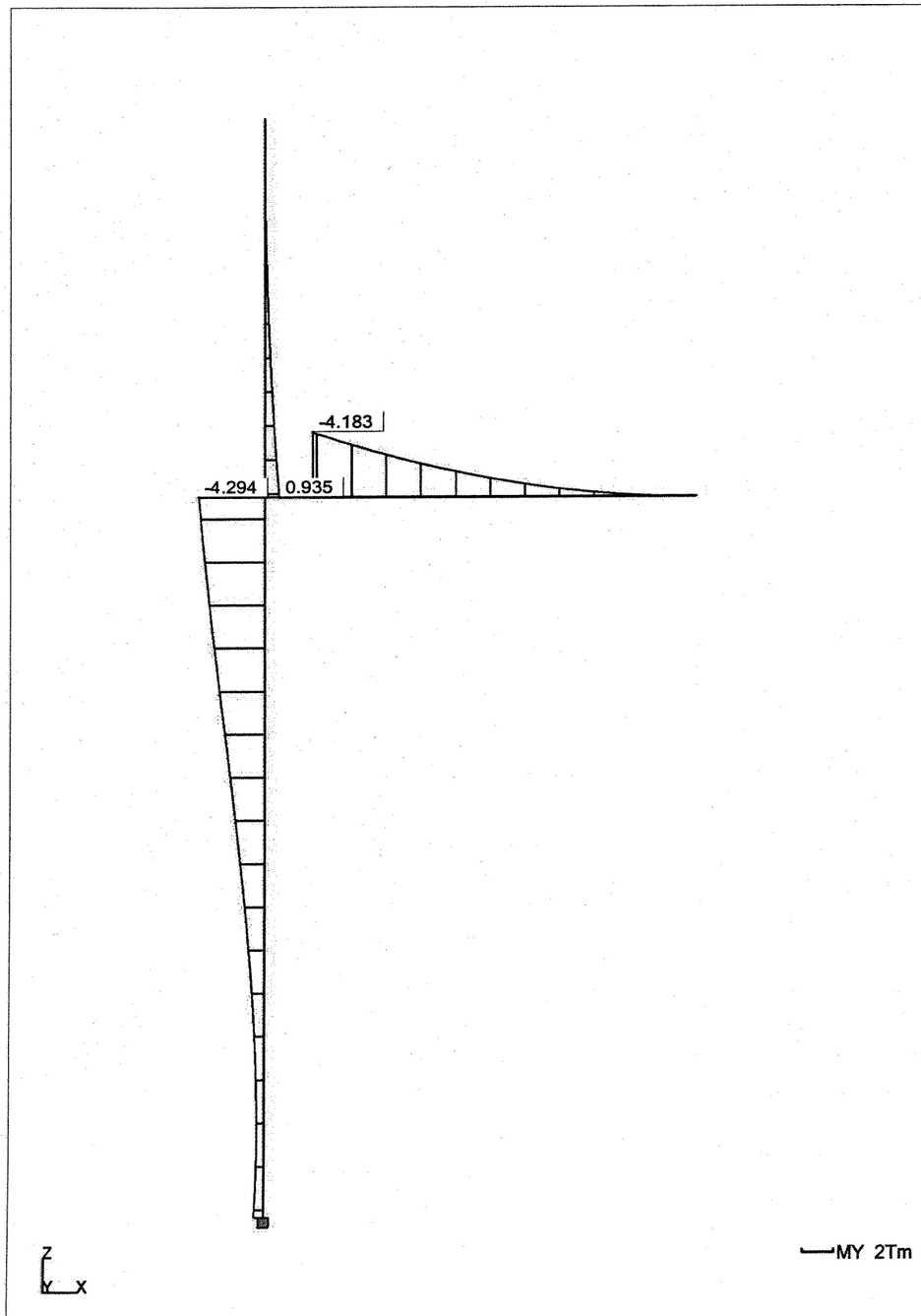



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## Momentos Flectores - ELS Terreno

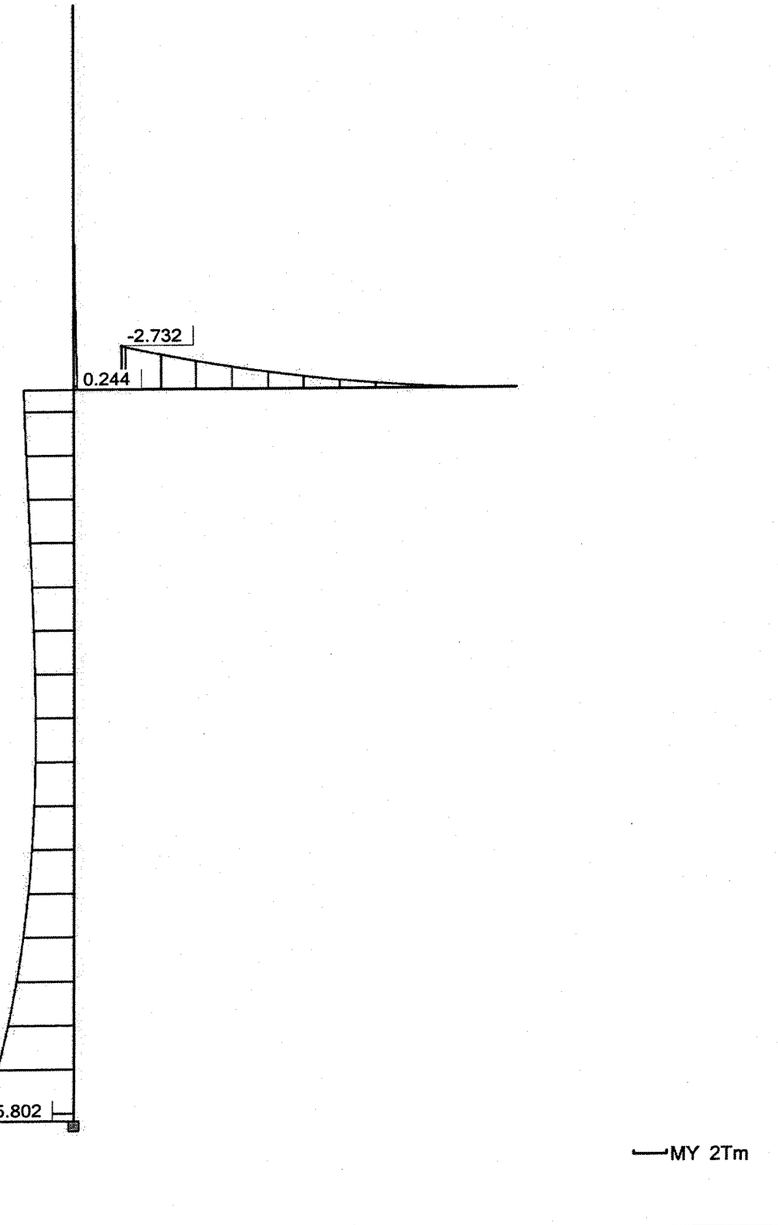


## Momentos Flectores - ELS Terreno+Sobrecarga

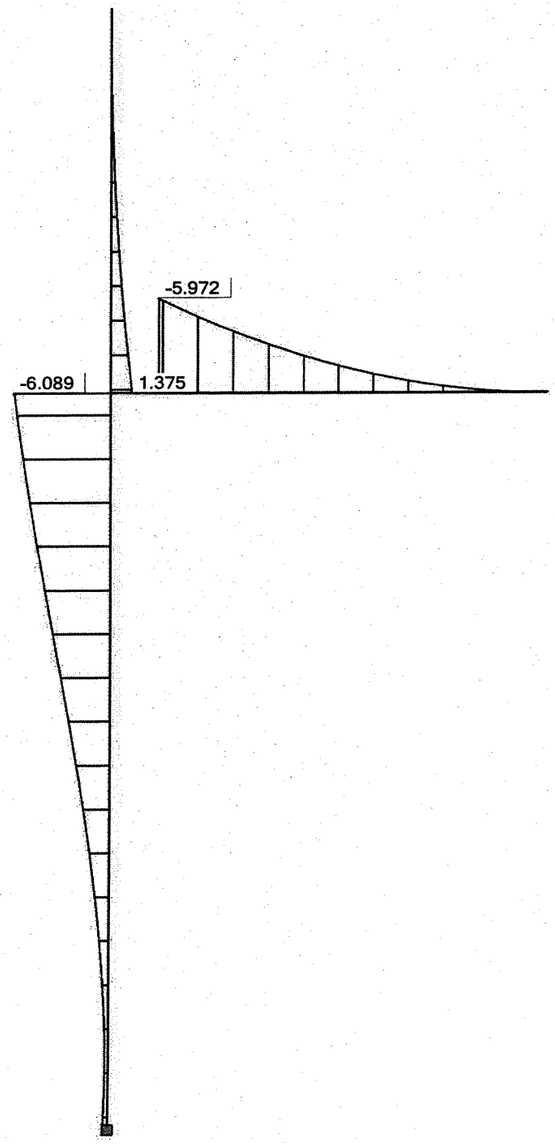



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## Momentos Flectores - ELU Terreno

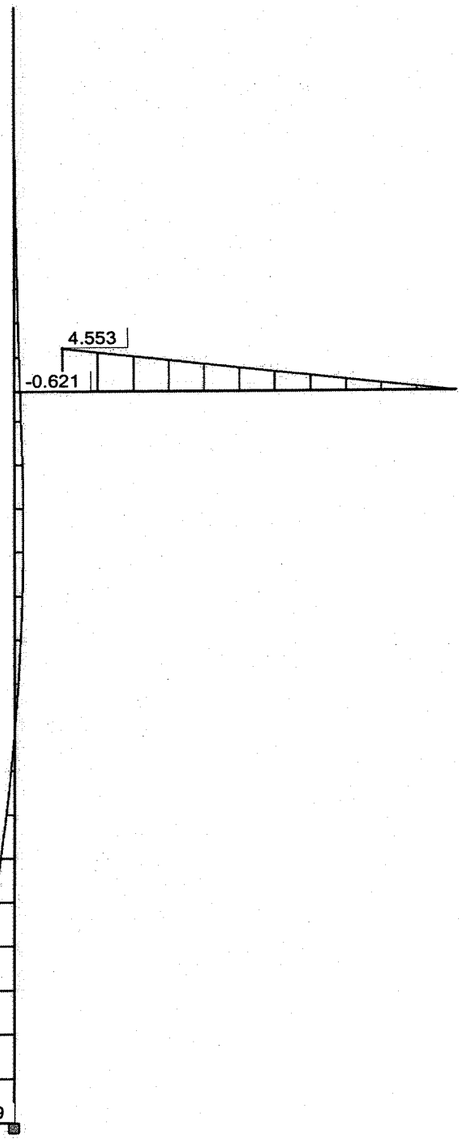


## Momentos Flectores - ELU Terreno+Sobrecarga

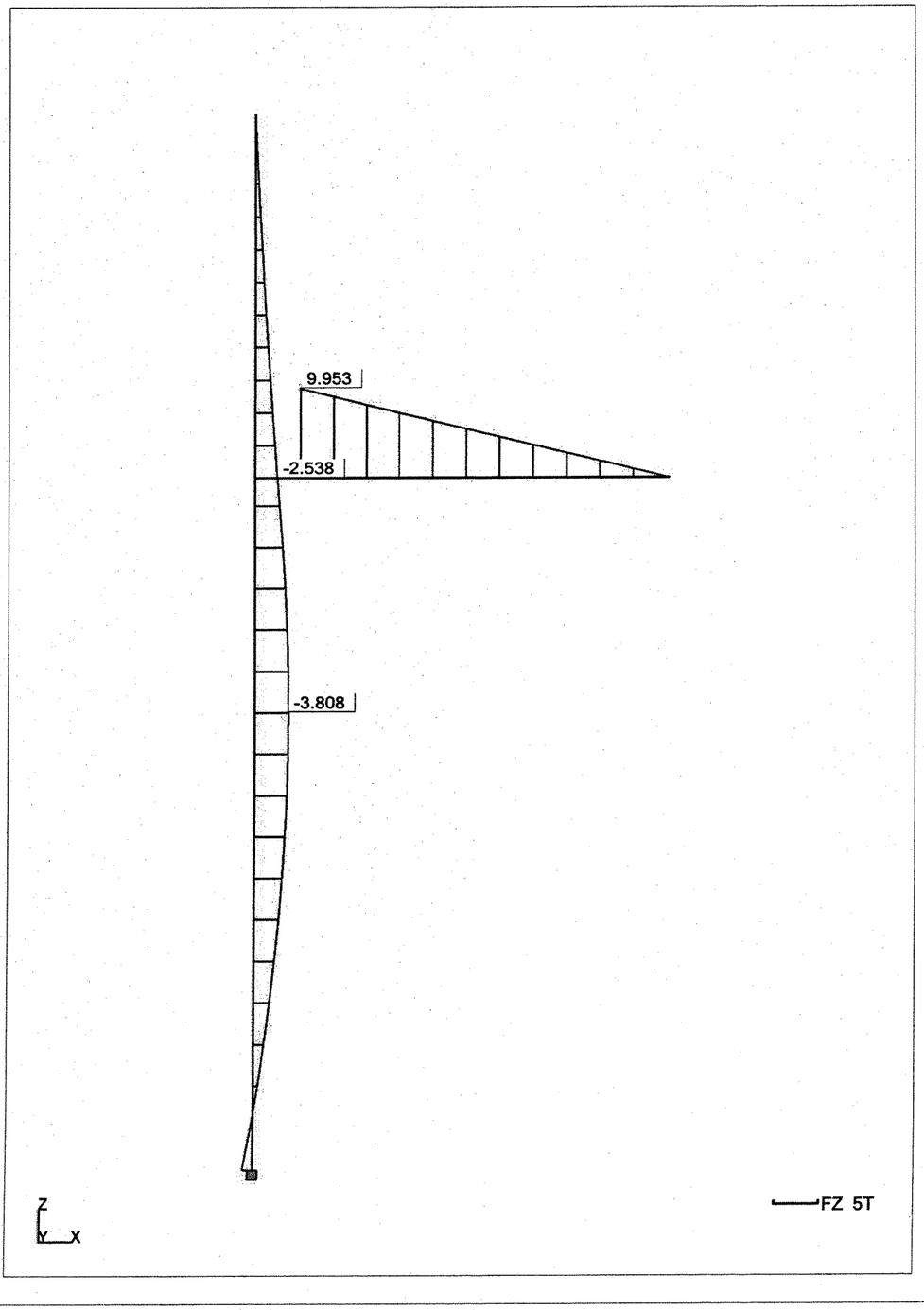



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## Esfuerzos Cortantes - ELU Terreno



## Esfuerzos Cortantes - ELU Terreno+Sobrecarga




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## Esfuerzos en Muro

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| | | | |
| **Nombre del caso** | **ELS (Terreno)** | | |
| **11 (C)/ 1/ 1** | 0.885 | -0.460 | 0.181 |
| **11 (C)/ 1/ 2/10** | 0.787 | -0.364 | 0.127 |
| **11 (C)/ 1/ 3/10** | 0.689 | -0.278 | 0.085 |
| **11 (C)/ 1/ 4/10** | 0.590 | -0.205 | 0.054 |
| **11 (C)/ 1/ 5/10** | 0.492 | -0.142 | 0.031 |
| **11 (C)/ 1/ 6/10** | 0.394 | -0.091 | 0.016 |
| **11 (C)/ 1/ 7/10** | 0.295 | -0.051 | 0.007 |
| **11 (C)/ 1/ 8/10** | 0.197 | -0.023 | 0.002 |
| **11 (C)/ 1/ 9/10** | 0.098 | -0.006 | 0.000 |
| **11 (C)/ 1/ 2** | 0.0 | 0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELS (Terreno+Sobrecarga)** | | |
| **12 (C)/ 1/ 1** | 0.885 | -1.738 | 0.935 |
| **12 (C)/ 1/ 2/10** | 0.787 | -1.500 | 0.723 |
| **12 (C)/ 1/ 3/10** | 0.689 | -1.272 | 0.541 |
| **12 (C)/ 1/ 4/10** | 0.590 | -1.056 | 0.389 |
| **12 (C)/ 1/ 5/10** | 0.492 | -0.852 | 0.264 |
| **12 (C)/ 1/ 6/10** | 0.394 | -0.659 | 0.165 |
| **12 (C)/ 1/ 7/10** | 0.295 | -0.477 | 0.090 |
| **12 (C)/ 1/ 8/10** | 0.197 | -0.307 | 0.039 |
| **12 (C)/ 1/ 9/10** | 0.098 | -0.148 | 0.010 |
| **12 (C)/ 1/ 2** | 0.0 | 0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno)** | | |
| **21 (C)/ 1/ 1** | 1.195 | -0.621 | 0.244 |
| **21 (C)/ 1/ 2/10** | 1.063 | -0.491 | 0.172 |
| **21 (C)/ 1/ 3/10** | 0.930 | -0.376 | 0.115 |
| **21 (C)/ 1/ 4/10** | 0.797 | -0.276 | 0.072 |
| **21 (C)/ 1/ 5/10** | 0.664 | -0.192 | 0.042 |
| **21 (C)/ 1/ 6/10** | 0.531 | -0.123 | 0.021 |
| **21 (C)/ 1/ 7/10** | 0.398 | -0.069 | 0.009 |
| **21 (C)/ 1/ 8/10** | 0.266 | -0.031 | 0.003 |
| **21 (C)/ 1/ 9/10** | 0.133 | -0.008 | 0.000 |
| **21 (C)/ 1/ 2** | 0.0 | 0.000 | 0.000 |
| | | | |
| **Nombre del caso** | **ELU (Terreno+Sobrecarga)** | | |
| **22 (C)/ 1/ 1** | 1.195 | -2.538 | 1.375 |
| **22 (C)/ 1/ 2/10** | 1.063 | -2.195 | 1.065 |
| **22 (C)/ 1/ 3/10** | 0.930 | -1.867 | 0.799 |
| **22 (C)/ 1/ 4/10** | 0.797 | -1.554 | 0.575 |
| **22 (C)/ 1/ 5/10** | 0.664 | -1.257 | 0.391 |
| **22 (C)/ 1/ 6/10** | 0.531 | -0.975 | 0.245 |
| **22 (C)/ 1/ 7/10** | 0.398 | -0.708 | 0.135 |
| **22 (C)/ 1/ 8/10** | 0.266 | -0.457 | 0.059 |
| **22 (C)/ 1/ 9/10** | 0.133 | -0.221 | 0.014 |
| **22 (C)/ 1/ 2** | 0.0 | 0.000 | 0.000 |

## Esfuerzos en Pantalla

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| Nombre del caso | ELS (Terreno) | | |
| 11 (C)/ 2/ 5 | 5.946 | 4.962 | -4.298 |
| 11 (C)/ 2/ 2/10 | 5.759 | 3.531 | -3.240 |
| 11 (C)/ 2/ 3/10 | 5.571 | 2.309 | -2.514 |
| 11 (C)/ 2/ 4/10 | 5.384 | 1.295 | -2.068 |
| 11 (C)/ 2/ 5/10 | 5.196 | 0.489 | -1.850 |
| 11 (C)/ 2/ 6/10 | 5.008 | -0.109 | -1.806 |
| 11 (C)/ 2/ 7/10 | 4.821 | -0.498 | -1.887 |
| 11 (C)/ 2/ 8/10 | 4.633 | -0.679 | -2.038 |
| 11 (C)/ 2/ 9/10 | 4.446 | -0.651 | -2.208 |
| 11 (C)/ 2/ 1 | 4.258 | -0.460 | -2.348 |
| Nombre del caso | ELS (Terreno+Sobrecarga) | | |
| 12 (C)/ 2/ 5 | 9.546 | 1.248 | -0.627 |
| 12 (C)/ 2/ 2/10 | 9.359 | 0.088 | -0.464 |
| 12 (C)/ 2/ 3/10 | 9.171 | -0.864 | -0.566 |
| 12 (C)/ 2/ 4/10 | 8.984 | -1.608 | -0.879 |
| 12 (C)/ 2/ 5/10 | 8.796 | -2.143 | -1.352 |
| 12 (C)/ 2/ 6/10 | 8.608 | -2.469 | -1.933 |
| 12 (C)/ 2/ 7/10 | 8.421 | -2.588 | -2.570 |
| 12 (C)/ 2/ 8/10 | 8.233 | -2.498 | -3.210 |
| 12 (C)/ 2/ 9/10 | 8.046 | -2.200 | -3.801 |
| 12 (C)/ 2/ 1 | 7.858 | -1.738 | -4.294 |
| Nombre del caso | ELU (Terreno) | | |
| 21 (C)/ 2/ 5 | 8.028 | 6.699 | -5.802 |
| 21 (C)/ 2/ 2/10 | 7.774 | 4.767 | -4.374 |
| 21 (C)/ 2/ 3/10 | 7.521 | 3.117 | -3.394 |
| 21 (C)/ 2/ 4/10 | 7.268 | 1.748 | -2.792 |
| 21 (C)/ 2/ 5/10 | 7.015 | 0.660 | -2.497 |
| 21 (C)/ 2/ 6/10 | 6.761 | -0.147 | -2.439 |
| 21 (C)/ 2/ 7/10 | 6.508 | -0.672 | -2.547 |
| 21 (C)/ 2/ 8/10 | 6.255 | -0.916 | -2.751 |
| 21 (C)/ 2/ 9/10 | 6.002 | -0.879 | -2.981 |
| 21 (C)/ 2/ 1 | 5.748 | -0.621 | -3.170 |
| Nombre del caso | ELU (Terreno+Sobrecarga) | | |
| 22 (C)/ 2/ 5 | 13.428 | 1.127 | -0.296 |
| 22 (C)/ 2/ 2/10 | 13.174 | -0.398 | -0.210 |
| 22 (C)/ 2/ 3/10 | 12.921 | -1.643 | -0.471 |
| 22 (C)/ 2/ 4/10 | 12.668 | -2.606 | -1.008 |
| 22 (C)/ 2/ 5/10 | 12.415 | -3.287 | -1.751 |
| 22 (C)/ 2/ 6/10 | 12.161 | -3.688 | -2.629 |
| 22 (C)/ 2/ 7/10 | 11.908 | -3.807 | -3.571 |
| 22 (C)/ 2/ 8/10 | 11.655 | -3.645 | -4.509 |
| 22 (C)/ 2/ 9/10 | 11.402 | -3.202 | -5.370 |
| 22 (C)/ 2/ 1 | 11.148 | -2.538 | -6.089 |

ROBOT v 17.0.1
Autor :

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Archivo : **Muro Tipo VI.rtd**

## Esfuerzos en Bandeja

| Caso/Barra/Punto | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|
| Nombre del caso | ELS (Terreno) | | |
| 11 (C)/ 3/ 4 | -0.000 | 3.372 | -2.023 |
| 11 (C)/ 3/ 2/10 | -0.000 | 2.998 | -1.599 |
| 11 (C)/ 3/ 3/10 | -0.000 | 2.623 | -1.224 |
| 11 (C)/ 3/ 4/10 | -0.000 | 2.248 | -0.899 |
| 11 (C)/ 3/ 5/10 | -0.000 | 1.874 | -0.625 |
| 11 (C)/ 3/ 6/10 | -0.000 | 1.499 | -0.400 |
| 11 (C)/ 3/ 7/10 | -0.000 | 1.124 | -0.225 |
| 11 (C)/ 3/ 8/10 | -0.000 | 0.749 | -0.100 |
| 11 (C)/ 3/ 9/10 | -0.000 | 0.375 | -0.025 |
| 11 (C)/ 3/ 3 | -0.000 | 0.000 | -0.000 |
| Nombre del caso | ELS (Terreno+Sobrecarga) | | |
| 12 (C)/ 3/ 4 | -0.000 | 6.972 | -4.183 |
| 12 (C)/ 3/ 2/10 | -0.000 | 6.198 | -3.305 |
| 12 (C)/ 3/ 3/10 | -0.000 | 5.423 | -2.531 |
| 12 (C)/ 3/ 4/10 | -0.000 | 4.648 | -1.859 |
| 12 (C)/ 3/ 5/10 | -0.000 | 3.874 | -1.291 |
| 12 (C)/ 3/ 6/10 | -0.000 | 3.099 | -0.826 |
| 12 (C)/ 3/ 7/10 | -0.000 | 2.324 | -0.465 |
| 12 (C)/ 3/ 8/10 | -0.000 | 1.549 | -0.207 |
| 12 (C)/ 3/ 9/10 | -0.000 | 0.775 | -0.052 |
| 12 (C)/ 3/ 3 | -0.000 | 0.000 | 0.000 |
| Nombre del caso | ELU (Terreno) | | |
| 21 (C)/ 3/ 4 | -0.000 | 4.553 | -2.732 |
| 21 (C)/ 3/ 2/10 | -0.000 | 4.047 | -2.158 |
| 21 (C)/ 3/ 3/10 | -0.000 | 3.541 | -1.653 |
| 21 (C)/ 3/ 4/10 | -0.000 | 3.035 | -1.214 |
| 21 (C)/ 3/ 5/10 | -0.000 | 2.529 | -0.843 |
| 21 (C)/ 3/ 6/10 | -0.000 | 2.023 | -0.540 |
| 21 (C)/ 3/ 7/10 | -0.000 | 1.518 | -0.304 |
| 21 (C)/ 3/ 8/10 | -0.000 | 1.012 | -0.135 |
| 21 (C)/ 3/ 9/10 | -0.000 | 0.506 | -0.034 |
| 21 (C)/ 3/ 3 | -0.000 | 0.000 | -0.000 |
| Nombre del caso | ELU (Terreno+Sobrecarga) | | |
| 22 (C)/ 3/ 4 | -0.000 | 9.953 | -5.972 |
| 22 (C)/ 3/ 2/10 | -0.000 | 8.847 | -4.718 |
| 22 (C)/ 3/ 3/10 | -0.000 | 7.741 | -3.613 |
| 22 (C)/ 3/ 4/10 | -0.000 | 6.635 | -2.654 |
| 22 (C)/ 3/ 5/10 | -0.000 | 5.529 | -1.843 |
| 22 (C)/ 3/ 6/10 | -0.000 | 4.423 | -1.180 |
| 22 (C)/ 3/ 7/10 | -0.000 | 3.318 | -0.664 |
| 22 (C)/ 3/ 8/10 | -0.000 | 2.212 | -0.295 |
| 22 (C)/ 3/ 9/10 | -0.000 | 1.106 | -0.074 |
| 22 (C)/ 3/ 3 | -0.000 | 0.000 | 0.000 |

## Reacciones en Apoyo

| Nudo/Caso | Nombre del caso | FX (T) | FZ (T) | MY (Tm) |
|---|---|---|---|---|
| 5/ 11 (C) | ELS (Terreno) | -4.962 | 5.946 | -4.298 |
| 5/ 12 (C) | ELS (Terreno+Sobrecarga) | -1.248 | 9.546 | -0.627 |
| 5/ 21 (C) | ELU (Terreno) | -6.699 | 8.028 | -5.802 |
| 5/ 22 (C) | ELU (Terreno+Sobrecarga) | -1.127 | 13.428 | -0.296 |

La estabilidad del muro se obtiene cuando los empujes pasivos son capaces de compensar los empujes activos. Para que se de este criterio, el momento de reacción en el apoyo de la pantalla deba ser cero.

En caso de tener un momento negativo, éste nos indica que el momento producido por los empujes pasivos es mayor que el producido por los empujes activos y, por tanto, la pantalla es capaz de generar mecanismos resistentes.

En las reacciones adjuntas se puede ver que los momentos en el apoyo de pantalla son siempre menores o iguales a cero. De este modo, podemos asegurar la estabilidad de la pantalla.

## 8.2 VERIFICACIÓN DE LOS ESTADOS LÍMITE Y ARMADO

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro VI - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: MURO y PANTALLA**

| Tipo de elemento | Muros |
|---|---|
| Momento Flector [T·m] | 6.09 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 30.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **1.78** |
| **ARMADURA NECESARIA(cm2)** | **5.81** |

| | |
|---|---|
| **Cuantía Mínima Vertical (cm2)** | **2.70** |
| **Cuantía Mínima Horizontal (cm2)** | **9.60** |

Arm Vert: cuantía mínima cara tracción. Arm Horiz: 2/3 en cara vista

**Se dispondrán una barra Ø12 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro VI - Estribo 1 - Pérgola**

**MURO y PANTALLA**

| | |
|---|---|
| D(mm) | 250 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 9.05 |
| Vrd(Tn) | 6.70 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.894 |
| Roele | 0.0036 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 118435.5 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 98696.28 |
| Vsu,p | 90000.00 |

| | |
|---|---|
| ***As,c =*** | ***0.0*** **cm²/m** |
| ***As,min=*** | ***8.3*** **cm²/m** |

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 3000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 1250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro VI - Estribo 1 - Pérgola**

### MURO y PANTALLA

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 30.00 |
| Arm. Tracción | As1 | cm2 | 9.05 |
| Canto útil | d | cm | 25.00 |
| Arm. Compresión | As2 | cm2 | 9.05 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 3000 |
| Area sec. Homog. | Ah | cm2 | 3139.41 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 15.00 |
| Inercia sec. Homog. | Ih | cm4 | 238941.44 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0036 |
| Cuantía mecánica 2 | ρ2 | 0.0036 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 4.086 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 2.18 |
| Inercia fisurada | If | cm4 | 39,442 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 4.29 |
| Diámetro | ϕ | mm | 12 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,821 |
| Tensión de servicio | Ts | kp/cm2 | 1,913 |
| Area eficaz | Ac,ef | cm2 | 750 |
| Alargamiento medio armaduras | εsm | | 0.0005 |
| Separación media de fisuras | Sm | mm | 162.72 |
| **Abertura característica** | **Wk** | **mm** | **0.14** |

## CÁLCULO DE LA ARMADURA DE FLEXIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro VI - Estribo 1 - Pérgola**

**CALCULO DE ARMADURA DE FLEXIÓN: BANDEJA**

Tipo de elemento Losas

| | |
|---|---|
| Momento Flector [T·m] | 5.97 |
| Axil [T] (COMPRESION POSITIVA) | 0.00 |
| Ancho = B [cm] | 100.0 |
| Canto = H [cm] | 30.0 |
| Recubrimiento [cm] | 5.0 |
| Fcd [kp/cm2] | 166.7 |
| Fyd [kp/cm2] | 4347.8 |

| | | |
|---|---|---|
| **POSICION FIBRA NEUTRA(cm)** | | **1.75** |
| **ARMADURA NECESARIA(cm2)** | | **5.69** |
| **Cuantía Mínima Vertical (cm2)** | **5.40** | |
| **Cuantía Mínima Horizontal (cm2)** | | |

La cuantía mínima corresponde a la cara de tracción

**Se dispondrán una barra Ø12 cada 0,125m**

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro VI - Estribo 1 - Pérgola**

**BANDEJA**

| | |
|---|---|
| D(mm) | 250 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 9.05 |
| Vrd(Tn) | 9.95 |
| N(Tn) | 0.00 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.894 |
| Roele | 0.0036 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 118435.5 |

**No necesita armadura de cortante**

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 98696.28 |
| Vsu,p | 90000.00 |

| | |
|---|---|
| ***As,c =*** | ***0.0*** **cm²/m** |
| ***As,min=*** | ***8.3*** **cm²/m** |

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 3000 |
| Sigmacd (N/mm2) | 0 |
| K | 1.000 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 1250000 |

**Verificada la resistencia del alma a la compresión**

## CÁLCULO DE FISURACIÓN

**Proyecto: LAV Castellbisbal-Papiol**
**Elemento: Muro VI - Estribo 1 - Pérgola**

**BANDEJA**

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 30.00 |
| Arm. Tracción | As1 | cm2 | 9.05 |
| Canto útil | d | cm | 25.00 |
| Arm. Compresión | As2 | cm2 | 9.05 |
| Dist. d' | d' | cm | 5.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,100,000 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.70 |
| Cuantía mecánica 1 | ρ1 | 0.0036 |
| Cuantía mecánica 2 | ρ2 | 0.0036 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 2.18 |
| Inercia fisurada | If | cm4 | 39,442 |

| DATOS PARA CÁLCULO ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 4.18 |
| Diámetro | ϕ | mm | 12 |
| Separación | s | cm | 12.5 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 5.00 |
| Area hormigón | Ac | cm2 | 3000 |
| Area sec. Homog. | Ah | cm2 | 3139.41 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 15.00 |
| Inercia sec. Homog. | Ih | cm4 | 238941.44 |

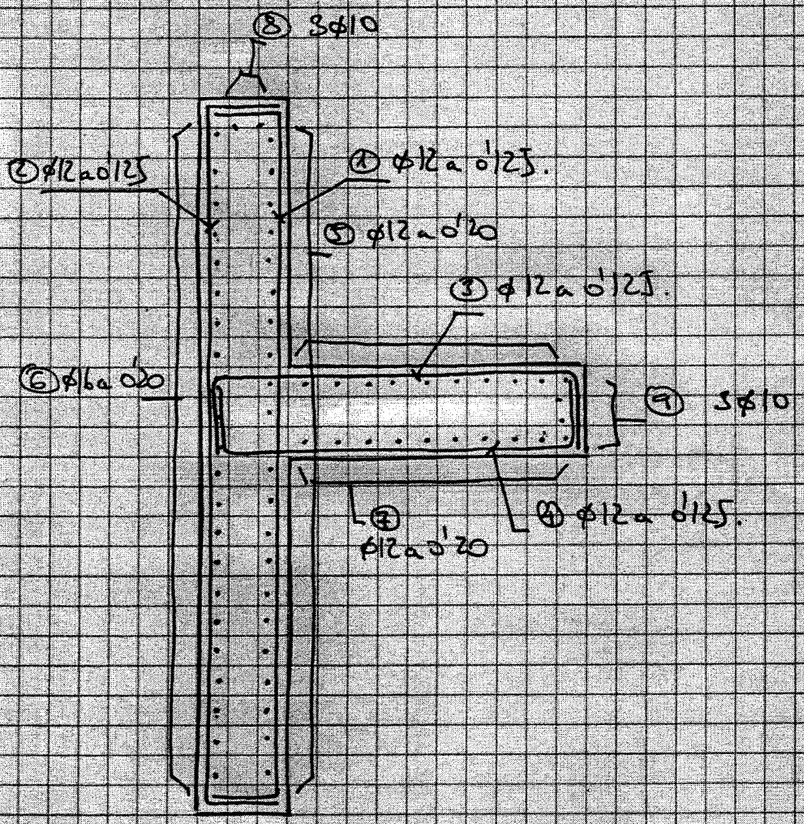
| CÁLCULO DEL MOMENTO DE FISURACIÓN | | |
|---|---|---|
| Momento de fisuración | Mfis | mT 4.086 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,821 |
| Tensión de servicio | Ts | kp/cm2 | 1,864 |
| Area eficaz | Ac,ef | cm2 | 750 |
| Alargamiento medio armaduras | εsm | | 0.0005 |
| Separación media de fisuras | Sm | mm | 162.72 |
| **Abertura característica** | **Wk** | **mm** | **0.13** |

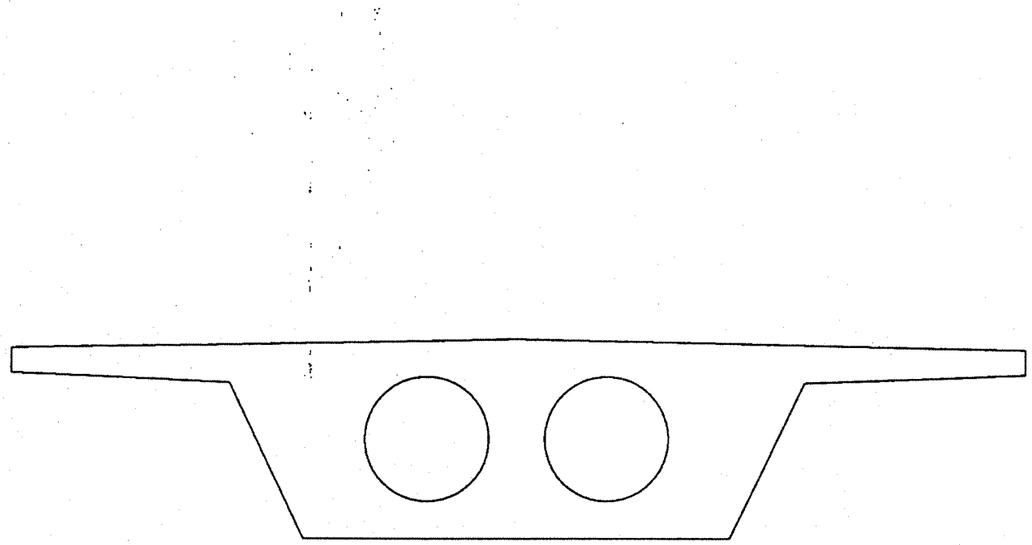
PEDELTA
INGENIERIA CIVIL

FECHA HOJA

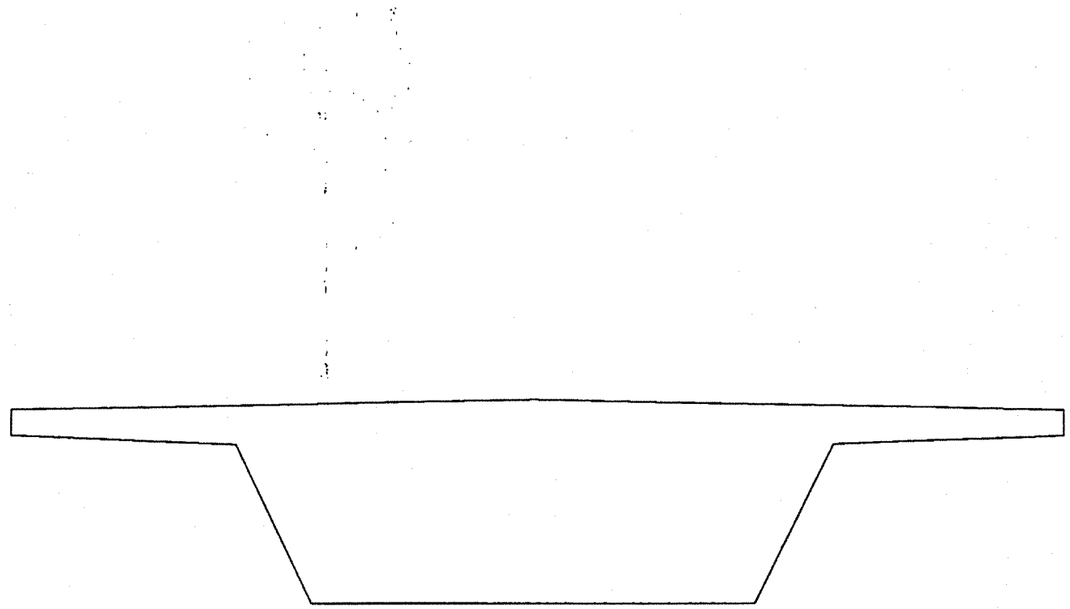
# ARMADO MURO TIPO VII.



# 5 CÁLCULO ESTRUCTURAL DEL TABLERO



Area: 5.9048
Perimeter: 24.6605
Bounding box: X: -4.1000 -- 4.1000
Y: 0.0000 -- 1.6000
Centroid: X: 0.0000
Y: 0.9265
Moments of inertia: X: 6.5586
Y: 17.8969
Product of inertia: XY: 0.0000
Radii of gyration: X: 1.0539
Y: 1.7409
Principal moments and X-Y directions about centroid:
I: 1.4893 along [1.0000 0.0000]
J: 17.8969 along [0.0000 1.0000]



Area: 7.4756
Perimeter: 18.3773
Bounding box: X: -4.1000 -- 4.1000
Y: 0.0000 -- 1.6000
Centroid: X: 0.0000
Y: 0.9000
Moments of inertia: X: 7.6621
Y: 18.8207
Product of inertia: XY: 0.0000
Radii of gyration: X: 1.0124
Y: 1.5867
Principal moments and X-Y directions about centroid:
I: 1.6074 along [1.0000 0.0000]
J: 18.8207 along [0.0000 1.0000]

PEDELTA
INGENIERÍA CIVIL

FECHA HOJA

Caract. a torsión en sección aligerada

$A = 5'9048\ m^2$
$u = 18'4\ m$
$\Rightarrow h_e = 0'32 \not< 0'3\ m \Rightarrow$

$\Rightarrow h_e = 0'3\ m$

$A_c = \left(\frac{3'26 + 4'47}{2}\right) \cdot 1'30 = 5'02\ m^2$

$u_c = 10'60\ m$

$J = \frac{4 \cdot A_c^2}{\sum \frac{s_i}{h_i}} = \frac{4 \cdot A_c^2}{\frac{1}{h_e}(\sum s_i) = u_c} = 2'85\ m^4$

Caract. a torsión de la sección maciza.

$A = 7'4756\ m^2$
$u = 18'4\ m$
$\Rightarrow h_e = 0'40\ m$

$A_c = \left(\frac{3'20 + 4'31}{2}\right) \cdot 1'20 = 4'51\ m^2$

$u_e = 10'15\ m$

$J = 3'20\ m^4$

PEDELTA
INGENIERÍA CIVIL

FECHA HOJA

Características a rasante:

a) Sección aligerada

$A_{vol} = 0'447\ m^2$
$Y = 1'41\ m$
$e = 0'30\ m$
} Caract voladizo

$I = 1'489\ m^4$
$V_{inf} = 0'927\ m$
} Caract. sección

$\tau_{rd} = \frac{m_e}{I \cdot e} \cdot V_d = \alpha_v \cdot V_d \Rightarrow$

$\Rightarrow \alpha_v = \frac{m_e}{I \cdot e} = \frac{0'447 \cdot (1'41 - 0'927)}{1'489 \cdot 0'30} = 0'483$

$\beta_v = \alpha_v \cdot e = 0'145$

b) Sección maciza

$I = 1'607\ m^4$
$V_{inf} = 0'9\ m$
$\Rightarrow \alpha_v = 0'473 \Rightarrow$

$\Rightarrow \beta_v = 0'142$

Proyecto: L.A.V. Madrid-Barcelona. Tramo: Castellbisbal-Papiol.
Estructura: Viaducto Puerto-Martorell

## CÁLCULO DE LAS CARGAS MUERTAS EN LOS PUENTES DE ANCHO IBÉRICO DE VÍA SIMPLE

### Impermeabilización del tablero

| | | |
|---|---|---|
| Ancho con impermeabilización bituminosa | 5.40 | Para ancho de puente de 14,00 m, distancia entre muretes guardabalasto = 10,10 m. |
| Espesor | 0.03 m | 0,03 m para impermeabilización tipo 1. |
| Densidad | 2.30 T/m3 | |
| **Valor de la carga** | **0.37 T/m** | |

### Cableado y paseos

| | | |
|---|---|---|
| **Valor de la carga** | **2.05 T/m** | Según especificaciones de las bases de cálculo del GIF para puentes de LAV. |

### Traviesas y carriles

| | | |
|---|---|---|
| Número de vías | 1 | |
| Peso del carril | 0.06 T/m | Para UIC 60, 0,060 T/m. |
| Peso de la traviesa | 0.30 T | Para traviesa monobloque RENFE, 0,300 T. |
| Separación de la traviesa | 0.60 m | Normalmente 0,60 m. |
| **Valor de la carga** | **0.62 T/m** | |

### Impostas y barandillas

| | | |
|---|---|---|
| Número de impostas | 2 | |
| Carga por imposta | 1.00 T/m | Por defecto 1 T/m imposta y barandilla. |
| **Valor de la carga** | **2.00 T/m** | |

### Soportes de catenarias

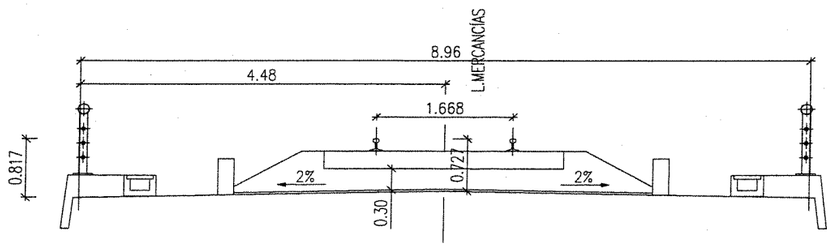
| | | |
|---|---|---|
| Valor de la carga | 5.00 T | Dos cargas de este valor a 5,70 m a cada lado del eje del tablero sobre cada pila. |

**VALOR TOTAL DE LAS CARGAS MUERTAS (VALORES MÁXIMOS)**

| | | |
|---|---|---|
| **CARGA VERTICAL** | **11.456 T** | |
| **MONENTO TORSOR** | **1.168 T*m** | **Positivo hacia el exterior de la curva** |

**VALOR TOTAL DE LAS CARGAS MUERTAS (VALORES MÍNIMO)**

| | | |
|---|---|---|
| **CARGA VERTICAL** | **8.496 T** | |
| **MONENTO TORSOR** | **0.629 T*m** | **Positivo hacia el exterior de la curva** |




### Carga de balasto

| | | |
|---|---|---|
| Peralte | 70 mm | |
| Espesor de balasto bajo traviesa | 0.35 m | Mínimo 0,30 m. |
| Espesor de traviesa | 0.242 m | 0,242 m para monobloque . |
| Altura de carril | 0.172 m | 0,172 m para UIC-60. |
| Separación entre carriles | 1.667 m | 1,435 m para vía UIC. |
| Distancia entre eje de vía y centro de tablero | 0 m | 2,35 m para vía UIC. |
| Distancia entre eje de vía y borde superior de balasto (hombro) | 1.9 m | |
| Distancia entre eje de tablero e interior de guardabalasto | 2.7 m | |

**Resultados para la cuña exterior**

| | | |
|---|---|---|
| Distancia de eje de tablero a hombro | 2.7335 m | |
| Altura de balasto en centro de tablero | 0.540 m | |
| Altura de balasto en extremo de hombro | 0.710 m | |
| Area 1-1 | 1.477 m2 | |
| Area 1-2 | 0.232 m2 | |
| Area 2 | -0.012 m2 | |
| Excentricidad 1-1 | 1.367 m | |
| Excentricidad 1-2 | 1.822 m | |
| Excentricidad 2 | 2.722 m | |
| Area total | 1.697 m2 | |
| Excentricidad total | 1.419 m | |
| **Peso total** | **2.715 T** | |
| **Momento torsor** | **3.853 T*m** | |

**Resultados para la cuña interior**

| | | |
|---|---|---|
| Distancia de eje de tablero a hombro | 2.7335 m | |
| Altura de balasto en centro de tablero | 0.540 m | |
| Altura de balasto en extremo de hombro | 0.480 m2 | |
| Area 1-1 | 1.477 m2 | |
| Area 1-2 | -0.082 m2 | |
| Area 2 | -0.008 m2 | |
| Excentricidad 1-1 | 1.367 m | |
| Excentricidad 1-2 | 1.822 m | |
| Excentricidad 2 | 2.722 m | |
| Area total | 1.387 m2 | |
| Excentricidad total | 1.332 m | |
| **Peso total** | **2.219 T** | |
| **Momento torsor** | **2.955 T*m** | |

**Valores totales para el conjunto de ambas vías. Valores máximos (=1,30*valores nominales).**

| | | |
|---|---|---|
| **Peso total** | **6.414 T** | |
| **Momento torsor** | **1.168 T*m** | Positivo hacia el exterior de la curva |

**Valores totales para el conjunto de ambas vías. Valores mínimos (=0,70*valores nominales).**

| | | |
|---|---|---|
| **Peso total** | **3.454 T** | |
| **Momento torsor** | **0.629 T*m** | Positivo hacia el exterior de la curva |

## CÁLCULO DE LA FUERZA CENTRÍFUGA SEGÚN LAS ESPECIFICACIONES DEL EUROCÓDIGO 1.

**PROYECTO:** L.A.V. MADRID-BARCELONA. TRAMO: CASTELLBISBAL-PAPIOL
**OBRA DE FÁBRICA:** VIADUCTO PUERTO-MARTORELL. TRAMO EN LOSA.
**REFERENCIA:** HIPÓTESIS DE FUERZA CENTRÍFUGA MÁXIMA EN CORONACIÓN DE PILAS

### DATOS BÁSICOS

| | | |
|---|---|---|
| RADIO MEDIO DEL PUENTE (m) = | R = | 1,100 |
| VELOCIDAD DE DISEÑO (km/h) = | V = | 200 |
| PUENTE CONTÍNUO (SÍ = 1) = | | 1 |

### DATOS COMPLEMENTARIOS

| | | |
|---|---|---|
| COEFICIENTE DE CLASIFICACIÓN | $\alpha$ = | 1.00 |
| COEFICIENTE DE IMPACTO = | $\phi$ = | 1.00 |
| LONGITUD CARGADA EN PILAS (en m) = | $L_{fp}$ = | 25.30 |
| LONGITUD CARGADA EN ESTRIBO (en m) = | $L_{fe}$ = | 10.25 |

### VALORES DE LAS CARGAS

| | | | |
|---|---|---|---|
| TREN LM71 | qk = | 80 | kN/m |
| | Qk = | 250 | kN |
| | c = | 6.4 | m |
| TREN SW/0 | qk = | 133 | kN/m |
| | a = | 15 | m |
| | c = | 5.3 | m |
| TREN SW/2 | qk = | 150 | kN/m |
| | a = | 25 | m |
| | c = | 7.0 | m |

### RESULTADOS

FUERZA CENTRÍFUGA SEGÚN EL TREN DE CARGA TIPO

| | TREN LM71 | | | | TREN SW/0 | | TREN SW/2 |
|---|---|---|---|---|---|---|---|
| | Caso a | | Caso b | | Caso a | Caso b | |
| | qk | Qk | qk | Qk | qk | qk | qk |
| | kN/m | kN | kN/m | kN | kN/m | kN/m | kN/m |
| PILA | 8.25 | 25.77 | 15.84 | 49.50 | 13.71 | 26.33 | 6.87 |
| ESTRIBO | 8.25 | 25.77 | 17.89 | 55.92 | 13.71 | 29.75 | 6.87 |

FUERZA CENTRÍFUGA. VALOR DE LA RESULTANTE MÁXIMA EN KN.

| | LM71 | SW/0 | SW/2 |
|---|---|---|---|
| PILA | 497.36 | 526.66 | 171.80 |
| ESTRIBO | 292.57 | 304.93 | 70.44 |

**Hipótesis de cálculo:**
De acuerdo con el EC1 la expresión utilizada para el cálculo de la fuerza centrífuga es la siguiente.

$$Q_{centrifuga} = \frac{V^2}{127 \cdot R} \cdot (f \cdot Q_{trafico})$$

Para los trenes LM71 y SW/0 se han considerado dos casos de carga:

Caso a: V = 120 km/h y f (factor de reducción) = 1
Caso b: V igual a la de diseño y f según la expresión del EC.

$$f = \left[1 - \frac{V - 120}{1000} \cdot \left(\frac{814}{V} + 1{,}75\right) \cdot \left(1 - \sqrt{\frac{2{,}88}{Lf}}\right)\right]$$

Si V<= 120 km/h ==> f = 1.
Si Lf <= 2,88 m ==> f = 1.
f >= 0,35

En el cálculo del factor de reducción f se ha tomado como velocidad máxima 300 km/h.

Los valores obtenidos son válidos para el caso de tráfico en una sola vía.
La velocidad de diseño de la vía se ha supuesto mayor o igual a 80 km/h.
La longitud de aplicación de las cargas se ha supuesto mayor que 2,88 m.

**CÁLCULO DE LA FUERZA CENTRÍFUGA SEGÚN LAS ESPECIFICACIONES DE LA IPF-75**

**PROYECTO:** L.A.V. MADRID-BARCELONA. TRAMO: CASTELLBISBAL-PAPIOL
**OBRA DE FÁBRICA:** VIADUCTO PUERTO-MARTORELL. TRAMO EN LOSA.
**REFERENCIA:** HIPÓTESIS DE FUERZA CENTRÍFUGA MÁXIMA EN CORONACIÓN DE PILAS

**DATOS BÁSICOS**

| | | |
|---|---|---|
| RADIO MEDIO DEL PUENTE (m) = | R = | 1,100 |
| VELOCIDAD DE DISEÑO (km/h) = | V = | 200 |
| COEFICIENTE DE IMPACTO = | $\phi$ = | 1.00 |
| LONGITUD CARGADA (m) = | L = | 25.30 |

**VALORES DE LAS CARGAS**

| | | | |
|---|---|---|---|
| TREN TIPO A | Qk = | 300 | kN |
| | c = | 1.5 | m |
| TREN TIPO B | qk1 = | 120 | kN/m |
| | a = | 30 | m |
| | qk2 = | 100 | kN/m |

**CÁLCULOS INTERMEDIOS**

| | |
|---|---|
| COCIENTE V2/127R | 0.28633 |
| Longitud aplicación qk1 | 25.30 |
| Longitud aplicación qk2 | 0.00 |
| Número de cargas Qk | 3 |

**RESULTADOS**

FUERZA CENTRÍFUGA SEGÚN EL TREN DE CARGA

| TREN A | TREN B | |
|---|---|---|
| Qk | qk1 | qk2 |
| kN | kN/m | kN/m |
| 85.90 | 34.36 | 28.63 |

FUERZA CENTRÍFUGA. VALOR TOTAL RESULTANTE

| TREN TIPO A | TREN TIPO B |
|---|---|
| 257.70 | 869.29 |

**Hipótesis de cálculo:**
De acuerdo con la instrucción IPF-75 la expresión utilizada para el cálculo de la fuerza centrífuga es la siguiente:

$$Q_{centrifuga} = \frac{V^2}{127 \cdot R} \cdot Q_{trafico}$$

Los valores obtenidos son válidos para el caso de tráfico en una sola vía.

## CÁLCULO DE EXCENTRICIDADES - LÍNEA DE MERCANCÍAS

**PROYECTO:** L.A.V. MADRID-BARCELONA-FRONTERA FRANCESA.
**TRAMO:** CASTELLBISBAL-PAPIOL
**SUBTRAMO:**
**OBRA DE FÁBRICA:** VIADUCTO PUERTO-MARTORELL. TABLERO EN LOSA.

| | | | |
|---|---|---|---|
| **EC-1 LM71** | Carga vertical | 8 | T/m |
| | Fuerza centrífuga | 1.58 | T/m |
| **EC-1 SW/0** | Carga vertical | 13.3 | T/m |
| | Fuerza centrífuga | 2.63 | T/m |
| **EC-1 SW/2** | Carga vertical | 15 | T/m |
| | Fuerza centrífuga | 0.69 | T/m |
| **IPF-75 TIPO A** | Carga vertical | 30 | T/m |
| | Fuerza centrífuga | 8.59 | T/m |
| **IPF-75 TIPO B** | Carga vertical | 12 | T/m |
| | Fuerza centrífuga | 3.44 | T/m |
| Distancia fib. sup. al c.d.g. del tablero | | 0.7 | m |
| Peralte | | 70 | mm |
| Altura del c.d.g. del tren sobre carril | | 1.8 | m |
| Distancia entre carriles | | 1.668 | m |
| Dif de cotas carril director-centro tablero | | 0.727 | m |

| Excentricidades | respecto cdg de vía | |
|---|---|---|
| Ripado | 0.3 | m |
| Peralte | 0.075 | m |
| L.M. 71 y SW/0 (EC1) | 0.093 | m |

Fuerza centrífuga — respecto cdg de vía

b= 3.260 m

Momento debido a la Fuerza Centrífuga

| | | |
|---|---|---|
| LM-71 | 5.151 | [mT/m] |
| SW/0 | 8.575 | |
| SW/2 | 2.250 | |
| TIPO A | 28.007 | |
| TIPO B | 11.216 | |

Excentricidad debida a la Fuerza Centrífuga (m)

| | | |
|---|---|---|
| LM-71 | 0.644 | [m] |
| SW/0 | 0.645 | |
| SW/2 | 0.150 | |
| TIPO A | 0.934 | |
| TIPO B | 0.935 | |

**Excentricidad total** — respecto cdg de vía

| | **LM-71** | **SW/0** | **SW/2** | **TIPO A** | **TIPO B** | |
|---|---|---|---|---|---|---|
| Peralte-f.centr+ripado | **-0.176** | **-0.177** | **0.225** | **-0.558** | **-0.559** | |
| Peralte-f.centr-ripado | **-0.961** | **-0.962** | **-0.375** | **-1.158** | **-1.159** | [m] |
| Peralte+ripado | **0.468** | **0.468** | **0.375** | **0.375** | **0.375** | |

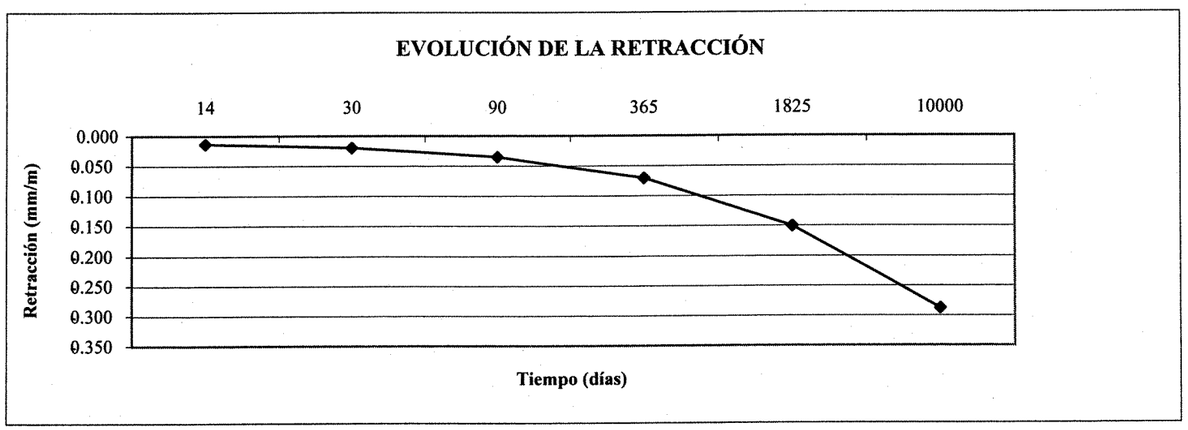
**PROYECTO:** [illegible] **Fecha:** 12/05/2004

## CÁLCULO DE RETRACCIÓN DEL HORMIGÓN

| | | |
|---|---|---|
| Área de la sección | 5.9 | m2 |
| Perímetro de la sección | 18.38 | m |
| fck | 40 | MPa |
| Humedad relativa | 60 | % |
| Espesor equivalente | 642 | mm |
| Comienzo retracción | 1 | días |
| Final de retracción | 10000 | días |
| RH | 1.215 | |
| Coef. básico de retracción | 0.000449624 | |
| **Retracción final** | **-0.000288** | |

**Evolución de la retracción del hormigón**

| Tiempo (días) | βds | εcs,s | εcs(mm/m) | |
|---|---|---|---|---|
| 14 | 0.03001 | 1.34913E-05 | 0.013 | |
| 30 | 0.04479 | 2.01392E-05 | 0.020 | |
| 90 | 0.07830 | 3.52078E-05 | 0.035 | |
| 365 | 0.15688 | 7.05372E-05 | 0.071 | |
| 1825 | 0.33503 | 0.000150639 | 0.151 | |
| 10000 | 0.63983 | 0.000287681 | 0.288 | |

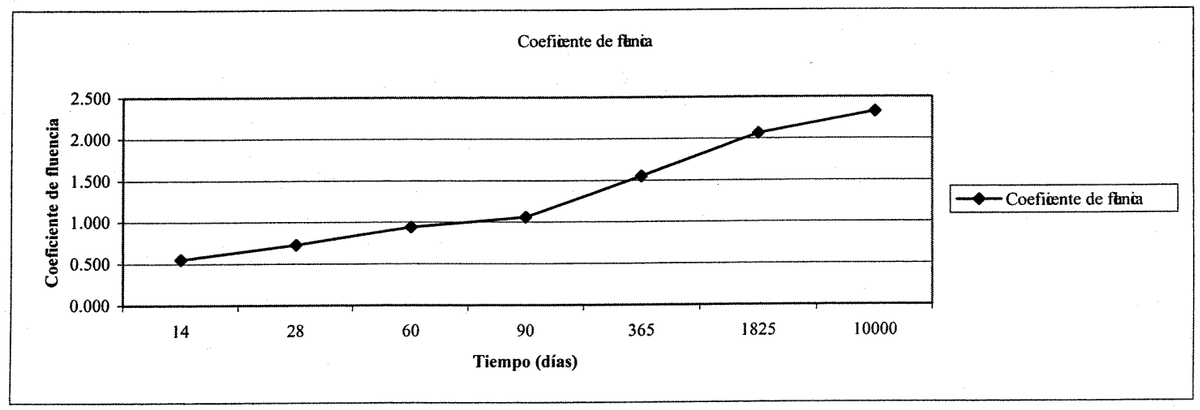



## CÁLCULO DE LA FLUENCIA DEL HORMIGÓN

| | | |
|---|---|---|
| PHRH | 1.468 | |
| βfc(fcm) | 2.425 | |
| Pestæn ægto,en días | 5 | |
| βfc(to) | 0.676 | |
| βch | 1216 | |
| βc(10000) | 0.966 | |
| **Phi (t=10000)** | **2.325** | |
| Coeficiente de reja | 0.691 | |

**Evolución de la fluencia del hormigón**

| Tiempo (días) | βc | Phi0 | Phi(10000) | |
|---|---|---|---|---|
| 14 | 0.229 | 2.406 | 0.551 | |
| 28 | 0.302 | 2.406 | 0.728 | |
| 60 | 0.390 | 2.406 | 0.938 | |
| 90 | 0.441 | 2.406 | 1.062 | |
| 365 | 0.642 | 2.406 | 1.545 | |
| 1825 | 0.858 | 2.406 | 2.064 | |
| 10000 | 0.966 | 2.406 | 2.325 | |



# CÁLCULO DE LA VARIACIÓN UNIFORME DE TEMPERATURA EN LA LOSA DE HORMIGÓN

| Datos | | |
|---|---|---|
| Zona | | 3 |
| Tipo de tablero (ver tabla) | 2 | |
| Canto, m | | 1.60 |
| Separación entre ejes de vigas (o puentes de vigas), m | 0.00 | |

| Cálculos intermedios | | |
|---|---|---|
| k | | 24.91 |
| a | | 0.292 |
| b | | 0.172 |
| c | | 0.000 |
| Canto de losa, m | | 1.500 |
| Separación de losa entre vigas, m | 1.000 | |

| Resultados | |
|---|---|
| Valor total de variación uniforme de temperatura, °C | **32.0** |
| Variación de losa (=T/2 -5) | **21.0** |

**Valores de la tabla**

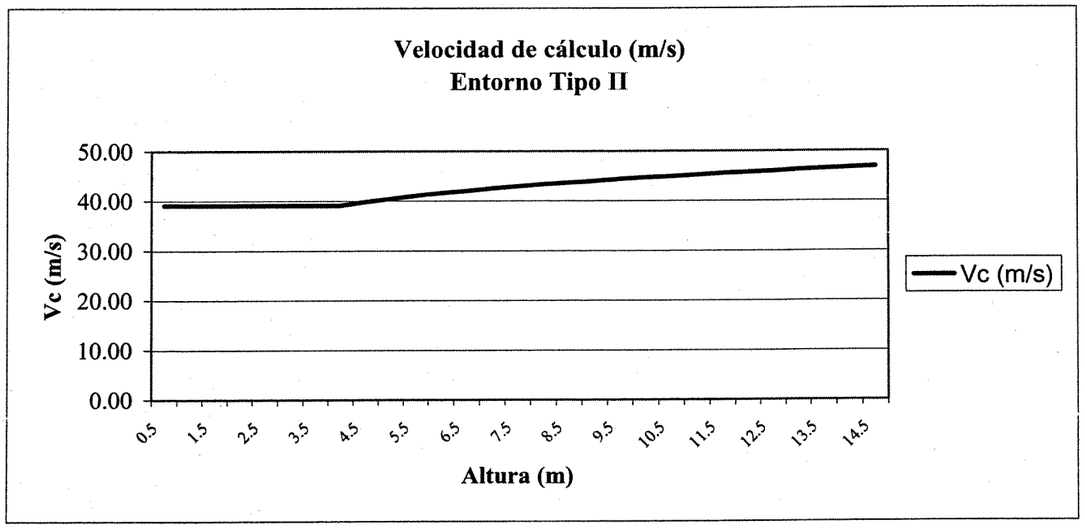
| Tipología de tablero | Tipo de tablero | k | a | b | c | Canto mínimo | Canto máximo |
|---|---|---|---|---|---|---|---|
| Losa maciza de hormigón | 1 | 23.89 | 0.292 | 0.139 | 0 | 0.3 | 1.2 | |
| Losa aligerada de hormigón | 2 | 24.91 | 0.292 | 0.172 | 0 | 0.6 | 1.5 |
| Cajón de hormigón | 3 | 29.13 | 0.301 | 0.148 | 0 | 1.7 | 4 |
| Viga de hormigón | 4 | 26.9 | 0.3 | 0.088 | 0.057 | 0.6 | 2.5 |
| Cajón metálico | 5 | 39.77 | 0.234 | 0.069 | 0 | 1.5 | 4.5 |
| Viga metálica | 6 | 40.11 | 0.228 | 0.072 | 0 | 2 | 6 |

## CÁLCULO DE EMPUJES DE VIENTO

**Proyecto:** L.A.V. MADRID-BARCELONA. TRAMO: CASTELLBISBAL-PAPIOL **Fecha:** mayo-04
**Estructura:** VIADUCTO PUERTO MARTORELL

| | | |
|---|---|---|
| Vref | 28 | m/s |
| Ct | 1 | |
| Periodo de retorno | 100 | |
| Cr | 1.04 | |
| Entorno Tipo | 2 | |
| Kz | 0.19 | |
| zo | 0.05 | m |
| Zmin | 4 | m |

| Altura (m) | Cz | Cg | Vc (m/s) |
|---|---|---|---|
| 0.5 | 0.833 | 1.612 | 39.07 |
| 1.0 | 0.833 | 1.612 | 39.07 |
| 1.5 | 0.833 | 1.612 | 39.07 |
| 2.0 | 0.833 | 1.612 | 39.07 |
| 2.5 | 0.833 | 1.612 | 39.07 |
| 3.0 | 0.833 | 1.612 | 39.07 |
| 3.5 | 0.833 | 1.612 | 39.07 |
| 4.0 | 0.833 | 1.612 | 39.07 |
| 4.5 | 0.855 | 1.599 | 39.80 |
| 5.0 | 0.875 | 1.587 | 40.45 |
| 5.5 | 0.893 | 1.578 | 41.03 |
| 6.0 | 0.910 | 1.569 | 41.56 |
| 6.5 | 0.925 | 1.561 | 42.05 |
| 7.0 | 0.939 | 1.555 | 42.50 |
| 7.5 | 0.952 | 1.548 | 42.92 |
| 8.0 | 0.964 | 1.542 | 43.31 |
| 8.5 | 0.976 | 1.537 | 43.68 |
| 9.0 | 0.987 | 1.532 | 44.03 |
| 9.5 | 0.997 | 1.528 | 44.35 |
| 10.0 | 1.007 | 1.524 | 44.66 |
| 10.5 | 1.016 | 1.520 | 44.96 |
| 11.0 | 1.025 | 1.516 | 45.24 |
| 11.5 | 1.033 | 1.512 | 45.50 |
| 12.0 | 1.041 | 1.509 | 45.76 |
| 12.5 | 1.049 | 1.506 | 46.00 |
| 13.0 | 1.057 | 1.503 | 46.24 |
| 13.5 | 1.064 | 1.500 | 46.47 |
| 14.0 | 1.071 | 1.497 | 46.68 |
| 14.5 | 1.077 | 1.495 | 46.89 |
| 15.0 | 1.084 | 1.492 | 47.10 |
| 15.5 | 1.090 | 1.490 | 47.29 |
| 16.0 | 1.096 | 1.488 | 47.48 |
| 16.5 | 1.102 | 1.486 | 47.67 |
| 17.0 | 1.107 | 1.484 | 47.84 |
| 17.5 | 1.113 | 1.482 | 48.02 |
| 18.0 | 1.118 | 1.480 | 48.19 |
| 18.5 | 1.124 | 1.478 | 48.35 |
| 19.0 | 1.129 | 1.476 | 48.51 |
| 19.5 | 1.134 | 1.474 | 48.66 |
| 20.0 | 1.138 | 1.473 | 48.81 |



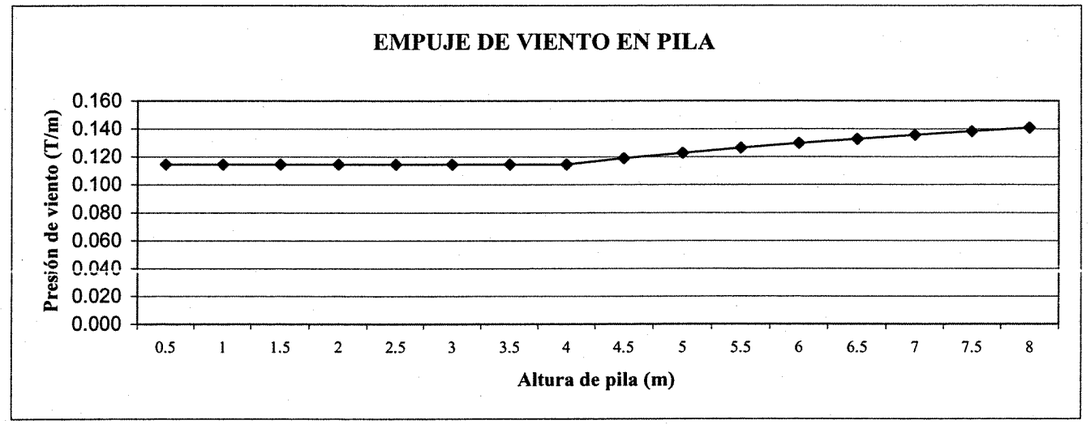
Proyecto: L.A.V. MADRID-BARCELONA. TRAMO: CASTELLBISBAL-PAPI Fecha: mayo-04
Estructura: VIADUCTO PUERTO MARTORELL

## Empuje en pilas

Area expuesta 1 m2
CDpila 1.2

Esfuerzos en base de pila s/altura

| Altura (m) | Cz | Cg | Vc (m/s) | F (T/m) | Cortante(T) | Momento (mT) |
|---|---|---|---|---|---|---|
| 0.5 | 0.833 | 1.612 | 39.07 | 0.115 | 0.057 | 0.014 |
| 1 | 0.833 | 1.612 | 39.07 | 0.115 | 0.115 | 0.057 |
| 1.5 | 0.833 | 1.612 | 39.07 | 0.115 | 0.172 | 0.129 |
| 2 | 0.833 | 1.612 | 39.07 | 0.115 | 0.229 | 0.229 |
| 2.5 | 0.833 | 1.612 | 39.07 | 0.115 | 0.286 | 0.358 |
| 3 | 0.833 | 1.612 | 39.07 | 0.115 | 0.344 | 0.515 |
| 3.5 | 0.833 | 1.612 | 39.07 | 0.115 | 0.401 | 0.701 |
| 4 | 0.833 | 1.612 | 39.07 | 0.115 | 0.458 | 0.916 |
| 4.5 | 0.855 | 1.599 | 39.80 | 0.119 | 0.516 | 1.160 |
| 5 | 0.875 | 1.587 | 40.45 | 0.123 | 0.577 | 1.433 |
| 5.5 | 0.893 | 1.578 | 41.03 | 0.126 | 0.639 | 1.737 |
| 6 | 0.910 | 1.569 | 41.56 | 0.130 | 0.703 | 2.073 |
| 6.5 | 0.925 | 1.561 | 42.05 | 0.133 | 0.768 | 2.441 |
| 7 | 0.939 | 1.555 | 42.50 | 0.135 | 0.836 | 2.842 |
| 7.5 | 0.952 | 1.548 | 42.92 | 0.138 | 0.904 | 3.277 |
| 8 | 0.964 | 1.542 | 43.31 | 0.141 | 0.974 | 3.746 |
| 8.5 | 0.976 | 1.537 | 43.68 | 0.143 | 1.045 | 4.251 |
| 9 | 0.987 | 1.532 | 44.03 | 0.145 | 1.117 | 4.791 |
| 9.5 | 0.997 | 1.528 | 44.35 | 0.148 | 1.190 | 5.368 |
| 10 | 1.007 | 1.524 | 44.66 | 0.150 | 1.264 | 5.981 |
| 10.5 | 1.016 | 1.520 | 44.96 | 0.152 | 1.340 | 6.632 |
| 11 | 1.025 | 1.516 | 45.24 | 0.153 | 1.416 | 7.321 |
| 11.5 | 1.033 | 1.512 | 45.50 | 0.155 | 1.493 | 8.048 |
| 12 | 1.041 | 1.509 | 45.76 | 0.157 | 1.571 | 8.814 |
| 12.5 | 1.049 | 1.506 | 46.00 | 0.159 | 1.650 | 9.620 |
| 13 | 1.057 | 1.503 | 46.24 | 0.160 | 1.730 | 10.465 |
| 13.5 | 1.064 | 1.500 | 46.47 | 0.162 | 1.810 | 11.350 |
| 14 | 1.071 | 1.497 | 46.68 | 0.163 | 1.892 | 12.275 |
| 14.5 | 1.077 | 1.495 | 46.89 | 0.165 | 1.974 | 13.242 |
| 15 | 1.084 | 1.492 | 47.10 | 0.166 | 2.057 | 14.249 |
| 15.5 | 1.090 | 1.490 | 47.29 | 0.168 | 2.140 | 15.299 |
| 16 | 1.096 | 1.488 | 47.48 | 0.169 | 2.224 | 16.390 |
| 16.5 | 1.102 | 1.486 | 47.67 | 0.170 | 2.309 | 17.523 |
| 17 | 1.107 | 1.484 | 47.84 | 0.172 | 2.395 | 18.699 |
| 17.5 | 1.113 | 1.482 | 48.02 | 0.173 | 2.481 | 19.918 |
| 18 | 1.118 | 1.480 | 48.19 | 0.174 | 2.568 | 21.180 |
| 18.5 | 1.124 | 1.478 | 48.35 | 0.175 | 2.655 | 22.486 |
| 19 | 1.129 | 1.476 | 48.51 | 0.176 | 2.743 | 23.836 |
| 19.5 | 1.134 | 1.474 | 48.66 | 0.178 | 2.832 | 25.229 |
| 20 | 1.138 | 1.473 | 48.81 | 0.179 | 2.921 | 26.667 |



Fecha: mayo-04

Proyecto: **L.A.V. MADRID-BARCELONA. TRAMO: CASTELLBISBAL-PAPIOL**
Estructura: **VIADUCTO PUERTO MARTORELL**

## Características de la sección transversal del tablero

| | | |
|---|---|---|
| Canto tablero | 1.6 | m |
| Distancia de fibra neutra a base inferior | 0.9 | m |
| Número de vigas o cajones | 1 | ud |
| Canto viga o cajón | 1.6 | m |
| Distancia libre entre vigas | 0 | m |
| Ancho tablero | 8.2 | m |
| Altura de barrera | 1 | m |
| Relación de solidez barrera | 1 | |
| Altura de balasto | 0.7 | m |
| Distancia entre barrera y balasto | 2 | m |
| Número de vías | 1 | ud |

**Valores sin tráfico**

| | | |
|---|---|---|
| Espaciamiento relativo entre barreras | 7.2 | |
| Espaciamiento relativo balasto | 2 | |
| Espaciamiento relativo entre vigas | 0.00 | |
| Coeficiente de ocultamiento barreras | 1 | |
| Coeficiente de ocultamiento balasto | 0.2 | |
| Coeficiente de ocultamiento vigas | 0 | |
| Altura equivalente sin trafico | 2.6 | m |
| Area transversal sin tráfico | 4.1 | m |
| CD sin trafico | 1.55 | |

**Valores con tráfico en 1 vía**

| | | |
|---|---|---|
| Separación entre ejes de vías | 0 | m |
| Distancia de eje de vía a barrera | 5.05 | m |
| Espaciamiento relativo entre barrera y tren | 0.76 | |
| Espaciamiento relativo balasto | 2 | |
| Espaciamiento relativo entre vigas | 0.00 | |
| Coeficiente de ocultamiento barreras | 0.06 | |
| Coeficiente de ocultamiento balasto | 0.2 | |
| Coeficiente de ocultamiento vigas | 0 | |
| Altura equivalente con trafico | 6.3 | m |
| CD con trafico | 2.11 | |
| Area transversal con tráfico en 1 vía | 7.16 | m2 |

Tabla de valores del coeficiente de ocultamiento

| Espaciamiento relativo | Relación de solidez | | | | | |
|---|---|---|---|---|---|---|
| | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 |
| 0 | 0.75 | 0.4 | 0.31 | 0.22 | 0.13 | 0.06 |
| 1 | 1 | 0.82 | 0.64 | 0.46 | 0.28 | 0.1 |
| 2 | 1 | 0.84 | 0.68 | 0.52 | 0.36 | 0.2 |
| 3 | 1 | 0.86 | 0.72 | 0.59 | 0.45 | 0.31 |
| 4 | 1 | 0.89 | 0.78 | 0.68 | 0.57 | 0.46 |
| 5 | 1 | 1 | 0.92 | 0.85 | 0.77 | 0.69 |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 |
| | 1 | 2 | 3 | 4 | 5 | 6 |

**Valores con tráfico en ambas vías**

| | | |
|---|---|---|
| Espaciamiento relativo entre barrera y tren | 0.76 | m |
| Espaciamiento relativo balasto | 2 | m |
| Espaciamiento relativo entre vigas | 0.00 | |
| Espaciamiento relativo entre trenes | -0.575 | |
| Coeficiente de ocultamiento barreras | 0.06 | |
| Coeficiente de ocultamiento balasto | 0.2 | |
| Coeficiente de ocultamiento vigas | 0 | |
| Coeficiente de ocultamiento de trenes | 0 | |
| Altura equivalente con trafico | 6.3 | m |
| CD con trafico | 2.11 | |
| Area transversal con tráfico en ambas vías | 7.16 | m2 |

| | | |
|---|---|---|
| Inclinación media del tablero+barrera | 0 | ° |
| Coeficiente reductor de CD | 1 | |
| Altura de tablero (del suelo a cara inferior tablero) | 7.5 | m |
| Altura equivalente con trafico | 6.3 | m |
| CD con trafico | 2.11 | |
| Longitud del tablero | 40 | m |

**Notación :**

Fh= Componente horizontal del empuje de viento
Fv= Componente vertical del empuje de viento
Mv= Momento de vuelco debido al empuje de viento

El viento longitudinal equivale a un 25 % del viento transversal

### Empuje de viento máximo sobre el tablero

| | | | | | | | Esfuerzos totales en tablero | | |
|---|---|---|---|---|---|---|---|---|---|
| Altura media del tablero+barrera | Cz | Cg | Vc (m/s) | Pw (T/m2) | Fh (T/m) | Fv (T/m) | Mv(mT/m) | Fh (T) | Fv (T) | Mv(mT) |
| 9.06 | 0.988 | 1.532 | 44.07 | 0.189 | 0.773 | 0.498 | 1.530 | 30.93 | 19.90 | 61.21 |

### Empuje de viento concomitante con sobrecarga sobre el tablero en una vía

| | | | | | | | Esfuerzos totales en tablero | | |
|---|---|---|---|---|---|---|---|---|---|
| Altura media del tablero+sobrecarga | Cz | Cg | Vc (m/s) | Pw (T/m2) | Fh (T/m) | Fv (T/m) | Mv(mT/m) | Fh (T) | Fv (T) | Mv(mT) |
| 11.28 | 1.030 | 1.514 | 45.39 | 0.136 | 0.972 | 0.264 | 1.183 | 38.89 | 10.56 | 47.31 |

### Empuje de viento concomitante con sobrecarga sobre el tablero en las dos vías

| | | | | | | | Esfuerzos totales en tablero | | |
|---|---|---|---|---|---|---|---|---|---|
| Altura media del tablero+sobrecarga | Cz | Cg | Vc (m/s) | Pw (T/m2) | Fh (T/m) | Fv (T/m) | Mv(mT/m) | Fh (T) | Fv (T) | Mv(mT) |
| 11.28 | 1.030 | 1.514 | 45.39 | 0.136 | 0.972 | 0.264 | 1.183 | 38.89 | 10.56 | 47.31 |

CÁLCULO DEL GRADIENTE TÉRMICO.

Tipología ⟶ Losa aligerada

Canto ⟶ $h = 1'6$ m.

Según borrador IAPF:

$$\Delta T_{SI} = (K_1 \cdot K_2)\,\Delta T_{SI,ref}$$

$\Delta T_{SI,ref} = 12\ ^\circ C$

$K_2 = 0'6$ (balasto)

$K_1 = 0'83$

$\Rightarrow \Delta T_{SI} = 5'976 = 6\ ^\circ C$



## Cálculo de la frecuencia propia del tablero

$$f = \frac{\alpha_v}{l^2}\cdot\sqrt{\frac{E\cdot I\cdot g}{G}}$$

$E = 10000\sqrt[3]{f_{cm}} = 10000\sqrt[3]{48} = 36340\ N/mm^2$

$I = 1'49\ m^4$

$l_1 = 18'5$ m y $l_2 = l = 20'5$ m

$G \equiv$ Peso tablero + carga muerta $= 25'9$ T/m

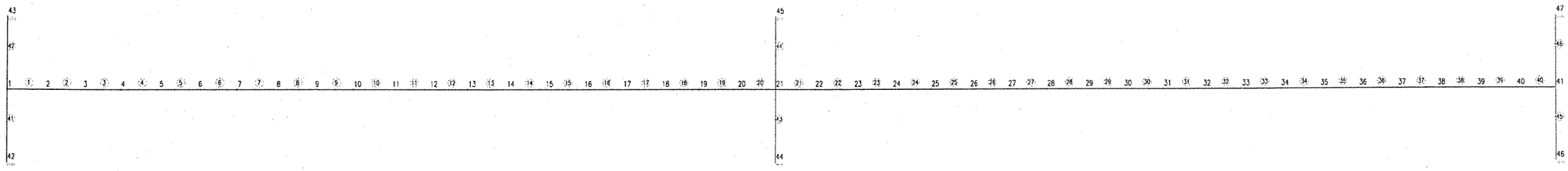
$$\alpha_v = \frac{\pi}{2}\sqrt{\frac{l^4\, I\cdot\Sigma\frac{1}{l_i}}{I\cdot\Sigma l_i^3}} = 1'1\cdot\frac{\pi}{2} \Rightarrow$$

$\Rightarrow f = 0'17$ s $\Rightarrow T = 5'88$ Hz

# MODELO DE CALCULO

(J) Numeracion de barras

J Numeracion de nudos



## 5.1 CÁLCULO ESTRUCTURAL CON MODELO DE VIGA CONTINUA

### 5.1.1. DISCRETIZACIÓN Y CARACTERÍSTICAS MECÁNICAS

Se modela el tablero mediante un emparrillado plano constituido por un nervio longitudinal, coincidente con el eje del tablero en planta, considerando 3 grados de libertad por nudo (desplazamiento vertical, giro de flexión longitudinal de la barra y giro a torsión). El nervio longitudinal se ha dividido para cada uno de los vanos del tablero en 20 barras de igual longitud asignando las características mecánicas en cada uno de los extremos de la barra. Las propiedades mecánicas de la barra se obtienen como media de las características de sus secciones extremas. En la zona de estribos se ha simulado la riostra de apoyo mediante 2 barras transversales, una a cada lado del nervio longitudinal, con su extremo final coincidente con la posición real de los apoyos de neopreno. En las barras transversales de las riostras de apoyo se ha despreciado su rigidez a torsión. En los apoyos se han prescrito únicamente los movimientos verticales del nudo.

La numeración de nudos y barras es correlativa, tomando como origen el extremo izquierdo del nervio longitudinal, en último lugar se numeran las barras y nudos que permiten simular las riostras de apoyo en los dos estribos. La discretización adoptada aparece en las hojas y esquemas adjuntos.

En los listados aparece la siguiente información:

1. Datos generales.
2. Discretización: numeración de barras y nudos, coordenadas de los nudos condiciones de vinculación.
3. Cargas en los nudos para cada hipótesis de carga.
4. Reacciones para cada hipótesis de carga.
5. Esfuerzos en extremo de barra para cada hipótesis de carga.

### 5.1.2 CÁLCULO DE ESFUERZOS LONGITUDINALES

El cálculo de esfuerzos longitudinales con el modelo de análisis estructural expuesto se detalla a continuación.

La notación adoptada para cada una de las hipótesis de carga es la siguiente:

- $\mathbf{g_1}$ Peso propio de la estructura.
- $\mathbf{g_2}$ Carga permanente.
- **q** Sobrecarga uniforme de ferrocarril.
- **ΔT** Gradiente de temperatura.
- **Pii** Pretensado inicial de descimbrado (pretensado parcial con pérdidas iniciales).
- **Pi** Pretensado inicial (con pérdidas iniciales).
- $\mathbf{P_\infty}$ Pretensado final (con pérdidas iniciales y diferidas).

# CÁLCULO ESTRUCTURAL DEL TABLERO CON MODELO DE EMPARRILLADO

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Referencia del Proyecto:

L.A.V. Castellbisbal-Papiol. Viaducto Puerto-Marto

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DATOS GENERALES DEL EMPARRILLADO
==========

No. de Barras = 46
No. de Nudos = 47
No. de Nudos con condiciones impuestas = 6
No. de Materiales = 3
No. de Hipotesis de carga = 1

Propiedades de barras =1, de secciones =0

TIPO DE PROPIEDADES = 0



PROPIEDADES DE LOS MATERIALES
==========

MATERIAL/SECCION 1

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 1.4893000 |
| Modulo de Torsion | (m4) | = | 2.5840001 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Coeficiente de Poisson | | = | 0.16 |
| Canto (m) | = | 1.60000 | |
| Vsup (m) | = | 0.67350 | |
| Vinf (m) | = | 0.92650 | |

MATERIAL/SECCION 2

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 1.6073999 |
| Modulo de Torsion | (m4) | = | 3.1889999 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Coeficiente de Poisson | | = | 0.16 |
| Canto (m) | = | 1.60000 | |
| Vsup (m) | = | 0.70000 | |
| Vinf (m) | = | 0.90000 | |

PROPIEDADES DE LOS MATERIALES
==========

MATERIAL/SECCION 3

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 2.0000000 |
| Modulo de Torsion | (m4) | = | 0.0000100 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Coeficiente de Poisson | | = | 0.16 |
| Canto (m) | = | 1.60000 | |
| Vsup (m) | = | 0.70000 | |
| Vinf (m) | = | 0.90000 | |

## DISCRETIZACION. DATOS DE LAS BARRAS

| Barra | Nudo 1 | Nudo 2 | No.de Secc Nud.1 | No.de Secc Nud.2 | No. MAT |
|---|---|---|---|---|---|
| 1 | 1 | 2 | 2 | 2 | 1 |
| 2 | 2 | 3 | 2 | 1 | 2 |
| 3 | 3 | 4 | 1 | 1 | 3 |
| 4 | 4 | 5 | 1 | 1 | 3 |
| 5 | 5 | 6 | 1 | 1 | 3 |
| 6 | 6 | 7 | 1 | 1 | 3 |
| 7 | 7 | 8 | 1 | 1 | 3 |
| 8 | 8 | 9 | 1 | 1 | 3 |
| 9 | 9 | 10 | 1 | 1 | 3 |
| 10 | 10 | 11 | 1 | 1 | 3 |
| 11 | 11 | 12 | 1 | 1 | 3 |
| 12 | 12 | 13 | 1 | 1 | 3 |
| 13 | 13 | 14 | 1 | 1 | 3 |
| 14 | 14 | 15 | 1 | 1 | 3 |
| 15 | 15 | 16 | 1 | 1 | 3 |
| 16 | 16 | 17 | 1 | 1 | 3 |
| 17 | 17 | 18 | 1 | 1 | 3 |
| 18 | 18 | 19 | 1 | 1 | 3 |
| 19 | 19 | 20 | 1 | 1 | 3 |
| 20 | 20 | 21 | 1 | 2 | 2 |
| 21 | 21 | 22 | 2 | 1 | 2 |
| 22 | 22 | 23 | 1 | 1 | 3 |
| 23 | 23 | 24 | 1 | 1 | 3 |
| 24 | 24 | 25 | 1 | 1 | 3 |
| 25 | 25 | 26 | 1 | 1 | 3 |
| 26 | 26 | 27 | 1 | 1 | 3 |
| 27 | 27 | 28 | 1 | 1 | 3 |
| 28 | 28 | 29 | 1 | 1 | 3 |
| 29 | 29 | 30 | 1 | 1 | 3 |
| 30 | 30 | 31 | 1 | 1 | 3 |
| 31 | 31 | 32 | 1 | 1 | 3 |
| 32 | 32 | 33 | 1 | 1 | 3 |
| 33 | 33 | 34 | 1 | 1 | 3 |
| 34 | 34 | 35 | 1 | 1 | 3 |
| 35 | 35 | 36 | 1 | 1 | 3 |
| 36 | 36 | 37 | 1 | 1 | 3 |
| 37 | 37 | 38 | 1 | 1 | 3 |
| 38 | 38 | 39 | 1 | 1 | 3 |
| 39 | 39 | 40 | 1 | 2 | 2 |
| 40 | 40 | 41 | 2 | 2 | 1 |
| 41 | 1 | 42 | 3 | 3 | 4 |
| 42 | 1 | 43 | 3 | 3 | 4 |
| 43 | 21 | 44 | 3 | 3 | 4 |
| 44 | 21 | 45 | 3 | 3 | 4 |
| 45 | 41 | 46 | 3 | 3 | 4 |
| 46 | 41 | 47 | 3 | 3 | 4 |



## PROPIEDADES DE LAS BARRAS

MATERIAL 1

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 1.6073999 |
| Modulo de Torsion | (m4) | = | 3.1889999 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Modulo de deformacion G | (T/m2) | = | 1798000.00 |
| Canto | (m) | = | 1.60000 |
| Vsup | (m) | = | 0.70000 |
| Vinf | (m) | = | 0.90000 |

MATERIAL 2

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 1.5483500 |
| Modulo de Torsion | (m4) | = | 2.8864999 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Modulo de deformacion G | (T/m2) | = | 1798000.00 |
| Canto | (m) | = | 1.60000 |
| Vsup | (m) | = | 0.68675 |
| Vinf | (m) | = | 0.91325 |

MATERIAL 3

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 1.4893000 |
| Modulo de Torsion | (m4) | = | 2.5840001 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Modulo de deformacion G | (T/m2) | = | 1798000.00 |
| Canto | (m) | = | 1.60000 |
| Vsup | (m) | = | 0.67350 |
| Vinf | (m) | = | 0.92650 |

MATERIAL 4

| | | | |
|---|---|---|---|
| Inercia a Flexion | (m4) | = | 2.0000000 |
| Modulo de Torsion | (m4) | = | 0.0000100 |
| Area a Cortante | (m2) | = | 0.0000000 |
| Modulo de elasticidad | (T/m2) | = | 3100000.00 |
| Modulo de deformacion G | (T/m2) | = | 1798000.00 |
| Canto | (m) | = | 1.60000 |
| Vsup | (m) | = | 0.70000 |
| Vinf | (m) | = | 0.90000 |

COORDENADAS DE LOS NUDOS

| Nudo | X | Y |
|---|---|---|
| 1 | 0.000 | 0.000 |
| 2 | 0.891 | 0.239 |
| 3 | 1.783 | 0.477 |
| 4 | 2.675 | 0.714 |
| 5 | 3.567 | 0.950 |
| 6 | 4.459 | 1.186 |
| 7 | 5.351 | 1.421 |
| 8 | 6.244 | 1.655 |
| 9 | 7.136 | 1.888 |
| 10 | 8.029 | 2.121 |
| 11 | 8.922 | 2.353 |
| 12 | 9.816 | 2.584 |
| 13 | 10.709 | 2.814 |
| 14 | 11.603 | 3.044 |
| 15 | 12.497 | 3.273 |
| 16 | 13.391 | 3.501 |
| 17 | 14.285 | 3.729 |
| 18 | 15.180 | 3.955 |
| 19 | 16.074 | 4.181 |
| 20 | 16.969 | 4.406 |
| 21 | 17.864 | 4.631 |
| 22 | 18.859 | 4.879 |
| 23 | 19.854 | 5.127 |
| 24 | 20.849 | 5.373 |
| 25 | 21.844 | 5.619 |
| 26 | 22.839 | 5.864 |
| 27 | 23.835 | 6.107 |
| 28 | 24.831 | 6.350 |
| 29 | 25.827 | 6.592 |
| 30 | 26.823 | 6.833 |
| 31 | 27.819 | 7.073 |
| 32 | 28.816 | 7.312 |
| 33 | 29.813 | 7.551 |
| 34 | 30.810 | 7.788 |
| 35 | 31.808 | 8.024 |
| 36 | 32.805 | 8.260 |
| 37 | 33.803 | 8.494 |
| 38 | 34.801 | 8.728 |
| 39 | 35.800 | 8.960 |
| 40 | 36.798 | 9.192 |
| 41 | 37.797 | 9.423 |
| 42 | -0.420 | 1.545 |
| 43 | 0.420 | -1.545 |
| 44 | 17.600 | 5.700 |
| 45 | 18.130 | 3.560 |
| 46 | 37.440 | 10.980 |
| 47 | 38.160 | 7.860 |



CONDICIONES DE VINCULACION

| Nudo | Codigo | RX | RZ | RY |
|---|---|---|---|---|
| 42 | 0 1 0 | 0.000 | 0.000 | 0.000 |
| 43 | 0 1 0 | 0.000 | 0.000 | 0.000 |
| 44 | 0 1 0 | 0.000 | 0.000 | 0.000 |
| 45 | 0 1 0 | 0.000 | 0.000 | 0.000 |
| 46 | 0 1 0 | 0.000 | 0.000 | 0.000 |
| 47 | 0 1 0 | 0.000 | 0.000 | 0.000 |

Ancho de banda = 129

HIPOTESIS 1 PESO PROPIO

REACCIONES

| Nudo | Flector | Reac_vert | Torsor |
|---|---|---|---|
| 42 | 0.00000 | 56.59833 | 0.00000 |
| 43 | 0.00000 | 55.85826 | 0.00000 |
| 44 | 0.00000 | 188.79039 | 0.00000 |
| 45 | 0.00000 | 188.19046 | 0.00000 |
| 46 | 0.00000 | 67.08292 | 0.00000 |
| 47 | 0.00000 | 65.17480 | 0.00000 |

SUMA DE REACCIONES

| | | |
|---|---|---|
| Suma Momentos Flectores | = | 0.000 |
| Suma Reacciones Vertic. | = | 621.695 |
| Suma Momentos Torsores | = | 0.000 |

HIPOTESIS 1 PESO PROPIO

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 104.45 | 1.19 | -88.41 | -87.21 | -1.19 |
| 2 | 88.41 | 87.22 | 1.07 | -160.96 | -69.96 | -1.07 |
| 3 | 160.96 | 69.96 | 0.90 | -219.23 | -56.33 | -0.90 |
| 4 | 219.23 | 56.32 | 0.67 | -264.92 | -42.70 | -0.67 |
| 5 | 264.91 | 42.72 | 0.67 | -298.04 | -29.10 | -0.67 |
| 6 | 298.04 | 29.09 | 0.36 | -318.59 | -15.47 | -0.36 |
| 7 | 318.59 | 15.48 | -0.07 | -326.59 | -1.85 | 0.07 |
| 8 | 326.59 | 1.86 | -0.32 | -322.04 | 11.75 | 0.32 |
| 9 | 322.04 | -11.76 | -0.41 | -304.89 | 25.39 | 0.41 |
| 10 | 304.89 | -25.39 | -0.73 | -275.19 | 39.01 | 0.73 |
| 11 | 275.18 | -39.00 | -1.09 | -232.89 | 52.63 | 1.09 |
| 12 | 232.88 | -52.64 | -1.27 | -178.06 | 66.25 | 1.27 |
| 13 | 178.06 | -66.26 | -1.32 | -110.61 | 79.89 | 1.32 |
| 14 | 110.61 | -79.85 | -1.44 | -30.63 | 93.48 | 1.44 |
| 15 | 30.62 | -93.48 | -1.47 | 61.90 | 107.10 | 1.47 |
| 16 | -61.90 | -107.10 | -1.47 | 166.99 | 120.72 | 1.47 |
| 17 | -167.00 | -120.72 | -1.07 | 284.72 | 134.35 | 1.07 |
| 18 | -284.72 | -134.35 | -1.15 | 414.88 | 147.96 | 1.15 |
| 19 | -414.88 | -147.96 | -0.60 | 559.39 | 165.21 | 0.60 |
| 20 | -559.39 | -165.21 | -0.60 | 719.80 | 182.45 | 0.60 |
| 21 | -720.08 | 194.53 | 1.06 | 530.43 | -175.36 | -1.06 |
| 22 | -530.43 | 175.36 | 1.06 | 360.43 | -156.20 | -1.06 |
| 23 | -360.43 | 156.20 | 1.74 | 208.09 | -141.06 | -1.74 |
| 24 | -208.09 | 141.06 | 1.74 | 71.26 | -125.93 | -1.74 |
| 25 | -71.25 | 125.93 | 1.81 | -50.04 | -110.80 | -1.81 |
| 26 | 50.05 | 110.81 | 1.70 | -155.88 | -95.68 | -1.70 |



HIPOTESIS 1 PESO PROPIO

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 27 | 155.87 | 95.69 | 1.70 | -246.21 | -80.56 | -1.70 |
| 28 | 246.21 | 80.54 | 1.47 | -321.01 | -65.41 | -1.47 |
| 29 | 321.00 | 65.43 | 1.16 | -380.28 | -50.30 | -1.16 |
| 30 | 380.27 | 50.28 | 0.80 | -424.05 | -35.16 | -0.80 |
| 31 | 424.03 | 35.14 | 0.30 | -452.32 | -20.01 | -0.30 |
| 32 | 452.30 | 19.96 | 0.31 | -465.01 | -4.83 | -0.31 |
| 33 | 465.01 | 4.86 | -0.58 | -462.24 | 10.27 | 0.58 |
| 34 | 462.25 | -10.24 | -1.12 | -443.97 | 25.37 | 1.12 |
| 35 | 443.96 | -25.38 | -1.02 | -410.20 | 40.51 | 1.02 |
| 36 | 410.20 | -40.52 | -1.89 | -360.91 | 55.65 | 1.89 |
| 37 | 360.91 | -55.65 | -1.89 | -296.10 | 70.78 | 1.89 |
| 38 | 296.09 | -70.80 | -2.52 | -215.73 | 85.94 | 2.52 |
| 39 | 215.72 | -85.93 | -2.47 | -117.87 | 105.08 | 2.47 |
| 40 | 117.87 | -105.09 | -2.61 | -0.29 | 124.25 | 2.61 |
| 41 | 87.41 | -52.60 | 0.00 | 0.00 | 56.60 | 0.00 |
| 42 | 86.23 | -51.86 | 0.00 | 0.00 | 55.86 | 0.00 |
| 43 | 207.88 | -188.79 | 0.00 | 0.00 | 188.79 | 0.00 |
| 44 | 207.67 | -188.19 | 0.00 | 0.00 | 188.19 | 0.00 |
| 45 | 103.97 | -63.09 | 0.00 | 0.00 | 67.08 | 0.00 |
| 46 | 101.36 | -61.16 | 0.00 | 0.00 | 65.17 | 0.00 |

HIPOTESIS 1 CARGA PERMANENTE

REACCIONES

| Nudo | Flector | Reac_vert | Torsor |
|---|---|---|---|
| 42 | 0.00000 | 41.62255 | 0.00000 |
| 43 | 0.00000 | 34.23617 | 0.00000 |
| 44 | 0.00000 | 150.31602 | 0.00000 |
| 45 | 0.00000 | 129.47974 | 0.00000 |
| 46 | 0.00000 | 49.78502 | 0.00000 |
| 47 | 0.00000 | 40.77182 | 0.00000 |

SUMA DE REACCIONES

| | | |
|---|---|---|
| Suma Momentos Flectores | = | 0.000 |
| Suma Reacciones Vertic. | = | 446.211 |
| Suma Momentos Torsores | = | 0.000 |

HIPOTESIS 1 CARGA PERMANENTE

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.04 | 75.86 | 11.83 | -65.15 | -65.29 | -10.75 |
| 2 | 65.16 | 65.30 | 10.66 | -120.56 | -54.72 | -9.59 |
| 3 | 120.56 | 54.72 | 9.46 | -166.19 | -44.15 | -8.38 |
| 4 | 166.19 | 44.15 | 8.21 | -202.05 | -33.58 | -7.13 |
| 5 | 202.04 | 33.57 | 7.13 | -228.15 | -23.00 | -6.05 |
| 6 | 228.15 | 23.01 | 5.81 | -244.51 | -12.44 | -4.73 |
| 7 | 244.51 | 12.45 | 4.41 | -251.12 | -1.88 | -3.33 |
| 8 | 251.13 | 1.88 | 3.14 | -247.99 | 8.68 | -2.06 |
| 9 | 248.00 | -8.68 | 1.99 | -235.11 | 19.25 | -0.91 |
| 10 | 235.11 | -19.26 | 0.67 | -212.46 | 29.83 | 0.41 |
| 11 | 212.46 | -29.83 | -0.69 | -180.04 | 40.41 | 1.77 |
| 12 | 180.03 | -40.39 | -1.91 | -137.91 | 50.95 | 2.99 |
| 13 | 137.90 | -50.97 | -3.02 | -85.97 | 61.54 | 4.10 |
| 14 | 85.97 | -61.52 | -4.19 | -24.32 | 72.09 | 5.27 |
| 15 | 24.31 | -72.09 | -5.30 | 47.08 | 82.66 | 6.37 |
| 16 | -47.08 | -82.66 | -6.37 | 128.22 | 93.23 | 7.45 |
| 17 | -128.23 | -93.23 | -7.15 | 219.17 | 103.80 | 8.23 |
| 18 | -219.17 | -103.80 | -8.28 | 319.76 | 114.36 | 9.36 |
| 19 | -319.77 | -114.36 | -8.94 | 430.19 | 124.93 | 10.02 |
| 20 | -430.19 | -124.93 | -10.02 | 550.36 | 135.50 | 11.10 |
| 21 | -550.62 | 144.29 | 12.65 | 408.68 | -132.55 | -11.45 |
| 22 | -408.68 | 132.55 | 11.45 | 278.79 | -120.80 | -10.25 |
| 23 | -278.77 | 120.80 | 10.78 | 160.97 | -109.06 | -9.58 |
| 24 | -160.97 | 109.06 | 9.58 | 55.21 | -97.32 | -8.38 |
| 25 | -55.19 | 97.32 | 8.44 | -38.51 | -85.58 | -7.24 |
| 26 | 38.53 | 85.58 | 7.16 | -120.25 | -73.84 | -5.96 |



HIPOTESIS 1 CARGA PERMANENTE

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 27 | 120.25 | 73.82 | 5.96 | -189.92 | -62.08 | -4.76 |
| 28 | 189.93 | 62.10 | 4.58 | -247.57 | -50.36 | -3.39 |
| 29 | 247.56 | 50.35 | 3.15 | -293.15 | -38.62 | -1.95 |
| 30 | 293.15 | 38.62 | 1.68 | -326.70 | -26.89 | -0.48 |
| 31 | 326.71 | 26.84 | 0.10 | -348.21 | -15.10 | 1.10 |
| 32 | 348.23 | 15.11 | -1.10 | -357.68 | -3.36 | 2.30 |
| 33 | 357.67 | 3.37 | -2.98 | -355.11 | 8.37 | 4.18 |
| 34 | 355.12 | -8.35 | -4.59 | -340.53 | 20.10 | 5.79 |
| 35 | 340.53 | -20.09 | -5.71 | -313.93 | 31.83 | 6.91 |
| 36 | 313.92 | -31.85 | -7.57 | -275.26 | 43.59 | 8.77 |
| 37 | 275.27 | -43.59 | -8.77 | -224.57 | 55.34 | 9.97 |
| 38 | 224.55 | -55.33 | -10.45 | -161.79 | 67.07 | 11.64 |
| 39 | 161.79 | -67.08 | -11.61 | -87.05 | 78.82 | 12.80 |
| 40 | 87.04 | -78.81 | -12.91 | -0.21 | 90.56 | 14.10 |
| 41 | 66.64 | -41.62 | 0.00 | 0.00 | 41.62 | 0.00 |
| 42 | 54.81 | -34.24 | 0.00 | 0.00 | 34.24 | 0.00 |
| 43 | 165.52 | -150.32 | 0.00 | 0.00 | 150.32 | 0.00 |
| 44 | 142.89 | -129.48 | 0.00 | 0.00 | 129.48 | 0.00 |
| 45 | 79.53 | -49.79 | 0.00 | 0.00 | 49.79 | 0.00 |
| 46 | 65.42 | -40.77 | 0.00 | 0.00 | 40.77 | 0.00 |

HIPOTESIS 1 GRADIENTE TERMICO, AT= 6 C

REACCIONES

| Nudo | Flector | Reac_vert | Torsor |
|---|---|---|---|
| 42 | 0.00000 | 7.35225 | 0.00000 |
| 43 | 0.00000 | 6.79312 | 0.00000 |
| 44 | 0.00000 | -12.12901 | 0.00000 |
| 45 | 0.00000 | -14.74430 | 0.00000 |
| 46 | 0.00000 | 6.63301 | 0.00000 |
| 47 | 0.00000 | 6.09443 | 0.00000 |

SUMA DE REACCIONES

| | | |
|---|---|---|
| Suma Momentos Flectores | = | 0.000 |
| Suma Reacciones Vertic. | = | 0.000 |
| Suma Momentos Torsores | = | 0.000 |

HIPOTESIS 1 GRADIENTE TERMICO, AT= 6 C

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 14.15 | 0.89 | -13.05 | -14.15 | -0.89 |
| 2 | 13.05 | 14.15 | 0.88 | -26.11 | -14.15 | -0.88 |
| 3 | 26.11 | 14.15 | 0.85 | -39.17 | -14.15 | -0.85 |
| 4 | 39.17 | 14.15 | 0.81 | -52.22 | -14.15 | -0.81 |
| 5 | 52.23 | 14.15 | 0.81 | -65.28 | -14.15 | -0.81 |
| 6 | 65.28 | 14.15 | 0.74 | -78.33 | -14.15 | -0.74 |
| 7 | 78.33 | 14.14 | 0.64 | -91.39 | -14.14 | -0.64 |
| 8 | 91.39 | 14.14 | 0.57 | -104.42 | -14.14 | -0.57 |
| 9 | 104.43 | 14.14 | 0.54 | -117.48 | -14.14 | -0.54 |
| 10 | 117.48 | 14.14 | 0.41 | -130.53 | -14.14 | -0.41 |
| 11 | 130.53 | 14.14 | 0.24 | -143.59 | -14.14 | -0.24 |
| 12 | 143.59 | 14.15 | 0.13 | -156.63 | -14.15 | -0.13 |
| 13 | 156.63 | 14.15 | 0.09 | -169.69 | -14.15 | -0.09 |
| 14 | 169.69 | 14.14 | -0.09 | -182.74 | -14.14 | 0.09 |
| 15 | 182.74 | 14.14 | -0.28 | -195.79 | -14.14 | 0.28 |
| 16 | 195.79 | 14.14 | -0.28 | -208.83 | -14.14 | 0.28 |
| 17 | 208.83 | 14.14 | -0.78 | -221.88 | -14.14 | 0.78 |
| 18 | 221.88 | 14.14 | -0.72 | -234.92 | -14.14 | 0.72 |
| 19 | 234.92 | 14.14 | -1.03 | -247.97 | -14.14 | 1.03 |
| 20 | 247.97 | 14.14 | -1.03 | -261.02 | -14.14 | 1.03 |
| 21 | 261.03 | -12.73 | 1.36 | -247.98 | 12.73 | -1.36 |
| 22 | 247.98 | -12.73 | 1.36 | -234.92 | 12.73 | -1.36 |
| 23 | 234.92 | -12.73 | 0.92 | -221.87 | 12.73 | -0.92 |
| 24 | 221.87 | -12.73 | 0.92 | -208.82 | 12.73 | -0.92 |
| 25 | 208.82 | -12.73 | 0.72 | -195.77 | 12.73 | -0.72 |
| 26 | 195.77 | -12.73 | 0.30 | -182.72 | 12.73 | -0.30 |



HIPOTESIS 1 GRADIENTE TERMICO, AT= 6 C

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 27 | 182.72 | -12.73 | 0.30 | -169.67 | 12.73 | -0.30 |
| 28 | 169.67 | -12.73 | 0.14 | -156.62 | 12.73 | -0.14 |
| 29 | 156.62 | -12.73 | -0.01 | -143.57 | 12.73 | 0.01 |
| 30 | 143.57 | -12.73 | -0.14 | -130.52 | 12.73 | 0.14 |
| 31 | 130.53 | -12.73 | -0.30 | -117.47 | 12.73 | 0.30 |
| 32 | 117.47 | -12.73 | -0.30 | -104.43 | 12.73 | 0.30 |
| 33 | 104.43 | -12.73 | -0.50 | -91.38 | 12.73 | 0.50 |
| 34 | 91.38 | -12.73 | -0.60 | -78.32 | 12.73 | 0.60 |
| 35 | 78.33 | -12.74 | -0.59 | -65.28 | 12.74 | 0.59 |
| 36 | 65.28 | -12.73 | -0.72 | -52.23 | 12.73 | 0.72 |
| 37 | 52.23 | -12.73 | -0.72 | -39.18 | 12.73 | 0.72 |
| 38 | 39.18 | -12.73 | -0.81 | -26.12 | 12.73 | 0.81 |
| 39 | 26.12 | -12.73 | -0.80 | -13.08 | 12.73 | 0.80 |
| 40 | 13.08 | -12.73 | -0.82 | -0.03 | 12.73 | 0.82 |
| 41 | 11.77 | -7.35 | 0.00 | 0.00 | 7.35 | 0.00 |
| 42 | 10.88 | -6.79 | 0.00 | 0.00 | 6.79 | 0.00 |
| 43 | -13.36 | 12.13 | 0.00 | 0.00 | -12.13 | 0.00 |
| 44 | -16.27 | 14.74 | 0.00 | 0.00 | -14.74 | 0.00 |
| 45 | 10.60 | -6.63 | 0.00 | 0.00 | 6.63 | 0.00 |
| 46 | 9.78 | -6.09 | 0.00 | 0.00 | 6.09 | 0.00 |

HIPOTESIS 1 PRETENSADO: PRIMER TESADO

REACCIONES

| Nudo | Flector | Reac_vert | Torsor |
|---|---|---|---|
| 42 | 0.00000 | 16.31394 | 0.00000 |
| 43 | 0.00000 | 20.33158 | 0.00000 |
| 44 | 0.00000 | -38.63897 | 0.00000 |
| 45 | 0.00000 | -30.98318 | 0.00000 |
| 46 | 0.00000 | 12.91614 | 0.00000 |
| 47 | 0.00000 | 20.03031 | 0.00000 |

SUMA DE REACCIONES

| | | |
|---|---|---|
| Suma Momentos Flectores | = | 0.000 |
| Suma Reacciones Vertic. | = | -0.030 |
| Suma Momentos Torsores | = | 0.000 |

HIPOTESIS 1 PRETENSADO: PRIMER TESADO

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -154.69 | 36.65 | -6.43 | 226.24 | -36.65 | 6.26 |
| 2 | -226.25 | 36.64 | -5.96 | 335.60 | -36.64 | 5.68 |
| 3 | -335.60 | 36.65 | -5.33 | 391.77 | -36.65 | 4.95 |
| 4 | -391.78 | 36.66 | -4.54 | 434.52 | -36.66 | 4.09 |
| 5 | -434.52 | 36.65 | -4.09 | 463.85 | -36.65 | 3.59 |
| 6 | -463.86 | 36.66 | -3.11 | 479.73 | -36.66 | 2.56 |
| 7 | -479.74 | 36.63 | -1.91 | 482.22 | -36.63 | 1.33 |
| 8 | -482.24 | 36.65 | -0.96 | 471.22 | -36.65 | 0.35 |
| 9 | -471.23 | 36.65 | -0.21 | 446.65 | -36.65 | -0.41 |
| 10 | -446.64 | 36.65 | 0.88 | 405.64 | -36.65 | -1.51 |
| 11 | -405.64 | 36.63 | 2.04 | 343.58 | -36.63 | -2.65 |
| 12 | -343.57 | 36.66 | 2.92 | 260.17 | -36.66 | -3.50 |
| 13 | -260.16 | 36.65 | 3.58 | 157.71 | -36.65 | -4.11 |
| 14 | -157.71 | 36.63 | 4.27 | 25.22 | -36.63 | -4.73 |
| 15 | -25.21 | 36.60 | 4.76 | -128.29 | -36.60 | -5.13 |
| 16 | 128.29 | 36.61 | 5.13 | -302.72 | -36.61 | -5.38 |
| 17 | 302.74 | 36.62 | 4.67 | -497.95 | -36.62 | -4.80 |
| 18 | 497.94 | 36.62 | 4.93 | -711.40 | -36.62 | -4.92 |
| 19 | 711.41 | 36.61 | 3.99 | -872.27 | -36.61 | -3.85 |
| 20 | 872.27 | 36.62 | 3.85 | -986.02 | -36.62 | -3.62 |
| 21 | 986.09 | -33.01 | -6.73 | -849.66 | 33.01 | 6.97 |
| 22 | 849.66 | -33.01 | -6.97 | -633.11 | 33.01 | 7.08 |
| 23 | 633.10 | -33.01 | -8.28 | -370.55 | 33.01 | 8.19 |
| 24 | 370.55 | -33.01 | -8.19 | -133.65 | 33.01 | 7.91 |
| 25 | 133.64 | -33.00 | -8.03 | 76.81 | 33.00 | 7.57 |
| 26 | -76.82 | -32.99 | -7.41 | 260.72 | 32.99 | 6.79 |



HIPOTESIS 1 PRETENSADO: PRIMER TESADO

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 27 | -260.71 | -32.99 | -6.79 | 418.02 | 32.99 | 6.05 |
| 28 | -418.04 | -32.96 | -5.66 | 548.91 | 32.96 | 4.82 |
| 29 | -548.93 | -32.97 | -4.29 | 653.62 | 32.97 | 3.37 |
| 30 | -653.64 | -33.05 | -2.75 | 714.40 | 33.05 | 1.78 |
| 31 | -714.37 | -32.92 | -0.94 | 756.45 | 32.92 | -0.03 |
| 32 | -756.48 | -32.88 | 0.04 | 775.73 | 32.88 | -1.03 |
| 33 | -775.72 | -33.00 | 2.50 | 774.36 | 33.00 | -3.46 |
| 34 | -774.35 | -32.96 | 4.36 | 752.20 | 32.96 | -5.27 |
| 35 | -752.20 | -33.00 | 5.11 | 709.40 | 33.00 | -5.96 |
| 36 | -709.37 | -32.98 | 7.47 | 645.58 | 32.98 | -8.24 |
| 37 | -645.57 | -32.98 | 8.24 | 560.70 | 32.98 | -8.91 |
| 38 | -560.65 | -32.98 | 10.11 | 455.34 | 32.98 | -10.66 |
| 39 | -455.32 | -32.96 | 10.55 | 288.03 | 32.96 | -10.95 |
| 40 | -288.02 | -32.95 | 11.29 | 154.16 | 32.95 | -11.51 |
| 41 | 26.12 | -16.31 | 0.00 | 0.00 | 16.31 | 0.00 |
| 42 | 32.55 | -20.33 | 0.00 | 0.00 | 20.33 | 0.00 |
| 43 | -42.55 | 38.64 | 0.00 | 0.00 | -38.64 | 0.00 |
| 44 | -34.19 | 30.98 | 0.00 | 0.00 | -30.98 | 0.00 |
| 45 | 20.63 | -12.92 | 0.00 | 0.00 | 12.92 | 0.00 |
| 46 | 32.14 | -20.03 | 0.00 | 0.00 | 20.03 | 0.00 |

HIPOTESIS 1 PRETENSADO INICIAL

REACCIONES

| Nudo | Flector | Reac_vert | Torsor |
|---|---|---|---|
| 42 | 0.00000 | 27.52239 | 0.00000 |
| 43 | 0.00000 | 34.37971 | 0.00000 |
| 44 | 0.00000 | -65.27045 | 0.00000 |
| 45 | 0.00000 | -52.33148 | 0.00000 |
| 46 | 0.00000 | 21.78006 | 0.00000 |
| 47 | 0.00000 | 33.86968 | 0.00000 |

SUMA DE REACCIONES

| | | |
|---|---|---|
| Suma Momentos Flectores | = | 0.000 |
| Suma Reacciones Vertic. | = | -0.050 |
| Suma Momentos Torsores | = | 0.000 |

HIPOTESIS 1 PRETENSADO INICIAL

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -264.09 | 61.91 | -10.98 | 386.82 | -61.91 | 10.69 |
| 2 | -386.84 | 61.89 | -10.17 | 574.08 | -61.89 | 9.70 |
| 3 | -574.08 | 61.91 | -9.09 | 670.50 | -61.91 | 8.45 |
| 4 | -670.51 | 61.94 | -7.75 | 743.98 | -61.94 | 6.99 |
| 5 | -743.98 | 61.89 | -6.98 | 794.56 | -61.89 | 6.12 |
| 6 | -794.55 | 61.89 | -5.29 | 822.18 | -61.89 | 4.35 |
| 7 | -822.18 | 61.90 | -3.26 | 826.88 | -61.90 | 2.26 |
| 8 | -826.90 | 61.89 | -1.62 | 808.60 | -61.89 | 0.57 |
| 9 | -808.62 | 61.90 | -0.35 | 767.15 | -61.90 | -0.71 |
| 10 | -767.14 | 61.89 | 1.53 | 706.78 | -61.89 | -2.60 |
| 11 | -706.75 | 61.86 | 3.53 | 590.66 | -61.86 | -4.58 |
| 12 | -590.65 | 61.91 | 5.04 | 439.46 | -61.91 | -6.02 |
| 13 | -439.44 | 61.89 | 6.14 | 252.92 | -61.89 | -7.03 |
| 14 | -252.91 | 61.85 | 7.30 | 31.35 | -61.85 | -8.07 |
| 15 | -31.33 | 61.84 | 8.10 | -225.27 | -61.84 | -8.71 |
| 16 | 225.27 | 61.84 | 8.71 | -516.75 | -61.84 | -9.14 |
| 17 | 516.77 | 61.86 | 7.92 | -842.89 | -61.86 | -8.14 |
| 18 | 842.89 | 61.85 | 8.37 | -1199.41 | -61.85 | -8.35 |
| 19 | 1199.42 | 61.85 | 6.77 | -1468.29 | -61.85 | -6.54 |
| 20 | 1468.29 | 61.85 | 6.54 | -1658.63 | -61.85 | -6.16 |
| 21 | 1658.74 | -55.75 | -11.32 | -1430.60 | 55.75 | 11.72 |
| 22 | 1430.60 | -55.75 | -11.72 | -1068.94 | 55.75 | 11.90 |
| 23 | 1068.91 | -55.75 | -13.92 | -630.57 | 55.75 | 13.78 |
| 24 | 630.58 | -55.76 | -13.78 | -234.96 | 55.76 | 13.31 |
| 25 | 234.95 | -55.72 | -13.53 | 116.54 | 55.72 | 12.76 |
| 26 | -116.59 | -55.68 | -12.52 | 423.78 | 55.68 | 11.49 |



HIPOTESIS 1 PRETENSADO INICIAL

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 27 | -423.80 | -55.73 | -11.49 | 686.74 | 55.73 | 10.25 |
| 28 | -686.73 | -55.78 | -9.60 | 905.73 | 55.78 | 8.20 |
| 29 | -905.71 | -55.67 | -7.34 | 1080.95 | 55.67 | 5.80 |
| 30 | -1080.99 | -55.72 | -4.77 | 1212.94 | 55.72 | 3.14 |
| 31 | -1212.96 | -55.67 | -1.72 | 1301.58 | 55.67 | 0.05 |
| 32 | -1301.58 | -55.62 | -0.04 | 1328.47 | 55.62 | -1.63 |
| 33 | -1328.44 | -55.70 | 4.16 | 1325.67 | 55.70 | -5.79 |
| 34 | -1325.63 | -55.79 | 7.35 | 1287.51 | 55.79 | -8.91 |
| 35 | -1287.47 | -55.70 | 8.61 | 1213.89 | 55.70 | -10.07 |
| 36 | -1213.86 | -55.72 | 12.65 | 1104.53 | 55.72 | -13.97 |
| 37 | -1104.52 | -55.64 | 13.97 | 959.10 | 55.64 | -15.12 |
| 38 | -959.07 | -55.67 | 17.16 | 778.66 | 55.67 | -18.10 |
| 39 | -778.65 | -55.67 | 17.93 | 492.43 | 55.67 | -18.60 |
| 40 | -492.41 | -55.65 | 19.18 | 263.18 | 55.65 | -19.56 |
| 41 | 44.06 | -27.52 | 0.00 | 0.00 | 27.52 | 0.00 |
| 42 | 55.05 | -34.38 | 0.00 | 0.00 | 34.38 | 0.00 |
| 43 | -71.87 | 65.27 | 0.00 | 0.00 | -65.27 | 0.00 |
| 44 | -57.75 | 52.33 | 0.00 | 0.00 | -52.33 | 0.00 |
| 45 | 34.79 | -21.78 | 0.00 | 0.00 | 21.78 | 0.00 |
| 46 | 54.35 | -33.87 | 0.00 | 0.00 | 33.87 | 0.00 |

HIPOTESIS 1 PRETENSADO FINAL

REACCIONES

| Nudo | Flector | Reac_vert | Torsor |
|---|---|---|---|
| 42 | 0.00000 | 23.56875 | 0.00000 |
| 43 | 0.00000 | 29.50485 | 0.00000 |
| 44 | 0.00000 | -55.94998 | 0.00000 |
| 45 | 0.00000 | -44.85689 | 0.00000 |
| 46 | 0.00000 | 18.70592 | 0.00000 |
| 47 | 0.00000 | 28.98670 | 0.00000 |

SUMA DE REACCIONES

| | | |
|---|---|---|
| Suma Momentos Flectores | = | 0.000 |
| Suma Reacciones Vertic. | = | -0.041 |
| Suma Momentos Torsores | = | 0.000 |

HIPOTESIS 1 PRETENSADO FINAL

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -231.49 | 53.08 | -9.51 | 338.40 | -53.08 | 9.25 |
| 2 | -338.41 | 53.07 | -8.80 | 496.38 | -53.07 | 8.39 |
| 3 | -496.39 | 53.07 | -7.86 | 579.13 | -53.07 | 7.31 |
| 4 | -579.12 | 53.07 | -6.70 | 642.06 | -53.07 | 6.05 |
| 5 | -642.05 | 53.08 | -6.04 | 685.33 | -53.08 | 5.30 |
| 6 | -685.35 | 53.10 | -4.59 | 709.08 | -53.10 | 3.77 |
| 7 | -709.09 | 53.08 | -2.83 | 713.38 | -53.08 | 1.97 |
| 8 | -713.40 | 53.08 | -1.42 | 698.17 | -53.08 | 0.52 |
| 9 | -698.20 | 53.08 | -0.33 | 663.31 | -53.08 | -0.59 |
| 10 | -663.31 | 53.05 | 1.29 | 612.73 | -53.05 | -2.22 |
| 11 | -612.72 | 53.06 | 3.03 | 514.80 | -53.06 | -3.93 |
| 12 | -514.80 | 53.10 | 4.33 | 386.81 | -53.10 | -5.19 |
| 13 | -386.82 | 53.09 | 5.29 | 227.95 | -53.09 | -6.06 |
| 14 | -227.95 | 53.05 | 6.30 | 37.85 | -53.05 | -6.97 |
| 15 | -37.84 | 53.03 | 7.01 | -183.88 | -53.03 | -7.54 |
| 16 | 183.88 | 53.02 | 7.54 | -437.10 | -53.02 | -7.92 |
| 17 | 437.12 | 53.04 | 6.88 | -720.94 | -53.04 | -7.07 |
| 18 | 720.94 | 53.03 | 7.27 | -1030.02 | -53.03 | -7.25 |
| 19 | 1030.03 | 53.03 | 5.89 | -1263.64 | -53.03 | -5.69 |
| 20 | 1263.64 | 53.03 | 5.69 | -1427.84 | -53.03 | -5.37 |
| 21 | 1427.94 | -47.78 | -9.63 | -1228.56 | 47.78 | 9.98 |
| 22 | 1228.56 | -47.78 | -9.98 | -916.98 | 47.78 | 10.14 |
| 23 | 916.96 | -47.77 | -11.87 | -535.78 | 47.77 | 11.75 |
| 24 | 535.78 | -47.79 | -11.75 | -191.97 | 47.79 | 11.33 |
| 25 | 191.95 | -47.75 | -11.52 | 110.70 | 47.75 | 10.84 |
| 26 | -110.74 | -47.74 | -10.61 | 371.47 | 47.74 | 9.73 |



HIPOTESIS 1 PRETENSADO FINAL

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 27 | -371.45 | -47.79 | -9.72 | 590.95 | 47.79 | 8.66 |
| 28 | -590.99 | -47.73 | -8.11 | 770.77 | 47.73 | 6.90 |
| 29 | -770.79 | -47.83 | -6.16 | 913.03 | 47.83 | 4.84 |
| 30 | -913.01 | -47.78 | -3.99 | 1019.42 | 47.78 | 2.61 |
| 31 | -1019.41 | -47.73 | -1.41 | 1091.27 | 47.73 | -0.01 |
| 32 | -1091.24 | -47.71 | 0.01 | 1113.94 | 47.71 | -1.43 |
| 33 | -1113.89 | -47.71 | 3.54 | 1113.14 | 47.71 | -4.92 |
| 34 | -1113.15 | -47.72 | 6.22 | 1084.03 | 47.72 | -7.54 |
| 35 | -1083.99 | -47.86 | 7.30 | 1026.11 | 47.86 | -8.54 |
| 36 | -1026.04 | -47.70 | 10.71 | 938.01 | 47.70 | -11.83 |
| 37 | -938.04 | -47.70 | 11.82 | 818.84 | 47.70 | -12.81 |
| 38 | -818.80 | -47.70 | 14.54 | 674.21 | 47.70 | -15.35 |
| 39 | -674.20 | -47.71 | 15.21 | 431.97 | 47.71 | -15.79 |
| 40 | -431.95 | -47.69 | 16.30 | 230.70 | 47.69 | -16.63 |
| 41 | 37.73 | -23.57 | 0.00 | 0.00 | 23.57 | 0.00 |
| 42 | 47.24 | -29.51 | 0.00 | 0.00 | 29.51 | 0.00 |
| 43 | -61.61 | 55.95 | 0.00 | 0.00 | -55.95 | 0.00 |
| 44 | -49.50 | 44.85 | 0.00 | 0.00 | -44.85 | 0.00 |
| 45 | 29.88 | -18.71 | 0.00 | 0.00 | 18.71 | 0.00 |
| 46 | 46.51 | -28.99 | 0.00 | 0.00 | 28.99 | 0.00 |

ENVOL. MAX. FLECTORES TREN TREN IPF-75 TIPO A en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3225 | 50.9417 | 61.2785 | 69.5187 | 74.9615 | 90.9856 |
| 2 | 69.5187 | 74.9615 | 90.9856 | 127.8547 | 69.0287 | 85.5829 |
| 3 | 127.8547 | 69.0287 | 85.5829 | 175.4036 | 63.1721 | 79.9297 |
| 4 | 175.4036 | 63.1721 | 79.9297 | 212.9933 | 33.1655 | 45.0969 |
| 5 | 212.9933 | 33.1655 | 45.0969 | 246.9871 | 27.4117 | 39.4422 |
| 6 | 246.9871 | 27.4117 | 39.4422 | 271.1975 | -2.5798 | 4.3939 |
| 7 | 271.1975 | -2.5798 | 4.3939 | 291.1185 | 21.7704 | 33.2866 |
| 8 | 291.1185 | 21.7704 | 33.2866 | 300.4703 | 16.2507 | 27.5795 |
| 9 | 300.4703 | 16.2507 | 27.5795 | 300.8711 | 10.8755 | 21.8180 |
| 10 | 300.8711 | 10.8755 | 21.8180 | 292.9791 | 5.6948 | 15.9032 |
| 11 | 292.9791 | 5.6948 | 15.9032 | 278.7102 | -24.3125 | -19.1399 |
| 12 | 278.7102 | -24.3125 | -19.1399 | 260.9192 | -29.3186 | -24.8338 |
| 13 | 260.9192 | -29.3186 | -24.8338 | 236.4716 | -34.0807 | -30.5239 |
| 14 | 236.4716 | -34.0807 | -30.5239 | 206.2757 | -38.6131 | -36.2742 |
| 15 | 206.2757 | -38.6131 | -36.2742 | 171.2277 | -42.9039 | -41.8851 |
| 16 | 171.2277 | -42.9039 | -41.8851 | 132.3380 | -46.9226 | -47.5345 |
| 17 | 132.3380 | -46.9226 | -47.5345 | 90.6586 | -50.6409 | -53.1363 |
| 18 | 90.6586 | -50.6409 | -53.1363 | 47.4566 | -54.0420 | -58.5242 |
| 19 | 47.4566 | -54.0420 | -58.5242 | 3.7197 | -57.1124 | -62.8742 |
| 20 | 3.7197 | -57.1124 | -62.8742 | 0.0000 | 0.0000 | 0.0000 |
| 21 | 0.0000 | 0.0000 | 0.0000 | 4.0626 | 57.4233 | 63.3330 |
| 22 | 4.0626 | 57.4233 | 63.3330 | 50.1195 | 24.8648 | 24.5613 |
| 23 | 50.1195 | 24.8648 | 24.5613 | 95.5645 | 22.0039 | 19.7306 |
| 24 | 95.5645 | 22.0039 | 19.7306 | 139.8539 | 18.8491 | 14.7808 |
| 25 | 139.8539 | 18.8491 | 14.7808 | 181.8911 | 15.4240 | 9.6110 |
| 26 | 181.8911 | 15.4240 | 9.6110 | 220.6133 | 11.7564 | 4.4691 |
| 27 | 220.6133 | 11.7564 | 4.4691 | 254.9737 | 7.8226 | -0.6008 |
| 28 | 254.9737 | 7.8226 | -0.6008 | 284.0024 | 3.6862 | -5.8273 |
| 29 | 284.0024 | 3.6862 | -5.8273 | 306.8807 | -0.6696 | -11.1021 |
| 30 | 306.8807 | -0.6696 | -11.1021 | 322.7823 | -5.2129 | -16.4444 |
| 31 | 322.7823 | -5.2129 | -16.4444 | 330.9160 | -9.9497 | -21.6446 |
| 32 | 330.9160 | -9.9497 | -21.6446 | 330.6527 | -14.8391 | -26.9764 |
| 33 | 330.6527 | -14.8391 | -26.9764 | 321.4280 | -19.8329 | -32.4969 |
| 34 | 321.4280 | -19.8329 | -32.4969 | 302.6935 | -24.9681 | -37.6505 |
| 35 | 302.6935 | -24.9681 | -37.6505 | 277.0804 | -24.9655 | -37.9105 |
| 36 | 277.0804 | -24.9655 | -37.9105 | 242.9686 | -30.2108 | -43.1815 |
| 37 | 242.9686 | -30.2108 | -43.1815 | 198.3186 | -35.5459 | -48.3307 |
| 38 | 198.3186 | -35.5459 | -48.3307 | 142.9109 | -40.9519 | -53.4100 |
| 39 | 142.9109 | -40.9519 | -53.4100 | 76.5100 | -46.4258 | -58.0851 |
| 40 | 76.5100 | -46.4258 | -58.0851 | 0.2117 | -76.4272 | -92.8698 |

ENVOL. MIN. FLECTORES TREN TREN IPF-75 TIPO A en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0005 | -9.8460 | -0.1592 | -9.2400 | -10.0158 | -0.1248 |
| 2 | -9.2400 | -10.0158 | -0.1248 | -18.4869 | -10.0159 | -0.1086 |
| 3 | -18.4869 | -10.0159 | -0.1086 | -27.7285 | -10.0145 | -0.0842 |
| 4 | -27.7285 | -10.0145 | -0.0842 | -36.9669 | -10.0141 | -0.0694 |
| 5 | -36.9669 | -10.0141 | -0.0694 | -46.2068 | -10.0118 | -0.0450 |
| 6 | -46.2068 | -10.0118 | -0.0450 | -55.4436 | -10.0118 | 0.0155 |
| 7 | -55.4436 | -10.0118 | 0.0155 | -64.6936 | -10.0196 | 0.0767 |
| 8 | -64.6936 | -10.0196 | 0.0767 | -73.9344 | -10.0218 | 0.1128 |
| 9 | -73.9344 | -10.0218 | 0.1128 | -83.1772 | -10.0218 | 0.1668 |
| 10 | -83.1772 | -10.0218 | 0.1668 | -92.4194 | -10.0231 | 0.2716 |
| 11 | -92.4194 | -10.0231 | 0.2716 | -101.6699 | -10.0177 | 0.3719 |
| 12 | -101.6699 | -10.0177 | 0.3719 | -110.9031 | -10.0133 | 0.4263 |
| 13 | -110.9031 | -10.0133 | 0.4263 | -120.1450 | -10.0232 | 0.5044 |
| 14 | -120.1450 | -10.0232 | 0.5044 | -129.4016 | -10.0364 | 0.6359 |
| 15 | -129.4016 | -10.0364 | 0.6359 | -138.6617 | -10.0343 | 0.7032 |
| 16 | -138.6617 | -10.0343 | 0.7032 | -147.9191 | -10.0278 | 0.8784 |
| 17 | -147.9191 | -10.0278 | 0.8784 | -157.1736 | -10.0280 | 1.0328 |
| 18 | -157.1736 | -10.0280 | 1.0328 | -166.4246 | -10.0311 | 1.1216 |
| 19 | -166.4246 | -10.0311 | 1.1216 | -175.6824 | -10.0329 | 1.2311 |
| 20 | -175.6824 | -10.0329 | 1.2311 | -185.0096 | 24.6508 | 30.2208 |
| 21 | -185.0096 | 24.6508 | 30.2208 | -142.0254 | 7.2864 | -1.3022 |
| 22 | -142.0254 | 7.2864 | -1.3022 | -134.5548 | 7.2875 | -1.1746 |
| 23 | -134.5548 | 7.2875 | -1.1746 | -127.0857 | 7.2899 | -1.0470 |
| 24 | -127.0857 | 7.2899 | -1.0470 | -119.6171 | 7.2890 | -0.9897 |
| 25 | -119.6171 | 7.2890 | -0.9897 | -112.1521 | 7.2933 | -0.8141 |
| 26 | -112.1521 | 7.2933 | -0.8141 | -104.6752 | 7.2910 | -0.6946 |
| 27 | -104.6752 | 7.2910 | -0.6946 | -97.2066 | 7.2870 | -0.6493 |
| 28 | -97.2066 | 7.2870 | -0.6493 | -89.7366 | 7.2902 | -0.5608 |
| 29 | -89.7366 | 7.2902 | -0.5608 | -82.2658 | 7.2880 | -0.4789 |
| 30 | -82.2658 | 7.2880 | -0.4789 | -74.7987 | 7.2903 | -0.3952 |
| 31 | -74.7987 | 7.2903 | -0.3952 | -67.3186 | 7.2975 | -0.3511 |
| 32 | -67.3186 | 7.2975 | -0.3511 | -59.8345 | 7.3004 | -0.2952 |
| 33 | -59.8345 | 7.3004 | -0.2952 | -52.3559 | 7.2961 | -0.2077 |
| 34 | -52.3559 | 7.2961 | -0.2077 | -44.8783 | 7.2913 | -0.1821 |
| 35 | -44.8783 | 7.2913 | -0.1821 | -37.4083 | 7.2911 | -0.1478 |
| 36 | -37.4083 | 7.2911 | -0.1478 | -29.9323 | 7.2929 | -0.1081 |
| 37 | -29.9323 | 7.2929 | -0.1081 | -22.4547 | 7.2951 | -0.0842 |
| 38 | -22.4547 | 7.2951 | -0.0842 | -14.9723 | 7.2960 | -0.0620 |
| 39 | -14.9723 | 7.2960 | -0.0620 | -7.4971 | 7.2964 | -0.0592 |
| 40 | -7.4971 | 7.2964 | -0.0592 | -0.0162 | 7.2963 | -0.0546 |

ENVOL. MAX. CORTANTES TREN TREN IPF-75 TIPO A en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3056 | 74.9609 | 91.0316 | 69.5187 | 74.9615 | 90.9856 |
| 2 | 69.5187 | 74.9615 | 90.9856 | 127.8547 | 69.0287 | 85.5829 |
| 3 | 127.8547 | 69.0287 | 85.5829 | 175.4036 | 63.1721 | 79.9297 |
| 4 | 175.4036 | 63.1721 | 79.9297 | 212.4128 | 57.4070 | 74.3123 |
| 5 | 212.4128 | 57.4070 | 74.3123 | 239.2861 | 51.7565 | 68.6245 |
| 6 | 239.2861 | 51.7565 | 68.6245 | 256.5135 | 46.2449 | 62.7515 |
| 7 | 256.5135 | 46.2449 | 62.7515 | 264.5451 | 40.8787 | 56.8981 |
| 8 | 264.5451 | 40.8787 | 56.8981 | 263.9070 | 35.6935 | 51.1745 |
| 9 | 263.9070 | 35.6935 | 51.1745 | 255.3124 | 30.6754 | 45.4000 |
| 10 | 255.3124 | 30.6754 | 45.4000 | 239.4951 | 25.9079 | 39.5084 |
| 11 | 239.4951 | 25.9079 | 39.5084 | 217.2671 | 21.3514 | 33.7013 |
| 12 | 217.2671 | 21.3514 | 33.7013 | 189.3797 | 17.0629 | 28.0396 |
| 13 | 189.3797 | 17.0629 | 28.0396 | 205.1526 | 17.0698 | 27.9067 |
| 14 | 205.1526 | 17.0698 | 27.9067 | 169.0750 | 13.0794 | 22.1911 |
| 15 | 169.0750 | 13.0794 | 22.1911 | 129.6350 | 9.3608 | 16.6047 |
| 16 | 129.6350 | 9.3608 | 16.6047 | 88.0417 | 5.9574 | 11.0715 |
| 17 | 88.0417 | 5.9574 | 11.0715 | 45.3564 | 2.8867 | 6.6388 |
| 18 | 45.3564 | 2.8867 | 6.6388 | 2.7011 | 0.1592 | 3.2975 |
| 19 | 2.7011 | 0.1592 | 3.2975 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 0.0000 | 0.0000 | 0.0000 | -78.5304 | 40.3045 | 47.5624 |
| 21 | -78.5304 | 40.3045 | 47.5624 | -25.8757 | 82.0051 | 89.2923 |
| 22 | -25.8757 | 82.0051 | 89.2923 | 26.4235 | 78.8521 | 84.3524 |
| 23 | 26.4235 | 78.8521 | 84.3524 | 77.0188 | 75.4311 | 79.4140 |
| 24 | 77.0188 | 75.4311 | 79.4140 | 124.7267 | 71.7491 | 74.3941 |
| 25 | 124.7267 | 71.7491 | 74.3941 | 168.6403 | 67.8279 | 69.1790 |
| 26 | 168.6403 | 67.8279 | 69.1790 | 207.7279 | 63.6720 | 64.0291 |
| 27 | 207.7279 | 63.6720 | 64.0291 | 241.0143 | 59.3254 | 58.9053 |
| 28 | 241.0143 | 59.3254 | 58.9053 | 267.7433 | 54.7921 | 53.6419 |
| 29 | 267.7433 | 54.7921 | 53.6419 | 287.0682 | 50.0696 | 48.3425 |
| 30 | 287.0682 | 50.0696 | 48.3425 | 298.3463 | 45.1873 | 42.9908 |
| 31 | 298.3463 | 45.1873 | 42.9908 | 300.9052 | 40.1590 | 37.7765 |
| 32 | 300.9052 | 40.1590 | 37.7765 | 294.1494 | 35.0319 | 32.4314 |
| 33 | 294.1494 | 35.0319 | 32.4314 | 277.7095 | 29.7958 | 26.9776 |
| 34 | 277.7095 | 29.7958 | 26.9776 | 250.9991 | 24.4547 | 21.8663 |
| 35 | 250.9991 | 24.4547 | 21.8663 | 213.7634 | 19.0508 | 16.6744 |
| 36 | 213.7634 | 19.0508 | 16.6744 | 165.6324 | 13.5758 | 11.7376 |
| 37 | 165.6324 | 13.5758 | 11.7376 | 107.4724 | 8.1474 | 6.8671 |
| 38 | 107.4724 | 8.1474 | 6.8671 | -14.9723 | 7.2960 | -0.0620 |
| 39 | -14.9723 | 7.2960 | -0.0620 | -7.4971 | 7.2964 | -0.0592 |
| 40 | -7.4971 | 7.2964 | -0.0592 | -0.0162 | 7.2963 | -0.0546 |

ENVOL. MIN. CORTANTES TREN TREN IPF-75 TIPO A en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0001 | -10.0156 | -0.1309 | -9.2400 | -10.0158 | -0.1248 |
| 2 | -9.2400 | -10.0158 | -0.1248 | -18.4869 | -10.0159 | -0.1086 |
| 3 | -18.4869 | -10.0159 | -0.1086 | -27.7285 | -10.0145 | -0.0842 |
| 4 | -27.7285 | -10.0145 | -0.0842 | -36.9669 | -10.0141 | -0.0694 |
| 5 | -36.9669 | -10.0141 | -0.0694 | 156.1156 | -15.0395 | -13.6356 |
| 6 | 156.1156 | -15.0395 | -13.6356 | 199.4553 | -20.9660 | -19.2304 |
| 7 | 199.4553 | -20.9660 | -19.2304 | 232.2758 | -26.8175 | -25.0456 |
| 8 | 232.2758 | -26.8175 | -25.0456 | 254.9934 | -32.5788 | -30.7684 |
| 9 | 254.9934 | -32.5788 | -30.7684 | 268.0017 | -38.2361 | -36.5238 |
| 10 | 268.0017 | -38.2361 | -36.5238 | 271.7593 | -43.7631 | -42.4274 |
| 11 | 271.7593 | -43.7631 | -42.4274 | 266.8826 | -49.1273 | -48.3065 |
| 12 | 266.8826 | -49.1273 | -48.3065 | 254.0789 | -54.3253 | -54.0227 |
| 13 | 254.0789 | -54.3253 | -54.0227 | 203.8933 | -54.3139 | -54.1639 |
| 14 | 203.8933 | -54.3139 | -54.1639 | 179.2041 | -59.2935 | -59.9466 |
| 15 | 179.2041 | -59.2935 | -59.9466 | 148.3128 | -64.0635 | -65.6037 |
| 16 | 148.3128 | -64.0635 | -65.6037 | 112.0144 | -68.6169 | -71.2543 |
| 17 | 112.0144 | -68.6169 | -71.2543 | 71.3279 | -72.9072 | -76.9272 |
| 18 | 71.3279 | -72.9072 | -76.9272 | 27.3808 | -76.9211 | -82.4257 |
| 19 | 27.3808 | -76.9211 | -82.4257 | -18.8051 | -80.6407 | -87.9219 |
| 20 | -18.8051 | -80.6407 | -87.9219 | -66.1736 | -40.4034 | -47.1607 |
| 21 | -66.1736 | -40.4034 | -47.1607 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 0.0000 | 0.0000 | 0.0000 | 6.1118 | -0.3281 | -3.1598 |
| 23 | 6.1118 | -0.3281 | -3.1598 | 45.0452 | -2.5770 | -6.2092 |
| 24 | 45.0452 | -2.5770 | -6.2092 | 84.4579 | -5.1333 | -10.2666 |
| 25 | 84.4579 | -5.1333 | -10.2666 | 123.2704 | -7.9996 | -15.2531 |
| 26 | 123.2704 | -7.9996 | -15.2531 | 160.3745 | -11.1473 | -20.3642 |
| 27 | 160.3745 | -11.1473 | -20.3642 | 194.6181 | -14.5706 | -25.4159 |
| 28 | 194.6181 | -14.5706 | -25.4159 | 225.0443 | -18.2647 | -30.5958 |
| 29 | 225.0443 | -18.2647 | -30.5958 | 250.5988 | -22.1653 | -35.8323 |
| 30 | 250.5988 | -22.1653 | -35.8323 | 270.3787 | -26.3302 | -41.1331 |
| 31 | 270.3787 | -26.3302 | -41.1331 | 283.5632 | -30.6941 | -46.3464 |
| 32 | 283.5632 | -30.6941 | -46.3464 | 289.3217 | -35.2330 | -51.6483 |
| 33 | 289.3217 | -35.2330 | -51.6483 | 287.0499 | -39.9416 | -57.1601 |
| 34 | 287.0499 | -39.9416 | -57.1601 | 276.0627 | -44.8049 | -62.3700 |
| 35 | 276.0627 | -44.8049 | -62.3700 | 255.8284 | -49.8104 | -67.6297 |
| 36 | 255.8284 | -49.8104 | -67.6297 | 225.7982 | -54.9664 | -72.9456 |
| 37 | 225.7982 | -54.9664 | -72.9456 | 185.5132 | -60.2114 | -78.1200 |
| 38 | 185.5132 | -60.2114 | -78.1200 | 134.6504 | -65.5490 | -83.2660 |
| 39 | 134.6504 | -65.5490 | -83.2660 | 73.0081 | -70.9570 | -88.1768 |
| 40 | 73.0081 | -70.9570 | -88.1768 | 0.2117 | -76.4272 | -92.8698 |

ENVOL. MAX. TORSORES TREN TREN IPF-75 TIPO A en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3056 | 74.9609 | 91.0316 | 69.5187 | 74.9615 | 90.9856 |
| 2 | 69.5187 | 74.9615 | 90.9856 | 127.8547 | 69.0287 | 85.5829 |
| 3 | 127.8547 | 69.0287 | 85.5829 | 175.4036 | 63.1721 | 79.9297 |
| 4 | 175.4036 | 63.1721 | 79.9297 | 212.4128 | 57.4070 | 74.3123 |
| 5 | 212.4128 | 57.4070 | 74.3123 | 239.2861 | 51.7565 | 68.6245 |
| 6 | 239.2861 | 51.7565 | 68.6245 | 256.5135 | 46.2449 | 62.7515 |
| 7 | 256.5135 | 46.2449 | 62.7515 | 264.5451 | 40.8787 | 56.8981 |
| 8 | 264.5451 | 40.8787 | 56.8981 | 263.9070 | 35.6935 | 51.1745 |
| 9 | 263.9070 | 35.6935 | 51.1745 | 255.3124 | 30.6754 | 45.4000 |
| 10 | 255.3124 | 30.6754 | 45.4000 | 239.4951 | 25.9079 | 39.5084 |
| 11 | 239.4951 | 25.9079 | 39.5084 | 217.2671 | 21.3514 | 33.7013 |
| 12 | 217.2671 | 21.3514 | 33.7013 | 189.3797 | 17.0629 | 28.0396 |
| 13 | 189.3797 | 17.0629 | 28.0396 | 205.1526 | 17.0698 | 27.9067 |
| 14 | 205.1526 | 17.0698 | 27.9067 | 169.0750 | 13.0794 | 22.1911 |
| 15 | 169.0750 | 13.0794 | 22.1911 | 129.6350 | 9.3608 | 16.6047 |
| 16 | 129.6350 | 9.3608 | 16.6047 | 88.0417 | 5.9574 | 11.0715 |
| 17 | 88.0417 | 5.9574 | 11.0715 | 45.3564 | 2.8867 | 6.6388 |
| 18 | 45.3564 | 2.8867 | 6.6388 | 2.7011 | 0.1592 | 3.2975 |
| 19 | 2.7011 | 0.1592 | 3.2975 | -38.8446 | -2.2197 | 1.6725 |
| 20 | -38.8446 | -2.2197 | 1.6725 | -78.5304 | 40.3045 | 47.5624 |
| 21 | -78.5304 | 40.3045 | 47.5624 | -25.8757 | 82.0051 | 89.2923 |
| 22 | -25.8757 | 82.0051 | 89.2923 | 26.4235 | 78.8521 | 84.3524 |
| 23 | 26.4235 | 78.8521 | 84.3524 | 77.0188 | 75.4311 | 79.4140 |
| 24 | 77.0188 | 75.4311 | 79.4140 | 124.7267 | 71.7491 | 74.3941 |
| 25 | 124.7267 | 71.7491 | 74.3941 | 168.6403 | 67.8279 | 69.1790 |
| 26 | 168.6403 | 67.8279 | 69.1790 | 207.7279 | 63.6720 | 64.0291 |
| 27 | 207.7279 | 63.6720 | 64.0291 | 241.0143 | 59.3254 | 58.9053 |
| 28 | 241.0143 | 59.3254 | 58.9053 | 267.7433 | 54.7921 | 53.6419 |
| 29 | 267.7433 | 54.7921 | 53.6419 | 287.0682 | 50.0696 | 48.3425 |
| 30 | 287.0682 | 50.0696 | 48.3425 | 298.3463 | 45.1873 | 42.9908 |
| 31 | 298.3463 | 45.1873 | 42.9908 | 300.9052 | 40.1590 | 37.7765 |
| 32 | 300.9052 | 40.1590 | 37.7765 | 294.1494 | 35.0319 | 32.4314 |
| 33 | 294.1494 | 35.0319 | 32.4314 | 277.7095 | 29.7958 | 26.9776 |
| 34 | 277.7095 | 29.7958 | 26.9776 | 250.9991 | 24.4547 | 21.8663 |
| 35 | 250.9991 | 24.4547 | 21.8663 | 213.7634 | 19.0508 | 16.6744 |
| 36 | 213.7634 | 19.0508 | 16.6744 | 165.6324 | 13.5758 | 11.7376 |
| 37 | 165.6324 | 13.5758 | 11.7376 | 107.4724 | 8.1474 | 6.8671 |
| 38 | 107.4724 | 8.1474 | 6.8671 | 63.3424 | 4.4661 | 3.8635 |
| 39 | 63.3424 | 4.4661 | 3.8635 | 26.9199 | 1.7722 | 1.5360 |
| 40 | 26.9199 | 1.7722 | 1.5360 | -0.0098 | 4.3794 | 0.0361 |

ENVOL. MIN. TORSORES TREN TREN IPF-75 TIPO A en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.1155 | -0.0109 | -0.3758 | 0.1051 | -0.0109 | -0.3759 |
| 2 | 0.1051 | -0.0109 | -0.3759 | 26.4132 | -2.0226 | -1.8386 |
| 3 | 26.4132 | -2.0226 | -1.8386 | 61.3218 | -5.0452 | -4.6417 |
| 4 | 61.3218 | -5.0452 | -4.6417 | 102.0298 | -9.0611 | -8.4607 |
| 5 | 102.0298 | -9.0611 | -8.4607 | 156.1156 | -15.0395 | -13.6356 |
| 6 | 156.1156 | -15.0395 | -13.6356 | 199.4553 | -20.9660 | -19.2304 |
| 7 | 199.4553 | -20.9660 | -19.2304 | 232.2758 | -26.8175 | -25.0456 |
| 8 | 232.2758 | -26.8175 | -25.0456 | 254.9934 | -32.5788 | -30.7684 |
| 9 | 254.9934 | -32.5788 | -30.7684 | 268.0017 | -38.2361 | -36.5238 |
| 10 | 268.0017 | -38.2361 | -36.5238 | 271.7593 | -43.7631 | -42.4274 |
| 11 | 271.7593 | -43.7631 | -42.4274 | 266.8826 | -49.1273 | -48.3065 |
| 12 | 266.8826 | -49.1273 | -48.3065 | 254.0789 | -54.3253 | -54.0227 |
| 13 | 254.0789 | -54.3253 | -54.0227 | 203.8933 | -54.3139 | -54.1639 |
| 14 | 203.8933 | -54.3139 | -54.1639 | 179.2041 | -59.2935 | -59.9466 |
| 15 | 179.2041 | -59.2935 | -59.9466 | 148.3128 | -64.0635 | -65.6037 |
| 16 | 148.3128 | -64.0635 | -65.6037 | 112.0144 | -68.6169 | -71.2543 |
| 17 | 112.0144 | -68.6169 | -71.2543 | 71.3279 | -72.9072 | -76.9272 |
| 18 | 71.3279 | -72.9072 | -76.9272 | 27.3808 | -76.9211 | -82.4257 |
| 19 | 27.3808 | -76.9211 | -82.4257 | -18.8051 | -80.6407 | -87.9219 |
| 20 | -18.8051 | -80.6407 | -87.9219 | -66.1736 | -40.4034 | -47.1607 |
| 21 | -66.1736 | -40.4034 | -47.1607 | -31.3155 | 1.6079 | -1.6839 |
| 22 | -31.3155 | 1.6079 | -1.6839 | 6.1118 | -0.3281 | -3.1598 |
| 23 | 6.1118 | -0.3281 | -3.1598 | 45.0452 | -2.5770 | -6.2092 |
| 24 | 45.0452 | -2.5770 | -6.2092 | 84.4579 | -5.1333 | -10.2666 |
| 25 | 84.4579 | -5.1333 | -10.2666 | 123.2704 | -7.9996 | -15.2531 |
| 26 | 123.2704 | -7.9996 | -15.2531 | 160.3745 | -11.1473 | -20.3642 |
| 27 | 160.3745 | -11.1473 | -20.3642 | 194.6181 | -14.5706 | -25.4159 |
| 28 | 194.6181 | -14.5706 | -25.4159 | 225.0443 | -18.2647 | -30.5958 |
| 29 | 225.0443 | -18.2647 | -30.5958 | 250.5988 | -22.1653 | -35.8323 |
| 30 | 250.5988 | -22.1653 | -35.8323 | 270.3787 | -26.3302 | -41.1331 |
| 31 | 270.3787 | -26.3302 | -41.1331 | 283.5632 | -30.6941 | -46.3464 |
| 32 | 283.5632 | -30.6941 | -46.3464 | 289.3217 | -35.2330 | -51.6483 |
| 33 | 289.3217 | -35.2330 | -51.6483 | 287.0499 | -39.9416 | -57.1601 |
| 34 | 287.0499 | -39.9416 | -57.1601 | 276.0627 | -44.8049 | -62.3700 |
| 35 | 276.0627 | -44.8049 | -62.3700 | 255.8284 | -49.8104 | -67.6297 |
| 36 | 255.8284 | -49.8104 | -67.6297 | 225.7982 | -54.9664 | -72.9456 |
| 37 | 225.7982 | -54.9664 | -72.9456 | 185.5132 | -60.2114 | -78.1200 |
| 38 | 185.5132 | -60.2114 | -78.1200 | 134.6504 | -65.5490 | -83.2660 |
| 39 | 134.6504 | -65.5490 | -83.2660 | 73.0081 | -70.9570 | -88.1768 |
| 40 | 73.0081 | -70.9570 | -88.1768 | 0.2117 | -76.4272 | -92.8698 |

ENVOL. MAX. FLECTORES TREN TREN SW/0, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4161 | 99.6228 | 111.2112 | 93.3679 | 100.7151 | 113.0737 |
| 2 | 93.3679 | 100.7151 | 113.0737 | 175.2243 | 87.4185 | 100.1240 |
| 3 | 175.2243 | 87.4185 | 100.1240 | 245.7817 | 74.1142 | 87.1075 |
| 4 | 245.7817 | 74.1142 | 87.1075 | 305.0013 | 60.8133 | 74.1835 |
| 5 | 305.0013 | 60.8133 | 74.1835 | 352.9842 | 47.5040 | 61.2057 |
| 6 | 352.9842 | 47.5040 | 61.2057 | 389.7447 | 34.2021 | 47.9706 |
| 7 | 389.7447 | 34.2021 | 47.9706 | 415.2739 | 20.9333 | 34.7533 |
| 8 | 415.2739 | 20.9333 | 34.7533 | 429.5319 | 7.6300 | 21.7409 |
| 9 | 429.5319 | 7.6300 | 21.7409 | 432.5134 | -5.6846 | 8.6611 |
| 10 | 432.5134 | -5.6846 | 8.6611 | 424.7874 | -17.4670 | -2.8700 |
| 11 | 424.7874 | -17.4670 | -2.8700 | 406.6535 | -30.7672 | -16.1045 |
| 12 | 406.6535 | -30.7672 | -16.1045 | 377.2872 | -44.0708 | -29.1080 |
| 13 | 377.2872 | -44.0708 | -29.1080 | 336.5825 | -44.0529 | -29.3347 |
| 14 | 336.5825 | -44.0529 | -29.3347 | 283.6822 | -57.3270 | -42.4552 |
| 15 | 283.6822 | -57.3270 | -42.4552 | 220.1366 | -68.6593 | -53.6259 |
| 16 | 220.1366 | -68.6593 | -53.6259 | 146.5611 | -81.9671 | -66.5935 |
| 17 | 146.5611 | -81.9671 | -66.5935 | 61.6880 | -95.2640 | -79.5515 |
| 18 | 61.6880 | -95.2640 | -79.5515 | 0.0000 | 0.0000 | 0.0000 |
| 19 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 21 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 23 | 0.0000 | 0.0000 | 0.0000 | 60.3058 | 100.2029 | 84.0564 |
| 24 | 60.3058 | 100.2029 | 84.0564 | 151.6819 | 86.9014 | 71.1893 |
| 25 | 151.6819 | 86.9014 | 71.1893 | 233.1210 | 77.9153 | 61.6653 |
| 26 | 233.1210 | 77.9153 | 61.6653 | 303.8874 | 69.2932 | 52.7591 |
| 27 | 303.8874 | 69.2932 | 52.7591 | 362.5905 | 55.9956 | 39.7968 |
| 28 | 362.5905 | 55.9956 | 39.7968 | 411.4163 | 46.9907 | 30.7322 |
| 29 | 411.4163 | 46.9907 | 30.7322 | 446.5419 | 33.6855 | 17.5302 |
| 30 | 446.5419 | 33.6855 | 17.5302 | 470.9442 | 10.9899 | -4.4734 |
| 31 | 470.9442 | 10.9899 | -4.4734 | 481.7612 | -2.3286 | -17.5441 |
| 32 | 481.7612 | -2.3286 | -17.5441 | 479.3261 | -12.1033 | -26.7247 |
| 33 | 479.3261 | -12.1033 | -26.7247 | 465.8327 | -25.3905 | -40.2455 |
| 34 | 465.8327 | -25.3905 | -40.2455 | 438.3868 | -38.6648 | -53.2615 |
| 35 | 438.3868 | -38.6648 | -53.2615 | 396.9784 | -51.9531 | -66.4302 |
| 36 | 396.9784 | -51.9531 | -66.4302 | 344.9048 | -62.0096 | -75.5056 |
| 37 | 344.9048 | -62.0096 | -75.5056 | 278.8391 | -75.3259 | -88.5965 |
| 38 | 278.8391 | -75.3259 | -88.5965 | 198.7737 | -88.6291 | -101.6653 |
| 39 | 198.7737 | -88.6291 | -101.6653 | 105.1976 | -98.9296 | -110.1984 |
| 40 | 105.1976 | -98.9296 | -110.1984 | 0.3060 | -112.2300 | -123.0548 |

ENVOL. MIN. FLECTORES TREN TREN SW/0, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0008 | -14.0008 | -0.3506 | -16.1340 | -17.4881 | -0.2750 |
| 2 | -16.1340 | -17.4881 | -0.2750 | -32.2785 | -17.4897 | -0.2467 |
| 3 | -32.2785 | -17.4897 | -0.2467 | -48.4174 | -17.4896 | -0.2042 |
| 4 | -48.4174 | -17.4896 | -0.2042 | -64.5478 | -17.4875 | -0.1790 |
| 5 | -64.5478 | -17.4875 | -0.1790 | -80.6810 | -17.4871 | -0.1368 |
| 6 | -80.6810 | -17.4871 | -0.1368 | -96.8118 | -17.4809 | -0.0300 |
| 7 | -96.8118 | -17.4809 | -0.0300 | -112.9594 | -17.4800 | 0.0765 |
| 8 | -112.9594 | -17.4800 | 0.0765 | -129.0947 | -17.4897 | 0.1383 |
| 9 | -129.0947 | -17.4897 | 0.1383 | -145.2386 | -17.4847 | 0.2320 |
| 10 | -145.2386 | -17.4847 | 0.2320 | -161.3676 | -17.4876 | 0.4143 |
| 11 | -161.3676 | -17.4876 | 0.4143 | -177.5211 | -17.4902 | 0.5922 |
| 12 | -177.5211 | -17.4902 | 0.5922 | -193.6422 | -17.4817 | 0.6869 |
| 13 | -193.6422 | -17.4817 | 0.6869 | -209.7831 | -17.4988 | 0.8238 |
| 14 | -209.7831 | -17.4988 | 0.8238 | -225.9466 | -17.5173 | 1.0520 |
| 15 | -225.9466 | -17.5173 | 1.0520 | -242.1108 | -17.5163 | 1.1702 |
| 16 | -242.1108 | -17.5163 | 1.1702 | -258.2773 | -17.5112 | 1.4756 |
| 17 | -258.2773 | -17.5112 | 1.4756 | -286.7945 | -92.1534 | -59.7139 |
| 18 | -286.7945 | -92.1534 | -59.7139 | -379.9006 | -103.6111 | -69.1495 |
| 19 | -379.9006 | -103.6111 | -69.1495 | -480.8091 | -114.5277 | -78.7016 |
| 20 | -480.8091 | -114.5277 | -78.7016 | -587.2990 | 1.0971 | 2.7173 |
| 21 | -587.2990 | 1.0971 | 2.7173 | -457.5538 | 126.8354 | 93.9972 |
| 22 | -457.5538 | 126.8354 | 93.9972 | -335.8295 | 115.7569 | 84.1898 |
| 23 | -335.8295 | 115.7569 | 84.1898 | -224.5772 | 12.8764 | -1.8537 |
| 24 | -224.5772 | 12.8764 | -1.8537 | -211.3802 | 12.8731 | -1.7530 |
| 25 | -211.3802 | 12.8731 | -1.7530 | -198.1884 | 12.8812 | -1.4422 |
| 26 | -198.1884 | 12.8812 | -1.4422 | -184.9760 | 12.8843 | -1.2311 |
| 27 | -184.9760 | 12.8843 | -1.2311 | -171.7729 | 12.8759 | -1.1501 |
| 28 | -171.7729 | 12.8759 | -1.1501 | -158.5753 | 12.8832 | -0.9944 |
| 29 | -158.5753 | 12.8832 | -0.9944 | -145.3700 | 12.8808 | -0.8480 |
| 30 | -145.3700 | 12.8808 | -0.8480 | -132.1826 | 12.8794 | -0.7018 |
| 31 | -132.1826 | 12.8794 | -0.7018 | -118.9594 | 12.8953 | -0.6240 |
| 32 | -118.9594 | 12.8953 | -0.6240 | -105.7337 | 12.9007 | -0.5238 |
| 33 | -105.7337 | 12.9007 | -0.5238 | -92.5217 | 12.8958 | -0.3702 |
| 34 | -92.5217 | 12.8958 | -0.3702 | -79.3058 | 12.8887 | -0.3262 |
| 35 | -79.3058 | 12.8887 | -0.3262 | -66.1046 | 12.8876 | -0.2649 |
| 36 | -66.1046 | 12.8876 | -0.2649 | -52.8924 | 12.8924 | -0.1943 |
| 37 | -52.8924 | 12.8924 | -0.1943 | -39.6789 | 12.8928 | -0.1519 |
| 38 | -39.6789 | 12.8928 | -0.1519 | -26.4579 | 12.8920 | -0.1130 |
| 39 | -26.4579 | 12.8920 | -0.1130 | -13.2480 | 12.8920 | -0.1079 |
| 40 | -13.2480 | 12.8920 | -0.1079 | -0.0297 | 12.8917 | -0.0998 |

ENVOL. MAX. CORTANTES TREN TREN SW/0, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3790 | 100.7134 | 113.1350 | 93.3679 | 100.7151 | 113.0737 |
| 2 | 93.3679 | 100.7151 | 113.0737 | 164.6530 | 88.9277 | 101.8670 |
| 3 | 164.6530 | 88.9277 | 101.8670 | 215.3741 | 77.5923 | 90.5352 |
| 4 | 215.3741 | 77.5923 | 90.5352 | 246.9499 | 66.7612 | 79.6817 |
| 5 | 246.9499 | 66.7612 | 79.6817 | 261.0736 | 56.4786 | 69.4535 |
| 6 | 261.0736 | 56.4786 | 69.4535 | 259.5018 | 46.7916 | 59.7467 |
| 7 | 259.5018 | 46.7916 | 59.7467 | 249.3801 | 37.1062 | 50.2720 |
| 8 | 249.3801 | 37.1062 | 50.2720 | 232.8152 | 27.1529 | 41.0240 |
| 9 | 232.8152 | 27.1529 | 41.0240 | 209.4695 | 16.9939 | 31.7522 |
| 10 | 209.4695 | 16.9939 | 31.7522 | 94.1243 | 10.1603 | 30.4544 |
| 11 | 94.1243 | 10.1603 | 30.4544 | 53.2430 | 5.2129 | 24.3534 |
| 12 | 53.2430 | 5.2129 | 24.3534 | 9.4072 | 0.8264 | 19.0210 |
| 13 | 9.4072 | 0.8264 | 19.0210 | 0.0000 | 0.0000 | 0.0000 |
| 14 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 15 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 16 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 17 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 18 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 19 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 0.0000 | 0.0000 | 0.0000 | -297.6454 | 61.9842 | 62.2687 |
| 21 | -297.6454 | 61.9842 | 62.2687 | -421.2170 | 146.8219 | 114.3519 |
| 22 | -421.2170 | 146.8219 | 114.3519 | -305.6567 | 137.1922 | 104.4725 |
| 23 | -305.6567 | 137.1922 | 104.4725 | -197.3101 | 126.8319 | 94.6170 |
| 24 | -197.3101 | 126.8319 | 94.6170 | -98.4157 | 115.7543 | 84.5544 |
| 25 | -98.4157 | 115.7543 | 84.5544 | -11.0549 | 103.9902 | 74.5121 |
| 26 | -11.0549 | 103.9902 | 74.5121 | 64.0344 | 92.3212 | 64.9572 |
| 27 | 64.0344 | 92.3212 | 64.9572 | 127.0743 | 80.7693 | 55.3787 |
| 28 | 127.0743 | 80.7693 | 55.3787 | 178.4089 | 69.3186 | 45.7305 |
| 29 | 178.4089 | 69.3186 | 45.7305 | 218.2728 | 57.9919 | 36.0524 |
| 30 | 218.2728 | 57.9919 | 36.0524 | 246.9449 | 46.7509 | 26.3286 |
| 31 | 246.9449 | 46.7509 | 26.3286 | 264.7179 | 35.6325 | 16.7196 |
| 32 | 264.7179 | 35.6325 | 16.7196 | 271.8560 | 24.7100 | 6.9824 |
| 33 | 271.8560 | 24.7100 | 6.9824 | 170.6486 | 18.5065 | 13.8559 |
| 34 | 170.6486 | 18.5065 | 13.8559 | 137.3383 | 13.4737 | 10.0068 |
| 35 | 137.3383 | 13.4737 | 10.0068 | -66.1046 | 12.8876 | -0.2649 |
| 36 | -66.1046 | 12.8876 | -0.2649 | -52.8924 | 12.8924 | -0.1943 |
| 37 | -52.8924 | 12.8924 | -0.1943 | -39.6789 | 12.8928 | -0.1519 |
| 38 | -39.6789 | 12.8928 | -0.1519 | -26.4579 | 12.8920 | -0.1130 |
| 39 | -26.4579 | 12.8920 | -0.1130 | -13.2480 | 12.8920 | -0.1079 |
| 40 | -13.2480 | 12.8920 | -0.1079 | -0.0297 | 12.8917 | -0.0998 |

ENVOL. MIN. CORTANTES TREN TREN SW/0, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0007 | -17.4869 | -0.2858 | -16.1340 | -17.4881 | -0.2750 |
| 2 | -16.1340 | -17.4881 | -0.2750 | -32.2785 | -17.4897 | -0.2467 |
| 3 | -32.2785 | -17.4897 | -0.2467 | -48.4174 | -17.4896 | -0.2042 |
| 4 | -48.4174 | -17.4896 | -0.2042 | -64.5478 | -17.4875 | -0.1790 |
| 5 | -64.5478 | -17.4875 | -0.1790 | -80.6810 | -17.4871 | -0.1368 |
| 6 | -80.6810 | -17.4871 | -0.1368 | -96.8118 | -17.4809 | -0.0300 |
| 7 | -96.8118 | -17.4809 | -0.0300 | 159.9234 | -18.5438 | -14.5005 |
| 8 | 159.9234 | -18.5438 | -14.5005 | 158.3005 | -25.2964 | -4.7748 |
| 9 | 158.3005 | -25.2964 | -4.7748 | 146.8634 | -36.2006 | -14.0190 |
| 10 | 146.8634 | -36.2006 | -14.0190 | 127.6192 | -47.2049 | -23.3267 |
| 11 | 127.6192 | -47.2049 | -23.3267 | 100.3481 | -58.3118 | -32.6063 |
| 12 | 100.3481 | -58.3118 | -32.6063 | 64.9438 | -69.5054 | -41.8121 |
| 13 | 64.9438 | -69.5054 | -41.8121 | 21.0397 | -80.7923 | -50.9808 |
| 14 | 21.0397 | -80.7923 | -50.9808 | -31.5242 | -92.1548 | -60.1700 |
| 15 | -31.5242 | -92.1548 | -60.1700 | -92.9337 | -103.6086 | -69.7704 |
| 16 | -92.9337 | -103.6086 | -69.7704 | -163.6104 | -114.5275 | -79.3173 |
| 17 | -163.6104 | -114.5275 | -79.3173 | -269.4155 | -114.5286 | -79.1596 |
| 18 | -269.4155 | -114.5286 | -79.1596 | -356.8743 | -124.6413 | -88.7976 |
| 19 | -356.8743 | -124.6413 | -88.7976 | -449.0440 | -133.9525 | -98.4100 |
| 20 | -449.0440 | -133.9525 | -98.4100 | -260.4016 | -61.2273 | -60.1200 |
| 21 | -260.4016 | -61.2273 | -60.1200 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 23 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 24 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 25 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 26 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 27 | 0.0000 | 0.0000 | 0.0000 | 23.8936 | -1.7774 | -16.2889 |
| 28 | 23.8936 | -1.7774 | -16.2889 | 70.9497 | -5.7446 | -20.9383 |
| 29 | 70.9497 | -5.7446 | -20.9383 | 115.6976 | -10.2280 | -26.2869 |
| 30 | 115.6976 | -10.2280 | -26.2869 | 307.8987 | -17.2184 | -30.4783 |
| 31 | 307.8987 | -17.2184 | -30.4783 | 329.1538 | -27.1709 | -40.0845 |
| 32 | 329.1538 | -27.1709 | -40.0845 | 341.0078 | -36.8306 | -49.8023 |
| 33 | 341.0078 | -36.8306 | -49.8023 | 344.1432 | -46.1236 | -59.7768 |
| 34 | 344.1432 | -46.1236 | -59.7768 | 339.3648 | -55.0760 | -69.3424 |
| 35 | 339.3648 | -55.0760 | -69.3424 | 327.1284 | -63.7063 | -78.4610 |
| 36 | 327.1284 | -63.7063 | -78.4610 | 298.8206 | -72.7492 | -87.6684 |
| 37 | 298.8206 | -72.7492 | -87.6684 | 253.0962 | -82.1467 | -96.7455 |
| 38 | 253.0962 | -82.1467 | -96.7455 | 188.7404 | -91.8907 | -105.7912 |
| 39 | 188.7404 | -91.8907 | -105.7912 | 104.8600 | -101.9291 | -114.4993 |
| 40 | 104.8600 | -101.9291 | -114.4993 | 0.3060 | -112.2300 | -123.0548 |

ENVOL. MAX. TORSORES TREN TREN SW/0, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3790 | 100.7134 | 113.1350 | 93.3679 | 100.7151 | 113.0737 |
| 2 | 93.3679 | 100.7151 | 113.0737 | 164.6530 | 88.9277 | 101.8670 |
| 3 | 164.6530 | 88.9277 | 101.8670 | 215.3741 | 77.5923 | 90.5352 |
| 4 | 215.3741 | 77.5923 | 90.5352 | 193.3350 | 52.2205 | 81.8953 |
| 5 | 193.3350 | 52.2205 | 81.8953 | 202.1942 | 43.7025 | 71.9986 |
| 6 | 202.1942 | 43.7025 | 71.9986 | 198.7249 | 35.8047 | 62.1954 |
| 7 | 198.7249 | 35.8047 | 62.1954 | 184.5743 | 28.5022 | 53.1423 |
| 8 | 184.5743 | 28.5022 | 53.1423 | 161.3177 | 21.7953 | 44.8988 |
| 9 | 161.3177 | 21.7953 | 44.8988 | 130.6467 | 15.6852 | 37.3368 |
| 10 | 130.6467 | 15.6852 | 37.3368 | 94.1243 | 10.1603 | 30.4544 |
| 11 | 94.1243 | 10.1603 | 30.4544 | 53.2430 | 5.2129 | 24.3534 |
| 12 | 53.2430 | 5.2129 | 24.3534 | 9.4072 | 0.8264 | 19.0210 |
| 13 | 9.4072 | 0.8264 | 19.0210 | -36.0255 | -3.0222 | 14.4109 |
| 14 | -36.0255 | -3.0222 | 14.4109 | -81.8337 | -6.3576 | 10.5611 |
| 15 | -81.8337 | -6.3576 | 10.5611 | -126.9085 | -9.1924 | 7.4042 |
| 16 | -126.9085 | -9.1924 | 7.4042 | -170.2816 | -11.5564 | 5.0752 |
| 17 | -170.2816 | -11.5564 | 5.0752 | -180.9345 | -11.5538 | 5.2520 |
| 18 | -180.9345 | -11.5538 | 5.2520 | -223.5215 | -13.4774 | 3.5796 |
| 19 | -223.5215 | -13.4774 | 3.5796 | -262.5333 | -14.9935 | 2.6289 |
| 20 | -262.5333 | -14.9935 | 2.6289 | -297.6454 | 61.9842 | 62.2687 |
| 21 | -297.6454 | 61.9842 | 62.2687 | -421.2170 | 146.8219 | 114.3519 |
| 22 | -421.2170 | 146.8219 | 114.3519 | -70.7381 | 122.5083 | 104.5016 |
| 23 | -70.7381 | 122.5083 | 104.5016 | 26.0751 | 113.4790 | 95.8419 |
| 24 | 26.0751 | 113.4790 | 95.8419 | 110.3771 | 104.0848 | 87.0018 |
| 25 | 110.3771 | 104.0848 | 87.0018 | 180.6169 | 94.3416 | 77.9321 |
| 26 | 180.6169 | 94.3416 | 77.9321 | 235.1888 | 84.2958 | 68.9705 |
| 27 | 235.1888 | 84.2958 | 68.9705 | 272.6868 | 74.0030 | 60.1255 |
| 28 | 272.6868 | 74.0030 | 60.1255 | 294.3278 | 64.0775 | 51.5225 |
| 29 | 294.3278 | 64.0775 | 51.5225 | 301.8694 | 54.7734 | 43.5517 |
| 30 | 301.8694 | 54.7734 | 43.5517 | 242.2285 | 38.1248 | 29.8083 |
| 31 | 242.2285 | 38.1248 | 29.8083 | 225.2477 | 30.8403 | 23.9123 |
| 32 | 225.2477 | 30.8403 | 23.9123 | 200.6785 | 24.3018 | 18.5775 |
| 33 | 200.6785 | 24.3018 | 18.5775 | 170.6486 | 18.5065 | 13.8559 |
| 34 | 170.6486 | 18.5065 | 13.8559 | 137.3383 | 13.4737 | 10.0068 |
| 35 | 137.3383 | 13.4737 | 10.0068 | 102.9852 | 9.2181 | 6.7409 |
| 36 | 102.9852 | 9.2181 | 6.7409 | 69.9767 | 5.7533 | 4.1544 |
| 37 | 69.9767 | 5.7533 | 4.1544 | 40.6926 | 3.0912 | 2.2280 |
| 38 | 40.6926 | 3.0912 | 2.2280 | 17.6188 | 1.2445 | 0.9531 |
| 39 | 17.6188 | 1.2445 | 0.9531 | 3.2098 | 0.2123 | 0.2395 |
| 40 | 3.2098 | 0.2123 | 0.2395 | -0.0186 | 8.2461 | 0.0800 |

ENVOL. MIN. TORSORES TREN TREN SW/0, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0007 | -15.3542 | -0.3615 | -14.1665 | -15.3547 | -0.3522 |
| 2 | -14.1665 | -15.3547 | -0.3522 | 11.7339 | -0.9004 | -0.8097 |
| 3 | 11.7339 | -0.9004 | -0.8097 | 32.6268 | -2.6876 | -2.1121 |
| 4 | 32.6268 | -2.6876 | -2.1121 | 60.2738 | -5.3548 | -4.1018 |
| 5 | 60.2738 | -5.3548 | -4.1018 | 92.2584 | -8.8972 | -6.7891 |
| 6 | 92.2584 | -8.8972 | -6.7891 | 126.2386 | -13.2954 | -10.2717 |
| 7 | 126.2386 | -13.2954 | -10.2717 | 159.9234 | -18.5438 | -14.5005 |
| 8 | 159.9234 | -18.5438 | -14.5005 | 191.1452 | -24.6255 | -19.3841 |
| 9 | 191.1452 | -24.6255 | -19.3841 | 217.7104 | -31.5103 | -25.0095 |
| 10 | 217.7104 | -31.5103 | -25.0095 | 237.6386 | -39.1672 | -31.4940 |
| 11 | 237.6386 | -39.1672 | -31.4940 | 249.0211 | -47.5992 | -38.6994 |
| 12 | 249.0211 | -47.5992 | -38.6994 | 250.1855 | -56.7366 | -46.4920 |
| 13 | 250.1855 | -56.7366 | -46.4920 | 21.0397 | -80.7923 | -50.9808 |
| 14 | 21.0397 | -80.7923 | -50.9808 | -31.5242 | -92.1548 | -60.1700 |
| 15 | -31.5242 | -92.1548 | -60.1700 | -92.9337 | -103.6086 | -69.7704 |
| 16 | -92.9337 | -103.6086 | -69.7704 | -163.6104 | -114.5275 | -79.3173 |
| 17 | -163.6104 | -114.5275 | -79.3173 | 30.1015 | -99.8318 | -84.8595 |
| 18 | 30.1015 | -99.8318 | -84.8595 | -51.9603 | -112.0289 | -95.8148 |
| 19 | -51.9603 | -112.0289 | -95.8148 | -149.4401 | -123.8280 | -106.8504 |
| 20 | -149.4401 | -123.8280 | -106.8504 | -260.4016 | -61.2273 | -60.1200 |
| 21 | -260.4016 | -61.2273 | -60.1200 | -235.4034 | 12.0786 | -2.6567 |
| 22 | -235.4034 | 12.0786 | -2.6567 | -202.3201 | 10.9591 | -3.2947 |
| 23 | -202.3201 | 10.9591 | -3.2947 | -162.2961 | 9.3070 | -4.5476 |
| 24 | -162.2961 | 9.3070 | -4.5476 | -118.2675 | 7.2101 | -6.5237 |
| 25 | -118.2675 | 7.2101 | -6.5237 | -71.8965 | 4.6801 | -9.0516 |
| 26 | -71.8965 | 4.6801 | -9.0516 | -24.1344 | 1.6914 | -12.3249 |
| 27 | -24.1344 | 1.6914 | -12.3249 | 23.8936 | -1.7774 | -16.2889 |
| 28 | 23.8936 | -1.7774 | -16.2889 | 70.9497 | -5.7446 | -20.9383 |
| 29 | 70.9497 | -5.7446 | -20.9383 | 115.6976 | -10.2280 | -26.2869 |
| 30 | 115.6976 | -10.2280 | -26.2869 | 156.6988 | -15.2498 | -32.3518 |
| 31 | 156.6988 | -15.2498 | -32.3518 | 329.1538 | -27.1709 | -40.0845 |
| 32 | 329.1538 | -27.1709 | -40.0845 | 341.0078 | -36.8306 | -49.8023 |
| 33 | 341.0078 | -36.8306 | -49.8023 | 344.1432 | -46.1236 | -59.7768 |
| 34 | 344.1432 | -46.1236 | -59.7768 | 339.3648 | -55.0760 | -69.3424 |
| 35 | 339.3648 | -55.0760 | -69.3424 | 327.1284 | -63.7063 | -78.4610 |
| 36 | 327.1284 | -63.7063 | -78.4610 | 298.8206 | -72.7492 | -87.6684 |
| 37 | 298.8206 | -72.7492 | -87.6684 | 253.0962 | -82.1467 | -96.7455 |
| 38 | 253.0962 | -82.1467 | -96.7455 | 188.7404 | -91.8907 | -105.7912 |
| 39 | 188.7404 | -91.8907 | -105.7912 | 104.8600 | -101.9291 | -114.4993 |
| 40 | 104.8600 | -101.9291 | -114.4993 | 0.2721 | -97.0694 | -123.7934 |

ENVOL. MAX. FLECTORES TREN TREN SW/2, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.1923 | 112.7965 | 51.8351 | 105.8607 | 114.5102 | 51.7463 |
| 2 | 105.8607 | 114.5102 | 51.7463 | 198.9424 | 99.5119 | 45.9450 |
| 3 | 198.9424 | 99.5119 | 45.9450 | 279.2964 | 84.5087 | 40.0682 |
| 4 | 279.2964 | 84.5087 | 40.0682 | 346.9087 | 69.5008 | 34.2958 |
| 5 | 346.9087 | 69.5008 | 34.2958 | 401.8407 | 54.4988 | 28.4595 |
| 6 | 401.8407 | 54.4988 | 28.4595 | 444.1076 | 39.5072 | 22.3315 |
| 7 | 444.1076 | 39.5072 | 22.3315 | 473.7155 | 24.5275 | 16.2303 |
| 8 | 473.7155 | 24.5275 | 16.2303 | 490.6245 | 9.5441 | 10.3537 |
| 9 | 490.6245 | 9.5441 | 10.3537 | 494.8447 | -5.4619 | 4.4004 |
| 10 | 494.8447 | -5.4619 | 4.4004 | 486.3613 | -20.4754 | -1.8045 |
| 11 | 486.3613 | -20.4754 | -1.8045 | 465.1956 | -35.4893 | -7.9304 |
| 12 | 465.1956 | -35.4893 | -7.9304 | 431.3516 | -50.4982 | -13.7971 |
| 13 | 431.3516 | -50.4982 | -13.7971 | 384.7346 | -50.4728 | -14.0548 |
| 14 | 384.7346 | -50.4728 | -14.0548 | 324.3854 | -65.4438 | -20.0538 |
| 15 | 324.3854 | -65.4438 | -20.0538 | 251.3943 | -80.4355 | -25.8478 |
| 16 | 251.3943 | -80.4355 | -25.8478 | 165.7059 | -95.4353 | -31.6709 |
| 17 | 165.7059 | -95.4353 | -31.6709 | 67.2576 | -110.4416 | -37.4836 |
| 18 | 67.2576 | -110.4416 | -37.4836 | -0.0311 | -0.0029 | -0.0605 |
| 19 | -0.0311 | -0.0029 | -0.0605 | -0.0339 | -0.0029 | -0.0605 |
| 20 | -0.0339 | -0.0029 | -0.0605 | -0.0367 | -0.0005 | -0.0305 |
| 21 | -0.0367 | -0.0005 | -0.0305 | -0.0349 | 0.0018 | -0.0006 |
| 22 | -0.0349 | 0.0018 | -0.0006 | -0.0331 | 0.0018 | -0.0006 |
| 23 | -0.0331 | 0.0018 | -0.0006 | 47.2000 | 128.3968 | 43.2353 |
| 24 | 47.2000 | 128.3968 | 43.2353 | 170.4981 | 113.3964 | 37.5301 |
| 25 | 170.4981 | 113.3964 | 37.5301 | 278.0491 | 98.4004 | 31.5288 |
| 26 | 278.0491 | 98.4004 | 31.5288 | 369.8794 | 83.3934 | 25.6091 |
| 27 | 369.8794 | 83.3934 | 25.6091 | 445.9138 | 68.3732 | 19.7741 |
| 28 | 445.9138 | 68.3732 | 19.7741 | 506.2031 | 53.3858 | 13.6966 |
| 29 | 506.2031 | 53.3858 | 13.6966 | 550.7263 | 38.4092 | 7.5680 |
| 30 | 550.7263 | 38.4092 | 7.5680 | 579.4967 | 23.3734 | 1.3433 |
| 31 | 579.4967 | 23.3734 | 1.3433 | 592.4706 | 8.3319 | -4.6238 |
| 32 | 592.4706 | 8.3319 | -4.6238 | 589.6593 | -6.6670 | -10.8071 |
| 33 | 589.6593 | -6.6670 | -10.8071 | 571.1199 | -21.6402 | -17.3248 |
| 34 | 571.1199 | -21.6402 | -17.3248 | 536.8534 | -36.6040 | -23.2237 |
| 35 | 536.8534 | -36.6040 | -23.2237 | 486.8726 | -51.6063 | -29.3050 |
| 36 | 486.8726 | -51.6063 | -29.3050 | 421.0847 | -66.6484 | -35.4456 |
| 37 | 421.0847 | -66.6484 | -35.4456 | 339.5058 | -81.6557 | -41.4321 |
| 38 | 339.5058 | -81.6557 | -41.4321 | 242.1551 | -96.6387 | -47.3915 |
| 39 | 242.1551 | -96.6387 | -47.3915 | 129.1570 | -111.6463 | -53.0656 |
| 40 | 129.1570 | -111.6463 | -53.0656 | 0.3110 | -126.5039 | -58.7957 |

ENVOL. MIN. FLECTORES TREN TREN SW/2, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0025 | -22.3666 | -0.8740 | -20.8431 | -22.5910 | -0.8324 |
| 2 | -20.8431 | -22.5910 | -0.8324 | -41.7006 | -22.5899 | -0.7964 |
| 3 | -41.7006 | -22.5899 | -0.7964 | -62.5426 | -22.5879 | -0.7405 |
| 4 | -62.5426 | -22.5879 | -0.7405 | -83.3838 | -22.5878 | -0.7070 |
| 5 | -83.3838 | -22.5878 | -0.7070 | -104.2211 | -22.5898 | -0.6529 |
| 6 | -104.2211 | -22.5898 | -0.6529 | -125.0593 | -22.6033 | -0.5151 |
| 7 | -125.0593 | -22.6033 | -0.5151 | -145.9278 | -22.6067 | -0.3759 |
| 8 | -145.9278 | -22.6067 | -0.3759 | -166.7629 | -22.5924 | -0.2979 |
| 9 | -166.7629 | -22.5924 | -0.2979 | -187.6127 | -22.5900 | -0.1758 |
| 10 | -187.6127 | -22.5900 | -0.1758 | -208.4563 | -22.5936 | 0.0613 |
| 11 | -208.4563 | -22.5936 | 0.0613 | -229.3206 | -22.5769 | 0.2873 |
| 12 | -229.3206 | -22.5769 | 0.2873 | -250.1431 | -22.5608 | 0.4101 |
| 13 | -250.1431 | -22.5608 | 0.4101 | -270.9948 | -22.5963 | 0.5859 |
| 14 | -270.9948 | -22.5963 | 0.5859 | -291.8668 | -22.6374 | 0.8831 |
| 15 | -291.8668 | -22.6374 | 0.8831 | -312.7549 | -22.6413 | 1.0359 |
| 16 | -312.7549 | -22.6413 | 1.0359 | -333.6422 | -22.6254 | 1.4319 |
| 17 | -333.6422 | -22.6254 | 1.4319 | -367.7133 | -76.0462 | -16.2142 |
| 18 | -367.7133 | -76.0462 | -16.2142 | -448.0356 | -97.4277 | -23.5455 |
| 19 | -448.0356 | -97.4277 | -23.5455 | -540.0784 | -108.6674 | -27.4557 |
| 20 | -540.0784 | -108.6674 | -27.4557 | -645.1727 | 11.3023 | 5.2060 |
| 21 | -645.1727 | 11.3023 | 5.2060 | -510.3379 | 118.1387 | 32.7927 |
| 22 | -510.3379 | 118.1387 | 32.7927 | -394.8778 | 106.2870 | 28.7910 |
| 23 | -394.8778 | 106.2870 | 28.7910 | -294.7096 | 94.7763 | 25.0831 |
| 24 | -294.7096 | 94.7763 | 25.0831 | -243.4250 | 14.8271 | -1.5547 |
| 25 | -243.4250 | 14.8271 | -1.5547 | -228.2301 | 14.8328 | -1.1973 |
| 26 | -228.2301 | 14.8328 | -1.1973 | -213.0230 | 14.8416 | -0.9546 |
| 27 | -213.0230 | 14.8416 | -0.9546 | -197.8118 | 14.8431 | -0.8620 |
| 28 | -197.8118 | 14.8431 | -0.8620 | -182.6128 | 14.8376 | -0.6809 |
| 29 | -182.6128 | 14.8376 | -0.6809 | -167.4130 | 14.8359 | -0.5145 |
| 30 | -167.4130 | 14.8359 | -0.5145 | -152.2158 | 14.8353 | -0.3456 |
| 31 | -152.2158 | 14.8353 | -0.3456 | -136.9936 | 14.8449 | -0.2552 |
| 32 | -136.9936 | 14.8449 | -0.2552 | -121.7592 | 14.8454 | -0.1385 |
| 33 | -121.7592 | 14.8454 | -0.1385 | -106.5549 | 14.8454 | 0.0380 |
| 34 | -106.5549 | 14.8454 | 0.0380 | -91.3250 | 14.8422 | 0.0887 |
| 35 | -91.3250 | 14.8422 | 0.0887 | -76.1252 | 14.8346 | 0.1599 |
| 36 | -76.1252 | 14.8346 | 0.1599 | -60.9118 | 14.8372 | 0.2401 |
| 37 | -60.9118 | 14.8372 | 0.2401 | -45.6947 | 14.8435 | 0.2889 |
| 38 | -45.6947 | 14.8435 | 0.2889 | -30.4692 | 14.8495 | 0.3336 |
| 39 | -30.4692 | 14.8495 | 0.3336 | -15.2563 | 14.8493 | 0.3393 |
| 40 | -15.2563 | 14.8493 | 0.3393 | -0.0334 | 14.6957 | 0.3776 |

ENVOL. MAX. CORTANTES TREN TREN SW/2, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.1909 | 114.5043 | 51.8157 | 105.8607 | 114.5102 | 51.7463 |
| 2 | 105.8607 | 114.5102 | 51.7463 | 198.9424 | 99.5119 | 45.9450 |
| 3 | 198.9424 | 99.5119 | 45.9450 | 279.2964 | 84.5087 | 40.0682 |
| 4 | 279.2964 | 84.5087 | 40.0682 | 346.9087 | 69.5008 | 34.2958 |
| 5 | 346.9087 | 69.5008 | 34.2958 | 401.8407 | 54.4988 | 28.4595 |
| 6 | 401.8407 | 54.4988 | 28.4595 | 220.8931 | 39.8639 | 26.5105 |
| 7 | 220.8931 | 39.8639 | 26.5105 | 191.6548 | 29.6504 | 22.4095 |
| 8 | 191.6548 | 29.6504 | 22.4095 | 149.6111 | 20.2454 | 18.7611 |
| 9 | 149.6111 | 20.2454 | 18.7611 | 97.1620 | 11.6796 | 15.4343 |
| 10 | 97.1620 | 11.6796 | 15.4343 | 38.4490 | 4.1504 | 12.4583 |
| 11 | 38.4490 | 4.1504 | 12.4583 | -0.0118 | -0.0029 | -0.0606 |
| 12 | -0.0118 | -0.0029 | -0.0606 | -0.0145 | -0.0030 | -0.0606 |
| 13 | -0.0145 | -0.0030 | -0.0606 | -0.0173 | -0.0030 | -0.0606 |
| 14 | -0.0173 | -0.0030 | -0.0606 | -0.0201 | -0.0029 | -0.0606 |
| 15 | -0.0201 | -0.0029 | -0.0606 | -0.0228 | -0.0029 | -0.0605 |
| 16 | -0.0228 | -0.0029 | -0.0605 | -0.0256 | -0.0029 | -0.0605 |
| 17 | -0.0256 | -0.0029 | -0.0605 | -0.0284 | -0.0029 | -0.0605 |
| 18 | -0.0284 | -0.0029 | -0.0605 | -0.0311 | -0.0029 | -0.0605 |
| 19 | -0.0311 | -0.0029 | -0.0605 | -0.0339 | -0.0029 | -0.0605 |
| 20 | -0.0339 | -0.0029 | -0.0605 | -417.2568 | 75.3842 | 31.0823 |
| 21 | -417.2568 | 75.3842 | 31.0823 | -454.8527 | 169.0734 | 53.0009 |
| 22 | -454.8527 | 169.0734 | 53.0009 | -321.1229 | 155.8127 | 47.8708 |
| 23 | -321.1229 | 155.8127 | 47.8708 | -205.7405 | 142.9009 | 43.0473 |
| 24 | -205.7405 | 142.9009 | 43.0473 | -107.6776 | 130.3387 | 38.2133 |
| 25 | -107.6776 | 130.3387 | 38.2133 | -25.8289 | 118.1342 | 33.6967 |
| 26 | -25.8289 | 118.1342 | 33.6967 | 40.9933 | 106.2787 | 29.4783 |
| 27 | 40.9933 | 106.2787 | 29.4783 | 93.9656 | 94.7733 | 25.4408 |
| 28 | 93.9656 | 94.7733 | 25.4408 | 134.3228 | 83.5844 | 21.5091 |
| 29 | 134.3228 | 83.5844 | 21.5091 | 163.2478 | 72.7077 | 17.5874 |
| 30 | 163.2478 | 72.7077 | 17.5874 | 181.9060 | 62.1205 | 13.6493 |
| 31 | 181.9060 | 62.1205 | 13.6493 | 191.3923 | 51.7985 | 9.8221 |
| 32 | 191.3923 | 51.7985 | 9.8221 | 192.6768 | 41.7337 | 5.8924 |
| 33 | 192.6768 | 41.7337 | 5.8924 | 186.6737 | 31.9036 | 1.9083 |
| 34 | 186.6737 | 31.9036 | 1.9083 | 175.2859 | 22.1048 | -1.8652 |
| 35 | 175.2859 | 22.1048 | -1.8652 | -76.1252 | 14.8346 | 0.1599 |
| 36 | -76.1252 | 14.8346 | 0.1599 | -60.9118 | 14.8372 | 0.2401 |
| 37 | -60.9118 | 14.8372 | 0.2401 | -45.6947 | 14.8435 | 0.2889 |
| 38 | -45.6947 | 14.8435 | 0.2889 | -30.4692 | 14.8495 | 0.3336 |
| 39 | -30.4692 | 14.8495 | 0.3336 | -15.2563 | 14.8493 | 0.3393 |
| 40 | -15.2563 | 14.8493 | 0.3393 | -0.0331 | 14.8486 | 0.3483 |

ENVOL. MIN. CORTANTES TREN TREN SW/2, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0023 | -22.5882 | -0.8464 | -20.8431 | -22.5910 | -0.8324 |
| 2 | -20.8431 | -22.5910 | -0.8324 | -41.7006 | -22.5899 | -0.7964 |
| 3 | -41.7006 | -22.5899 | -0.7964 | -62.5426 | -22.5879 | -0.7405 |
| 4 | -62.5426 | -22.5879 | -0.7405 | -83.3838 | -22.5878 | -0.7070 |
| 5 | -83.3838 | -22.5878 | -0.7070 | -104.2211 | -22.5898 | -0.6529 |
| 6 | -104.2211 | -22.5898 | -0.6529 | 70.1991 | -28.0007 | 0.8390 |
| 7 | 70.1991 | -28.0007 | 0.8390 | 75.6949 | -37.0845 | -2.7642 |
| 8 | 75.6949 | -37.0845 | -2.7642 | 77.7085 | -46.4064 | -6.3286 |
| 9 | 77.7085 | -46.4064 | -6.3286 | 75.2970 | -55.9900 | -9.8839 |
| 10 | 75.2970 | -55.9900 | -9.8839 | 67.5572 | -65.8614 | -13.4882 |
| 11 | 67.5572 | -65.8614 | -13.4882 | 53.3975 | -76.0434 | -17.1095 |
| 12 | 53.3975 | -76.0434 | -17.1095 | 31.8392 | -86.5631 | -20.7171 |
| 13 | 31.8392 | -86.5631 | -20.7171 | -48.0825 | -86.5613 | -20.6966 |
| 14 | -48.0825 | -86.5613 | -20.6966 | -88.4109 | -97.4274 | -24.4263 |
| 15 | -88.4109 | -97.4274 | -24.4263 | -138.9275 | -108.6662 | -28.5103 |
| 16 | -138.9275 | -108.6662 | -28.5103 | -200.9200 | -120.2940 | -32.6805 |
| 17 | -200.9200 | -120.2940 | -32.6805 | -275.6232 | -132.3192 | -37.2712 |
| 18 | -275.6232 | -132.3192 | -37.2712 | -363.9341 | -144.7337 | -42.1214 |
| 19 | -363.9341 | -144.7337 | -42.1214 | -467.1030 | -157.5392 | -47.2583 |
| 20 | -467.1030 | -157.5392 | -47.2583 | -304.0762 | -70.3007 | -28.2410 |
| 21 | -304.0762 | -70.3007 | -28.2410 | -0.0349 | 0.0018 | -0.0006 |
| 22 | -0.0349 | 0.0018 | -0.0006 | -0.0331 | 0.0018 | -0.0006 |
| 23 | -0.0331 | 0.0018 | -0.0006 | -0.0313 | 0.0018 | -0.0006 |
| 24 | -0.0313 | 0.0018 | -0.0006 | -0.0294 | 0.0018 | -0.0005 |
| 25 | -0.0294 | 0.0018 | -0.0005 | -0.0276 | 0.0018 | -0.0005 |
| 26 | -0.0276 | 0.0018 | -0.0005 | -0.0258 | 0.0018 | -0.0005 |
| 27 | -0.0258 | 0.0018 | -0.0005 | -0.0239 | 0.0018 | -0.0005 |
| 28 | -0.0239 | 0.0018 | -0.0005 | 9.1103 | -0.7337 | -9.3413 |
| 29 | 9.1103 | -0.7337 | -9.3413 | 63.6401 | -5.6309 | -11.6405 |
| 30 | 63.6401 | -5.6309 | -11.6405 | 117.5009 | -11.4465 | -14.3111 |
| 31 | 117.5009 | -11.4465 | -14.3111 | 168.0966 | -18.2052 | -17.2805 |
| 32 | 168.0966 | -18.2052 | -17.2805 | 234.0678 | -26.7706 | -20.3663 |
| 33 | 234.0678 | -26.7706 | -20.3663 | 262.6172 | -36.5574 | -24.5489 |
| 34 | 262.6172 | -36.5574 | -24.5489 | 285.7356 | -46.4148 | -28.5430 |
| 35 | 285.7356 | -46.4148 | -28.5430 | 293.4810 | -57.1847 | -32.9304 |
| 36 | 293.4810 | -57.1847 | -32.9304 | 282.8329 | -68.8987 | -37.7258 |
| 37 | 282.8329 | -68.8987 | -37.7258 | 339.5058 | -81.6557 | -41.4321 |
| 38 | 339.5058 | -81.6557 | -41.4321 | 242.1551 | -96.6387 | -47.3915 |
| 39 | 242.1551 | -96.6387 | -47.3915 | 129.1570 | -111.6463 | -53.0656 |
| 40 | 129.1570 | -111.6463 | -53.0656 | 0.3105 | -126.6559 | -58.7673 |

ENVOL. MAX. TORSORES TREN TREN SW/2, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.1921 | 113.6950 | 51.8484 | 105.1135 | 113.6967 | 51.7793 |
| 2 | 105.1135 | 113.6967 | 51.7793 | 166.0359 | 89.8274 | 45.9907 |
| 3 | 166.0359 | 89.8274 | 45.9907 | 208.3370 | 75.1481 | 40.6249 |
| 4 | 208.3370 | 75.1481 | 40.6249 | 231.9660 | 62.7771 | 35.6922 |
| 5 | 231.9660 | 62.7771 | 35.6922 | 235.1010 | 50.8995 | 31.0140 |
| 6 | 235.1010 | 50.8995 | 31.0140 | 220.8931 | 39.8639 | 26.5105 |
| 7 | 220.8931 | 39.8639 | 26.5105 | 191.6548 | 29.6504 | 22.4095 |
| 8 | 191.6548 | 29.6504 | 22.4095 | 149.6111 | 20.2454 | 18.7611 |
| 9 | 149.6111 | 20.2454 | 18.7611 | 97.1620 | 11.6796 | 15.4343 |
| 10 | 97.1620 | 11.6796 | 15.4343 | 38.4490 | 4.1504 | 12.4583 |
| 11 | 38.4490 | 4.1504 | 12.4583 | -23.7947 | -2.3569 | 9.9132 |
| 12 | -23.7947 | -2.3569 | 9.9132 | -86.9552 | -7.8594 | 7.7318 |
| 13 | -86.9552 | -7.8594 | 7.7318 | -94.2060 | -7.8707 | 7.7935 |
| 14 | -94.2060 | -7.8707 | 7.7935 | -159.9981 | -12.4130 | 6.0741 |
| 15 | -159.9981 | -12.4130 | 6.0741 | -221.0885 | -15.9956 | 4.6237 |
| 16 | -221.0885 | -15.9956 | 4.6237 | -275.4207 | -18.6666 | 3.6796 |
| 17 | -275.4207 | -18.6666 | 3.6796 | -321.2809 | -20.5020 | 3.0242 |
| 18 | -321.2809 | -20.5020 | 3.0242 | -360.6014 | -21.7382 | 2.5359 |
| 19 | -360.6014 | -21.7382 | 2.5359 | -392.7059 | -22.4284 | 2.3752 |
| 20 | -392.7059 | -22.4284 | 2.3752 | -417.2568 | 75.3842 | 31.0823 |
| 21 | -417.2568 | 75.3842 | 31.0823 | -250.6111 | 158.5966 | 54.4613 |
| 22 | -250.6111 | 158.5966 | 54.4613 | -106.5776 | 144.1917 | 49.2971 |
| 23 | -106.5776 | 144.1917 | 49.2971 | 14.9307 | 130.2487 | 44.3899 |
| 24 | 14.9307 | 130.2487 | 44.3899 | 114.5741 | 116.7964 | 39.5606 |
| 25 | 114.5741 | 116.7964 | 39.5606 | -25.8289 | 118.1342 | 33.6967 |
| 26 | -25.8289 | 118.1342 | 33.6967 | 40.9933 | 106.2787 | 29.4783 |
| 27 | 40.9933 | 106.2787 | 29.4783 | 93.9656 | 94.7733 | 25.4408 |
| 28 | 93.9656 | 94.7733 | 25.4408 | 134.3228 | 83.5844 | 21.5091 |
| 29 | 134.3228 | 83.5844 | 21.5091 | 163.2478 | 72.7077 | 17.5874 |
| 30 | 163.2478 | 72.7077 | 17.5874 | 181.9060 | 62.1205 | 13.6493 |
| 31 | 181.9060 | 62.1205 | 13.6493 | 191.3923 | 51.7985 | 9.8221 |
| 32 | 191.3923 | 51.7985 | 9.8221 | 192.6768 | 41.7337 | 5.8924 |
| 33 | 192.6768 | 41.7337 | 5.8924 | 186.6737 | 31.9036 | 1.9083 |
| 34 | 186.6737 | 31.9036 | 1.9083 | -77.9297 | 12.6611 | 0.1583 |
| 35 | -77.9297 | 12.6611 | 0.1583 | -69.5029 | 13.5448 | 0.2188 |
| 36 | -69.5029 | 13.5448 | 0.2188 | -55.6133 | 13.5510 | 0.2919 |
| 37 | -55.6133 | 13.5510 | 0.2919 | -41.7202 | 13.5536 | 0.3361 |
| 38 | -41.7202 | 13.5536 | 0.3361 | -27.8166 | 13.5533 | 0.3779 |
| 39 | -27.8166 | 13.5533 | 0.3779 | -13.9303 | 13.5546 | 0.3831 |
| 40 | -13.9303 | 13.5546 | 0.3831 | -0.0330 | 14.2460 | 0.3914 |

ENVOL. MIN. TORSORES TREN TREN SW/2, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0020 | -21.7783 | -0.8798 | -20.0948 | -21.7785 | -0.8664 |
| 2 | -20.0948 | -21.7785 | -0.8664 | -40.2002 | -21.7773 | -0.8314 |
| 3 | -40.2002 | -21.7773 | -0.8314 | 36.7038 | -3.0234 | -0.8792 |
| 4 | 36.7038 | -3.0234 | -0.8792 | 67.8503 | -6.0308 | -1.7234 |
| 5 | 67.8503 | -6.0308 | -1.7234 | 103.8981 | -10.0229 | -2.8763 |
| 6 | 103.8981 | -10.0229 | -2.8763 | 142.2011 | -14.9846 | -4.4484 |
| 7 | 142.2011 | -14.9846 | -4.4484 | 180.1746 | -20.8964 | -6.3849 |
| 8 | 180.1746 | -20.8964 | -6.3849 | 215.3658 | -27.7465 | -8.5815 |
| 9 | 215.3658 | -27.7465 | -8.5815 | 245.3262 | -35.4993 | -11.1371 |
| 10 | 245.3262 | -35.4993 | -11.1371 | 267.8037 | -44.1565 | -14.1817 |
| 11 | 267.8037 | -44.1565 | -14.1817 | 280.6628 | -53.6597 | -17.5635 |
| 12 | 280.6628 | -53.6597 | -17.5635 | 281.9799 | -63.9712 | -21.1302 |
| 13 | 281.9799 | -63.9712 | -21.1302 | 222.9155 | -63.9493 | -21.2841 |
| 14 | 222.9155 | -63.9493 | -21.2841 | 200.5887 | -75.0225 | -25.2632 |
| 15 | 200.5887 | -75.0225 | -25.2632 | 162.5905 | -86.8503 | -29.4441 |
| 16 | 162.5905 | -86.8503 | -29.4441 | 107.4847 | -99.3894 | -33.9200 |
| 17 | 107.4847 | -99.3894 | -33.9200 | 34.0225 | -112.5591 | -38.7292 |
| 18 | 34.0225 | -112.5591 | -38.7292 | -58.5075 | -126.3253 | -43.6276 |
| 19 | -58.5075 | -126.3253 | -43.6276 | -171.0544 | -140.6342 | -48.8160 |
| 20 | -171.0544 | -140.6342 | -48.8160 | -304.0762 | -70.3007 | -28.2410 |
| 21 | -304.0762 | -70.3007 | -28.2410 | -285.1794 | 14.6318 | -2.3384 |
| 22 | -285.1794 | 14.6318 | -2.3384 | -259.1119 | 14.0340 | -2.4521 |
| 23 | -259.1119 | 14.0340 | -2.4521 | -226.3561 | 12.9813 | -2.8250 |
| 24 | -226.3561 | 12.9813 | -2.8250 | -187.4946 | 11.4267 | -3.5862 |
| 25 | -187.4946 | 11.4267 | -3.5862 | -143.3582 | 9.3180 | -4.4559 |
| 26 | -143.3582 | 9.3180 | -4.4559 | -94.9888 | 6.6231 | -5.7349 |
| 27 | -94.9888 | 6.6231 | -5.7349 | -43.6772 | 3.2806 | -7.3895 |
| 28 | -43.6772 | 3.2806 | -7.3895 | 9.1103 | -0.7337 | -9.3413 |
| 29 | 9.1103 | -0.7337 | -9.3413 | 63.6401 | -5.6309 | -11.6405 |
| 30 | 63.6401 | -5.6309 | -11.6405 | 117.5009 | -11.4465 | -14.3111 |
| 31 | 117.5009 | -11.4465 | -14.3111 | 168.0966 | -18.2052 | -17.2805 |
| 32 | 168.0966 | -18.2052 | -17.2805 | 212.6655 | -25.9155 | -20.6365 |
| 33 | 212.6655 | -25.9155 | -20.6365 | 262.6172 | -36.5574 | -24.5489 |
| 34 | 262.6172 | -36.5574 | -24.5489 | 285.7356 | -46.4148 | -28.5430 |
| 35 | 285.7356 | -46.4148 | -28.5430 | 293.4810 | -57.1847 | -32.9304 |
| 36 | 293.4810 | -57.1847 | -32.9304 | 282.8329 | -68.8987 | -37.7258 |
| 37 | 282.8329 | -68.8987 | -37.7258 | 250.9650 | -81.4902 | -42.7133 |
| 38 | 250.9650 | -81.4902 | -42.7133 | 195.0175 | -94.9914 | -47.9971 |
| 39 | 195.0175 | -94.9914 | -47.9971 | 112.3963 | -109.3324 | -53.2859 |
| 40 | 112.3963 | -109.3324 | -53.2859 | 0.3037 | -125.3685 | -58.8092 |

ENVOL. MAX. FLECTORES TREN TREN SIN CARGA, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0160 | 9.4745 | 4.3209 | 8.8218 | 9.5422 | 4.3123 |
| 2 | 8.8218 | 9.5422 | 4.3123 | 16.5788 | 8.2920 | 3.8289 |
| 3 | 16.5788 | 8.2920 | 3.8289 | 23.2748 | 7.0414 | 3.3391 |
| 4 | 23.2748 | 7.0414 | 3.3391 | 28.9089 | 5.7912 | 2.8580 |
| 5 | 28.9089 | 5.7912 | 2.8580 | 33.4865 | 4.5426 | 2.3719 |
| 6 | 33.4865 | 4.5426 | 2.3719 | 37.0091 | 3.2939 | 1.8609 |
| 7 | 37.0091 | 3.2939 | 1.8609 | 39.4763 | 2.0448 | 1.3523 |
| 8 | 39.4763 | 2.0448 | 1.3523 | 40.8856 | 0.7942 | 0.8627 |
| 9 | 40.8856 | 0.7942 | 0.8627 | 41.2364 | -0.4574 | 0.3669 |
| 10 | 41.2364 | -0.4574 | 0.3669 | 40.5306 | -1.7079 | -0.1502 |
| 11 | 40.5306 | -1.7079 | -0.1502 | 38.7651 | -2.9582 | -0.6614 |
| 12 | 38.7651 | -2.9582 | -0.6614 | 35.9460 | -4.2080 | -1.1500 |
| 13 | 35.9460 | -4.2080 | -1.1500 | 32.0610 | -4.2060 | -1.1713 |
| 14 | 32.0610 | -4.2060 | -1.1713 | 27.0326 | -5.4536 | -1.6711 |
| 15 | 27.0326 | -5.4536 | -1.6711 | 20.9494 | -6.7030 | -2.1542 |
| 16 | 20.9494 | -6.7030 | -2.1542 | 13.8088 | -7.9534 | -2.6392 |
| 17 | 13.8088 | -7.9534 | -2.6392 | 5.6048 | -9.2032 | -3.1235 |
| 18 | 5.6048 | -9.2032 | -3.1235 | -0.0026 | -0.0002 | -0.0050 |
| 19 | -0.0026 | -0.0002 | -0.0050 | -0.0028 | -0.0002 | -0.0050 |
| 20 | -0.0028 | -0.0002 | -0.0050 | -0.0030 | 0.0000 | -0.0025 |
| 21 | -0.0030 | 0.0000 | -0.0025 | -0.0029 | 0.0001 | -0.0001 |
| 22 | -0.0029 | 0.0001 | -0.0001 | -0.0028 | 0.0001 | 0.0000 |
| 23 | -0.0028 | 0.0001 | 0.0000 | -0.0026 | 0.0001 | 0.0000 |
| 24 | -0.0026 | 0.0001 | 0.0000 | -0.0025 | 0.0001 | 0.0000 |
| 25 | -0.0025 | 0.0001 | 0.0000 | 4.1519 | 9.4344 | 2.5277 |
| 26 | 4.1519 | 9.4344 | 2.5277 | 13.0702 | 8.1842 | 2.0545 |
| 27 | 13.0702 | 8.1842 | 2.0545 | 20.6745 | 6.9356 | 1.5758 |
| 28 | 20.6745 | 6.9356 | 1.5758 | 26.9666 | 5.6863 | 1.0845 |
| 29 | 26.9666 | 5.6863 | 1.0845 | 31.9427 | 4.4361 | 0.5877 |
| 30 | 31.9427 | 4.4361 | 0.5877 | 35.6063 | 3.1845 | 0.0831 |
| 31 | 35.6063 | 3.1845 | 0.0831 | 37.9560 | 1.9322 | -0.4067 |
| 32 | 37.9560 | 1.9322 | -0.4067 | 38.9909 | 0.6825 | -0.9124 |
| 33 | 38.9909 | 0.6825 | -0.9124 | 38.7150 | -0.5663 | -1.4408 |
| 34 | 38.7150 | -0.5663 | -1.4408 | 37.1273 | -1.8156 | -1.9279 |
| 35 | 37.1273 | -1.8156 | -1.9279 | 34.2285 | -3.0658 | -2.4286 |
| 36 | 34.2285 | -3.0658 | -2.4286 | 30.0139 | -4.3160 | -2.9338 |
| 37 | 30.0139 | -4.3160 | -2.9338 | 24.4851 | -5.5662 | -3.4287 |
| 38 | 24.4851 | -5.5662 | -3.4287 | 17.6404 | -6.8172 | -3.9216 |
| 39 | 17.6404 | -6.8172 | -3.9216 | 9.4915 | -8.0674 | -4.3939 |
| 40 | 9.4915 | -8.0674 | -4.3939 | 0.0230 | -9.3178 | -4.8681 |

ENVOL. MIN. FLECTORES TREN TREN SIN CARGA, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0016 | -0.0002 | -0.0050 | 0.0013 | -0.0002 | -0.0050 |
| 2 | 0.0013 | -0.0002 | -0.0050 | 0.0011 | -0.0002 | -0.0050 |
| 3 | 0.0011 | -0.0002 | -0.0050 | 0.0009 | -0.0002 | -0.0051 |
| 4 | 0.0009 | -0.0002 | -0.0051 | 0.0006 | -0.0002 | -0.0051 |
| 5 | 0.0006 | -0.0002 | -0.0051 | 0.0004 | -0.0002 | -0.0051 |
| 6 | 0.0004 | -0.0002 | -0.0051 | 0.0002 | -0.0002 | -0.0051 |
| 7 | 0.0002 | -0.0002 | -0.0051 | -0.0001 | -0.0002 | -0.0051 |
| 8 | -0.0001 | -0.0002 | -0.0051 | -0.0003 | -0.0002 | -0.0051 |
| 9 | -0.0003 | -0.0002 | -0.0051 | -0.0005 | -0.0002 | -0.0051 |
| 10 | -0.0005 | -0.0002 | -0.0051 | -0.0008 | -0.0002 | -0.0050 |
| 11 | -0.0008 | -0.0002 | -0.0050 | -0.0010 | -0.0002 | -0.0050 |
| 12 | -0.0010 | -0.0002 | -0.0050 | -0.0012 | -0.0002 | -0.0050 |
| 13 | -0.0012 | -0.0002 | -0.0050 | -0.0014 | -0.0002 | -0.0050 |
| 14 | -0.0014 | -0.0002 | -0.0050 | -0.0017 | -0.0002 | -0.0050 |
| 15 | -0.0017 | -0.0002 | -0.0050 | -5.1133 | -8.5881 | -2.0678 |
| 16 | -5.1133 | -8.5881 | -2.0678 | -13.9946 | -9.8386 | -2.5199 |
| 17 | -13.9946 | -9.8386 | -2.5199 | -23.9379 | -11.0887 | -2.9754 |
| 18 | -23.9379 | -11.0887 | -2.9754 | -34.9259 | -12.3384 | -3.4243 |
| 19 | -34.9259 | -12.3384 | -3.4243 | -46.9800 | -13.5884 | -3.8701 |
| 20 | -46.9800 | -13.5884 | -3.8701 | -60.1111 | 0.4235 | 0.2368 |
| 21 | -60.1111 | 0.4235 | 0.2368 | -44.6491 | 14.4355 | 4.3437 |
| 22 | -44.6491 | 14.4355 | 4.3437 | -30.4741 | 13.1854 | 3.9037 |
| 23 | -30.4741 | 13.1854 | 3.9037 | -21.5515 | 1.2357 | -0.1392 |
| 24 | -21.5515 | 1.2357 | -0.1392 | -20.2852 | 1.2355 | -0.1295 |
| 25 | -20.2852 | 1.2355 | -0.1295 | -19.0191 | 1.2356 | -0.0997 |
| 26 | -19.0191 | 1.2356 | -0.0997 | -17.7519 | 1.2362 | -0.0794 |
| 27 | -17.7519 | 1.2362 | -0.0794 | -16.4845 | 1.2364 | -0.0718 |
| 28 | -16.4845 | 1.2364 | -0.0718 | -15.2177 | 1.2364 | -0.0567 |
| 29 | -15.2177 | 1.2364 | -0.0567 | -13.9510 | 1.2363 | -0.0428 |
| 30 | -13.9510 | 1.2363 | -0.0428 | -12.6847 | 1.2366 | -0.0287 |
| 31 | -12.6847 | 1.2366 | -0.0287 | -11.4163 | 1.2376 | -0.0212 |
| 32 | -11.4163 | 1.2376 | -0.0212 | -10.1469 | 1.2380 | -0.0118 |
| 33 | -10.1469 | 1.2380 | -0.0118 | -8.8788 | 1.2376 | 0.0030 |
| 34 | -8.8788 | 1.2376 | 0.0030 | -7.6106 | 1.2366 | 0.0074 |
| 35 | -7.6106 | 1.2366 | 0.0074 | -6.3439 | 1.2362 | 0.0133 |
| 36 | -6.3439 | 1.2362 | 0.0133 | -5.0760 | 1.2369 | 0.0200 |
| 37 | -5.0760 | 1.2369 | 0.0200 | -3.8078 | 1.2372 | 0.0240 |
| 38 | -3.8078 | 1.2372 | 0.0240 | -2.5391 | 1.2373 | 0.0278 |
| 39 | -2.5391 | 1.2373 | 0.0278 | -1.2713 | 1.2374 | 0.0282 |
| 40 | -1.2713 | 1.2374 | 0.0282 | -0.0028 | 1.2374 | 0.0290 |

ENVOL. MAX. CORTANTES TREN TREN SIN CARGA, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0159 | 9.5420 | 4.3180 | 8.8218 | 9.5422 | 4.3123 |
| 2 | 8.8218 | 9.5422 | 4.3123 | 16.5788 | 8.2920 | 3.8289 |
| 3 | 16.5788 | 8.2920 | 3.8289 | 23.2748 | 7.0414 | 3.3391 |
| 4 | 23.2748 | 7.0414 | 3.3391 | 28.9089 | 5.7912 | 2.8580 |
| 5 | 28.9089 | 5.7912 | 2.8580 | 33.4865 | 4.5426 | 2.3719 |
| 6 | 33.4865 | 4.5426 | 2.3719 | 37.0091 | 3.2939 | 1.8609 |
| 7 | 37.0091 | 3.2939 | 1.8609 | 39.4763 | 2.0448 | 1.3523 |
| 8 | 39.4763 | 2.0448 | 1.3523 | 40.8856 | 0.7942 | 0.8627 |
| 9 | 40.8856 | 0.7942 | 0.8627 | -0.0005 | -0.0002 | -0.0051 |
| 10 | -0.0005 | -0.0002 | -0.0051 | -0.0008 | -0.0002 | -0.0050 |
| 11 | -0.0008 | -0.0002 | -0.0050 | -0.0010 | -0.0002 | -0.0050 |
| 12 | -0.0010 | -0.0002 | -0.0050 | -0.0012 | -0.0002 | -0.0050 |
| 13 | -0.0012 | -0.0002 | -0.0050 | -0.0014 | -0.0002 | -0.0050 |
| 14 | -0.0014 | -0.0002 | -0.0050 | -0.0017 | -0.0002 | -0.0050 |
| 15 | -0.0017 | -0.0002 | -0.0050 | -0.0019 | -0.0002 | -0.0050 |
| 16 | -0.0019 | -0.0002 | -0.0050 | -0.0021 | -0.0002 | -0.0050 |
| 17 | -0.0021 | -0.0002 | -0.0050 | -0.0024 | -0.0002 | -0.0050 |
| 18 | -0.0024 | -0.0002 | -0.0050 | -0.0026 | -0.0002 | -0.0050 |
| 19 | -0.0026 | -0.0002 | -0.0050 | -0.0028 | -0.0002 | -0.0050 |
| 20 | -0.0028 | -0.0002 | -0.0050 | -60.1111 | 0.4235 | 0.2368 |
| 21 | -60.1111 | 0.4235 | 0.2368 | -44.6491 | 14.4355 | 4.3437 |
| 22 | -44.6491 | 14.4355 | 4.3437 | -30.4741 | 13.1854 | 3.9037 |
| 23 | -30.4741 | 13.1854 | 3.9037 | -17.6185 | 11.9351 | 3.4638 |
| 24 | -17.6185 | 11.9351 | 3.4638 | -6.0771 | 10.6851 | 2.9979 |
| 25 | -6.0771 | 10.6851 | 2.9979 | 4.1519 | 9.4344 | 2.5277 |
| 26 | 4.1519 | 9.4344 | 2.5277 | 13.0702 | 8.1842 | 2.0545 |
| 27 | 13.0702 | 8.1842 | 2.0545 | 20.6745 | 6.9356 | 1.5758 |
| 28 | 20.6745 | 6.9356 | 1.5758 | 26.9666 | 5.6863 | 1.0845 |
| 29 | 26.9666 | 5.6863 | 1.0845 | 31.9427 | 4.4361 | 0.5877 |
| 30 | 31.9427 | 4.4361 | 0.5877 | 35.6063 | 3.1845 | 0.0831 |
| 31 | 35.6063 | 3.1845 | 0.0831 | 37.9560 | 1.9322 | -0.4067 |
| 32 | 37.9560 | 1.9322 | -0.4067 | -10.1469 | 1.2380 | -0.0118 |
| 33 | -10.1469 | 1.2380 | -0.0118 | -8.8788 | 1.2376 | 0.0030 |
| 34 | -8.8788 | 1.2376 | 0.0030 | -7.6106 | 1.2366 | 0.0074 |
| 35 | -7.6106 | 1.2366 | 0.0074 | -6.3439 | 1.2362 | 0.0133 |
| 36 | -6.3439 | 1.2362 | 0.0133 | -5.0760 | 1.2369 | 0.0200 |
| 37 | -5.0760 | 1.2369 | 0.0200 | -3.8078 | 1.2372 | 0.0240 |
| 38 | -3.8078 | 1.2372 | 0.0240 | -2.5391 | 1.2373 | 0.0278 |
| 39 | -2.5391 | 1.2373 | 0.0278 | -1.2713 | 1.2374 | 0.0282 |
| 40 | -1.2713 | 1.2374 | 0.0282 | -0.0028 | 1.2374 | 0.0290 |

ENVOL. MIN. CORTANTES TREN TREN SIN CARGA, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0016 | -0.0002 | -0.0050 | 0.0013 | -0.0002 | -0.0050 |
| 2 | 0.0013 | -0.0002 | -0.0050 | 1.0978 | -0.0843 | -0.0277 |
| 3 | 1.0978 | -0.0843 | -0.0277 | 3.0587 | -0.2519 | -0.0733 |
| 4 | 3.0587 | -0.2519 | -0.0733 | 5.6542 | -0.5026 | -0.1436 |
| 5 | 5.6542 | -0.5026 | -0.1436 | 8.6581 | -0.8351 | -0.2397 |
| 6 | 8.6581 | -0.8351 | -0.2397 | 11.8502 | -1.2485 | -0.3706 |
| 7 | 11.8502 | -1.2485 | -0.3706 | 15.0143 | -1.7411 | -0.5321 |
| 8 | 15.0143 | -1.7411 | -0.5321 | 17.9473 | -2.3127 | -0.7151 |
| 9 | 17.9473 | -2.3127 | -0.7151 | 20.4435 | -2.9588 | -0.9280 |
| 10 | 20.4435 | -2.9588 | -0.9280 | 22.3178 | -3.6797 | -1.1819 |
| 11 | 22.3178 | -3.6797 | -1.1819 | 19.6558 | -4.8405 | -0.6370 |
| 12 | 19.6558 | -4.8405 | -0.6370 | 15.1009 | -6.0901 | -1.1156 |
| 13 | 15.1009 | -6.0901 | -1.1156 | 9.4778 | -6.0891 | -1.1225 |
| 14 | 9.4778 | -6.0891 | -1.1225 | 2.7093 | -7.3380 | -1.5977 |
| 15 | 2.7093 | -7.3380 | -1.5977 | -5.1133 | -8.5881 | -2.0678 |
| 16 | -5.1133 | -8.5881 | -2.0678 | -13.9946 | -9.8386 | -2.5199 |
| 17 | -13.9946 | -9.8386 | -2.5199 | -23.9379 | -11.0887 | -2.9754 |
| 18 | -23.9379 | -11.0887 | -2.9754 | -34.9259 | -12.3384 | -3.4243 |
| 19 | -34.9259 | -12.3384 | -3.4243 | -46.9800 | -13.5884 | -3.8701 |
| 20 | -46.9800 | -13.5884 | -3.8701 | -25.3396 | -5.8583 | -2.3534 |
| 21 | -25.3396 | -5.8583 | -2.3534 | -0.0029 | 0.0001 | -0.0001 |
| 22 | -0.0029 | 0.0001 | -0.0001 | -0.0028 | 0.0001 | 0.0000 |
| 23 | -0.0028 | 0.0001 | 0.0000 | -0.0026 | 0.0001 | 0.0000 |
| 24 | -0.0026 | 0.0001 | 0.0000 | -0.0025 | 0.0001 | 0.0000 |
| 25 | -0.0025 | 0.0001 | 0.0000 | -0.0023 | 0.0001 | 0.0000 |
| 26 | -0.0023 | 0.0001 | 0.0000 | -0.0021 | 0.0001 | 0.0000 |
| 27 | -0.0021 | 0.0001 | 0.0000 | -0.0020 | 0.0001 | 0.0000 |
| 28 | -0.0020 | 0.0001 | 0.0000 | 0.7574 | -0.0609 | -0.7785 |
| 29 | 0.7574 | -0.0609 | -0.7785 | 5.1370 | -0.4545 | -0.9704 |
| 30 | 5.1370 | -0.4545 | -0.9704 | 9.3452 | -0.9104 | -1.1931 |
| 31 | 9.3452 | -0.9104 | -1.1931 | 13.2134 | -1.4308 | -1.4406 |
| 32 | 13.2134 | -1.4308 | -1.4406 | 16.5614 | -2.0182 | -1.7194 |
| 33 | 16.5614 | -2.0182 | -1.7194 | 19.2006 | -2.6734 | -2.0408 |
| 34 | 19.2006 | -2.6734 | -2.0408 | 20.9301 | -3.3990 | -2.3709 |
| 35 | 20.9301 | -3.3990 | -2.3709 | 21.5438 | -4.1981 | -2.7325 |
| 36 | 21.5438 | -4.1981 | -2.7325 | 20.8181 | -5.0703 | -3.1266 |
| 37 | 20.8181 | -5.0703 | -3.1266 | 18.5326 | -6.0195 | -3.5373 |
| 38 | 18.5326 | -6.0195 | -3.5373 | 14.4566 | -7.0411 | -3.9731 |
| 39 | 14.4566 | -7.0411 | -3.9731 | 8.3702 | -8.1413 | -4.4111 |
| 40 | 8.3702 | -8.1413 | -4.4111 | 0.0230 | -9.3178 | -4.8681 |

ENVOL. MAX. TORSORES TREN TREN SIN CARGA, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0160 | 9.4745 | 4.3209 | 8.7594 | 9.4747 | 4.3151 |
| 2 | 8.7594 | 9.4747 | 4.3151 | 16.4538 | 8.2246 | 3.8318 |
| 3 | 16.4538 | 8.2246 | 3.8318 | 23.0872 | 6.9741 | 3.3424 |
| 4 | 23.0872 | 6.9741 | 3.3424 | 28.6594 | 5.7241 | 2.8614 |
| 5 | 28.6594 | 5.7241 | 2.8614 | 33.1746 | 4.4740 | 2.3753 |
| 6 | 33.1746 | 4.4740 | 2.3753 | 36.2206 | 3.1508 | 1.8648 |
| 7 | 36.2206 | 3.1508 | 1.8648 | 38.5570 | 1.9018 | 1.3568 |
| 8 | 38.5570 | 1.9018 | 1.3568 | 39.8349 | 0.6511 | 0.8679 |
| 9 | 39.8349 | 0.6511 | 0.8679 | 39.2578 | -0.6974 | 0.3731 |
| 10 | 39.2578 | -0.6974 | 0.3731 | -0.0008 | -0.0002 | -0.0050 |
| 11 | -0.0008 | -0.0002 | -0.0050 | -0.0010 | -0.0002 | -0.0050 |
| 12 | -0.0010 | -0.0002 | -0.0050 | -0.0012 | -0.0002 | -0.0050 |
| 13 | -0.0012 | -0.0002 | -0.0050 | -0.0014 | -0.0002 | -0.0050 |
| 14 | -0.0014 | -0.0002 | -0.0050 | -0.0017 | -0.0002 | -0.0050 |
| 15 | -0.0017 | -0.0002 | -0.0050 | -0.0019 | -0.0002 | -0.0050 |
| 16 | -0.0019 | -0.0002 | -0.0050 | -0.0021 | -0.0002 | -0.0050 |
| 17 | -0.0021 | -0.0002 | -0.0050 | -0.0024 | -0.0002 | -0.0050 |
| 18 | -0.0024 | -0.0002 | -0.0050 | -0.0026 | -0.0002 | -0.0050 |
| 19 | -0.0026 | -0.0002 | -0.0050 | -0.0028 | -0.0002 | -0.0050 |
| 20 | -0.0028 | -0.0002 | -0.0050 | -60.1111 | 0.4235 | 0.2368 |
| 21 | -60.1111 | 0.4235 | 0.2368 | -44.6491 | 14.4355 | 4.3437 |
| 22 | -44.6491 | 14.4355 | 4.3437 | -30.4741 | 13.1854 | 3.9037 |
| 23 | -30.4741 | 13.1854 | 3.9037 | -17.6185 | 11.9351 | 3.4638 |
| 24 | -17.6185 | 11.9351 | 3.4638 | -6.0771 | 10.6851 | 2.9979 |
| 25 | -6.0771 | 10.6851 | 2.9979 | 4.1519 | 9.4344 | 2.5277 |
| 26 | 4.1519 | 9.4344 | 2.5277 | 13.0702 | 8.1842 | 2.0545 |
| 27 | 13.0702 | 8.1842 | 2.0545 | 20.6745 | 6.9356 | 1.5758 |
| 28 | 20.6745 | 6.9356 | 1.5758 | 26.9666 | 5.6863 | 1.0845 |
| 29 | 26.9666 | 5.6863 | 1.0845 | 31.9427 | 4.4361 | 0.5877 |
| 30 | 31.9427 | 4.4361 | 0.5877 | 35.6063 | 3.1845 | 0.0831 |
| 31 | 35.6063 | 3.1845 | 0.0831 | -0.0014 | 0.0001 | 0.0000 |
| 32 | -0.0014 | 0.0001 | 0.0000 | -2.3531 | 0.2869 | 0.0005 |
| 33 | -2.3531 | 0.2869 | 0.0005 | -6.9570 | 0.9696 | 0.0096 |
| 34 | -6.9570 | 0.9696 | 0.0096 | -6.4939 | 1.0554 | 0.0132 |
| 35 | -6.4939 | 1.0554 | 0.0132 | -5.7919 | 1.1286 | 0.0182 |
| 36 | -5.7919 | 1.1286 | 0.0182 | -4.6346 | 1.1295 | 0.0243 |
| 37 | -4.6346 | 1.1295 | 0.0243 | -3.4764 | 1.1296 | 0.0281 |
| 38 | -3.4764 | 1.1296 | 0.0281 | -2.3182 | 1.1293 | 0.0315 |
| 39 | -2.3182 | 1.1293 | 0.0315 | -1.1608 | 1.1295 | 0.0319 |
| 40 | -1.1608 | 1.1295 | 0.0319 | -0.0026 | 1.1296 | 0.0326 |

ENVOL. MIN. TORSORES TREN TREN SIN CARGA, EC-1 en via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0016 | -0.0002 | -0.0050 | 0.0013 | -0.0002 | -0.0050 |
| 2 | 0.0013 | -0.0002 | -0.0050 | 1.0978 | -0.0843 | -0.0277 |
| 3 | 1.0978 | -0.0843 | -0.0277 | 3.0587 | -0.2519 | -0.0733 |
| 4 | 3.0587 | -0.2519 | -0.0733 | 5.6542 | -0.5026 | -0.1436 |
| 5 | 5.6542 | -0.5026 | -0.1436 | 8.6581 | -0.8351 | -0.2397 |
| 6 | 8.6581 | -0.8351 | -0.2397 | 11.8502 | -1.2485 | -0.3706 |
| 7 | 11.8502 | -1.2485 | -0.3706 | 15.0143 | -1.7411 | -0.5321 |
| 8 | 15.0143 | -1.7411 | -0.5321 | 17.9473 | -2.3127 | -0.7151 |
| 9 | 17.9473 | -2.3127 | -0.7151 | 20.4435 | -2.9588 | -0.9280 |
| 10 | 20.4435 | -2.9588 | -0.9280 | 22.3178 | -3.6797 | -1.1819 |
| 11 | 22.3178 | -3.6797 | -1.1819 | 23.3881 | -4.4717 | -1.4636 |
| 12 | 23.3881 | -4.4717 | -1.4636 | 23.4985 | -5.3314 | -1.7608 |
| 13 | 23.4985 | -5.3314 | -1.7608 | 18.5765 | -5.3293 | -1.7737 |
| 14 | 18.5765 | -5.3293 | -1.7737 | 16.7153 | -6.2519 | -2.1052 |
| 15 | 16.7153 | -6.2519 | -2.1052 | 13.5491 | -7.2371 | -2.4537 |
| 16 | 13.5491 | -7.2371 | -2.4537 | 8.9570 | -8.2824 | -2.8266 |
| 17 | 8.9570 | -8.2824 | -2.8266 | 2.8354 | -9.3794 | -3.2275 |
| 18 | 2.8354 | -9.3794 | -3.2275 | -4.8756 | -10.5267 | -3.6356 |
| 19 | -4.8756 | -10.5267 | -3.6356 | -14.2546 | -11.7197 | -4.0680 |
| 20 | -14.2546 | -11.7197 | -4.0680 | -25.3396 | -5.8583 | -2.3534 |
| 21 | -25.3396 | -5.8583 | -2.3534 | -23.7648 | 1.2193 | -0.1948 |
| 22 | -23.7648 | 1.2193 | -0.1948 | -21.5926 | 1.1692 | -0.2043 |
| 23 | -21.5926 | 1.1692 | -0.2043 | -18.8631 | 1.0815 | -0.2354 |
| 24 | -18.8631 | 1.0815 | -0.2354 | -15.6247 | 0.9521 | -0.2988 |
| 25 | -15.6247 | 0.9521 | -0.2988 | -11.9465 | 0.7767 | -0.3714 |
| 26 | -11.9465 | 0.7767 | -0.3714 | -7.9156 | 0.5517 | -0.4779 |
| 27 | -7.9156 | 0.5517 | -0.4779 | -3.6398 | 0.2734 | -0.6158 |
| 28 | -3.6398 | 0.2734 | -0.6158 | 0.7574 | -0.0609 | -0.7785 |
| 29 | 0.7574 | -0.0609 | -0.7785 | 5.1370 | -0.4545 | -0.9704 |
| 30 | 5.1370 | -0.4545 | -0.9704 | 9.3452 | -0.9104 | -1.1931 |
| 31 | 9.3452 | -0.9104 | -1.1931 | 13.2134 | -1.4308 | -1.4406 |
| 32 | 13.2134 | -1.4308 | -1.4406 | 16.5614 | -2.0182 | -1.7194 |
| 33 | 16.5614 | -2.0182 | -1.7194 | 19.2006 | -2.6734 | -2.0408 |
| 34 | 19.2006 | -2.6734 | -2.0408 | 20.9301 | -3.3990 | -2.3709 |
| 35 | 20.9301 | -3.3990 | -2.3709 | 21.5438 | -4.1981 | -2.7325 |
| 36 | 21.5438 | -4.1981 | -2.7325 | 20.8181 | -5.0703 | -3.1266 |
| 37 | 20.8181 | -5.0703 | -3.1266 | 18.5326 | -6.0195 | -3.5373 |
| 38 | 18.5326 | -6.0195 | -3.5373 | 14.4566 | -7.0411 | -3.9731 |
| 39 | 14.4566 | -7.0411 | -3.9731 | 8.3702 | -8.1413 | -4.4111 |
| 40 | 8.3702 | -8.1413 | -4.4111 | 0.0230 | -9.3178 | -4.8681 |

ENVOLVENTE MAXIMOS FLECTORES TREN IPF-B, l=30 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4463 | 90.9428 | 129.4766 | -82.8200 | -85.1189 | -119.7850 |
| 2 | 85.3254 | 87.7131 | 119.4977 | -159.9644 | -76.4052 | -106.3555 |
| 3 | 160.0425 | 76.4031 | 106.2282 | -224.4419 | -65.0937 | -93.0728 |
| 4 | 224.5127 | 65.0827 | 92.8964 | -278.6713 | -53.7799 | -79.7654 |
| 5 | 278.6672 | 53.7873 | 79.7649 | -322.6302 | -42.4861 | -66.6213 |
| 6 | 322.6794 | 42.4895 | 66.3674 | -356.4501 | -31.1901 | -53.1675 |
| 7 | 356.5009 | 31.1971 | 52.8122 | -380.1018 | -19.8893 | -39.6119 |
| 8 | 380.1292 | 19.9022 | 39.3914 | -393.5135 | -8.5975 | -26.2481 |
| 9 | 393.5183 | 8.5864 | 26.1669 | -396.6927 | 2.7189 | -12.9963 |
| 10 | 396.7001 | -2.7257 | 12.6845 | -389.6787 | 14.0251 | 0.5318 |
| 11 | 389.6732 | -14.0207 | -0.9189 | -372.4359 | 25.3359 | 14.1284 |
| 12 | 372.4344 | -25.3534 | -14.3455 | -345.0029 | 36.6539 | 27.4900 |
| 13 | 344.9972 | -36.6453 | -27.5598 | -307.3332 | 44.9450 | 37.2409 |
| 14 | 307.3022 | -44.9138 | -37.4839 | -259.2596 | 56.2120 | 50.6612 |
| 15 | 259.2184 | -56.2006 | -50.8649 | -201.0063 | 67.5032 | 63.9991 |
| 16 | 201.0090 | -67.5030 | -63.9997 | -132.5895 | 78.8097 | 77.1403 |
| 17 | 132.4493 | -78.8230 | -77.3763 | -53.7700 | 90.1321 | 90.5190 |
| 18 | 64.2854 | -65.0252 | -65.9219 | -7.4274 | 51.2284 | 53.4408 |
| 19 | 20.4041 | -21.6073 | -22.9928 | 3.3684 | 29.9129 | 32.6191 |
| 20 | 4.5293 | -7.8298 | -8.6725 | 6.5289 | 16.1346 | 18.2802 |
| 21 | -0.0093 | -0.0003 | -0.0190 | 0.0089 | -0.0005 | 0.0003 |
| 22 | 4.6656 | 8.7479 | 9.6228 | -8.9042 | 0.4811 | 1.0736 |
| 23 | 20.7701 | 24.2478 | 25.5509 | -40.8959 | -15.0231 | -14.8595 |
| 24 | 51.9236 | 36.3795 | 36.8307 | -102.2765 | -50.8298 | -47.9355 |
| 25 | 120.8311 | 84.0233 | 80.2984 | -200.4963 | -71.8003 | -66.0811 |
| 26 | 207.3889 | 79.0508 | 72.5408 | -281.9092 | -66.8227 | -58.3269 |
| 27 | 281.9068 | 66.8274 | 58.3263 | -343.8019 | -54.6007 | -44.1197 |
| 28 | 343.8391 | 54.6008 | 43.8681 | -393.1233 | -42.3742 | -29.6208 |
| 29 | 393.1410 | 42.3738 | 29.3287 | -429.8031 | -30.1490 | -15.0739 |
| 30 | 429.8161 | 30.1453 | 14.7617 | -453.8690 | -17.9224 | -0.4885 |
| 31 | 453.8676 | 17.9040 | 0.0786 | -465.3060 | -5.6707 | 14.1547 |
| 32 | 465.3050 | 5.6561 | -14.1550 | -464.0964 | 6.5688 | 28.4309 |
| 33 | 464.0471 | -6.5492 | -29.1025 | -450.2596 | 18.7631 | 43.4363 |
| 34 | 450.2282 | -18.7649 | -43.8356 | -423.8354 | 30.9911 | 58.0604 |
| 35 | 423.8398 | -30.9696 | -57.9890 | -384.8766 | 43.1925 | 72.2394 |
| 36 | 384.7578 | -43.2139 | -72.8588 | -333.1483 | 55.4408 | 87.1266 |
| 37 | 333.1483 | -55.4381 | -87.1284 | -268.9220 | 67.6668 | 101.3667 |
| 38 | 268.7533 | -67.6719 | -101.8000 | -191.8773 | 79.9040 | 116.0384 |
| 39 | 191.8945 | -79.9089 | -116.0060 | -102.4949 | 92.1304 | 130.1801 |
| 40 | 102.3787 | -92.1314 | -130.2711 | -0.2971 | 104.2798 | 144.4841 |

ENVOLVENTE MAXIMOS CORTANTES TREN IPF-B, l=30 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4446 | 96.0100 | 129.2192 | -85.2088 | -87.7090 | -119.5830 |
| 2 | 81.7044 | 87.9727 | 119.7855 | -156.5830 | -76.6648 | -106.6433 |
| 3 | 146.5481 | 77.4363 | 107.2056 | -211.9011 | -66.1269 | -94.0502 |
| 4 | 196.3186 | 67.4018 | 95.0273 | -252.6171 | -56.0990 | -81.8963 |
| 5 | 232.3525 | 57.8979 | 83.5036 | -280.1084 | -46.5967 | -70.3600 |
| 6 | 256.2129 | 48.8934 | 72.2491 | -295.8909 | -37.5940 | -59.0489 |
| 7 | 269.2028 | 40.3887 | 61.3765 | -301.2877 | -29.0809 | -48.1757 |
| 8 | 272.6066 | 32.3657 | 51.1152 | -297.4821 | -21.0610 | -37.9719 |
| 9 | 267.6959 | 24.8067 | 41.4918 | -186.7777 | -14.6079 | -25.5801 |
| 10 | 156.6563 | 18.8222 | 29.4655 | -170.1934 | -10.5184 | -19.8419 |
| 11 | 140.4978 | 15.1945 | 24.2081 | -150.6911 | -6.8843 | -14.5764 |
| 12 | 122.0785 | 11.9934 | 19.5490 | -129.3117 | -3.6941 | -9.9302 |
| 13 | 102.4718 | 9.2351 | 15.4554 | -107.1617 | -0.9271 | -5.8265 |
| 14 | 82.6358 | 6.8808 | 11.7746 | -85.1543 | 1.4250 | -2.1486 |
| 15 | 63.4744 | 4.9095 | 8.6101 | -64.1734 | 3.3940 | 1.0138 |
| 16 | 45.7709 | 3.3046 | 6.0021 | -44.9892 | 4.9989 | 3.6218 |
| 17 | 30.2337 | 2.0438 | 3.7873 | -28.2859 | 6.2641 | 5.8414 |
| 18 | 17.4475 | 1.1103 | 2.1488 | -14.6450 | 7.1888 | 7.4699 |
| 19 | 7.9228 | 0.4757 | 0.9538 | -4.5293 | 7.8299 | 8.6725 |
| 20 | 2.0178 | 0.1143 | 0.2400 | 105.5596 | -2.2002 | -3.3586 |
| 21 | -537.5443 | 123.8222 | 119.0414 | 414.8758 | -138.1113 | -127.5372 |
| 22 | -417.1163 | 138.2263 | 127.8345 | 281.5941 | -125.9975 | -113.7175 |
| 23 | -288.2212 | 126.3646 | 114.9261 | 164.9932 | -114.1395 | -100.8144 |
| 24 | -176.4055 | 114.7924 | 102.1144 | 65.1293 | -102.5675 | -87.9469 |
| 25 | -81.0270 | 103.5369 | 89.8312 | -18.6332 | -91.3138 | -75.6441 |
| 26 | -1.5672 | 92.6286 | 78.0300 | -86.8695 | -80.4018 | -63.8357 |
| 27 | 62.4645 | 82.1010 | 66.7364 | -135.8920 | -70.1792 | -55.4885 |
| 28 | 107.8916 | 72.2785 | 58.8577 | -168.7062 | -60.5898 | -45.4763 |
| 29 | 137.5792 | 63.1220 | 49.3687 | -188.3921 | -51.5269 | -36.1011 |
| 30 | 154.7698 | 54.5014 | 40.5367 | -196.2909 | -43.0094 | -27.3768 |
| 31 | 160.8881 | 46.4557 | 32.3405 | -193.9088 | -35.0560 | -19.3266 |
| 32 | 157.4518 | 39.0011 | 24.9683 | -182.7270 | -27.7099 | -12.0429 |
| 33 | 146.1728 | 32.1633 | 18.0590 | -80.9704 | -21.0484 | -5.4932 |
| 34 | 45.2210 | 26.0244 | 12.1743 | -67.1740 | -16.7944 | -1.4870 |
| 35 | 33.1779 | 22.3137 | 8.8278 | -51.3149 | -13.0911 | 1.8445 |
| 36 | 20.1921 | 19.1551 | 5.9150 | -35.0983 | -9.9299 | 4.7609 |
| 37 | 7.8785 | 16.5569 | 3.6646 | -20.1218 | -7.3320 | 7.0181 |
| 38 | -2.0496 | 14.5266 | 1.9059 | -8.1153 | -5.2961 | 8.7829 |
| 39 | -7.8535 | 13.0714 | 0.7165 | -0.8149 | -3.8503 | 9.9700 |
| 40 | -7.7768 | 12.1971 | -0.0043 | 0.0021 | -2.9693 | 10.6980 |

ENVOLVENTE MAXIMOS TORSORES TREN IPF-B, l=30 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4383 | 89.3723 | 129.4947 | -79.0789 | -81.0700 | -119.8603 |
| 2 | 75.5748 | 81.3333 | 120.0671 | -142.0271 | -69.8683 | -107.0471 |
| 3 | 130.1548 | 69.6443 | 107.6172 | -184.3161 | -58.3407 | -94.7025 |
| 4 | 168.7341 | 59.6166 | 95.6928 | -212.4524 | -48.4784 | -82.9246 |
| 5 | 192.1883 | 50.2771 | 84.5320 | -226.4332 | -39.3060 | -71.8825 |
| 6 | 197.7766 | 40.5694 | 73.7963 | -222.5252 | -29.7651 | -61.2486 |
| 7 | 184.3575 | 30.4830 | 63.6259 | -199.5818 | -19.8410 | -51.2128 |
| 8 | 152.2588 | 20.2369 | 54.1982 | -158.0676 | -9.7694 | -41.9522 |
| 9 | 117.3633 | 12.0404 | 45.4953 | -115.9699 | -1.7280 | -33.3654 |
| 10 | 72.7382 | 4.3630 | 37.3670 | -64.8833 | 5.7882 | -25.3635 |
| 11 | 35.1917 | -1.1099 | 29.8955 | -22.7241 | 11.1536 | -18.0268 |
| 12 | -5.8905 | -6.0383 | 23.1072 | 22.2845 | 15.9619 | -11.3939 |
| 13 | -49.1258 | -10.4216 | 16.9588 | 62.5817 | 18.7304 | -7.3336 |
| 14 | -87.1080 | -12.8021 | 13.4531 | 90.1344 | 15.0125 | -3.1252 |
| 15 | -111.8130 | -8.6835 | 9.7706 | 123.6535 | 16.9870 | -0.1471 |
| 16 | -142.0598 | -10.2903 | 7.1625 | 155.3838 | 18.5938 | 2.4612 |
| 17 | -170.1357 | -11.5370 | 5.4228 | 184.6207 | 19.8449 | 4.2059 |
| 18 | -195.4606 | -12.4809 | 3.7269 | 210.7956 | 20.7800 | 5.8917 |
| 19 | -217.5157 | -13.1141 | 2.8291 | 233.4507 | 21.4197 | 6.7972 |
| 20 | -235.9619 | -13.4779 | 2.1153 | 356.0844 | 11.3920 | -5.2341 |
| 21 | -354.6231 | 114.9056 | 120.7939 | 217.6131 | -127.9891 | -129.6239 |
| 22 | -219.8542 | 128.1055 | 129.9208 | 96.1833 | -115.9550 | -115.9526 |
| 23 | -102.8072 | 116.3220 | 116.8495 | -7.6783 | -104.2381 | -102.9974 |
| 24 | -3.7337 | 104.8902 | 104.2974 | -93.9885 | -92.8735 | -90.5117 |
| 25 | 78.0921 | 93.8418 | 92.2569 | -163.4949 | -81.9007 | -78.5550 |
| 26 | 143.2966 | 83.2137 | 80.6492 | -216.9044 | -71.3450 | -67.0657 |
| 27 | 192.4973 | 73.0453 | 69.9661 | -254.8278 | -61.2613 | -56.4973 |
| 28 | 226.8302 | 63.3601 | 59.7548 | -278.5034 | -51.6714 | -46.3733 |
| 29 | 247.3774 | 54.2017 | 50.1606 | -289.0489 | -42.6066 | -36.8929 |
| 30 | 255.4278 | 45.5817 | 41.2329 | -287.8115 | -34.0897 | -28.0730 |
| 31 | 252.4088 | 37.5280 | 32.9295 | -276.2760 | -26.1283 | -19.9154 |
| 32 | 239.8208 | 30.0682 | 25.5570 | -255.9367 | -18.7770 | -12.6317 |
| 33 | 219.3814 | 23.2392 | 18.5086 | -166.3858 | -9.1483 | -6.0812 |
| 34 | 130.6374 | 14.1245 | 12.6881 | -140.3891 | -4.8948 | -1.9908 |
| 35 | 106.3912 | 10.4180 | 9.3441 | -112.3422 | -1.1970 | 1.3428 |
| 36 | 73.5653 | 8.7496 | 6.3232 | -75.7443 | -0.0260 | 4.3681 |
| 37 | 48.5242 | 6.6507 | 4.0572 | -49.3910 | 2.1777 | 6.6328 |
| 38 | 21.8020 | 6.7771 | 2.2493 | -23.5534 | 2.2261 | 8.4455 |
| 39 | 7.5844 | 5.5489 | 1.0565 | -8.5455 | 3.6726 | 9.6308 |
| 40 | -0.7201 | 5.3296 | 0.3283 | -0.0132 | 3.8985 | 10.3665 |

ENVOLVENTE MINIMOS FLECTORES TREN IPF-B, l=30 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0114 | -10.9776 | -0.2091 | 10.1168 | 10.9776 | 0.2091 |
| 2 | -12.5054 | -13.5696 | 0.0095 | 25.0325 | 13.5696 | -0.0095 |
| 3 | -25.0311 | -13.5685 | 0.0362 | 37.5535 | 13.5685 | -0.0364 |
| 4 | -37.5527 | -13.5655 | 0.0758 | 50.0684 | 13.5655 | -0.0757 |
| 5 | -50.0672 | -13.5665 | 0.0759 | 62.5846 | 13.5665 | -0.0762 |
| 6 | -62.5837 | -13.5701 | 0.1414 | 75.1006 | 13.5701 | -0.1414 |
| 7 | -75.0995 | -13.5734 | 0.2414 | 87.6289 | 13.5734 | -0.2415 |
| 8 | -87.6307 | -13.5753 | 0.3083 | 100.7943 | 17.4663 | -2.5467 |
| 9 | -100.7949 | -17.4620 | 2.5748 | 117.2146 | 18.4617 | -1.4183 |
| 10 | -117.2118 | -18.4616 | 1.5367 | 134.4734 | 19.4618 | -0.3861 |
| 11 | -134.4694 | -19.4596 | 0.5519 | 152.5909 | 20.4601 | 0.5958 |
| 12 | -152.5929 | -20.4539 | -0.4880 | 171.5280 | 21.4541 | 1.6379 |
| 13 | -171.5294 | -21.4548 | -1.5982 | 191.3370 | 21.4559 | 1.5805 |
| 14 | -191.3374 | -21.4813 | -1.4091 | 212.0832 | 22.4826 | 2.5339 |
| 15 | -212.0819 | -22.4881 | -2.3500 | 233.6726 | 23.4890 | 3.4892 |
| 16 | -233.6764 | -23.4909 | -3.4897 | 256.1204 | 24.4902 | 4.5824 |
| 17 | -256.1168 | -24.4761 | -4.1075 | 279.4036 | 25.4749 | 5.2095 |
| 18 | -289.9005 | -50.5837 | -29.8521 | 337.1596 | 51.5847 | 30.9685 |
| 19 | -350.2366 | -81.2038 | -61.0852 | 439.0397 | 98.0215 | 78.8825 |
| 20 | -446.9377 | -120.1058 | -102.8288 | 559.5012 | 88.9618 | 74.9249 |
| 21 | -566.6722 | 114.8630 | 108.4791 | 419.4701 | -137.4421 | -126.4682 |
| 22 | -424.1445 | 128.6950 | 116.8449 | 294.1162 | -125.0751 | -112.7351 |
| 23 | -305.8216 | 100.3462 | 86.5266 | 219.9399 | -73.6995 | -59.3255 |
| 24 | -230.9696 | 52.3436 | 37.3538 | 177.3199 | -52.3433 | -37.3767 |
| 25 | -195.8126 | 19.1477 | 5.0556 | 176.1930 | -19.1484 | -5.1274 |
| 26 | -182.9713 | 11.8921 | -1.3950 | 170.7781 | -11.8928 | 1.3464 |
| 27 | -170.7760 | 11.8917 | -1.3461 | 158.5845 | -11.8907 | 1.3275 |
| 28 | -158.5873 | 11.8912 | -1.2158 | 146.3988 | -11.8918 | 1.1791 |
| 29 | -146.3998 | 11.8937 | -1.0740 | 134.2121 | -11.8928 | 1.0408 |
| 30 | -134.2133 | 11.8922 | -0.9452 | 122.0305 | -11.8937 | 0.9116 |
| 31 | -122.0306 | 11.9017 | -0.8044 | 109.8252 | -11.9042 | 0.7861 |
| 32 | -109.8270 | 11.9094 | -0.7860 | 97.6154 | -11.9092 | 0.7628 |
| 33 | -97.6143 | 11.9004 | -0.6236 | 85.4187 | -11.9006 | 0.5882 |
| 34 | -85.4197 | 11.9004 | -0.5140 | 73.2179 | -11.9001 | 0.5040 |
| 35 | -73.2161 | 11.8962 | -0.5165 | 61.0296 | -11.8946 | 0.5019 |
| 36 | -61.0295 | 11.8982 | -0.4053 | 48.8333 | -11.8986 | 0.3889 |
| 37 | -48.8327 | 11.9014 | -0.3887 | 36.6330 | -11.9021 | 0.3790 |
| 38 | -36.6329 | 11.9021 | -0.3205 | 24.4267 | -11.9019 | 0.3115 |
| 39 | -24.4263 | 11.9024 | -0.3156 | 12.2317 | -11.9028 | 0.3144 |
| 40 | -12.2314 | 11.9035 | -0.3036 | 0.0267 | -11.9039 | 0.3018 |

ENVOLVENTE MINIMOS CORTANTES TREN IPF-B, l=30 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0435 | -5.5249 | 9.3325 | 8.8842 | 13.8273 | 0.2901 |
| 2 | -1.8913 | -6.2941 | 8.6763 | 8.8956 | 14.8052 | 1.1377 |
| 3 | 4.1130 | -7.7824 | 7.3781 | 1.9997 | 16.4918 | 2.6048 |
| 4 | 16.0828 | -9.9789 | 5.4221 | -9.8432 | 18.8854 | 4.7453 |
| 5 | 32.0812 | -12.8748 | 2.8060 | -24.7031 | 21.9787 | 7.5502 |
| 6 | 50.1908 | -16.4674 | -0.4996 | -40.6909 | 25.7608 | 11.0650 |
| 7 | 68.5878 | -20.7336 | -4.5285 | -55.9833 | 30.2263 | 15.3009 |
| 8 | 85.4019 | -25.6744 | -9.2674 | -68.8069 | 35.3419 | 20.2080 |
| 9 | 99.0141 | -31.2583 | -14.6374 | -77.4515 | 41.1162 | 25.7878 |
| 10 | 107.6385 | -37.4885 | -20.7450 | -80.2701 | 47.5223 | 32.1174 |
| 11 | 109.7592 | -44.3254 | -27.5888 | -75.7193 | 54.5393 | 39.1657 |
| 12 | 103.8202 | -51.7775 | -35.1142 | -54.0596 | 62.7184 | 41.8612 |
| 13 | 80.2423 | -60.3534 | -38.2694 | -20.6897 | 68.6562 | 47.9241 |
| 14 | 44.3463 | -66.6845 | -44.8103 | 23.7882 | 77.9865 | 57.9431 |
| 15 | -3.0848 | -76.3772 | -55.2883 | 79.9098 | 87.6815 | 68.3990 |
| 16 | -62.4780 | -86.4251 | -66.2570 | 148.3546 | 97.7294 | 79.3375 |
| 17 | -134.6902 | -96.7928 | -77.3836 | 229.9557 | 108.1009 | 90.4741 |
| 18 | -219.9720 | -107.4687 | -89.3398 | 324.7381 | 118.7677 | 102.3981 |
| 19 | -318.8293 | -118.4043 | -101.3426 | 433.5429 | 129.7094 | 114.4030 |
| 20 | -431.5173 | -129.5952 | -114.1251 | 493.9429 | 120.5879 | 111.9014 |
| 21 | -63.2834 | -4.9463 | -6.1714 | -2.2317 | 0.1142 | 0.2978 |
| 22 | 4.6656 | 8.7479 | 9.6228 | -8.9042 | 0.4811 | 1.0736 |
| 23 | 16.2546 | 8.0902 | 8.3006 | -19.8192 | 1.1345 | 2.3908 |
| 24 | 32.0504 | 7.1201 | 6.4908 | -34.6206 | 2.1045 | 4.2005 |
| 25 | 51.5714 | 5.7981 | 4.1191 | -52.7880 | 3.4243 | 6.5696 |
| 26 | 74.1892 | 4.1045 | 1.1111 | -73.6685 | 5.1224 | 9.5828 |
| 27 | 99.1377 | 2.0058 | -2.3070 | -96.4642 | 7.2212 | 13.0009 |
| 28 | 125.4775 | -0.5241 | -6.3647 | -121.9615 | 9.8862 | 22.8299 |
| 29 | 153.9234 | -3.6417 | -16.7715 | -156.1270 | 13.8083 | 28.9084 |
| 30 | 190.3529 | -8.0417 | -23.4282 | -188.6089 | 18.3557 | 35.7514 |
| 31 | 224.3461 | -13.0777 | -30.8951 | -217.7352 | 23.5551 | 43.4001 |
| 32 | 254.1575 | -18.7940 | -38.8714 | -241.7143 | 29.4292 | 51.5684 |
| 33 | 277.7756 | -25.1696 | -48.0211 | -258.7140 | 35.9882 | 60.9295 |
| 34 | 293.5863 | -32.2795 | -57.8087 | -266.7698 | 43.2934 | 70.8611 |
| 35 | 299.3997 | -40.1160 | -67.9616 | -263.7478 | 51.3240 | 81.1949 |
| 36 | 292.9003 | -48.7455 | -79.3750 | -247.1478 | 60.1566 | 92.8072 |
| 37 | 271.9712 | -58.1207 | -91.0554 | -234.3437 | 70.2915 | 103.6666 |
| 38 | 253.3794 | -68.8411 | -102.8284 | -175.3043 | 81.0732 | 117.0668 |
| 39 | 187.7412 | -80.2025 | -116.3105 | -98.0407 | 92.4240 | 130.4846 |
| 40 | 102.3787 | -92.1314 | -130.2711 | -0.2969 | 104.3607 | 144.4585 |

ENVOLVENTE MINIMOS TORSORES TREN IPF-B, l=30 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0428 | -2.0032 | 9.1252 | 5.6359 | 10.3056 | 0.4974 |
| 2 | 1.3567 | -2.7720 | 8.4647 | 2.3961 | 11.2831 | 1.3493 |
| 3 | 12.4499 | -3.2648 | 7.1587 | -10.5064 | 11.9742 | 2.8242 |
| 4 | 28.5884 | -5.4623 | 5.1895 | -26.5159 | 14.3688 | 4.9779 |
| 5 | 48.7534 | -8.3580 | 2.5733 | -45.5431 | 17.4619 | 7.7829 |
| 6 | 75.7919 | -10.9173 | -0.7570 | -71.4119 | 20.2107 | 11.3224 |
| 7 | 110.7884 | -13.1067 | -4.8356 | -105.2236 | 22.5994 | 15.6079 |
| 8 | 153.2841 | -15.1586 | -9.6203 | -146.3844 | 24.8261 | 20.5610 |
| 9 | 187.5097 | -19.2678 | -15.0136 | -177.0135 | 29.1257 | 26.1640 |
| 10 | 220.3108 | -23.9187 | -21.2374 | -205.4631 | 33.9525 | 32.6098 |
| 11 | 234.9482 | -30.7578 | -28.2470 | -213.4384 | 40.9717 | 39.8232 |
| 12 | 241.5413 | -38.2161 | -35.8795 | -212.6377 | 48.5790 | 47.6067 |
| 13 | 238.8218 | -46.2133 | -44.0546 | -192.3201 | 54.5163 | 53.7147 |
| 14 | 215.9771 | -52.5192 | -50.7723 | -171.0124 | 63.0385 | 62.7176 |
| 15 | 191.7145 | -61.4237 | -60.2467 | -137.4579 | 72.0941 | 72.3568 |
| 16 | 154.8935 | -70.8358 | -70.2143 | -90.7062 | 81.6454 | 82.5113 |
| 17 | 104.3670 | -80.7229 | -81.0323 | -29.6618 | 91.6660 | 93.5283 |
| 18 | 39.6470 | -91.0234 | -92.3366 | 45.8709 | 102.0763 | 104.9693 |
| 19 | -39.9642 | -101.7143 | -104.2109 | 136.8645 | 112.8814 | 117.0357 |
| 20 | -134.8391 | -112.7648 | -116.7578 | 243.4181 | 106.9957 | 113.7769 |
| 21 | -246.2046 | 3.9703 | -7.9239 | 228.6998 | -11.7350 | 2.7365 |
| 22 | -226.2653 | 20.5957 | 7.1845 | 207.6677 | -11.2476 | 3.7159 |
| 23 | -200.3205 | 19.8190 | 5.9700 | 181.0591 | -10.3836 | 5.0916 |
| 24 | -168.8282 | 18.6390 | 3.7900 | 149.3423 | -9.1041 | 7.4652 |
| 25 | -132.3928 | 17.0078 | 0.9935 | 113.2061 | -7.3644 | 10.3958 |
| 26 | -91.8070 | 14.8950 | -2.4234 | 73.5004 | -5.1287 | 14.0148 |
| 27 | -48.0291 | 12.2558 | -6.7387 | 31.2874 | -2.3614 | 18.5205 |
| 28 | -2.2769 | 9.0590 | -11.7726 | -12.1643 | 0.9678 | 23.7269 |
| 29 | 44.1252 | 5.2786 | -17.5634 | -55.4702 | 4.8880 | 29.7002 |
| 30 | 89.6949 | 0.8780 | -24.1244 | -97.0883 | 9.4360 | 36.4476 |
| 31 | 132.8254 | -4.1500 | -31.4841 | -135.3680 | 14.6274 | 43.9889 |
| 32 | 171.7885 | -9.8611 | -39.4601 | -168.5046 | 20.4963 | 52.1572 |
| 33 | 204.5670 | -16.2455 | -48.4707 | -194.6518 | 27.0641 | 61.3791 |
| 34 | 229.5231 | -23.3556 | -58.1841 | -211.8572 | 34.3695 | 71.2367 |
| 35 | 244.4889 | -31.1960 | -68.3497 | -217.9763 | 42.4040 | 81.5827 |
| 36 | 254.7829 | -41.3141 | -79.6693 | -216.6485 | 52.7252 | 93.1013 |
| 37 | 241.4722 | -50.6870 | -91.3493 | -192.0958 | 62.2940 | 104.9373 |
| 38 | 216.5491 | -62.6038 | -104.0572 | -152.8888 | 74.4161 | 117.8250 |
| 39 | 165.3259 | -73.5451 | -117.0713 | -88.0959 | 85.5438 | 130.9491 |
| 40 | 93.1078 | -85.9066 | -130.7290 | -0.2834 | 98.1090 | 144.7622 |

ENVOLVENTE MAXIMOS FLECTORES TREN IPF-B, l=15 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4402 | 92.6330 | 127.8666 | -82.4192 | -84.6961 | -118.9325 |
| 2 | 84.9246 | 87.2903 | 118.6452 | -159.1724 | -75.9819 | -105.5041 |
| 3 | 159.2505 | 75.9798 | 105.3768 | -223.2604 | -64.6717 | -92.2230 |
| 4 | 223.3312 | 64.6607 | 92.0466 | -277.0992 | -53.3545 | -78.9157 |
| 5 | 277.0951 | 53.3619 | 78.9152 | -320.6674 | -42.0601 | -65.7727 |
| 6 | 320.7166 | 42.0635 | 65.5188 | -354.1983 | -31.1417 | -52.9290 |
| 7 | 354.2491 | 31.1487 | 52.5737 | -377.8084 | -19.8447 | -39.3761 |
| 8 | 377.8358 | 19.8576 | 39.1556 | -391.1795 | -8.5611 | -26.0123 |
| 9 | 391.1843 | 8.5500 | 25.9311 | -394.3250 | 2.7595 | -12.7632 |
| 10 | 394.3324 | -2.7663 | 12.4514 | -387.2688 | 14.0689 | 0.7626 |
| 11 | 387.2633 | -14.0645 | -1.1497 | -370.0964 | 24.9720 | 13.8243 |
| 12 | 370.0949 | -24.9895 | -14.0414 | -343.0022 | 36.2873 | 27.1850 |
| 13 | 342.9965 | -36.2787 | -27.2548 | -305.6665 | 44.5822 | 36.9347 |
| 14 | 305.6355 | -44.5510 | -37.1777 | -257.9293 | 55.8507 | 50.3532 |
| 15 | 257.8881 | -55.8393 | -50.5569 | -200.1200 | 66.6980 | 63.2067 |
| 16 | 200.1227 | -66.6978 | -63.2073 | -132.4459 | 78.0028 | 76.3478 |
| 17 | 132.3057 | -78.0161 | -76.5838 | -54.3712 | 89.3268 | 89.7261 |
| 18 | 64.8866 | -64.2199 | -65.1290 | -7.4274 | 51.2284 | 53.4408 |
| 19 | 20.4041 | -21.6073 | -22.9928 | 3.3684 | 29.9129 | 32.6191 |
| 20 | 4.5293 | -7.8298 | -8.6725 | 6.5289 | 16.1346 | 18.2802 |
| 21 | -0.0093 | -0.0003 | -0.0190 | 0.0089 | -0.0005 | 0.0003 |
| 22 | 4.6656 | 8.7479 | 9.6228 | -8.9042 | 0.4811 | 1.0736 |
| 23 | 20.7701 | 24.2478 | 25.5509 | -40.8959 | -15.0231 | -14.8595 |
| 24 | 51.9236 | 36.3795 | 36.8307 | -102.4867 | -48.1124 | -45.3957 |
| 25 | 121.0413 | 81.3059 | 77.7586 | -198.4487 | -70.0140 | -64.4681 |
| 26 | 205.3413 | 77.2645 | 70.9278 | -278.3241 | -65.8456 | -57.5703 |
| 27 | 278.3217 | 65.8503 | 57.5697 | -339.2160 | -53.6251 | -43.3647 |
| 28 | 339.2532 | 53.6252 | 43.1131 | -387.9737 | -42.0841 | -29.6607 |
| 29 | 387.9914 | 42.0837 | 29.3686 | -424.3510 | -29.8623 | -15.1182 |
| 30 | 424.3640 | 29.8586 | 14.8060 | -448.1557 | -18.1980 | -1.2684 |
| 31 | 448.1543 | 18.1796 | 0.8585 | -459.8725 | -5.9472 | 13.3709 |
| 32 | 459.8715 | 5.9326 | -13.3712 | -458.9476 | 6.2918 | 27.6426 |
| 33 | 458.8983 | -6.2722 | -28.3142 | -445.3971 | 18.4857 | 42.6399 |
| 34 | 445.3657 | -18.4875 | -43.0392 | -419.3062 | 30.2585 | 56.5702 |
| 35 | 419.3106 | -30.2370 | -56.4988 | -381.1051 | 42.4596 | 70.7459 |
| 36 | 380.9863 | -42.4810 | -71.3653 | -330.1292 | 54.7089 | 85.6282 |
| 37 | 330.1292 | -54.7062 | -85.6300 | -266.6562 | 66.9330 | 99.8664 |
| 38 | 266.4875 | -66.9381 | -100.2997 | -190.3684 | 79.1700 | 114.5360 |
| 39 | 190.3856 | -79.1749 | -114.5036 | -101.7383 | 91.3969 | 128.6773 |
| 40 | 101.6221 | -91.3979 | -128.7683 | -0.2947 | 103.6265 | 142.9550 |

ENVOLVENTE MAXIMOS CORTANTES TREN IPF-B, l=15 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4343 | 95.5878 | 128.3667 | -84.8080 | -87.2862 | -118.7305 |
| 2 | 81.3036 | 87.5499 | 118.9330 | -154.4852 | -76.6216 | -106.3971 |
| 3 | 144.4503 | 77.3931 | 106.9594 | -206.8786 | -66.4903 | -94.3304 |
| 4 | 191.2961 | 67.7652 | 95.3075 | -243.5484 | -56.9033 | -82.6428 |
| 5 | 223.2838 | 58.7022 | 84.2501 | -266.0237 | -47.8843 | -71.6178 |
| 6 | 242.1282 | 50.1810 | 73.5069 | -276.0018 | -39.4295 | -60.9551 |
| 7 | 249.3137 | 42.2242 | 63.2827 | -275.0212 | -31.5297 | -50.8619 |
| 8 | 246.3401 | 34.8145 | 53.8014 | -264.5046 | -24.1958 | -41.5553 |
| 9 | 234.7184 | 27.9415 | 45.0752 | -246.0962 | -17.3977 | -32.9373 |
| 10 | 215.9748 | 21.6120 | 36.8227 | -221.2597 | -11.1606 | -24.7945 |
| 11 | 191.5641 | 15.8367 | 29.1607 | -150.6911 | -6.8843 | -14.5764 |
| 12 | 122.0785 | 11.9934 | 19.5490 | -129.3117 | -3.6941 | -9.9302 |
| 13 | 102.4718 | 9.2351 | 15.4554 | -107.1617 | -0.9271 | -5.8265 |
| 14 | 82.6358 | 6.8808 | 11.7746 | -85.1543 | 1.4250 | -2.1486 |
| 15 | 63.4744 | 4.9095 | 8.6101 | -64.1734 | 3.3940 | 1.0138 |
| 16 | 45.7709 | 3.3046 | 6.0021 | -44.9892 | 4.9989 | 3.6218 |
| 17 | 30.2337 | 2.0438 | 3.7873 | -28.2859 | 6.2641 | 5.8414 |
| 18 | 17.4475 | 1.1103 | 2.1488 | -14.6450 | 7.1888 | 7.4699 |
| 19 | 7.9228 | 0.4757 | 0.9538 | -4.5293 | 7.8299 | 8.6725 |
| 20 | 2.0178 | 0.1143 | 0.2400 | 94.1985 | -1.1490 | -2.0607 |
| 21 | -526.1832 | 122.7710 | 117.7435 | 385.5980 | -135.0940 | -126.1947 |
| 22 | -387.8385 | 135.2090 | 126.4920 | 258.4268 | -123.7873 | -113.1986 |
| 23 | -265.0539 | 124.1544 | 114.4072 | 147.1678 | -112.6141 | -101.0570 |
| 24 | -158.5801 | 113.2670 | 102.3570 | 52.3358 | -101.6140 | -88.9005 |
| 25 | -68.2335 | 102.5834 | 90.7848 | -26.2716 | -90.8179 | -77.2544 |
| 26 | 6.0712 | 92.1327 | 79.6403 | -88.8231 | -80.2640 | -66.0566 |
| 27 | 64.4181 | 81.9632 | 68.9573 | -135.8920 | -70.1792 | -55.4885 |
| 28 | 107.8916 | 72.2785 | 58.8577 | -168.7062 | -60.5898 | -45.4763 |
| 29 | 137.5792 | 63.1220 | 49.3687 | -188.3921 | -51.5269 | -36.1011 |
| 30 | 154.7698 | 54.5014 | 40.5367 | -196.2909 | -43.0094 | -27.3768 |
| 31 | 160.8881 | 46.4557 | 32.3405 | -193.9088 | -35.0560 | -19.3266 |
| 32 | 157.4518 | 39.0011 | 24.9683 | -182.7270 | -27.7099 | -12.0429 |
| 33 | 146.1728 | 32.1633 | 18.0590 | -164.5376 | -20.9958 | -5.2292 |
| 34 | 128.7882 | 25.9718 | 11.9103 | -67.7934 | -16.6906 | -1.5096 |
| 35 | 33.7973 | 22.2099 | 8.8504 | -51.8305 | -12.9886 | 1.8224 |
| 36 | 20.7077 | 19.0526 | 5.9371 | -35.5114 | -9.8284 | 4.7394 |
| 37 | 8.2916 | 16.4554 | 3.6861 | -20.4312 | -7.2306 | 6.9971 |
| 38 | -1.7402 | 14.4252 | 1.9269 | -8.3218 | -5.1954 | 8.7621 |
| 39 | -7.6470 | 12.9707 | 0.7373 | -0.9185 | -3.7496 | 9.9493 |
| 40 | -7.6732 | 12.0964 | 0.0164 | 0.0020 | -2.8684 | 10.6773 |

ENVOLVENTE MAXIMOS TORSORES TREN IPF-B, l=15 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4350 | 92.0661 | 128.5740 | -81.5597 | -83.7645 | -118.9378 |
| 2 | 78.0556 | 84.0278 | 119.1446 | -147.9857 | -73.0995 | -106.6087 |
| 3 | 136.1134 | 72.8755 | 107.1788 | -194.3725 | -61.9727 | -94.5498 |
| 4 | 178.7905 | 63.2486 | 95.5401 | -226.8757 | -52.3867 | -82.8754 |
| 5 | 206.6116 | 54.1854 | 84.4828 | -245.1837 | -43.3675 | -71.8505 |
| 6 | 216.5271 | 44.6309 | 73.7643 | -245.2808 | -33.8794 | -61.2125 |
| 7 | 207.1131 | 34.5973 | 63.5898 | -225.7809 | -23.9028 | -51.1689 |
| 8 | 178.4579 | 24.2987 | 54.1543 | -186.9271 | -13.6800 | -41.9083 |
| 9 | 146.2228 | 15.9510 | 45.4514 | -146.5342 | -5.4072 | -33.3135 |
| 10 | 103.3025 | 8.0422 | 37.3151 | -96.0667 | 2.4092 | -25.2869 |
| 11 | 66.3751 | 2.2691 | 29.8189 | -53.7574 | 8.0983 | -17.9320 |
| 12 | 25.1428 | -2.9830 | 23.0124 | -7.8597 | 13.2402 | -11.2984 |
| 13 | -18.9816 | -7.6999 | 16.8633 | 29.9252 | 16.0069 | -7.2168 |
| 14 | -54.4515 | -10.0786 | 13.3363 | 90.1344 | 15.0125 | -3.1252 |
| 15 | -111.8130 | -8.6835 | 9.7706 | 123.6535 | 16.9870 | -0.1471 |
| 16 | -142.0598 | -10.2903 | 7.1625 | 155.3838 | 18.5938 | 2.4612 |
| 17 | -170.1357 | -11.5370 | 5.4228 | 184.6207 | 19.8449 | 4.2059 |
| 18 | -195.4606 | -12.4809 | 3.7269 | 210.7956 | 20.7800 | 5.8917 |
| 19 | -217.5157 | -13.1141 | 2.8291 | 233.4507 | 21.4197 | 6.7972 |
| 20 | -235.9619 | -13.4779 | 2.1153 | 344.7233 | 12.4432 | -3.9362 |
| 21 | -343.2620 | 113.8544 | 119.4960 | 211.8212 | -126.1774 | -127.9472 |
| 22 | -214.0623 | 126.2938 | 128.2441 | 93.7933 | -114.8721 | -114.9505 |
| 23 | -100.4172 | 115.2391 | 115.8474 | -8.3296 | -103.6988 | -102.4966 |
| 24 | -3.0824 | 104.3509 | 103.7966 | -94.0236 | -92.6979 | -90.3403 |
| 25 | 78.1272 | 93.6662 | 92.0855 | -163.4949 | -81.9007 | -78.5550 |
| 26 | 143.2966 | 83.2137 | 80.6492 | -216.9044 | -71.3450 | -67.0657 |
| 27 | 192.4973 | 73.0453 | 69.9661 | -254.8278 | -61.2613 | -56.4973 |
| 28 | 226.8302 | 63.3601 | 59.7548 | -278.5034 | -51.6714 | -46.3733 |
| 29 | 247.3774 | 54.2017 | 50.1606 | -289.0489 | -42.6066 | -36.8929 |
| 30 | 255.4278 | 45.5817 | 41.2329 | -287.8115 | -34.0897 | -28.0730 |
| 31 | 252.4088 | 37.5280 | 32.9295 | -276.2760 | -26.1283 | -19.9154 |
| 32 | 239.8208 | 30.0682 | 25.5570 | -255.9367 | -18.7770 | -12.6317 |
| 33 | 219.3814 | 23.2392 | 18.5086 | -166.3858 | -9.1483 | -6.0812 |
| 34 | 130.6374 | 14.1245 | 12.6881 | -140.3891 | -4.8948 | -1.9908 |
| 35 | 106.3912 | 10.4180 | 9.3441 | -112.3422 | -1.1970 | 1.3428 |
| 36 | 73.5653 | 8.7496 | 6.3232 | -75.7443 | -0.0260 | 4.3681 |
| 37 | 48.5242 | 6.6507 | 4.0572 | -49.3910 | 2.1777 | 6.6328 |
| 38 | 21.8020 | 6.7771 | 2.2493 | -23.5534 | 2.2261 | 8.4455 |
| 39 | 7.5844 | 5.5489 | 1.0565 | -8.5455 | 3.6726 | 9.6308 |
| 40 | -0.7201 | 5.3296 | 0.3283 | -0.0132 | 3.8985 | 10.3665 |

ENVOLVENTE MINIMOS FLECTORES TREN IPF-B, l=15 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0114 | -10.9776 | -0.2091 | 10.1168 | 10.9776 | 0.2091 |
| 2 | -12.5054 | -13.5696 | 0.0095 | 25.0325 | 13.5696 | -0.0095 |
| 3 | -25.0311 | -13.5685 | 0.0362 | 37.5535 | 13.5685 | -0.0364 |
| 4 | -37.5527 | -13.5655 | 0.0758 | 50.0684 | 13.5655 | -0.0757 |
| 5 | -50.0672 | -13.5665 | 0.0759 | 62.5846 | 13.5665 | -0.0762 |
| 6 | -62.5837 | -13.5701 | 0.1414 | 75.1006 | 13.5701 | -0.1414 |
| 7 | -75.0995 | -13.5734 | 0.2414 | 87.6289 | 13.5734 | -0.2415 |
| 8 | -87.6307 | -13.5753 | 0.3083 | 100.1473 | 13.5753 | -0.3084 |
| 9 | -100.1479 | -13.5710 | 0.3365 | 114.2837 | 18.1097 | -1.3763 |
| 10 | -114.2809 | -18.1096 | 1.4947 | 131.2167 | 19.1096 | -0.3405 |
| 11 | -131.2127 | -19.1074 | 0.5063 | 149.0090 | 20.1061 | 0.6451 |
| 12 | -149.0110 | -20.0999 | -0.5373 | 167.6198 | 21.1001 | 1.6891 |
| 13 | -167.6212 | -21.1008 | -1.6494 | 187.1027 | 21.1040 | 1.6344 |
| 14 | -187.1031 | -21.1294 | -1.4630 | 207.5241 | 22.1309 | 2.5925 |
| 15 | -207.5228 | -22.1364 | -2.4086 | 228.7870 | 23.1356 | 3.5501 |
| 16 | -228.7908 | -23.1375 | -3.5506 | 250.9076 | 24.1359 | 4.6496 |
| 17 | -250.9040 | -24.1218 | -4.1747 | 273.8649 | 25.1221 | 5.2822 |
| 18 | -284.3618 | -50.2309 | -29.9248 | 331.2955 | 51.2315 | 31.0443 |
| 19 | -344.3725 | -80.8506 | -61.1610 | 419.5227 | 81.8507 | 62.2723 |
| 20 | -427.4207 | -103.9350 | -86.2186 | 523.8485 | 82.9725 | 67.8717 |
| 21 | -531.0195 | 120.8523 | 115.5323 | 390.0146 | -131.1556 | -121.5787 |
| 22 | -394.6890 | 122.4085 | 111.9554 | 281.9173 | -98.3268 | -85.5176 |
| 23 | -293.6227 | 73.5979 | 59.3091 | 218.1864 | -73.5984 | -59.3600 |
| 24 | -229.2161 | 52.2425 | 37.3883 | 175.6701 | -52.2428 | -37.4103 |
| 25 | -194.1628 | 19.0472 | 5.0892 | 174.6457 | -19.0478 | -5.1585 |
| 26 | -181.4240 | 11.7915 | -1.3639 | 169.3341 | -11.7924 | 1.3169 |
| 27 | -169.3320 | 11.7913 | -1.3166 | 157.2442 | -11.7916 | 1.2988 |
| 28 | -157.2470 | 11.7921 | -1.1871 | 145.1620 | -11.7921 | 1.1521 |
| 29 | -145.1630 | 11.7940 | -1.0470 | 133.0770 | -11.7935 | 1.0146 |
| 30 | -133.0782 | 11.7929 | -0.9190 | 120.9982 | -11.7929 | 0.8862 |
| 31 | -120.9983 | 11.8009 | -0.7790 | 108.8971 | -11.8034 | 0.7614 |
| 32 | -108.8989 | 11.8086 | -0.7613 | 96.7899 | -11.8101 | 0.7390 |
| 33 | -96.7888 | 11.8013 | -0.5998 | 84.6956 | -11.7995 | 0.5657 |
| 34 | -84.6966 | 11.7993 | -0.4915 | 72.5985 | -11.7963 | 0.4814 |
| 35 | -72.5967 | 11.7924 | -0.4939 | 60.5140 | -11.7921 | 0.4798 |
| 36 | -60.5139 | 11.7957 | -0.3832 | 48.4202 | -11.7971 | 0.3674 |
| 37 | -48.4196 | 11.7999 | -0.3672 | 36.3236 | -11.8007 | 0.3580 |
| 38 | -36.3235 | 11.8007 | -0.2995 | 24.2202 | -11.8012 | 0.2907 |
| 39 | -24.2198 | 11.8017 | -0.2948 | 12.1281 | -11.8021 | 0.2937 |
| 40 | -12.1278 | 11.8028 | -0.2829 | 0.0266 | -11.7595 | 0.2634 |

ENVOLVENTE MINIMOS CORTANTES TREN IPF-B, l=15 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0435 | -5.5249 | 9.3325 | 8.8842 | 13.8273 | 0.2901 |
| 2 | -1.8913 | -6.2941 | 8.6763 | 8.8956 | 14.8052 | 1.1377 |
| 3 | 4.1130 | -7.7824 | 7.3781 | 1.9997 | 16.4918 | 2.6048 |
| 4 | 16.0828 | -9.9789 | 5.4221 | -9.8432 | 18.8854 | 4.7453 |
| 5 | 32.0812 | -12.8748 | 2.8060 | -24.7031 | 21.9787 | 7.5502 |
| 6 | 50.1908 | -16.4674 | -0.4996 | -40.6909 | 25.7608 | 11.0650 |
| 7 | 68.5878 | -20.7336 | -4.5285 | -55.9833 | 30.2263 | 15.3009 |
| 8 | 85.4019 | -25.6744 | -9.2674 | -68.8069 | 35.3419 | 20.2080 |
| 9 | 99.0141 | -31.2583 | -14.6374 | -77.4515 | 41.1162 | 25.7878 |
| 10 | 107.6385 | -37.4885 | -20.7450 | -80.2701 | 47.5223 | 32.1174 |
| 11 | 109.7592 | -44.3254 | -27.5888 | -75.7193 | 54.5393 | 39.1657 |
| 12 | 103.8202 | -51.7775 | -35.1142 | -62.4101 | 62.1404 | 46.8410 |
| 13 | 88.5928 | -59.7754 | -43.2492 | -29.5709 | 68.0784 | 52.9094 |
| 14 | 53.2275 | -66.1067 | -49.7956 | 4.2763 | 76.6260 | 61.7410 |
| 15 | 16.4271 | -75.0167 | -59.0862 | 50.3690 | 85.6871 | 71.1959 |
| 16 | -32.9372 | -84.4307 | -69.0539 | 109.6668 | 95.2403 | 81.3507 |
| 17 | -96.0024 | -94.3037 | -79.3968 | 183.2420 | 105.2463 | 91.8680 |
| 18 | -173.2583 | -104.6141 | -90.7337 | 271.0746 | 115.5312 | 103.2333 |
| 19 | -265.1658 | -115.1678 | -102.1778 | 373.7841 | 126.0677 | 114.7509 |
| 20 | -371.7585 | -125.9535 | -114.4730 | 491.1123 | 120.2551 | 111.4948 |
| 21 | -60.4528 | -4.6135 | -5.7648 | -2.2317 | 0.1142 | 0.2978 |
| 22 | 4.6656 | 8.7479 | 9.6228 | -8.9042 | 0.4811 | 1.0736 |
| 23 | 16.2546 | 8.0902 | 8.3006 | -19.8192 | 1.1345 | 2.3908 |
| 24 | 32.0504 | 7.1201 | 6.4908 | -34.6206 | 2.1045 | 4.2005 |
| 25 | 51.5714 | 5.7981 | 4.1191 | -52.7880 | 3.4243 | 6.5696 |
| 26 | 74.1892 | 4.1045 | 1.1111 | -73.6685 | 5.1224 | 9.5828 |
| 27 | 99.1377 | 2.0058 | -2.3070 | -101.9771 | 7.6308 | 17.4283 |
| 28 | 130.9904 | -0.9337 | -10.7921 | -137.2203 | 11.1254 | 22.7465 |
| 29 | 169.1822 | -4.8809 | -16.6881 | -171.9338 | 15.2085 | 28.8271 |
| 30 | 206.1597 | -9.4419 | -23.3469 | -204.5434 | 19.9094 | 35.6752 |
| 31 | 240.2806 | -14.6314 | -30.8189 | -233.3523 | 25.2476 | 43.3224 |
| 32 | 269.7746 | -20.4865 | -38.7937 | -256.5642 | 31.2400 | 51.4934 |
| 33 | 292.6255 | -26.9804 | -47.9461 | -272.2058 | 37.8698 | 60.8644 |
| 34 | 307.0781 | -34.1611 | -57.7436 | -278.4188 | 45.1883 | 70.7906 |
| 35 | 311.0487 | -42.0109 | -67.8911 | -273.2103 | 53.1722 | 81.1190 |
| 36 | 302.3628 | -50.5937 | -79.2991 | -254.2488 | 61.8825 | 92.6696 |
| 37 | 279.0722 | -59.8466 | -90.9178 | -219.7242 | 71.2677 | 104.3286 |
| 38 | 238.7599 | -69.8173 | -103.4904 | -167.1539 | 81.3656 | 116.9632 |
| 39 | 179.5908 | -80.4949 | -116.2069 | -94.8810 | 92.1476 | 129.6688 |
| 40 | 99.2190 | -91.8550 | -129.4553 | -0.2947 | 103.6265 | 142.9550 |

ENVOLVENTE MINIMOS TORSORES TREN IPF-B, l=15 m, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0428 | -2.0032 | 9.1252 | 5.6359 | 10.3056 | 0.4974 |
| 2 | 1.3567 | -2.7720 | 8.4647 | 2.3961 | 11.2831 | 1.3493 |
| 3 | 12.4499 | -3.2648 | 7.1587 | -10.5064 | 11.9742 | 2.8242 |
| 4 | 28.5884 | -5.4623 | 5.1895 | -26.5159 | 14.3688 | 4.9779 |
| 5 | 48.7534 | -8.3580 | 2.5733 | -45.5431 | 17.4619 | 7.7829 |
| 6 | 75.7919 | -10.9173 | -0.7570 | -71.4119 | 20.2107 | 11.3224 |
| 7 | 110.7884 | -13.1067 | -4.8356 | -105.2236 | 22.5994 | 15.6079 |
| 8 | 153.2841 | -15.1586 | -9.6203 | -146.3844 | 24.8261 | 20.5610 |
| 9 | 187.5097 | -19.2678 | -15.0136 | -177.0135 | 29.1257 | 26.1640 |
| 10 | 220.3108 | -23.9187 | -21.2374 | -205.4631 | 33.9525 | 32.6098 |
| 11 | 234.9482 | -30.7578 | -28.2470 | -213.4384 | 40.9717 | 39.8232 |
| 12 | 241.5413 | -38.2161 | -35.8795 | -212.6377 | 48.5790 | 47.6067 |
| 13 | 238.8218 | -46.2133 | -44.0546 | -192.3201 | 54.5163 | 53.7147 |
| 14 | 215.9771 | -52.5192 | -50.7723 | -171.0124 | 63.0385 | 62.7176 |
| 15 | 191.7145 | -61.4237 | -60.2467 | -137.4579 | 72.0941 | 72.3568 |
| 16 | 154.8935 | -70.8358 | -70.2143 | -90.7062 | 81.6454 | 82.5113 |
| 17 | 104.3670 | -80.7229 | -81.0323 | -29.6646 | 91.6655 | 93.5035 |
| 18 | 39.6498 | -91.0229 | -92.3118 | 45.6340 | 101.9400 | 104.8115 |
| 19 | -39.7273 | -101.5780 | -104.0531 | 135.8042 | 112.4779 | 116.6262 |
| 20 | -133.7788 | -112.3613 | -116.3483 | 240.5875 | 106.6629 | 113.3703 |
| 21 | -243.3740 | 4.3031 | -7.5173 | 224.2776 | -11.5074 | 2.6997 |
| 22 | -221.8431 | 20.3681 | 7.2213 | 201.4858 | -10.9126 | 3.6674 |
| 23 | -194.1386 | 19.4840 | 6.0185 | 173.0426 | -9.9235 | 5.0328 |
| 24 | -160.8117 | 18.1789 | 3.8488 | 139.5070 | -8.5050 | 7.3929 |
| 25 | -122.5575 | 16.4087 | 1.0658 | 101.6586 | -6.6149 | 10.3225 |
| 26 | -80.2595 | 14.1455 | -2.3501 | 60.4306 | -4.2183 | 13.9397 |
| 27 | -34.9593 | 11.3454 | -6.6636 | 16.9587 | -1.2871 | 18.4371 |
| 28 | 12.0518 | 7.9847 | -11.6892 | -27.4231 | 2.2070 | 23.6435 |
| 29 | 59.3840 | 4.0394 | -17.4800 | -71.2770 | 6.2882 | 29.6189 |
| 30 | 105.5017 | -0.5222 | -24.0431 | -113.0228 | 10.9897 | 36.3714 |
| 31 | 148.7599 | -5.7037 | -31.4079 | -150.9851 | 16.3199 | 43.9112 |
| 32 | 187.4056 | -11.5536 | -39.3824 | -183.3545 | 22.3071 | 52.0822 |
| 33 | 219.4169 | -18.0563 | -48.3957 | -208.1436 | 28.9457 | 61.3140 |
| 34 | 243.0149 | -25.2372 | -58.1190 | -223.5062 | 36.2644 | 71.1662 |
| 35 | 256.1379 | -33.0909 | -68.2792 | -227.4388 | 44.2522 | 81.5068 |
| 36 | 264.2454 | -43.1623 | -79.5934 | -223.7495 | 54.4511 | 92.9637 |
| 37 | 248.5732 | -52.4129 | -91.2117 | -196.8445 | 63.8340 | 104.6225 |
| 38 | 221.2978 | -64.1438 | -103.7424 | -155.5103 | 75.6921 | 117.2152 |
| 39 | 167.9474 | -74.8211 | -116.4615 | -89.0508 | 86.4738 | 129.9234 |
| 40 | 94.0627 | -86.8366 | -129.7033 | -0.2835 | 98.6081 | 143.2030 |

ENVOLVENTE MAXIMOS FLECTORES TREN UIC-71, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3804 | 104.4249 | 113.4041 | -90.3735 | -93.8420 | -103.9617 |
| 2 | 91.3124 | 94.7709 | 103.7759 | -169.5928 | -84.2230 | -94.1979 |
| 3 | 169.6494 | 84.2202 | 94.0849 | -237.0679 | -64.6341 | -75.1854 |
| 4 | 237.1205 | 64.6244 | 75.0291 | -294.0644 | -54.1342 | -65.4084 |
| 5 | 294.0618 | 54.1384 | 65.4077 | -340.6190 | -46.7589 | -58.2478 |
| 6 | 340.6579 | 46.7658 | 58.0231 | -375.7175 | -36.3360 | -48.2804 |
| 7 | 375.7549 | 36.3416 | 47.9650 | -398.8782 | -25.9870 | -38.2174 |
| 8 | 398.8999 | 25.9987 | 38.0226 | -412.3857 | -6.4210 | -19.1349 |
| 9 | 412.3887 | 6.4058 | 19.0615 | -415.2772 | 3.8715 | -9.3623 |
| 10 | 415.2840 | -3.8746 | 9.0853 | -408.3084 | 11.2610 | -1.8144 |
| 11 | 408.3063 | -11.2558 | 1.4713 | -390.5165 | 21.4367 | 8.2814 |
| 12 | 390.5125 | -21.4464 | -8.4756 | -361.9595 | 31.5127 | 18.1343 |
| 13 | 361.9532 | -31.5146 | -18.1956 | -323.0054 | 41.4580 | 27.8605 |
| 14 | 322.9864 | -41.4291 | -28.0754 | -275.0141 | 61.0059 | 47.0102 |
| 15 | 274.9840 | -60.9921 | -47.1914 | -218.0861 | 70.8115 | 56.8159 |
| 16 | 218.0899 | -70.8111 | -56.8160 | -151.9337 | 80.4981 | 66.4529 |
| 17 | 151.8312 | -80.5126 | -66.6622 | -76.9263 | 90.0521 | 76.2878 |
| 18 | 86.2597 | -67.7371 | -58.0456 | -23.9366 | 77.1028 | 67.5638 |
| 19 | 35.4717 | -50.7744 | -45.0464 | 2.9894 | 26.5877 | 24.0499 |
| 20 | 4.0297 | -6.9589 | -6.3703 | 5.7989 | 14.3417 | 13.4651 |
| 21 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 4.1586 | 7.7751 | 7.1016 | -24.1969 | -31.5381 | -27.4749 |
| 23 | 34.7489 | 53.5191 | 47.1335 | -78.7526 | -43.6040 | -37.0643 |
| 24 | 88.5642 | 62.5856 | 53.3187 | -142.4980 | -52.5191 | -43.2039 |
| 25 | 159.0037 | 82.0242 | 67.1806 | -233.0743 | -71.8231 | -56.9613 |
| 26 | 239.1895 | 78.2663 | 61.7048 | -309.2393 | -67.9332 | -51.5020 |
| 27 | 309.2352 | 67.9419 | 51.5002 | -368.1113 | -57.4906 | -41.3238 |
| 28 | 368.1363 | 57.4902 | 41.1006 | -415.3409 | -46.9331 | -30.8458 |
| 29 | 415.3541 | 46.9254 | 30.5873 | -450.4361 | -36.2621 | -20.3126 |
| 30 | 450.4438 | 36.2690 | 20.0345 | -473.0346 | -25.5102 | -9.7304 |
| 31 | 473.0321 | 25.4813 | 9.3673 | -483.6041 | -5.0724 | 10.3342 |
| 32 | 483.6073 | 5.0515 | -10.3349 | -481.8354 | 5.7984 | 20.6356 |
| 33 | 481.8034 | -5.7701 | -21.2340 | -467.0478 | 26.1624 | 41.0888 |
| 34 | 467.0238 | -26.1551 | -41.4447 | -440.5097 | 37.0777 | 51.6659 |
| 35 | 440.5092 | -37.0605 | -51.6012 | -400.4084 | 48.0338 | 61.8567 |
| 36 | 400.3173 | -48.0559 | -62.4078 | -346.8253 | 56.2659 | 70.4382 |
| 37 | 346.8276 | -56.2732 | -70.4380 | -281.4519 | 67.3144 | 80.6566 |
| 38 | 281.3302 | -67.3104 | -81.0423 | -201.7972 | 78.4001 | 91.2318 |
| 39 | 201.8082 | -78.4033 | -91.2032 | -108.0655 | 89.5334 | 101.2119 |
| 40 | 107.9797 | -89.5363 | -101.2929 | -0.2993 | 109.9389 | 120.9230 |

ENVOLVENTE MAXIMOS CORTANTES TREN UIC-71, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3800 | 105.3496 | 113.2937 | -91.2263 | -94.7667 | -103.8513 |
| 2 | 88.0981 | 95.0014 | 103.9863 | -166.5913 | -84.4535 | -94.4083 |
| 3 | 157.6640 | 85.1380 | 94.8002 | -224.2406 | -74.6422 | -85.1431 |
| 4 | 210.3852 | 75.7749 | 85.8348 | -265.6412 | -65.3451 | -76.2001 |
| 5 | 247.6361 | 66.9419 | 77.3779 | -292.2608 | -56.5892 | -67.7058 |
| 6 | 271.0203 | 58.6334 | 69.0622 | -305.7084 | -48.3604 | -59.3052 |
| 7 | 281.9824 | 50.8431 | 60.9772 | -307.4553 | -40.6672 | -51.2295 |
| 8 | 281.9620 | 43.5890 | 53.3726 | -298.8966 | -33.5236 | -43.6973 |
| 9 | 272.4232 | 36.8474 | 46.2822 | -281.6635 | -26.8920 | -36.5782 |
| 10 | 254.8918 | 30.6407 | 39.4159 | -257.1986 | -20.8166 | -29.6648 |
| 11 | 230.8051 | 24.9722 | 32.8567 | -250.4713 | -17.5816 | -25.6419 |
| 12 | 225.0392 | 22.1252 | 29.2982 | -216.5453 | -12.4534 | -19.6573 |
| 13 | 192.6912 | 17.3746 | 23.7333 | -179.4802 | -7.8389 | -14.0814 |
| 14 | 157.6836 | 13.1319 | 18.4591 | -140.6846 | -3.7632 | -8.8333 |
| 15 | 121.4159 | 9.3950 | 13.5942 | -101.4937 | -0.1963 | -4.3668 |
| 16 | 85.1389 | 6.1498 | 9.5473 | -63.1691 | 2.8738 | -0.6310 |
| 17 | 50.0548 | 3.3860 | 6.0879 | -26.9043 | 5.4569 | 2.2320 |
| 18 | 17.2719 | 1.0979 | 3.6677 | -13.0186 | 6.3891 | 5.4885 |
| 19 | 7.0452 | 0.4238 | 0.7245 | -4.0297 | 6.9590 | 6.3703 |
| 20 | 1.7988 | 0.1025 | 0.2031 | 59.8725 | -13.2201 | -13.3800 |
| 21 | -443.6844 | 121.3191 | 98.7406 | 314.6244 | -135.0659 | -108.3987 |
| 22 | -316.6172 | 135.1682 | 108.6165 | 196.6029 | -125.1022 | -98.5081 |
| 23 | -202.5196 | 125.4299 | 99.4574 | 92.0426 | -115.2263 | -89.3608 |
| 24 | -102.1879 | 115.8081 | 90.3106 | 1.5162 | -105.4789 | -80.1632 |
| 25 | -15.6583 | 106.3386 | 81.5506 | -74.9636 | -95.8917 | -71.3105 |
| 26 | 56.9905 | 97.0627 | 73.0618 | -137.4256 | -86.4964 | -62.8501 |
| 27 | 115.7319 | 88.0103 | 64.9769 | -185.8033 | -77.3461 | -54.7728 |
| 28 | 160.9046 | 79.2104 | 57.2366 | -220.5701 | -68.4449 | -46.9659 |
| 29 | 192.8990 | 70.6889 | 49.8133 | -242.1452 | -59.8516 | -39.5252 |
| 30 | 212.2556 | 62.5059 | 42.7718 | -251.1418 | -51.5827 | -32.4683 |
| 31 | 219.6720 | 54.6327 | 36.1061 | -248.3676 | -43.6436 | -25.8632 |
| 32 | 215.9717 | 47.1521 | 30.0194 | -234.5841 | -36.1093 | -19.7191 |
| 33 | 202.0923 | 40.0733 | 24.1264 | -210.9144 | -28.9903 | -13.7989 |
| 34 | 179.1374 | 33.4182 | 18.7166 | -178.3793 | -22.2880 | -8.5981 |
| 35 | 148.1635 | 27.1917 | 14.0213 | -138.5419 | -16.0669 | -3.8651 |
| 36 | 110.8796 | 21.4561 | 9.5796 | -101.1776 | -11.0259 | -0.0564 |
| 37 | 76.9866 | 16.9152 | 6.2812 | -14.1389 | -7.7282 | 5.0926 |
| 38 | -5.5647 | 14.1274 | 1.4930 | -4.7162 | -5.9231 | 6.3801 |
| 39 | -9.4766 | 12.8340 | 0.6351 | 0.5265 | -4.6377 | 7.2406 |
| 40 | -8.1619 | 12.0569 | 0.1130 | 0.0049 | -3.8544 | 7.7677 |

ENVOLVENTE MAXIMOS TORSORES TREN UIC-71, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.3804 | 103.0476 | 113.4204 | -89.1030 | -92.4647 | -103.9779 |
| 2 | 85.9751 | 92.6993 | 104.1158 | -162.3428 | -82.1514 | -94.5378 |
| 3 | 153.4161 | 82.8359 | 94.9343 | -217.8681 | -72.3401 | -85.2772 |
| 4 | 201.7208 | 72.6460 | 85.9766 | -254.0899 | -62.2162 | -76.3419 |
| 5 | 236.0855 | 63.8118 | 77.5196 | -277.8224 | -53.4591 | -67.8476 |
| 6 | 256.5819 | 55.5035 | 69.2189 | -288.3830 | -45.2305 | -59.4622 |
| 7 | 254.6815 | 45.9091 | 61.1649 | -275.6001 | -35.7332 | -51.4171 |
| 8 | 238.2025 | 36.8096 | 53.5885 | -248.8868 | -26.7442 | -43.9132 |
| 9 | 215.8669 | 29.1845 | 46.5119 | -218.0374 | -19.2291 | -36.8082 |
| 10 | 154.7657 | 18.5816 | 39.7330 | -145.9465 | -8.7575 | -29.9819 |
| 11 | 119.5560 | 12.9115 | 33.3211 | -128.0871 | -5.5209 | -26.1058 |
| 12 | 102.6539 | 10.0719 | 29.8580 | -83.0450 | -0.4001 | -20.2169 |
| 13 | 59.1906 | 5.3221 | 24.3285 | -34.8527 | 4.2136 | -14.6765 |
| 14 | 13.0560 | 1.0576 | 19.2064 | 15.0851 | 8.3111 | -9.5805 |
| 15 | -34.3516 | -2.6869 | 14.5052 | 65.4209 | 11.8856 | -5.2777 |
| 16 | -81.7765 | -5.9330 | 10.4583 | 114.8927 | 14.9566 | -1.5419 |
| 17 | -128.0036 | -8.6842 | 7.4210 | 162.2952 | 17.5271 | 0.8988 |
| 18 | -171.9284 | -10.9812 | 4.9498 | 206.5968 | 19.6314 | 3.0682 |
| 19 | -212.5672 | -12.8170 | 3.4092 | 298.0619 | 24.2105 | 4.1853 |
| 20 | -300.2921 | -17.1497 | 2.3881 | 282.5010 | -1.1418 | -14.9262 |
| 21 | -281.1764 | 113.3981 | 100.1995 | 160.2399 | -127.1449 | -109.8577 |
| 22 | -162.2330 | 127.2474 | 110.0748 | 50.3414 | -117.1814 | -99.9664 |
| 23 | -56.2554 | 117.5083 | 100.6392 | -46.1024 | -107.3047 | -90.5426 |
| 24 | 35.9577 | 107.8859 | 91.4919 | -128.5101 | -97.5567 | -81.3444 |
| 25 | 114.3696 | 98.4175 | 82.6086 | -196.8740 | -87.9706 | -72.3682 |
| 26 | 178.9030 | 89.1366 | 73.8607 | -251.2130 | -78.5703 | -63.6488 |
| 27 | 229.5186 | 80.0865 | 65.7753 | -291.4657 | -69.4223 | -55.5717 |
| 28 | 266.5706 | 71.2872 | 57.9354 | -318.1148 | -60.5217 | -47.6651 |
| 29 | 290.4439 | 62.7658 | 50.4192 | -331.5699 | -51.9285 | -40.1306 |
| 30 | 301.6809 | 54.5813 | 43.2925 | -332.4493 | -43.6581 | -32.9892 |
| 31 | 300.9788 | 46.7022 | 36.5313 | -321.5438 | -35.7131 | -26.2884 |
| 32 | 289.1480 | 39.2172 | 30.4445 | -299.6238 | -28.1744 | -20.1442 |
| 33 | 267.1322 | 32.1426 | 24.4284 | -267.8264 | -21.0596 | -14.1008 |
| 34 | 234.6479 | 25.6854 | 18.9526 | -225.9591 | -14.5552 | -8.8340 |
| 35 | 196.9466 | 19.2678 | 14.2682 | -179.2056 | -8.1430 | -4.1120 |
| 36 | 133.7368 | 16.9998 | 9.7591 | -119.4668 | -6.5696 | -0.2360 |
| 37 | 95.2751 | 12.4591 | 6.4606 | -78.5023 | -2.3476 | 2.8593 |
| 38 | 55.0675 | 9.9571 | 3.7010 | -39.7314 | -0.2544 | 5.1579 |
| 39 | 25.5386 | 7.1652 | 1.8587 | -15.4398 | 1.9019 | 6.6568 |
| 40 | 7.8047 | 5.5171 | 0.6929 | -0.0046 | 0.4554 | 7.5808 |

ENVOLVENTE MINIMOS FLECTORES TREN UIC-71, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0009 | -16.1677 | -0.3286 | 15.1862 | 16.4598 | 0.3075 |
| 2 | -16.0388 | -17.3858 | -0.1823 | 32.0895 | 17.3859 | 0.1737 |
| 3 | -32.0876 | -17.3856 | -0.1498 | 48.1326 | 17.3844 | 0.1366 |
| 4 | -48.1321 | -17.3803 | -0.1017 | 64.1673 | 17.3802 | 0.0941 |
| 5 | -64.1650 | -17.3840 | -0.0938 | 80.2043 | 17.3846 | 0.0807 |
| 6 | -80.2041 | -17.3852 | -0.0229 | 96.2400 | 17.3871 | -0.0097 |
| 7 | -96.2396 | -17.3896 | 0.0982 | 112.2940 | 17.3908 | -0.1312 |
| 8 | -112.2960 | -17.3956 | 0.1911 | 128.3347 | 17.3950 | -0.2099 |
| 9 | -128.3355 | -17.3888 | 0.2343 | 144.3810 | 17.3862 | -0.2631 |
| 10 | -144.3794 | -17.3869 | 0.3683 | 160.4196 | 17.3876 | -0.4240 |
| 11 | -160.4166 | -17.3892 | 0.5713 | 176.4735 | 17.3916 | -0.6249 |
| 12 | -176.4746 | -17.3842 | 0.7208 | 192.5022 | 17.3821 | -0.7493 |
| 13 | -192.5025 | -17.3813 | 0.7849 | 208.5469 | 17.3846 | -0.8261 |
| 14 | -208.5470 | -17.4064 | 0.9783 | 224.6137 | 17.4127 | -1.0482 |
| 15 | -224.6115 | -17.4203 | 1.2120 | 240.6850 | 17.4206 | -1.2480 |
| 16 | -240.6858 | -17.4215 | 1.2481 | 256.7562 | 17.4212 | -1.3411 |
| 17 | -256.7528 | -17.4086 | 1.7633 | 272.8189 | 17.4100 | -1.8458 |
| 18 | -282.1380 | -39.7253 | -16.4368 | 318.7676 | 39.7239 | 16.3903 |
| 19 | -330.3755 | -66.0507 | -38.6133 | 391.3277 | 66.0491 | 38.5553 |
| 20 | -398.3463 | -85.6772 | -56.2347 | 477.4465 | 67.0876 | 43.2838 |
| 21 | -483.7498 | 114.0715 | 92.0375 | 361.3722 | -96.4747 | -69.9251 |
| 22 | -365.5305 | 88.6999 | 62.8242 | 274.5743 | -88.6989 | -62.8915 |
| 23 | -285.0075 | 66.7192 | 43.6023 | 216.6240 | -66.7196 | -43.6698 |
| 24 | -226.4380 | 47.7395 | 27.4153 | 177.5065 | -47.7406 | -27.4455 |
| 25 | -193.9670 | 18.2322 | 3.5060 | 175.2835 | -18.2322 | -3.5995 |
| 26 | -181.3131 | 11.7862 | -1.2003 | 169.2307 | -11.7868 | 1.1366 |
| 27 | -169.2300 | 11.7845 | -1.1363 | 157.1469 | -11.7825 | 1.1128 |
| 28 | -157.1505 | 11.7819 | -1.0127 | 145.0732 | -11.7807 | 0.9658 |
| 29 | -145.0734 | 11.7806 | -0.8725 | 132.9987 | -11.7845 | 0.8289 |
| 30 | -132.9993 | 11.7860 | -0.7442 | 120.9237 | -11.7902 | 0.7008 |
| 31 | -120.9230 | 11.7961 | -0.6051 | 108.8306 | -11.7961 | 0.5814 |
| 32 | -108.8307 | 11.8005 | -0.5813 | 96.7310 | -11.7989 | 0.5510 |
| 33 | -96.7312 | 11.7947 | -0.4279 | 84.6442 | -11.7954 | 0.3821 |
| 34 | -84.6474 | 11.7931 | -0.3161 | 72.5533 | -11.7926 | 0.3027 |
| 35 | -72.5525 | 11.7881 | -0.3138 | 60.4760 | -11.7865 | 0.2951 |
| 36 | -60.4763 | 11.7908 | -0.2090 | 48.3906 | -11.7908 | 0.1882 |
| 37 | -48.3901 | 11.7909 | -0.1878 | 36.3016 | -11.7916 | 0.1750 |
| 38 | -36.3008 | 11.7943 | -0.1232 | 24.2054 | -11.7947 | 0.1115 |
| 39 | -24.2051 | 11.7947 | -0.1150 | 12.1206 | -11.7953 | 0.1135 |
| 40 | -12.1208 | 11.7958 | -0.1041 | 0.0262 | -11.7552 | 0.0867 |

ENVOLVENTE MINIMOS CORTANTES TREN UIC-71, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0227 | -10.2345 | 6.6859 | 12.8245 | 17.6150 | 0.4032 |
| 2 | -6.6144 | -10.9180 | 6.2126 | 20.1032 | 18.3038 | 0.8764 |
| 3 | -8.5459 | -12.0617 | 5.4087 | 23.0846 | 19.4441 | 1.6737 |
| 4 | -7.0184 | -13.6517 | 4.2501 | 23.0188 | 21.0332 | 2.8358 |
| 5 | -3.2572 | -15.6939 | 2.7390 | -64.3582 | 23.6176 | 8.6968 |
| 6 | 87.0079 | -18.7159 | -3.4939 | -91.1482 | 28.6746 | 12.6919 |
| 7 | 115.9395 | -24.2041 | -7.8736 | -118.3199 | 34.7915 | 17.4785 |
| 8 | 144.4656 | -30.7500 | -13.0314 | -138.1832 | 41.2886 | 22.6578 |
| 9 | 165.0307 | -37.6573 | -18.5520 | -149.8465 | 48.1506 | 28.2475 |
| 10 | 176.6758 | -44.9245 | -24.5376 | -152.4792 | 55.3503 | 34.3052 |
| 11 | 178.6909 | -52.5090 | -30.9785 | -145.3908 | 62.8795 | 40.7428 |
| 12 | 170.3639 | -60.4191 | -37.7674 | -128.0307 | 70.6857 | 47.4456 |
| 13 | 151.2994 | -68.5911 | -44.8047 | -84.5576 | 75.9661 | 51.9704 |
| 14 | 105.5913 | -74.2107 | -49.6811 | -46.3772 | 84.3826 | 59.3948 |
| 15 | 64.7857 | -82.9527 | -57.4407 | 3.5758 | 93.0223 | 67.0939 |
| 16 | 11.9201 | -91.9033 | -65.5213 | 65.4598 | 101.8528 | 75.1677 |
| 17 | -53.2916 | -101.0226 | -73.6897 | 139.4933 | 110.8555 | 83.3429 |
| 18 | -130.6233 | -110.2922 | -82.5207 | 225.1896 | 119.9690 | 92.0826 |
| 19 | -219.9223 | -119.6460 | -91.2574 | 322.6786 | 129.1811 | 100.8252 |
| 20 | -320.8793 | -129.0779 | -100.6219 | 431.4141 | 115.4293 | 90.5048 |
| 21 | -48.7017 | -12.6457 | -12.5208 | -1.9931 | 0.1021 | 0.2171 |
| 22 | 4.1586 | 7.7751 | 7.1016 | -7.9254 | 0.4284 | 0.7821 |
| 23 | 14.4603 | 7.1904 | 6.1331 | -25.3029 | 1.4474 | 3.8966 |
| 24 | 36.1756 | 5.8902 | 2.6621 | -58.2932 | 3.5437 | 6.4514 |
| 25 | 73.3609 | 3.4814 | -0.3103 | -94.2898 | 6.1158 | 9.8377 |
| 26 | 113.3136 | 0.5762 | -4.1835 | -132.1534 | 9.1897 | 14.1608 |
| 27 | 154.7901 | -2.8539 | -8.7856 | -170.5542 | 12.7699 | 18.9168 |
| 28 | 196.3428 | -6.8162 | -14.0281 | -208.1157 | 16.8820 | 24.2354 |
| 29 | 236.5275 | -11.3370 | -19.7784 | -243.3007 | 21.5340 | 30.0135 |
| 30 | 273.7241 | -16.4010 | -25.9890 | -274.5808 | 26.7331 | 36.2586 |
| 31 | 306.3481 | -22.0481 | -32.7070 | -300.3316 | 32.5113 | 42.9414 |
| 32 | 332.7033 | -28.2856 | -39.6005 | -318.8704 | 38.8461 | 49.8814 |
| 33 | 350.9343 | -35.0504 | -47.3321 | -328.4961 | 45.7115 | 57.7148 |
| 34 | 359.4952 | -42.4112 | -55.4634 | -327.5354 | 53.1702 | 65.7080 |
| 35 | 356.5310 | -50.3476 | -63.5697 | -314.2852 | 61.1794 | 73.8340 |
| 36 | 340.2115 | -58.8888 | -72.5754 | -286.7705 | 69.8156 | 82.8739 |
| 37 | 308.8339 | -68.0177 | -81.5922 | -243.4400 | 79.0036 | 91.8233 |
| 38 | 260.3879 | -77.7055 | -91.2745 | -182.2960 | 88.7529 | 101.4970 |
| 39 | 193.3446 | -87.9781 | -100.9432 | -101.9570 | 99.0637 | 111.0393 |
| 40 | 105.8299 | -98.8055 | -110.8986 | -0.2993 | 109.9389 | 120.9230 |

ENVOLVENTE MINIMOS TORSORES TREN UIC-71, via 1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0617 | -2.6084 | 6.5392 | 5.7497 | 9.9884 | 0.5530 |
| 2 | 0.4601 | -3.2913 | 6.0599 | -4.7126 | 11.4951 | 1.5259 |
| 3 | 16.2693 | -5.2530 | 4.7546 | -21.9690 | 13.7837 | 3.2335 |
| 4 | 40.3271 | -7.1645 | 2.6826 | -48.7231 | 16.1746 | 5.5630 |
| 5 | 68.4840 | -10.8341 | 0.0119 | -78.7966 | 20.4875 | 8.8386 |
| 6 | 101.4463 | -15.5860 | -3.6506 | -108.4736 | 25.5447 | 12.8489 |
| 7 | 143.2404 | -19.2701 | -8.0613 | -150.1751 | 29.8575 | 17.6661 |
| 8 | 188.2251 | -23.9706 | -13.2473 | -188.1930 | 34.5092 | 22.8737 |
| 9 | 221.5870 | -29.9944 | -18.7817 | -213.4726 | 40.4877 | 28.4775 |
| 10 | 276.8019 | -32.8654 | -24.8547 | -263.7313 | 43.2912 | 34.6223 |
| 11 | 289.9400 | -40.4483 | -31.4429 | -267.7750 | 50.8188 | 41.2067 |
| 12 | 292.7492 | -48.3658 | -38.3272 | -261.5310 | 58.6324 | 48.0052 |
| 13 | 284.8000 | -56.5386 | -45.3999 | -229.1851 | 63.9136 | 52.5655 |
| 14 | 250.2189 | -62.1364 | -50.4284 | -202.1469 | 72.3083 | 60.1420 |
| 15 | 220.5532 | -70.8708 | -58.3517 | -163.3388 | 80.9404 | 68.0048 |
| 16 | 178.8355 | -79.8205 | -66.4323 | -112.6020 | 89.7700 | 76.0786 |
| 17 | 124.7668 | -88.9524 | -75.0228 | -49.7062 | 98.7853 | 84.6761 |
| 18 | 58.5770 | -98.2131 | -83.8028 | 24.8509 | 107.8899 | 93.3646 |
| 19 | -19.5866 | -107.5684 | -92.8038 | 111.1967 | 117.1035 | 102.3713 |
| 20 | -109.3981 | -116.9996 | -102.1680 | 208.7856 | 103.3510 | 92.0510 |
| 21 | -211.2097 | -4.7247 | -13.9797 | 182.2609 | -9.3518 | 2.4265 |
| 22 | -180.0951 | 17.2288 | 4.8929 | 149.9563 | -8.1226 | 3.4264 |
| 23 | -143.4241 | 15.7422 | 3.7653 | 112.8421 | -6.4742 | 5.0784 |
| 24 | -101.9700 | 13.8124 | 1.4808 | 71.7331 | -4.3785 | 7.6326 |
| 25 | -56.6670 | 11.4025 | -1.3683 | 27.6206 | -1.8053 | 10.8954 |
| 26 | -8.5989 | 8.5023 | -4.9824 | -18.3660 | 1.2636 | 14.9595 |
| 27 | 41.0034 | 5.0699 | -9.5840 | -64.8918 | 4.8461 | 19.7157 |
| 28 | 90.6768 | 1.1070 | -14.7269 | -110.5710 | 8.9588 | 24.9346 |
| 29 | 138.9826 | -3.4139 | -20.3843 | -153.8760 | 13.6109 | 30.6189 |
| 30 | 184.2988 | -8.4764 | -26.5097 | -193.2733 | 18.8085 | 36.7795 |
| 31 | 225.0413 | -14.1176 | -33.1322 | -227.1554 | 24.5808 | 43.3666 |
| 32 | 259.5270 | -20.3507 | -40.0256 | -253.8307 | 30.9112 | 50.3065 |
| 33 | 285.8944 | -27.1197 | -47.6341 | -271.5841 | 37.7808 | 58.0167 |
| 34 | 304.8388 | -34.7974 | -55.6994 | -280.6877 | 45.5564 | 65.9439 |
| 35 | 307.7479 | -42.4237 | -63.8166 | -273.6215 | 53.2555 | 74.0809 |
| 36 | 317.3543 | -54.4325 | -72.7549 | -268.4813 | 65.3593 | 83.0535 |
| 37 | 290.5454 | -63.5616 | -81.7716 | -229.7196 | 74.5475 | 92.0026 |
| 38 | 250.3987 | -74.4597 | -91.4285 | -175.6352 | 85.5071 | 101.6511 |
| 39 | 186.6838 | -84.7322 | -101.0987 | -98.6219 | 95.8178 | 111.1948 |
| 40 | 102.4945 | -95.5594 | -111.0502 | -0.2921 | 106.6928 | 121.0746 |

ENVOLVENTE DE MAX. FLECTORES CON SOBRECARGA UNIFORME

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0056 | 0.9665 | 1.6715 | -0.8972 | -0.9665 | -1.6715 |
| 2 | 5.1355 | 5.2237 | 1.7430 | -9.6488 | -4.5544 | -1.7430 |
| 3 | 9.6503 | 4.5540 | 1.7327 | -13.5449 | -3.8849 | -1.7327 |
| 4 | 13.5465 | 3.8841 | 1.7184 | -16.8219 | -3.2152 | -1.7184 |
| 5 | 16.8214 | 3.2160 | 1.7184 | -19.4802 | -2.5470 | -1.7184 |
| 6 | 19.4817 | 2.5470 | 1.6980 | -21.5232 | -1.8783 | -1.6980 |
| 7 | 21.5249 | 1.8796 | 1.6698 | -22.9513 | -1.2103 | -1.6698 |
| 8 | 22.9526 | 1.2105 | 1.6522 | -23.7604 | -0.5421 | -1.6521 |
| 9 | 23.7606 | 0.5412 | 1.6453 | -23.9516 | 0.1279 | -1.6454 |
| 10 | 23.9532 | -0.1281 | 1.6203 | -23.5261 | 0.7970 | -1.6203 |
| 11 | 23.5280 | -0.7965 | 1.5892 | -22.4835 | 1.4659 | -1.5891 |
| 12 | 22.4850 | -1.4671 | 1.5715 | -20.8238 | 2.1357 | -0.7767 |
| 13 | 20.8236 | -2.1352 | 0.7711 | -18.5433 | 2.8045 | 0.0247 |
| 14 | 18.5431 | -2.8018 | -0.0440 | -15.6488 | 3.4709 | 0.8396 |
| 15 | 15.6477 | -3.4702 | -0.8559 | -12.1374 | 4.1391 | 1.6513 |
| 16 | 12.1375 | -4.1388 | -1.6513 | -8.0105 | 4.8077 | 2.4466 |
| 17 | 8.0045 | -4.8095 | -2.4657 | -3.2559 | 5.4787 | 3.2615 |
| 18 | 4.0965 | -3.4578 | -3.2010 | -0.5998 | 4.1263 | 3.9959 |
| 19 | 1.6444 | -1.7405 | -1.8964 | 0.2708 | 2.4096 | 2.6919 |
| 20 | 0.3655 | -0.6306 | -0.7134 | 0.5251 | 1.2997 | 1.5089 |
| 21 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 0.3765 | 0.7047 | 0.7951 | -0.7179 | 0.0388 | 0.0888 |
| 23 | 1.6738 | 1.9534 | 2.1109 | -3.2950 | -1.2103 | -1.2274 |
| 24 | 4.1833 | 2.9306 | 3.0422 | -6.8061 | -2.1875 | -2.1587 |
| 25 | 8.3008 | 4.8613 | 4.8313 | -12.9013 | -4.1184 | -3.9480 |
| 26 | 13.4570 | 4.7028 | 4.4822 | -17.8970 | -3.9595 | -3.5983 |
| 27 | 17.8968 | 3.9597 | 3.5983 | -21.5754 | -3.2164 | -2.7145 |
| 28 | 21.5779 | 3.2165 | 2.6943 | -24.4942 | -2.4734 | -1.8107 |
| 29 | 24.4955 | 2.4735 | 1.7872 | -26.6494 | -1.7306 | -0.9039 |
| 30 | 26.6501 | 1.7306 | 0.8787 | -28.0426 | -0.9878 | 0.0042 |
| 31 | 28.0421 | 0.9856 | -0.0373 | -28.6717 | -0.2423 | 0.9212 |
| 32 | 28.6717 | 0.2410 | -0.9212 | -28.5377 | 0.5023 | 1.8049 |
| 33 | 28.5339 | -0.5010 | -1.8591 | -27.6395 | 1.2440 | 2.7425 |
| 34 | 27.6371 | -1.2433 | -2.7747 | -25.9814 | 1.9868 | 3.6586 |
| 35 | 25.9815 | -1.9856 | -3.6527 | -23.5669 | 2.7284 | 4.5362 |
| 36 | 23.5568 | -2.7294 | -4.5858 | -20.3780 | 3.4726 | 5.4694 |
| 37 | 20.3783 | -3.4733 | -5.4695 | -16.4371 | 4.2164 | 6.3531 |
| 38 | 16.4234 | -4.2163 | -6.3881 | -11.7179 | 4.9599 | 7.2722 |
| 39 | 11.7193 | -4.9603 | -7.2695 | -6.2567 | 5.7031 | 8.1527 |
| 40 | 6.2472 | -5.7030 | -8.1602 | -0.0183 | 6.4464 | 9.0441 |
| 41 | 5.5921 | -3.4926 | 0.0000 | 0.0000 | 3.4926 | 0.0000 |
| 42 | 3.9081 | -2.4410 | 0.0000 | 0.0000 | 2.4410 | 0.0000 |
| 43 | 16.8675 | -15.3186 | 0.0000 | 0.0000 | 15.3186 | 0.0000 |
| 44 | 2.6787 | -2.4273 | 0.0000 | 0.0000 | 2.4273 | 0.0000 |
| 45 | 9.6723 | -6.0550 | 0.0000 | 0.0000 | 6.0550 | 0.0000 |
| 46 | 0.7380 | -0.4599 | 0.0000 | 0.0000 | 0.4599 | 0.0000 |

ENVOLVENTE DE MIN. FLECTORES CON SOBRECARGA UNIFORME

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0000 | 3.8328 | 0.0824 | -3.2275 | -3.1639 | -0.0824 |
| 2 | -1.0082 | -1.0931 | 0.0055 | 2.0176 | 1.0931 | -0.0054 |
| 3 | -2.0172 | -1.0930 | 0.0075 | 3.0262 | 1.0930 | -0.0075 |
| 4 | -3.0262 | -1.0926 | 0.0107 | 4.0341 | 1.0926 | -0.0107 |
| 5 | -4.0341 | -1.0929 | 0.0107 | 5.0422 | 1.0929 | -0.0107 |
| 6 | -5.0422 | -1.0930 | 0.0159 | 6.0503 | 1.0930 | -0.0159 |
| 7 | -6.0503 | -1.0934 | 0.0242 | 7.0597 | 1.0934 | -0.0242 |
| 8 | -7.0598 | -1.0937 | 0.0296 | 8.0679 | 1.0937 | -0.0296 |
| 9 | -8.0678 | -1.0934 | 0.0319 | 9.0769 | 1.0934 | -0.0320 |
| 10 | -9.0769 | -1.0932 | 0.0414 | 10.0854 | 1.0932 | -0.0413 |
| 11 | -10.0850 | -1.0933 | 0.0545 | 11.0946 | 1.0933 | -0.0544 |
| 12 | -11.0949 | -1.0928 | 0.0633 | 12.1021 | 1.0928 | -0.0634 |
| 13 | -12.1022 | -1.0929 | 0.0666 | 13.1109 | 1.0929 | -0.0666 |
| 14 | -13.1109 | -1.0946 | 0.0804 | 14.1209 | 1.0946 | -0.0804 |
| 15 | -14.1206 | -1.0954 | 0.0951 | 15.1313 | 1.0954 | -0.0951 |
| 16 | -15.1313 | -1.0953 | 0.0951 | 16.1418 | 1.0953 | -0.0951 |
| 17 | -16.1413 | -1.0943 | 0.1334 | 17.1514 | 1.0943 | -0.1334 |
| 18 | -17.9912 | -3.1146 | 0.0696 | 20.8634 | 3.1146 | -0.0696 |
| 19 | -21.9132 | -5.5007 | -2.0031 | 26.9892 | 5.5007 | 2.0032 |
| 20 | -27.6254 | -7.2795 | -3.9817 | 34.3435 | 7.2795 | 3.9817 |
| 21 | -34.9139 | 9.1363 | 8.8024 | 25.9262 | -8.3929 | -7.9185 |
| 22 | -26.3027 | 7.6882 | 7.1234 | 18.4186 | -7.6882 | -7.1234 |
| 23 | -19.3614 | 5.6962 | 4.9567 | 13.5225 | -5.6962 | -4.9567 |
| 24 | -14.4109 | 3.9761 | 3.1419 | 10.3356 | -3.9761 | -3.1418 |
| 25 | -11.8250 | 1.3016 | 0.4725 | 10.4912 | -1.3016 | -0.4725 |
| 26 | -11.0369 | 0.7176 | -0.0665 | 10.3014 | -0.7176 | 0.0665 |
| 27 | -10.3014 | 0.7171 | -0.0663 | 9.5662 | -0.7171 | 0.0663 |
| 28 | -9.5662 | 0.7172 | -0.0576 | 8.8310 | -0.7172 | 0.0576 |
| 29 | -8.8311 | 0.7174 | -0.0491 | 8.0955 | -0.7174 | 0.0491 |
| 30 | -8.0958 | 0.7175 | -0.0414 | 7.3609 | -0.7175 | 0.0412 |
| 31 | -7.3608 | 0.7179 | -0.0329 | 6.6250 | -0.7179 | 0.0329 |
| 32 | -6.6249 | 0.7183 | -0.0327 | 5.8885 | -0.7183 | 0.0328 |
| 33 | -5.8881 | 0.7179 | -0.0214 | 5.1524 | -0.7179 | 0.0214 |
| 34 | -5.1526 | 0.7177 | -0.0158 | 4.4168 | -0.7177 | 0.0158 |
| 35 | -4.4166 | 0.7173 | -0.0167 | 3.6814 | -0.7173 | 0.0167 |
| 36 | -3.6815 | 0.7176 | -0.0089 | 2.9455 | -0.7176 | 0.0089 |
| 37 | -2.9456 | 0.7178 | -0.0089 | 2.2098 | -0.7178 | 0.0089 |
| 38 | -2.2098 | 0.7179 | -0.0042 | 1.4736 | -0.7179 | 0.0042 |
| 39 | -1.4736 | 0.7178 | -0.0043 | 0.7375 | -0.7178 | 0.0043 |
| 40 | -0.7375 | 0.7178 | -0.0034 | 0.0015 | -0.7178 | 0.0034 |
| 41 | -0.8728 | 0.5451 | 0.0000 | 0.0000 | -0.5451 | 0.0000 |
| 42 | -0.9430 | 0.5889 | 0.0000 | 0.0000 | -0.5889 | 0.0000 |
| 43 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 44 | -0.0335 | 0.0303 | 0.0000 | 0.0000 | -0.0303 | 0.0000 |
| 45 | -0.5729 | 0.3587 | 0.0000 | 0.0000 | -0.3587 | 0.0000 |
| 46 | -0.6861 | 0.4277 | 0.0000 | 0.0000 | -0.4277 | 0.0000 |

ENVOLVENTE DE MAX. CORTANTES CON SOBRECARGA UNIFORME

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0056 | 5.8922 | 1.7499 | -5.1330 | -5.2233 | -1.7499 |
| 2 | 4.8462 | 5.2445 | 1.7421 | -9.3786 | -4.5752 | -1.7421 |
| 3 | 8.5684 | 4.6370 | 1.7300 | -12.5395 | -3.9679 | -1.7300 |
| 4 | 11.2833 | 4.0704 | 1.7146 | -14.7306 | -3.4015 | -1.7146 |
| 5 | 13.1016 | 3.5465 | 1.7112 | -16.0651 | -2.8775 | -1.7112 |
| 6 | 14.1405 | 3.0619 | 1.6916 | -16.6570 | -2.3932 | -1.6916 |
| 7 | 14.5073 | 2.6187 | 1.6690 | -16.6158 | -1.9494 | -1.6690 |
| 8 | 14.3072 | 2.2135 | 1.6562 | -16.0398 | -1.5451 | -1.6561 |
| 9 | 13.6431 | 1.8462 | 1.6516 | -15.0383 | -1.1771 | -1.6517 |
| 10 | 12.6142 | 1.5169 | 1.6375 | -13.7049 | -0.8480 | -1.6375 |
| 11 | 11.3153 | 1.2244 | 1.6235 | -12.1368 | -0.5550 | -1.6234 |
| 12 | 9.8343 | 0.9666 | 1.6188 | -10.4173 | -0.2980 | -0.8240 |
| 13 | 8.2550 | 0.7441 | 1.2807 | -8.6329 | -0.0748 | -0.4849 |
| 14 | 6.6571 | 0.5544 | 0.9766 | -6.8601 | 0.1147 | -0.1811 |
| 15 | 5.1137 | 0.3955 | 0.7152 | -5.1700 | 0.2734 | 0.0803 |
| 16 | 3.6876 | 0.2663 | 0.4994 | -3.6247 | 0.4026 | 0.2960 |
| 17 | 2.4360 | 0.1647 | 0.3164 | -2.2791 | 0.5045 | 0.4793 |
| 18 | 1.4061 | 0.0895 | 0.1809 | -1.1803 | 0.5790 | 0.6140 |
| 19 | 0.6389 | 0.0384 | 0.0821 | -0.3655 | 0.6307 | 0.7134 |
| 20 | 0.1632 | 0.0093 | 0.0230 | 0.1369 | 0.6598 | 0.7725 |
| 21 | -34.9139 | 9.1363 | 8.8024 | 25.9262 | -8.3929 | -7.9185 |
| 22 | -26.1067 | 8.4021 | 7.9431 | 17.8717 | -7.6586 | -7.0592 |
| 23 | -18.4054 | 7.6883 | 7.1577 | 10.9055 | -6.9452 | -6.2742 |
| 24 | -11.8248 | 6.9980 | 6.3818 | 5.0330 | -6.2549 | -5.4982 |
| 25 | -6.3135 | 6.3326 | 5.6539 | 0.2052 | -5.5897 | -4.7706 |
| 26 | -1.8317 | 5.6964 | 4.9681 | -3.6268 | -4.9531 | -4.0842 |
| 27 | 1.6607 | 5.0893 | 4.3243 | -6.4973 | -4.3460 | -3.4405 |
| 28 | 4.2415 | 4.5153 | 3.7190 | -8.4892 | -3.7722 | -2.8354 |
| 29 | 5.9816 | 3.9762 | 3.1574 | -9.6758 | -3.2333 | -2.2741 |
| 30 | 6.9669 | 3.4731 | 2.6410 | -10.1444 | -2.7303 | -1.7582 |
| 31 | 7.2926 | 3.0074 | 2.1682 | -9.9949 | -2.2641 | -1.2843 |
| 32 | 7.0584 | 2.5820 | 1.7508 | -9.3243 | -1.8387 | -0.8670 |
| 33 | 6.3799 | 2.1975 | 1.3646 | -8.2512 | -1.4545 | -0.4812 |
| 34 | 5.3715 | 1.8555 | 1.0332 | -6.8930 | -1.1120 | -0.1492 |
| 35 | 4.1543 | 1.5567 | 0.7558 | -5.3688 | -0.8139 | 0.1276 |
| 36 | 2.8615 | 1.3022 | 0.5140 | -3.8158 | -0.5590 | 0.3696 |
| 37 | 1.6230 | 1.0928 | 0.3264 | -2.3622 | -0.3497 | 0.5572 |
| 38 | 0.5761 | 0.9294 | 0.1801 | -1.1479 | -0.1858 | 0.7040 |
| 39 | -0.1385 | 0.8120 | 0.0811 | -0.3135 | -0.0692 | 0.8021 |
| 40 | -0.3786 | 0.7415 | 0.0214 | -0.0005 | 0.0019 | 0.8625 |
| 41 | -0.8728 | 0.5451 | 0.0000 | 0.0000 | -0.5451 | 0.0000 |
| 42 | -0.9430 | 0.5889 | 0.0000 | 0.0000 | -0.5889 | 0.0000 |
| 43 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 44 | -0.0335 | 0.0303 | 0.0000 | 0.0000 | -0.0303 | 0.0000 |
| 45 | -0.5729 | 0.3587 | 0.0000 | 0.0000 | -0.3587 | 0.0000 |
| 46 | -0.6861 | 0.4277 | 0.0000 | 0.0000 | -0.4277 | 0.0000 |

ENVOLVENTE DE MIN. CORTANTES CON SOBRECARGA UNIFORME

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0000 | -0.4448 | 0.0053 | 0.7190 | 1.1137 | -0.0053 |
| 2 | -0.1588 | -0.5067 | 0.0093 | 0.9357 | 1.1760 | -0.0092 |
| 3 | 0.1091 | -0.6102 | 0.0137 | 0.7630 | 1.2793 | -0.0137 |
| 4 | 0.6901 | -0.7542 | 0.0179 | 0.3142 | 1.4231 | -0.0179 |
| 5 | 1.4736 | -0.9390 | 0.0226 | -0.2991 | 1.6080 | -0.0226 |
| 6 | 2.3491 | -1.1637 | 0.0260 | -0.9674 | 1.8324 | -0.0260 |
| 7 | 3.2118 | -1.4270 | 0.0267 | -1.5857 | 2.0963 | -0.0267 |
| 8 | 3.9527 | -1.7301 | 0.0263 | -2.0497 | 2.3985 | -0.0263 |
| 9 | 4.4803 | -2.0692 | 0.0265 | -2.2621 | 2.7383 | -0.0266 |
| 10 | 4.6923 | -2.4456 | 0.0234 | -2.1274 | 3.1145 | -0.0233 |
| 11 | 4.5028 | -2.8567 | 0.0170 | -1.5559 | 3.5261 | -0.0169 |
| 12 | 3.8212 | -3.3039 | 0.3521 | -0.4668 | 3.9725 | 0.4427 |
| 13 | 2.5764 | -3.7820 | -0.1459 | 1.2238 | 4.4513 | 0.9416 |
| 14 | 0.6843 | -4.2918 | -0.6840 | 3.5850 | 4.9609 | 1.4796 |
| 15 | -1.9148 | -4.8318 | -1.2603 | 6.6814 | 5.5007 | 2.0555 |
| 16 | -5.2770 | -5.3990 | -1.8784 | 10.5666 | 6.0679 | 2.6736 |
| 17 | -9.4603 | -5.9933 | -2.5128 | 15.3016 | 6.6625 | 3.3086 |
| 18 | -14.4981 | -6.6108 | -3.2143 | 20.9023 | 7.2793 | 4.0092 |
| 19 | -20.4235 | -7.2505 | -3.9225 | 27.4232 | 7.9196 | 4.7181 |
| 20 | -27.2599 | -7.9101 | -4.6951 | 34.8686 | 8.5792 | 5.4906 |
| 21 | -0.1912 | 0.7342 | 0.8593 | -0.1805 | 0.0092 | 0.0246 |
| 22 | 0.3765 | 0.7047 | 0.7951 | -0.7179 | 0.0388 | 0.0888 |
| 23 | 1.3101 | 0.6518 | 0.6858 | -1.5972 | 0.0913 | 0.1977 |
| 24 | 2.5825 | 0.5736 | 0.5361 | -2.7895 | 0.1695 | 0.3474 |
| 25 | 4.1551 | 0.4670 | 0.3399 | -4.2529 | 0.2759 | 0.5434 |
| 26 | 5.9770 | 0.3305 | 0.0915 | -5.9348 | 0.4128 | 0.7923 |
| 27 | 7.9865 | 0.1616 | -0.1912 | -7.7713 | 0.5817 | 1.0750 |
| 28 | 10.1084 | -0.0422 | -0.5265 | -9.6842 | 0.7853 | 1.4101 |
| 29 | 12.2590 | -0.2823 | -0.9093 | -11.5891 | 1.0252 | 1.7926 |
| 30 | 14.3460 | -0.5600 | -1.3397 | -13.3918 | 1.3028 | 2.2227 |
| 31 | 16.2702 | -0.8784 | -1.8209 | -14.9885 | 1.6217 | 2.7047 |
| 32 | 17.9226 | -1.2383 | -2.3305 | -16.2721 | 1.9816 | 3.2143 |
| 33 | 19.1772 | -1.6386 | -2.9202 | -17.1170 | 2.3816 | 3.8036 |
| 34 | 19.9261 | -2.0821 | -3.5453 | -17.4102 | 2.8256 | 4.4292 |
| 35 | 20.0386 | -2.5705 | -4.1894 | -17.0249 | 3.3133 | 5.0727 |
| 36 | 19.3729 | -3.1046 | -4.9212 | -15.8095 | 3.8478 | 5.8048 |
| 37 | 17.8094 | -3.6847 | -5.6598 | -13.6516 | 4.4278 | 6.5434 |
| 38 | 15.1849 | -4.3105 | -6.4732 | -10.3828 | 5.0541 | 7.3573 |
| 39 | 11.3847 | -4.9840 | -7.2947 | -5.8979 | 5.7268 | 8.1779 |
| 40 | 6.2472 | -5.7030 | -8.1602 | -0.0183 | 6.4464 | 9.0441 |
| 41 | 5.5921 | -3.4926 | 0.0000 | 0.0000 | 3.4926 | 0.0000 |
| 42 | 3.9081 | -2.4410 | 0.0000 | 0.0000 | 2.4410 | 0.0000 |
| 43 | 16.8675 | -15.3186 | 0.0000 | 0.0000 | 15.3186 | 0.0000 |
| 44 | 2.6787 | -2.4273 | 0.0000 | 0.0000 | 2.4273 | 0.0000 |
| 45 | 9.6723 | -6.0550 | 0.0000 | 0.0000 | 6.0550 | 0.0000 |
| 46 | 0.7380 | -0.4599 | 0.0000 | 0.0000 | 0.4599 | 0.0000 |

ENVOLVENTE DE MAX. TORSORES CON SOBRECARGA UNIFORME

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2 | 0.1388 | -0.0100 | 0.0630 | -0.1295 | 0.0100 | -0.0630 |
| 3 | 0.5283 | -0.0406 | 0.2124 | -0.4909 | 0.0406 | -0.2124 |
| 4 | 1.1124 | -0.0918 | 0.4569 | -1.0277 | 0.0918 | -0.4569 |
| 5 | 1.8339 | -0.1634 | 0.8031 | -1.6831 | 0.1634 | -0.8031 |
| 6 | 2.6402 | -0.2554 | 1.2479 | -2.4047 | 0.2554 | -1.2479 |
| 7 | 3.4757 | -0.3671 | 1.7906 | -3.1366 | 0.3671 | -1.7907 |
| 8 | 4.2864 | -0.4987 | 2.4350 | -3.8266 | 0.4987 | -2.4350 |
| 9 | 5.0192 | -0.6492 | 3.1803 | -4.4199 | 0.6492 | -3.1804 |
| 10 | 5.6306 | -0.8189 | 4.0229 | -4.8749 | 0.8189 | -4.0229 |
| 11 | 6.0716 | -1.0068 | 4.9627 | -5.1419 | 1.0068 | -4.9627 |
| 12 | 6.2933 | -1.2127 | 6.0061 | -5.1748 | 1.2127 | -6.0061 |
| 13 | 6.2522 | -1.4356 | 7.1515 | -4.9270 | 1.4356 | -7.1515 |
| 14 | 5.9191 | -1.6740 | 8.3944 | -4.3740 | 1.6740 | -8.3944 |
| 15 | 5.2534 | -1.9285 | 9.7377 | -3.4742 | 1.9285 | -9.7377 |
| 16 | 4.2118 | -2.1984 | 11.1867 | -2.1836 | 2.1984 | -11.1866 |
| 17 | 2.8045 | -2.4828 | 12.7306 | -0.5126 | 2.4828 | -12.7306 |
| 18 | 0.9433 | -2.7796 | 14.3820 | 1.6194 | 2.7796 | -14.3820 |
| 19 | -1.3303 | -3.0886 | 16.1345 | 4.1805 | 3.0886 | -16.1345 |
| 20 | -4.0818 | -3.4089 | 17.9879 | 7.2274 | 3.4089 | -17.9879 |
| 21 | -7.2326 | 0.3524 | 0.0910 | 6.8712 | -0.3524 | -0.0910 |
| 22 | -6.7782 | 0.3475 | 0.1567 | 6.4220 | -0.3475 | -0.1567 |
| 23 | -6.1448 | 0.3323 | 0.3416 | 5.8035 | -0.3323 | -0.3416 |
| 24 | -5.3423 | 0.3056 | 0.6272 | 5.0292 | -0.3056 | -0.6272 |
| 25 | -4.3835 | 0.2661 | 1.0301 | 4.1107 | -0.2661 | -1.0301 |
| 26 | -3.2877 | 0.2124 | 1.5477 | 3.0700 | -0.2124 | -1.5477 |
| 27 | -2.0884 | 0.1433 | 2.1699 | 1.9411 | -0.1433 | -2.1698 |
| 28 | -0.8106 | 0.0581 | 2.9061 | 0.7505 | -0.0581 | -2.9059 |
| 29 | 0.5056 | -0.0446 | 3.7517 | -0.4602 | 0.0446 | -3.7517 |
| 30 | 1.8168 | -0.1652 | 4.7074 | -1.6473 | 0.1652 | -4.7073 |
| 31 | 3.0769 | -0.3044 | 5.7724 | -2.7640 | 0.3044 | -5.7724 |
| 32 | 4.2271 | -0.4646 | 6.9524 | -3.7509 | 0.4646 | -6.9524 |
| 33 | 5.2341 | -0.6447 | 8.2346 | -4.5733 | 0.6447 | -8.2346 |
| 34 | 6.0195 | -0.8458 | 9.6295 | -5.1521 | 0.8458 | -9.6294 |
| 35 | 6.5128 | -1.0686 | 11.1442 | -5.4180 | 1.0686 | -11.1443 |
| 36 | 6.6926 | -1.3136 | 12.7550 | -5.3456 | 1.3136 | -12.7549 |
| 37 | 6.4372 | -1.5811 | 14.4907 | -4.8166 | 1.5811 | -14.4906 |
| 38 | 5.7388 | -1.8717 | 16.3273 | -3.8190 | 1.8717 | -16.3273 |
| 39 | 4.4555 | -2.1854 | 18.2893 | -2.2165 | 2.1854 | -18.2893 |
| 40 | 2.5828 | -2.5223 | 20.3528 | 0.0035 | 2.5223 | -20.3528 |
| 41 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 42 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 43 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 44 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 45 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 46 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

ENVOLVENTE DE MIN. TORSORES CON SOBRECARGA UNIFORME

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0617 | 2.0916 | -18.3909 | -1.8677 | -2.0916 | 18.3909 |
| 2 | 1.5712 | 1.7869 | -16.5324 | -3.2215 | -1.7869 | 16.5324 |
| 3 | 2.6899 | 1.5033 | -14.7709 | -4.0780 | -1.5033 | 14.7709 |
| 4 | 3.3445 | 1.2400 | -13.1117 | -4.4887 | -1.2400 | 13.1117 |
| 5 | 3.6023 | 0.9967 | -11.5496 | -4.5223 | -0.9967 | 11.5497 |
| 6 | 3.4929 | 0.7740 | -10.0929 | -4.2071 | -0.7740 | 10.0928 |
| 7 | 3.0795 | 0.5705 | -8.7356 | -3.6062 | -0.5705 | 8.7356 |
| 8 | 2.4235 | 0.3867 | -7.4774 | -2.7795 | -0.3867 | 7.4774 |
| 9 | 1.5690 | 0.2213 | -6.3164 | -1.7730 | -0.2213 | 6.3164 |
| 10 | 0.5574 | 0.0741 | -5.2565 | -0.6257 | -0.0741 | 5.2566 |
| 11 | -0.5630 | -0.0547 | -4.2944 | 0.6137 | 0.0547 | 4.2944 |
| 12 | -1.7435 | -0.1673 | -3.4325 | 1.8977 | 0.1673 | 3.4325 |
| 13 | -2.9480 | -0.2629 | -2.6707 | 3.1907 | 0.2629 | 2.6707 |
| 14 | -4.1434 | -0.3432 | -2.0062 | 4.4601 | 0.3432 | 2.0062 |
| 15 | -5.2940 | -0.4090 | -1.4411 | 5.6714 | 0.4090 | 1.4412 |
| 16 | -6.3695 | -0.4601 | -0.9820 | 6.7938 | 0.4601 | 0.9821 |
| 17 | -7.3501 | -0.4975 | -0.6066 | 7.8094 | 0.4975 | 0.6066 |
| 18 | -8.2076 | -0.5234 | -0.3511 | 8.6906 | 0.5234 | 0.3511 |
| 19 | -8.9308 | -0.5382 | -0.1831 | 9.4273 | 0.5382 | 0.1830 |
| 20 | -9.5056 | -0.5426 | -0.1227 | 10.0065 | 0.5426 | 0.1227 |
| 21 | -9.8844 | 3.8403 | -19.9671 | 5.9463 | -3.8403 | 19.9671 |
| 22 | -6.0478 | 3.4832 | -17.9069 | 2.4760 | -3.4832 | 17.9069 |
| 23 | -2.8079 | 3.1378 | -15.9552 | -0.4081 | -3.1378 | 15.9552 |
| 24 | -0.0867 | 2.8053 | -14.1216 | -2.7890 | -2.8053 | 14.1216 |
| 25 | 2.0915 | 2.4871 | -12.4032 | -4.6401 | -2.4871 | 12.4032 |
| 26 | 3.7519 | 2.1837 | -10.8023 | -5.9907 | -2.1837 | 10.8023 |
| 27 | 4.9658 | 1.8967 | -9.3044 | -6.9102 | -1.8967 | 9.3044 |
| 28 | 5.7347 | 1.6274 | -7.9248 | -7.4029 | -1.6274 | 7.9248 |
| 29 | 6.1102 | 1.3763 | -6.6575 | -7.5204 | -1.3763 | 6.6575 |
| 30 | 6.1387 | 1.1438 | -5.5017 | -7.3105 | -1.1438 | 5.5017 |
| 31 | 5.8678 | 0.9306 | -4.4571 | -6.8222 | -0.9306 | 4.4572 |
| 32 | 5.3606 | 0.7386 | -3.5167 | -6.1179 | -0.7386 | 3.5167 |
| 33 | 4.6610 | 0.5681 | -2.6978 | -5.2433 | -0.5681 | 2.6978 |
| 34 | 3.8392 | 0.4187 | -1.9839 | -4.2685 | -0.4187 | 1.9839 |
| 35 | 2.9613 | 0.2920 | -1.3764 | -3.2604 | -0.2920 | 1.3764 |
| 36 | 2.0826 | 0.1873 | -0.8866 | -2.2747 | -0.1873 | 0.8866 |
| 37 | 1.2800 | 0.1057 | -0.5027 | -1.3882 | -0.1057 | 0.5027 |
| 38 | 0.6155 | 0.0470 | -0.2329 | -0.6637 | -0.0470 | 0.2329 |
| 39 | 0.1665 | 0.0118 | -0.0680 | -0.1786 | -0.0118 | 0.0680 |
| 40 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 41 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 42 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 43 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 44 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 45 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 46 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

ENVOLVENTES DE ESFUERZOS CON IMPACTO

ENVOL. MAX. FLECTORES -IPF

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.5579 | 113.6785 | 161.8457 | -103.5250 | -106.3986 | -149.7313 |
| 2 | 106.6568 | 109.6414 | 149.3721 | -199.9555 | -95.5065 | -132.9444 |
| 3 | 200.0531 | 95.5039 | 132.7852 | -280.5524 | -81.3671 | -116.3410 |
| 4 | 280.6409 | 81.3534 | 116.1205 | -348.3391 | -67.2249 | -99.7068 |
| 5 | 348.3340 | 67.2341 | 99.7061 | -403.2877 | -53.1076 | -83.2766 |
| 6 | 403.3493 | 53.1119 | 82.9593 | -445.5626 | -38.9876 | -66.4594 |
| 7 | 445.6261 | 38.9964 | 66.0153 | -475.1273 | -24.8616 | -49.5149 |
| 8 | 475.1615 | 24.8778 | 49.2393 | -491.8918 | -10.7469 | -32.8101 |
| 9 | 491.8979 | 10.7330 | 32.7086 | -495.8658 | 3.3986 | -16.2454 |
| 10 | 495.8751 | -3.4071 | 15.8556 | -487.0984 | 17.5314 | 0.6647 |
| 11 | 487.0915 | -17.5259 | -1.1486 | -465.5449 | 31.6699 | 17.6605 |
| 12 | 465.5430 | -31.6917 | -17.9319 | -431.2536 | 45.8174 | 34.3625 |
| 13 | 431.2465 | -45.8066 | -34.4497 | -384.1665 | 56.1813 | 46.5511 |
| 14 | 384.1277 | -56.1423 | -46.8549 | -324.0745 | 70.2650 | 63.3265 |
| 15 | 324.0230 | -70.2507 | -63.5811 | -251.2579 | 84.3790 | 79.9989 |
| 16 | 251.2613 | -84.3787 | -79.9996 | -165.7369 | 98.5121 | 96.4254 |
| 17 | 165.5616 | -98.5287 | -96.7204 | -113.3232 | 63.3011 | 66.4204 |
| 18 | 113.3232 | -63.3011 | -66.4204 | -59.3208 | 67.5525 | 73.1553 |
| 19 | 59.3208 | -67.5525 | -73.1553 | -4.6496 | 71.3905 | 78.5928 |
| 20 | 5.6616 | -9.7873 | -10.8406 | 0.0000 | 0.0000 | 0.0000 |
| 21 | 0.0000 | 0.0000 | 0.0000 | -5.0782 | -71.7791 | -79.1663 |
| 22 | 5.8320 | 10.9349 | 12.0285 | -62.6494 | -31.0810 | -30.7016 |
| 23 | 62.6494 | 31.0810 | 30.7016 | -119.4556 | -27.5049 | -24.6632 |
| 24 | 119.4556 | 27.5049 | 24.6632 | -174.8174 | -23.5614 | -18.4760 |
| 25 | 174.8174 | 23.5614 | 18.4760 | -250.6204 | -89.7504 | -82.6014 |
| 26 | 259.2361 | 98.8135 | 90.6760 | -352.3865 | -83.5284 | -72.9086 |
| 27 | 352.3835 | 83.5342 | 72.9079 | -429.7524 | -68.2509 | -55.1496 |
| 28 | 429.7989 | 68.2510 | 54.8351 | -491.4041 | -52.9678 | -37.0260 |
| 29 | 491.4262 | 52.9672 | 36.6609 | -537.2539 | -37.6862 | -18.8424 |
| 30 | 537.2701 | 37.6816 | 18.4521 | -567.3362 | -22.4030 | -0.6106 |
| 31 | 567.3345 | 22.3800 | 0.0982 | -581.6325 | -7.0884 | 17.6934 |
| 32 | 581.6312 | 7.0701 | -17.6938 | -580.1205 | 8.2110 | 35.5386 |
| 33 | 580.0588 | -8.1865 | -36.3781 | -562.8245 | 23.4539 | 54.2954 |
| 34 | 562.7853 | -23.4561 | -54.7945 | -529.7943 | 38.7389 | 72.5755 |
| 35 | 529.7997 | -38.7120 | -72.4863 | -481.0957 | 53.9906 | 90.2993 |
| 36 | 480.9473 | -54.0174 | -91.0735 | -416.4354 | 69.3010 | 108.9082 |
| 37 | 416.4354 | -69.2976 | -108.9105 | -336.1525 | 84.5835 | 126.7084 |
| 38 | 335.9416 | -84.5899 | -127.2500 | -239.8466 | 99.8800 | 145.0480 |
| 39 | 239.8681 | -99.8861 | -145.0075 | -128.1186 | 115.1630 | 162.7251 |
| 40 | 127.9734 | -115.1643 | -162.8389 | -0.3714 | 130.3497 | 180.6051 |

ENVOLVENTES DE ESFUERZOS CON IMPACTO

ENVOL. MAX CORTANTES -IPF

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.5558 | 120.0125 | 161.5240 | -106.5110 | -109.6362 | -149.4787 |
| 2 | 102.1305 | 109.9659 | 149.7319 | -195.7287 | -95.8310 | -133.3041 |
| 3 | 183.1851 | 96.7954 | 134.0070 | -258.5983 | -83.1129 | -117.9130 |
| 4 | 239.1201 | 84.7065 | 119.1344 | -265.5160 | -71.7588 | -92.8904 |
| 5 | 279.1047 | 73.3778 | 105.3126 | -299.1076 | -64.6956 | -85.7806 |
| 6 | 299.1076 | 64.6956 | 85.7806 | -320.6418 | -57.8061 | -78.4394 |
| 7 | 320.6418 | 57.8061 | 78.4394 | -330.6814 | -51.0984 | -71.1226 |
| 8 | 330.6814 | 51.0984 | 71.1226 | -329.8838 | -44.6169 | -63.9681 |
| 9 | 329.8838 | 44.6169 | 63.9681 | -319.1405 | -38.3442 | -56.7500 |
| 10 | 319.1405 | 38.3442 | 56.7500 | -299.3689 | -32.3849 | -49.3855 |
| 11 | 299.3689 | 32.3849 | 49.3855 | -271.5839 | -26.6893 | -42.1266 |
| 12 | 271.5839 | 26.6893 | 42.1266 | -236.7246 | -21.3286 | -35.0495 |
| 13 | 236.7246 | 21.3286 | 35.0495 | -256.4408 | -21.3372 | -34.8834 |
| 14 | 256.4408 | 21.3372 | 34.8834 | -211.3437 | -16.3493 | -27.7389 |
| 15 | 211.3437 | 16.3493 | 27.7389 | -162.0437 | -11.7010 | -20.7559 |
| 16 | 162.0437 | 11.7010 | 20.7559 | -110.0521 | -7.4467 | -13.8394 |
| 17 | 110.0521 | 7.4467 | 13.8394 | -56.6955 | -3.6084 | -8.2985 |
| 18 | 56.6955 | 3.6084 | 8.2985 | -3.3764 | -0.1990 | -4.1219 |
| 19 | 9.9035 | 0.5946 | 1.1923 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 2.5223 | 0.1429 | 0.3000 | 98.1630 | -50.3806 | -59.4530 |
| 21 | -671.9304 | 154.7777 | 148.8017 | 518.5947 | -172.6391 | -159.4215 |
| 22 | -521.3954 | 172.7829 | 159.7931 | 351.9926 | -157.4969 | -142.1469 |
| 23 | -360.2765 | 157.9557 | 143.6576 | 206.2415 | -142.6744 | -126.0180 |
| 24 | -220.5069 | 143.4905 | 127.6430 | 81.4116 | -128.2094 | -109.9336 |
| 25 | -101.2838 | 129.4211 | 112.2890 | -23.2915 | -114.1422 | -94.5551 |
| 26 | -1.9590 | 115.7858 | 97.5375 | -108.5869 | -100.5023 | -79.7946 |
| 27 | 78.0806 | 102.6263 | 83.4205 | -169.8650 | -87.7240 | -69.3606 |
| 28 | 134.8645 | 90.3481 | 73.5721 | -210.8828 | -75.7373 | -56.8454 |
| 29 | 171.9740 | 78.9025 | 61.7109 | -235.4901 | -64.4086 | -45.1264 |
| 30 | 193.4622 | 68.1267 | 50.6709 | -372.9329 | -56.4841 | -53.7385 |
| 31 | 201.1101 | 58.0696 | 40.4256 | -376.1315 | -50.1987 | -47.2206 |
| 32 | 376.1315 | 50.1987 | 47.2206 | -367.6868 | -43.7899 | -40.5392 |
| 33 | 367.6868 | 43.7899 | 40.5392 | -347.1369 | -37.2448 | -33.7220 |
| 34 | 347.1369 | 37.2448 | 33.7220 | -313.7489 | -30.5684 | -27.3329 |
| 35 | 313.7489 | 30.5684 | 27.3329 | -267.2043 | -23.8135 | -20.8430 |
| 36 | 25.2401 | 23.9439 | 7.3938 | -207.0405 | -16.9697 | -14.6720 |
| 37 | 9.8481 | 20.6961 | 4.5807 | -134.3405 | -10.1842 | -8.5839 |
| 38 | -2.5620 | 18.1582 | 2.3824 | 18.7154 | -9.1200 | 0.0775 |
| 39 | -9.8169 | 16.3392 | 0.8956 | 9.3714 | -9.1205 | 0.0740 |
| 40 | -9.7210 | 15.2464 | -0.0054 | 0.0203 | -9.1204 | 0.0683 |

ENVOLVENTES DE ESFUERZOS CON IMPACTO

ENVOL. MAX. TORSORES -IPF

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.5479 | 111.7154 | 161.8684 | -98.8486 | -101.3375 | -149.8254 |
| 2 | 94.4685 | 101.6666 | 150.0839 | -177.5339 | -87.3354 | -133.8089 |
| 3 | 162.6935 | 87.0554 | 134.5215 | -230.3951 | -72.9259 | -118.3781 |
| 4 | 210.9176 | 74.5208 | 119.6160 | -265.5655 | -60.5980 | -103.6557 |
| 5 | 240.2354 | 62.8464 | 105.6650 | -283.0415 | -49.1325 | -89.8531 |
| 6 | 247.2207 | 50.7118 | 92.2454 | -320.6418 | -57.8061 | -78.4394 |
| 7 | 230.4469 | 38.1037 | 79.5324 | -330.6814 | -51.0984 | -71.1226 |
| 8 | 330.6814 | 51.0984 | 71.1226 | -329.8838 | -44.6169 | -63.9681 |
| 9 | 329.8838 | 44.6169 | 63.9681 | -319.1405 | -38.3442 | -56.7500 |
| 10 | 319.1405 | 38.3442 | 56.7500 | -299.3689 | -32.3849 | -49.3855 |
| 11 | 299.3689 | 32.3849 | 49.3855 | -271.5839 | -26.6893 | -42.1266 |
| 12 | 271.5839 | 26.6893 | 42.1266 | -236.7246 | -21.3286 | -35.0495 |
| 13 | 236.7246 | 21.3286 | 35.0495 | -256.4408 | -21.3372 | -34.8834 |
| 14 | 256.4408 | 21.3372 | 34.8834 | -211.3437 | -16.3493 | -27.7389 |
| 15 | 211.3437 | 16.3493 | 27.7389 | -162.0437 | -11.7010 | -20.7559 |
| 16 | 162.0437 | 11.7010 | 20.7559 | -110.0521 | -7.4467 | -13.8394 |
| 17 | 110.0521 | 7.4467 | 13.8394 | -56.6955 | -3.6084 | -8.2985 |
| 18 | 56.6955 | 3.6084 | 8.2985 | -3.3764 | -0.1990 | -4.1219 |
| 19 | 3.3764 | 0.1990 | 4.1219 | 48.5558 | 2.7746 | -2.0906 |
| 20 | -294.9524 | -16.8474 | 2.6441 | 98.1630 | -50.3806 | -59.4530 |
| 21 | -443.2789 | 143.6320 | 150.9924 | 272.0164 | -159.9864 | -162.0299 |
| 22 | -274.8177 | 160.1319 | 162.4010 | 120.2291 | -144.9438 | -144.9408 |
| 23 | -128.5090 | 145.4025 | 146.0619 | -9.5979 | -130.2976 | -128.7467 |
| 24 | -4.6671 | 131.1127 | 130.3717 | -117.4856 | -116.0919 | -113.1396 |
| 25 | 97.6151 | 117.3022 | 115.3211 | -204.3686 | -102.3759 | -98.1937 |
| 26 | 179.1208 | 104.0171 | 100.8115 | -271.1305 | -89.1813 | -83.8321 |
| 27 | 240.6216 | 91.3066 | 87.4576 | -301.2679 | -74.1568 | -73.6316 |
| 28 | 283.5378 | 79.2001 | 74.6935 | -334.6791 | -68.4901 | -67.0524 |
| 29 | 334.6791 | 68.4901 | 67.0524 | -358.8353 | -62.5870 | -60.4281 |
| 30 | 358.8353 | 62.5870 | 60.4281 | -372.9329 | -56.4841 | -53.7385 |
| 31 | 372.9329 | 56.4841 | 53.7385 | -376.1315 | -50.1987 | -47.2206 |
| 32 | 376.1315 | 50.1987 | 47.2206 | -367.6868 | -43.7899 | -40.5392 |
| 33 | 367.6868 | 43.7899 | 40.5392 | -347.1369 | -37.2448 | -33.7220 |
| 34 | 347.1369 | 37.2448 | 33.7220 | -313.7489 | -30.5684 | -27.3329 |
| 35 | 313.7489 | 30.5684 | 27.3329 | -267.2043 | -23.8135 | -20.8430 |
| 36 | 267.2043 | 23.8135 | 20.8430 | -207.0405 | -16.9697 | -14.6720 |
| 37 | 207.0405 | 16.9697 | 14.6720 | -134.3405 | -10.1842 | -8.5839 |
| 38 | 134.3405 | 10.1842 | 8.5839 | -79.1780 | -5.5826 | -4.8294 |
| 39 | 79.1780 | 5.5826 | 4.8294 | -33.6499 | -2.2153 | -1.9200 |
| 40 | 33.6499 | 2.2153 | 1.9200 | 0.0123 | -5.4742 | -0.0451 |

ENVOLVENTES DE ESFUERZOS CON IMPACTO

ENVOL. MIN. FLECTORES -IPF

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0006 | -12.3075 | -0.1990 | 12.6460 | 13.7220 | 0.2614 |
| 2 | -15.6318 | -16.9620 | 0.0119 | 31.2906 | 16.9620 | -0.0119 |
| 3 | -31.2889 | -16.9606 | 0.0453 | 46.9419 | 16.9606 | -0.0455 |
| 4 | -46.9409 | -16.9569 | 0.0948 | 62.5855 | 16.9569 | -0.0946 |
| 5 | -62.5840 | -16.9581 | 0.0949 | 78.2308 | 16.9581 | -0.0953 |
| 6 | -78.2296 | -16.9626 | 0.1767 | 93.8757 | 16.9626 | -0.1767 |
| 7 | -93.8744 | -16.9667 | 0.3018 | 109.5361 | 16.9667 | -0.3019 |
| 8 | -109.5384 | -16.9691 | 0.3854 | 125.9929 | 21.8329 | -3.1834 |
| 9 | -125.9936 | -21.8275 | 3.2185 | 146.5182 | 23.0771 | -1.7729 |
| 10 | -146.5148 | -23.0770 | 1.9209 | 168.0918 | 24.3272 | -0.4826 |
| 11 | -168.0868 | -24.3245 | 0.6899 | 190.7386 | 25.5751 | 0.7447 |
| 12 | -190.7411 | -25.5674 | -0.6100 | 214.4100 | 26.8176 | 2.0474 |
| 13 | -214.4118 | -26.8185 | -1.9977 | 239.1713 | 26.8199 | 1.9756 |
| 14 | -239.1718 | -26.8516 | -1.7614 | 265.1040 | 28.1032 | 3.1674 |
| 15 | -265.1024 | -28.1101 | -2.9375 | 292.0908 | 29.3612 | 4.3615 |
| 16 | -292.0955 | -29.3636 | -4.3621 | 320.1505 | 30.6128 | 5.7280 |
| 17 | -320.1460 | -30.5951 | -5.1344 | 349.2545 | 31.8436 | 6.5119 |
| 18 | -362.3756 | -63.2296 | -37.3151 | 421.4495 | 64.4809 | 38.7106 |
| 19 | -437.7957 | -101.5047 | -76.3565 | 548.7996 | 122.5269 | 98.6031 |
| 20 | -558.6721 | -150.1322 | -128.5360 | 699.3765 | 111.2022 | 93.6561 |
| 21 | -708.3402 | 143.5788 | 135.5989 | 524.3376 | -171.8026 | -158.0853 |
| 22 | -530.1806 | 160.8688 | 146.0561 | 367.6453 | -156.3439 | -140.9189 |
| 23 | -382.2770 | 125.4327 | 108.1583 | 274.9249 | -92.1244 | -74.1569 |
| 24 | -288.7120 | 65.4295 | 46.6923 | 221.6499 | -65.4291 | -46.7209 |
| 25 | -244.7658 | 23.9346 | 6.3195 | 220.2412 | -23.9355 | -6.4092 |
| 26 | -228.7141 | 14.8651 | -1.7437 | 213.4726 | -14.8660 | 1.6830 |
| 27 | -213.4700 | 14.8646 | -1.6826 | 198.2306 | -14.8634 | 1.6594 |
| 28 | -198.2341 | 14.8640 | -1.5198 | 182.9985 | -14.8647 | 1.4739 |
| 29 | -182.9997 | 14.8671 | -1.3425 | 167.7651 | -14.8660 | 1.3010 |
| 30 | -167.7666 | 14.8653 | -1.1815 | 152.5381 | -14.8671 | 1.1395 |
| 31 | -152.5383 | 14.8771 | -1.0055 | 137.2815 | -14.8802 | 0.9826 |
| 32 | -137.2838 | 14.8868 | -0.9825 | 122.0193 | -14.8865 | 0.9535 |
| 33 | -122.0179 | 14.8755 | -0.7795 | 106.7734 | -14.8758 | 0.7352 |
| 34 | -106.7746 | 14.8755 | -0.6425 | 91.5224 | -14.8751 | 0.6300 |
| 35 | -91.5201 | 14.8703 | -0.6456 | 76.2870 | -14.8682 | 0.6274 |
| 36 | -76.2869 | 14.8728 | -0.5066 | 61.0416 | -14.8732 | 0.4861 |
| 37 | -61.0409 | 14.8767 | -0.4859 | 45.7912 | -14.8776 | 0.4737 |
| 38 | -45.7911 | 14.8776 | -0.4006 | 30.5334 | -14.8774 | 0.3894 |
| 39 | -30.5329 | 14.8780 | -0.3945 | 15.2896 | -14.8785 | 0.3930 |
| 40 | -15.2892 | 14.8794 | -0.3795 | 0.0334 | -14.8799 | 0.3773 |

ENVOLVENTES DE ESFUERZOS CON IMPACTO

ENVOL. MIN. CORTANTES -IPF

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.0001 | -12.5195 | -0.1636 | 11.1053 | 17.2841 | 0.3626 |
| 2 | -11.5500 | -12.5198 | -0.1560 | 11.1195 | 18.5065 | 1.4221 |
| 3 | -23.1086 | -12.5199 | -0.1357 | 2.4996 | 20.6147 | 3.2560 |
| 4 | -34.6606 | -12.5181 | -0.1053 | -12.3040 | 23.6068 | 5.9316 |
| 5 | 40.1015 | -16.0935 | 3.5075 | -30.8789 | 27.4734 | 9.4377 |
| 6 | 62.7385 | -20.5842 | -0.6245 | -50.8636 | 32.2010 | 13.8312 |
| 7 | 249.3191 | -26.2075 | -24.0380 | -69.9791 | 37.7829 | 19.1261 |
| 8 | 290.3448 | -33.5219 | -31.3070 | -86.0086 | 44.1774 | 25.2600 |
| 9 | 318.7417 | -40.7235 | -38.4605 | -96.8144 | 51.3952 | 32.2347 |
| 10 | 335.0021 | -47.7951 | -45.6548 | -100.3376 | 59.4029 | 40.1468 |
| 11 | 137.1990 | -55.4068 | -34.4860 | -94.6491 | 68.1741 | 48.9571 |
| 12 | 129.7753 | -64.7219 | -43.8927 | -67.5745 | 78.3980 | 52.3265 |
| 13 | 100.3029 | -75.4417 | -47.8368 | -25.8621 | 85.8202 | 59.9051 |
| 14 | 55.4329 | -83.3556 | -56.0129 | 29.7353 | 97.4831 | 72.4289 |
| 15 | -3.8560 | -95.4715 | -69.1104 | 99.8872 | 109.6019 | 85.4987 |
| 16 | -78.0975 | -108.0314 | -82.8213 | 185.4433 | 122.1618 | 99.1719 |
| 17 | -168.3627 | -120.9910 | -96.7295 | 287.4446 | 135.1261 | 113.0926 |
| 18 | -274.9650 | -134.3359 | -111.6747 | 405.9226 | 148.4596 | 127.9976 |
| 19 | -398.5367 | -148.0054 | -126.6782 | 541.9286 | 162.1367 | 143.0038 |
| 20 | -539.3966 | -161.9940 | -142.6564 | 617.4286 | 150.7349 | 139.8767 |
| 21 | -82.7170 | -50.5042 | -58.9509 | -2.7896 | 0.1428 | 0.3723 |
| 22 | 0.0000 | 0.0000 | 0.0000 | -11.1302 | 0.6014 | 1.3420 |
| 23 | 7.6398 | -0.4101 | -3.9497 | -56.3065 | 3.2212 | 7.7615 |
| 24 | 56.3065 | -3.2212 | -7.7615 | -105.5724 | 6.4166 | 12.8333 |
| 25 | 105.5724 | -6.4166 | -12.8333 | -154.0880 | 9.9995 | 19.0664 |
| 26 | 154.0880 | -9.9995 | -19.0664 | -200.4681 | 13.9341 | 25.4552 |
| 27 | 200.4681 | -13.9341 | -25.4552 | -243.2726 | 18.2132 | 31.7699 |
| 28 | 243.2726 | -18.2132 | -31.7699 | -281.3054 | 22.8309 | 38.2448 |
| 29 | 281.3054 | -22.8309 | -38.2448 | -313.2485 | 27.7066 | 44.7904 |
| 30 | 313.2485 | -27.7066 | -44.7904 | -337.9734 | 32.9128 | 51.4164 |
| 31 | 337.9734 | -32.9128 | -51.4164 | -354.4540 | 38.3676 | 57.9330 |
| 32 | 354.4540 | -38.3676 | -57.9330 | -361.6521 | 44.0413 | 64.5604 |
| 33 | 361.6521 | -44.0413 | -64.5604 | -358.8124 | 49.9270 | 71.4501 |
| 34 | 358.8124 | -49.9270 | -71.4501 | -348.0235 | 56.4854 | 88.4883 |
| 35 | 345.0784 | -56.0061 | -77.9625 | -341.5129 | 66.4652 | 101.3988 |
| 36 | 377.9535 | -63.2421 | -99.1239 | -317.8110 | 77.3531 | 115.8370 |
| 37 | 348.8403 | -74.8083 | -113.6472 | -274.6552 | 89.0846 | 130.4108 |
| 38 | 298.4499 | -87.2716 | -129.3630 | -208.9424 | 101.7070 | 146.2040 |
| 39 | 224.4885 | -100.6186 | -145.2586 | -122.5509 | 115.5300 | 163.1058 |
| 40 | 127.9734 | -115.1643 | -162.8389 | -0.3711 | 130.4509 | 180.5731 |

ENVOLVENTES DE ESFUERZOS CON IMPACTO

ENVOL. MIN. TORSORES -IPF

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.1444 | -0.0136 | -0.4698 | 7.0449 | 12.8820 | 0.6217 |
| 2 | 0.1314 | -0.0136 | -0.4699 | -33.0165 | 2.5282 | 2.2982 |
| 3 | 33.0165 | -2.5282 | -2.2982 | -76.6523 | 6.3065 | 5.8021 |
| 4 | 76.6523 | -6.3065 | -5.8021 | -127.5372 | 11.3264 | 10.5759 |
| 5 | 127.5372 | -11.3264 | -10.5759 | -195.1445 | 18.7994 | 17.0445 |
| 6 | 195.1445 | -18.7994 | -17.0445 | -249.3191 | 26.2075 | 24.0380 |
| 7 | 249.3191 | -26.2075 | -24.0380 | -290.3448 | 33.5219 | 31.3070 |
| 8 | 290.3448 | -33.5219 | -31.3070 | -318.7417 | 40.7235 | 38.4605 |
| 9 | 318.7417 | -40.7235 | -38.4605 | -335.0021 | 47.7951 | 45.6548 |
| 10 | 335.0021 | -47.7951 | -45.6548 | -339.6991 | 54.7039 | 53.0342 |
| 11 | 339.6991 | -54.7039 | -53.0342 | -333.6032 | 61.4091 | 60.3831 |
| 12 | 333.6032 | -61.4091 | -60.3831 | -317.5986 | 67.9066 | 67.5284 |
| 13 | 317.5986 | -67.9066 | -67.5284 | -254.8666 | 67.8924 | 67.7049 |
| 14 | 254.8666 | -67.8924 | -67.7049 | -213.7655 | 78.7981 | 78.3970 |
| 15 | 239.6431 | -76.7796 | -75.3084 | -171.8224 | 90.1176 | 90.4460 |
| 16 | 193.6169 | -88.5448 | -87.7679 | -113.3828 | 102.0567 | 103.1391 |
| 17 | 130.4587 | -100.9036 | -101.2904 | -37.0773 | 114.5825 | 116.9104 |
| 18 | 49.5588 | -113.7793 | -115.4208 | 57.3386 | 127.5954 | 131.2116 |
| 19 | -49.9552 | -127.1429 | -130.2636 | 171.0806 | 141.1017 | 146.2946 |
| 20 | -168.5489 | -140.9560 | -145.9473 | 304.2726 | 133.7446 | 142.2211 |
| 21 | -82.7170 | -50.5042 | -58.9509 | 285.8748 | -14.6687 | 3.4206 |
| 22 | -39.1444 | 2.0099 | -2.1049 | 259.5846 | -14.0595 | 4.6449 |
| 23 | 7.6398 | -0.4101 | -3.9497 | -56.3065 | 3.2212 | 7.7615 |
| 24 | 56.3065 | -3.2212 | -7.7615 | -105.5724 | 6.4166 | 12.8333 |
| 25 | 105.5724 | -6.4166 | -12.8333 | -154.0880 | 9.9995 | 19.0664 |
| 26 | 154.0880 | -9.9995 | -19.0664 | -200.4681 | 13.9341 | 25.4552 |
| 27 | 200.4681 | -13.9341 | -25.4552 | -243.2726 | 18.2132 | 31.7699 |
| 28 | 243.2726 | -18.2132 | -31.7699 | -281.3054 | 22.8309 | 38.2448 |
| 29 | 281.3054 | -22.8309 | -38.2448 | -313.2485 | 27.7066 | 44.7904 |
| 30 | 313.2485 | -27.7066 | -44.7904 | -337.9734 | 32.9128 | 51.4164 |
| 31 | 337.9734 | -32.9128 | -51.4164 | -354.4540 | 38.3676 | 57.9330 |
| 32 | 354.4540 | -38.3676 | -57.9330 | -210.6307 | 25.6204 | 65.1965 |
| 33 | 361.6521 | -44.0413 | -64.5604 | -243.3147 | 33.8301 | 76.7239 |
| 34 | 286.9039 | -29.1945 | -72.7301 | -264.8215 | 42.9619 | 89.0459 |
| 35 | 305.6111 | -38.9950 | -85.4371 | -272.4704 | 53.0050 | 101.9784 |
| 36 | 318.4786 | -51.6426 | -99.5866 | -270.8106 | 65.9065 | 116.3766 |
| 37 | 301.8402 | -63.3587 | -114.1866 | -240.1198 | 77.8675 | 131.1716 |
| 38 | 270.6864 | -78.2548 | -130.0715 | -191.1110 | 93.0201 | 147.2812 |
| 39 | 206.6574 | -91.9314 | -146.3391 | -110.1199 | 106.9297 | 163.6864 |
| 40 | 116.3848 | -107.3833 | -163.4113 | -0.3543 | 122.6363 | 180.9528 |

ENVOL. MAX. FLECTORES -EC1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4702 | 112.5738 | 125.6687 | -119.6226 | -129.3965 | -58.4733 |
| 2 | 119.6226 | 129.3965 | 58.4733 | -224.8049 | -112.4484 | -51.9179 |
| 3 | 224.8049 | 112.4484 | 51.9179 | -315.6049 | -95.4948 | -45.2771 |
| 4 | 315.6049 | 95.4948 | 45.2771 | -392.0068 | -78.5359 | -38.7543 |
| 5 | 392.0068 | 78.5359 | 38.7543 | -454.0800 | -61.5836 | -32.1592 |
| 6 | 454.0800 | 61.5836 | 32.1592 | -501.8416 | -44.6431 | -25.2346 |
| 7 | 501.8416 | 44.6431 | 25.2346 | -535.2985 | -27.7161 | -18.3402 |
| 8 | 535.2985 | 27.7161 | 18.3402 | -554.4057 | -10.7848 | -11.6997 |
| 9 | 554.4057 | 10.7848 | 11.6997 | -559.1745 | 6.1719 | -4.9725 |
| 10 | 559.1745 | -6.1719 | 4.9725 | -549.5883 | 23.1372 | 2.0391 |
| 11 | 549.5883 | -23.1372 | -2.0391 | -525.6710 | 40.1029 | 8.9614 |
| 12 | 525.6710 | -40.1029 | -8.9614 | -487.4273 | 57.0630 | 15.5907 |
| 13 | 487.4273 | -57.0630 | -15.5907 | -434.7501 | 57.0343 | 15.8819 |
| 14 | 434.7501 | -57.0343 | -15.8819 | -366.5555 | 73.9515 | 22.6608 |
| 15 | 366.5555 | -73.9515 | -22.6608 | -284.0756 | 90.8921 | 29.2080 |
| 16 | 284.0756 | -90.8921 | -29.2080 | -187.2477 | 107.8419 | 35.7881 |
| 17 | 187.2477 | -107.8419 | -35.7881 | -86.9267 | 101.7589 | 86.2052 |
| 18 | 97.4735 | -76.5429 | -65.5915 | -27.0484 | 87.1262 | 76.3471 |
| 19 | 40.0830 | -57.3751 | -50.9024 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 4.5536 | -7.8636 | -7.1984 | 0.0000 | 0.0000 | 0.0000 |
| 21 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 22 | 4.6992 | 8.7859 | 8.0248 | -27.3425 | -35.6381 | -31.0466 |
| 23 | 39.2663 | 60.4766 | 53.2609 | -88.9904 | -49.2725 | -41.8827 |
| 24 | 100.0775 | 70.7217 | 60.2501 | -192.6628 | -128.1379 | -42.4090 |
| 25 | 192.6628 | 128.1379 | 42.4090 | -314.1955 | -111.1925 | -35.6275 |
| 26 | 314.1955 | 111.1925 | 35.6275 | -417.9637 | -94.2345 | -28.9383 |
| 27 | 417.9637 | 94.2345 | 28.9383 | -503.8826 | -77.2617 | -22.3447 |
| 28 | 503.8826 | 77.2617 | 22.3447 | -572.0095 | -60.3260 | -15.4772 |
| 29 | 572.0095 | 60.3260 | 15.4772 | -622.3207 | -43.4024 | -8.5518 |
| 30 | 622.3207 | 43.4024 | 8.5518 | -654.8313 | -26.4119 | -1.5179 |
| 31 | 654.8313 | 26.4119 | 1.5179 | -669.4918 | -9.4150 | 5.2249 |
| 32 | 669.4918 | 9.4150 | -5.2249 | -666.3150 | 7.5337 | 12.2120 |
| 33 | 666.3150 | -7.5337 | -12.2120 | -645.3655 | 24.4534 | 19.5770 |
| 34 | 645.3655 | -24.4534 | -19.5770 | -606.6443 | 41.3625 | 26.2428 |
| 35 | 606.6443 | -41.3625 | -26.2428 | -550.1660 | 58.3151 | 33.1147 |
| 36 | 550.1660 | -58.3151 | -33.1147 | -475.8257 | 75.3127 | 40.0535 |
| 37 | 475.8257 | -75.3127 | -40.0535 | -383.6415 | 92.2709 | 46.8183 |
| 38 | 383.6415 | -92.2709 | -46.8183 | -273.6353 | 109.2017 | 53.5524 |
| 39 | 273.6353 | -109.2017 | -53.5524 | -145.9474 | 126.1603 | 59.9641 |
| 40 | 145.9474 | -126.1603 | -59.9641 | -0.3514 | 142.9494 | 66.4391 |

ENVOL. MAX CORTANTES -EC1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.2157 | 129.3899 | 58.5517 | -119.6226 | -129.3965 | -58.4733 |
| 2 | 119.6226 | 129.3965 | 58.4733 | -224.8049 | -112.4484 | -51.9179 |
| 3 | 224.8049 | 112.4484 | 51.9179 | -315.6049 | -95.4948 | -45.2771 |
| 4 | 315.6049 | 95.4948 | 45.2771 | -392.0068 | -78.5359 | -38.7543 |
| 5 | 392.0068 | 78.5359 | 38.7543 | -330.2547 | -63.9458 | -76.5076 |
| 6 | 306.2529 | 66.2557 | 78.0403 | -345.4505 | -54.6473 | -67.0149 |
| 7 | 318.6401 | 57.4527 | 68.9042 | -347.4245 | -45.9539 | -57.8893 |
| 8 | 318.6171 | 49.2556 | 60.3110 | -337.7532 | -37.8817 | -49.3779 |
| 9 | 307.8382 | 41.6376 | 52.2989 | -318.2798 | -30.3880 | -41.3334 |
| 10 | 288.0277 | 34.6240 | 44.5400 | -290.6344 | -23.5228 | -33.5212 |
| 11 | 260.8098 | 28.2186 | 37.1281 | -283.0326 | -19.8672 | -28.9753 |
| 12 | 254.2943 | 25.0015 | 33.1070 | -244.6962 | -14.0723 | -22.2127 |
| 13 | 217.7410 | 19.6333 | 26.8186 | -202.8126 | -8.8580 | -15.9120 |
| 14 | 178.1825 | 14.8390 | 20.8588 | -158.9736 | -4.2524 | -9.9816 |
| 15 | 137.2000 | 10.6164 | 15.3614 | -114.6879 | -0.2218 | -4.9345 |
| 16 | 96.2070 | 6.9493 | 10.7884 | 0.0000 | 0.0000 | 0.0000 |
| 17 | 56.5619 | 3.8262 | 6.8793 | 0.0000 | 0.0000 | 0.0000 |
| 18 | 19.5172 | 1.2406 | 4.1445 | 0.0000 | 0.0000 | 0.0000 |
| 19 | 7.9611 | 0.4789 | 0.8187 | 0.0000 | 0.0000 | 0.0000 |
| 20 | 2.0326 | 0.1158 | 0.2295 | 471.5002 | -85.1841 | -35.1230 |
| 21 | -501.3633 | 137.0906 | 111.5769 | 513.9835 | -191.0529 | -59.8910 |
| 22 | -513.9835 | 191.0529 | 59.8910 | 362.8689 | -176.0683 | -54.0940 |
| 23 | -362.8689 | 176.0683 | 54.0940 | 232.4868 | -161.4780 | -48.6434 |
| 24 | -232.4868 | 161.4780 | 48.6434 | 121.6757 | -147.2827 | -43.1810 |
| 25 | -121.6757 | 147.2827 | 43.1810 | 29.1867 | -133.4917 | -38.0773 |
| 26 | -29.1867 | 133.4917 | 38.0773 | -46.3224 | -120.0949 | -33.3105 |
| 27 | 46.3224 | 120.0949 | 33.3105 | -106.1811 | -107.0938 | -28.7481 |
| 28 | 106.1811 | 107.0938 | 28.7481 | -151.7848 | -94.4504 | -24.3053 |
| 29 | 151.7848 | 94.4504 | 24.3053 | -184.4700 | -82.1597 | -19.8738 |
| 30 | 184.4700 | 82.1597 | 19.8738 | -205.5538 | -70.1962 | -15.4237 |
| 31 | 205.5538 | 70.1962 | 15.4237 | -216.2733 | -58.5323 | -11.0990 |
| 32 | 216.2733 | 58.5323 | 11.0990 | -217.7248 | -47.1591 | -6.6584 |
| 33 | 217.7248 | 47.1591 | 6.6584 | -210.9413 | -36.0511 | -2.1564 |
| 34 | 202.4253 | 37.7626 | 21.1498 | -201.5686 | -25.1854 | -9.7159 |
| 35 | 167.4248 | 30.7266 | 15.8441 | -156.5524 | -18.1556 | -4.3676 |
| 36 | 125.2939 | 24.2454 | 10.8249 | 68.8303 | -16.7660 | -0.2713 |
| 37 | 86.9949 | 19.1142 | 7.0978 | 51.6350 | -16.7732 | -0.3265 |
| 38 | -51.6350 | 16.7732 | 0.3265 | 34.4302 | -16.7799 | -0.3770 |
| 39 | -34.4302 | 16.7799 | 0.3770 | 17.2396 | -16.7797 | -0.3834 |
| 40 | -17.2396 | 16.7797 | 0.3834 | 0.0374 | -16.7789 | -0.3936 |

ENVOL. MAX. TORSORES -EC1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.4299 | 116.4438 | 128.1651 | -105.5057 | -113.8081 | -127.7733 |
| 2 | 105.5057 | 113.8081 | 127.7733 | -186.0579 | -100.4883 | -115.1097 |
| 3 | 186.0579 | 100.4883 | 115.1097 | -243.3727 | -87.6793 | -102.3048 |
| 4 | 243.3727 | 87.6793 | 102.3048 | -218.4686 | -59.0092 | -92.5417 |
| 5 | 218.4686 | 59.0092 | 92.5417 | -228.4794 | -49.3838 | -81.3584 |
| 6 | 228.4794 | 49.3838 | 81.3584 | -224.5591 | -40.4593 | -70.2808 |
| 7 | 224.5591 | 40.4593 | 70.2808 | -208.5690 | -32.2075 | -60.0508 |
| 8 | 269.1688 | 41.5948 | 60.5550 | -182.2890 | -24.6287 | -50.7356 |
| 9 | 243.9296 | 32.9785 | 52.5584 | -147.6308 | -17.7243 | -42.1906 |
| 10 | 174.8852 | 20.9972 | 44.8983 | -106.3605 | -11.4811 | -34.4135 |
| 11 | 135.0983 | 14.5900 | 37.6528 | -144.7384 | -6.2386 | -29.4996 |
| 12 | 115.9989 | 11.3812 | 33.7395 | -93.8409 | -0.4521 | -22.8451 |
| 13 | 66.8854 | 6.0140 | 27.4912 | -39.3835 | 4.7614 | -16.5844 |
| 14 | 14.7533 | 1.1951 | 21.7032 | 92.4721 | 7.1841 | -11.9340 |
| 15 | -38.8173 | -3.0362 | 16.3909 | 143.4066 | 10.3874 | -8.3667 |
| 16 | -92.4074 | -6.7043 | 11.8179 | 192.4182 | 13.0587 | -5.7350 |
| 17 | -144.6441 | -9.8131 | 8.3857 | 204.4560 | 13.0558 | -5.9348 |
| 18 | -204.4560 | -13.0558 | 5.9348 | 252.5793 | 15.2295 | -4.0449 |
| 19 | -252.5793 | -15.2295 | 4.0449 | 296.6626 | 16.9427 | -2.9707 |
| 20 | -296.6626 | -16.9427 | 2.9707 | 336.3393 | -70.0421 | -70.3636 |
| 21 | -317.7293 | 128.1399 | 113.2254 | 475.9752 | -165.9088 | -129.2177 |
| 22 | -475.9752 | 165.9088 | 129.2177 | 79.9341 | -138.4344 | -118.0868 |
| 23 | -79.9341 | 138.4344 | 118.0868 | -29.4649 | -128.2313 | -108.3014 |
| 24 | 29.4649 | 128.2313 | 108.3014 | -124.7261 | -117.6158 | -98.3120 |
| 25 | 124.7261 | 117.6158 | 98.3120 | -204.0971 | -106.6060 | -88.0633 |
| 26 | 204.0971 | 106.6060 | 88.0633 | -265.7633 | -95.2542 | -77.9367 |
| 27 | 265.7633 | 95.2542 | 77.9367 | -308.1361 | -83.6234 | -67.9418 |
| 28 | 308.1361 | 83.6234 | 67.9418 | -332.5904 | -72.4076 | -58.2204 |
| 29 | 332.5904 | 72.4076 | 58.2204 | -341.1124 | -61.8939 | -49.2134 |
| 30 | 341.1124 | 61.8939 | 49.2134 | -375.6677 | -49.3337 | -37.2778 |
| 31 | 340.1060 | 52.7735 | 41.2804 | -363.3445 | -40.3558 | -29.7059 |
| 32 | 326.7372 | 44.3154 | 34.4023 | -338.5749 | -31.8371 | -22.7629 |
| 33 | 301.8594 | 36.3211 | 27.6041 | -302.6438 | -23.7973 | -15.9339 |
| 34 | 265.1521 | 29.0245 | 21.4164 | -155.1923 | -15.2253 | -11.3077 |
| 35 | 222.5497 | 21.7726 | 16.1231 | -116.3733 | -10.4165 | -7.6172 |
| 36 | 151.1226 | 19.2098 | 11.0278 | -79.0737 | -6.5012 | -4.6945 |
| 37 | 107.6609 | 14.0788 | 7.3005 | -45.9826 | -3.4931 | -2.5176 |
| 38 | 62.2263 | 11.2515 | 4.1821 | -19.9092 | -1.4063 | -1.0770 |
| 39 | 28.8586 | 8.0967 | 2.1003 | 15.7412 | -15.3167 | -0.4329 |
| 40 | 8.8193 | 6.2343 | 0.7830 | 0.0373 | -16.0980 | -0.4423 |

ENVOL. MIN. FLECTORES -EC1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0028 | -25.2743 | -0.9876 | 23.5527 | 25.5278 | 0.9406 |
| 2 | -23.5527 | -25.5278 | -0.9406 | 47.1217 | 25.5266 | 0.8999 |
| 3 | -47.1217 | -25.5266 | -0.8999 | 70.6731 | 25.5243 | 0.8368 |
| 4 | -70.6731 | -25.5243 | -0.8368 | 94.2237 | 25.5242 | 0.7989 |
| 5 | -94.2237 | -25.5242 | -0.7989 | 117.7698 | 25.5265 | 0.7378 |
| 6 | -117.7698 | -25.5265 | -0.7378 | 141.3170 | 25.5417 | 0.5821 |
| 7 | -141.3170 | -25.5417 | -0.5821 | 164.8984 | 25.5456 | 0.4248 |
| 8 | -164.8984 | -25.5456 | -0.4248 | 188.4421 | 25.5294 | 0.3366 |
| 9 | -188.4421 | -25.5294 | -0.3366 | 212.0023 | 25.5267 | 0.1987 |
| 10 | -212.0023 | -25.5267 | -0.1987 | 235.5556 | 25.5308 | -0.0693 |
| 11 | -235.5556 | -25.5308 | 0.0693 | 259.1323 | 25.5119 | -0.3246 |
| 12 | -259.1323 | -25.5119 | 0.3246 | 282.6617 | 25.4937 | -0.4634 |
| 13 | -282.6617 | -25.4937 | 0.4634 | 306.2241 | 25.5338 | -0.6621 |
| 14 | -306.2241 | -25.5338 | 0.6621 | 329.8095 | 25.5803 | -0.9979 |
| 15 | -329.8095 | -25.5803 | 0.9979 | 353.4131 | 25.5847 | -1.1706 |
| 16 | -353.4131 | -25.5847 | 1.1706 | 377.0157 | 25.5667 | -1.6180 |
| 17 | -377.0157 | -25.5667 | 1.6180 | 415.5160 | 85.9322 | 18.3220 |
| 18 | -415.5160 | -85.9322 | -18.3220 | 506.2802 | 110.0933 | 26.6064 |
| 19 | -506.2802 | -110.0933 | -26.6064 | 610.2886 | 122.7942 | 31.0249 |
| 20 | -610.2886 | -122.7942 | -31.0249 | 729.0452 | -12.7716 | -5.8828 |
| 21 | -729.0452 | 12.7716 | 5.8828 | 576.6818 | -133.4967 | -37.0558 |
| 22 | -576.6818 | 133.4967 | 37.0558 | 446.2119 | -120.1043 | -32.5338 |
| 23 | -446.2119 | 120.1043 | 32.5338 | 333.0219 | -107.0972 | -28.3439 |
| 24 | -333.0219 | 107.0972 | 28.3439 | 275.0703 | -16.7546 | 1.7568 |
| 25 | -275.0703 | 16.7546 | -1.7568 | 257.9000 | -16.7611 | 1.3529 |
| 26 | -257.9000 | 16.7611 | -1.3529 | 240.7160 | -16.7710 | 1.0787 |
| 27 | -240.7160 | 16.7710 | -1.0787 | 223.5273 | -16.7727 | 0.9741 |
| 28 | -223.5273 | 16.7727 | -0.9741 | 206.3525 | -16.7665 | 0.7694 |
| 29 | -206.3525 | 16.7665 | -0.7694 | 189.1767 | -16.7646 | 0.5814 |
| 30 | -189.1767 | 16.7646 | -0.5814 | 172.0039 | -16.7639 | 0.3905 |
| 31 | -172.0039 | 16.7639 | -0.3905 | 154.8028 | -16.7747 | 0.2884 |
| 32 | -154.8028 | 16.7747 | -0.2884 | 137.5879 | -16.7753 | 0.1565 |
| 33 | -137.5879 | 16.7753 | -0.1565 | 120.4070 | -16.7753 | -0.0429 |
| 34 | -120.4070 | 16.7753 | 0.0429 | 103.1972 | -16.7717 | -0.1002 |
| 35 | -103.1972 | 16.7717 | 0.1002 | 86.0215 | -16.7631 | -0.1807 |
| 36 | -86.0215 | 16.7631 | 0.1807 | 68.8303 | -16.7660 | -0.2713 |
| 37 | -68.8303 | 16.7660 | 0.2713 | 51.6350 | -16.7732 | -0.3265 |
| 38 | -51.6350 | 16.7732 | 0.3265 | 34.4302 | -16.7799 | -0.3770 |
| 39 | -34.4302 | 16.7799 | 0.3770 | 17.2396 | -16.7797 | -0.3834 |
| 40 | -17.2396 | 16.7797 | 0.3834 | 0.0377 | -16.6061 | -0.4267 |

ENVOL. MIN. CORTANTES -EC1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0026 | -25.5247 | -0.9564 | 23.5527 | 25.5278 | 0.9406 |
| 2 | -23.5527 | -25.5278 | -0.9406 | 47.1217 | 25.5266 | 0.8999 |
| 3 | -47.1217 | -25.5266 | -0.8999 | 70.6731 | 25.5243 | 0.8368 |
| 4 | -70.6731 | -25.5243 | -0.8368 | 94.2237 | 25.5242 | 0.7989 |
| 5 | -94.2237 | -25.5242 | -0.7989 | -72.7248 | 26.6879 | 9.8274 |
| 6 | -117.7698 | -25.5265 | -0.7378 | -102.9975 | 32.4023 | 14.3418 |
| 7 | 79.3250 | -31.6408 | 0.9481 | -85.5352 | 41.9055 | 3.1235 |
| 8 | 85.5352 | -41.9055 | -3.1235 | -87.8106 | 52.4392 | 7.1513 |
| 9 | 87.8106 | -52.4392 | -7.1513 | -85.0856 | 63.2687 | 11.1688 |
| 10 | 85.0856 | -63.2687 | -11.1688 | -76.3396 | 74.4234 | 15.2417 |
| 11 | 76.3396 | -74.4234 | -15.2417 | -60.3392 | 85.9290 | 19.3337 |
| 12 | 60.3392 | -85.9290 | -19.3337 | -35.9783 | 97.8163 | 23.4103 |
| 13 | 35.9783 | -97.8163 | -23.4103 | 54.3332 | 97.8143 | 23.3872 |
| 14 | -54.3332 | -97.8143 | -23.3872 | 99.9043 | 110.0930 | 27.6017 |
| 15 | -99.9043 | -110.0930 | -27.6017 | 156.9881 | 122.7928 | 32.2166 |
| 16 | -156.9881 | -122.7928 | -32.2166 | 227.0396 | 135.9322 | 36.9290 |
| 17 | -227.0396 | -135.9322 | -36.9290 | 311.4542 | 149.5207 | 42.1165 |
| 18 | -311.4542 | -149.5207 | -42.1165 | 411.2455 | 163.5491 | 47.5972 |
| 19 | -411.2455 | -163.5491 | -47.5972 | 527.8264 | 178.0193 | 53.4019 |
| 20 | -527.8264 | -178.0193 | -53.4019 | 487.4979 | 130.4351 | 102.2704 |
| 21 | -343.6061 | -79.4398 | -31.9123 | -2.2522 | 0.1154 | 0.2453 |
| 22 | 0.0000 | 0.0000 | 0.0000 | -8.9557 | 0.4841 | 0.8838 |
| 23 | 0.0000 | 0.0000 | 0.0000 | -28.5923 | 1.6356 | 4.4032 |
| 24 | 0.0000 | 0.0000 | 0.0000 | -65.8713 | 4.0044 | 7.2901 |
| 25 | 0.0000 | 0.0000 | 0.0000 | -106.5475 | 6.9109 | 11.1166 |
| 26 | 0.0000 | 0.0000 | 0.0000 | -149.3333 | 10.3844 | 16.0017 |
| 27 | 174.9128 | -3.2249 | -9.9277 | -192.7262 | 14.4300 | 21.3760 |
| 28 | 221.8674 | -7.7023 | -15.8518 | -235.1707 | 19.0767 | 27.3860 |
| 29 | 267.2761 | -12.8108 | -22.3496 | -274.9298 | 24.3334 | 33.9153 |
| 30 | 309.3082 | -18.5331 | -29.3676 | -310.2763 | 30.2084 | 40.9722 |
| 31 | 346.1734 | -24.9144 | -36.9589 | -339.3747 | 36.7378 | 48.5238 |
| 32 | 375.9547 | -31.9627 | -44.7486 | -360.3235 | 43.8961 | 56.3660 |
| 33 | 385.3388 | -41.6186 | -56.2766 | -388.8818 | 52.1197 | 67.5478 |
| 34 | 388.8818 | -52.1197 | -67.5478 | -383.4822 | 62.2359 | 78.3569 |
| 35 | 383.4822 | -62.2359 | -78.3569 | -369.6551 | 71.9881 | 88.6609 |
| 36 | 369.6551 | -71.9881 | -88.6609 | -337.6673 | 82.2066 | 99.0653 |
| 37 | 337.6673 | -82.2066 | -99.0653 | -285.9987 | 92.8258 | 109.3224 |
| 38 | 285.9987 | -92.8258 | -109.3224 | -273.6353 | 109.2017 | 53.5524 |
| 39 | 273.6353 | -109.2017 | -53.5524 | -145.9474 | 126.1603 | 59.9641 |
| 40 | 145.9474 | -126.1603 | -59.9641 | -0.3509 | 143.1212 | 66.4071 |

ENVOL. MIN. TORSORES -EC1

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -0.0023 | -24.6095 | -0.9942 | 22.7071 | 24.6097 | 0.9790 |
| 2 | -22.7071 | -24.6097 | -0.9790 | -5.3252 | 12.9895 | 1.7243 |
| 3 | -45.4262 | -24.6083 | -0.9395 | -24.8250 | 15.5756 | 3.6539 |
| 4 | 36.8683 | -3.0370 | -2.3867 | -55.0571 | 18.2773 | 6.2862 |
| 5 | 68.1094 | -6.0509 | -4.6350 | -89.0402 | 23.1509 | 9.9876 |
| 6 | 104.2520 | -10.0538 | -7.6717 | -122.5752 | 28.8655 | 14.5193 |
| 7 | 142.6496 | -15.0238 | -11.6070 | -169.6979 | 33.7390 | 19.9627 |
| 8 | 180.7134 | -20.9545 | -16.3856 | -212.6581 | 38.9954 | 25.8473 |
| 9 | 215.9941 | -27.8268 | -21.9040 | -241.2240 | 45.7511 | 32.1796 |
| 10 | 246.0128 | -35.6066 | -28.2607 | -298.0164 | 48.9191 | 39.1232 |
| 11 | 268.5316 | -44.2589 | -35.5882 | -302.5858 | 57.4252 | 46.5636 |
| 12 | 281.3939 | -53.7871 | -43.7303 | -295.5300 | 66.2546 | 54.2459 |
| 13 | 282.7096 | -64.1124 | -52.5360 | -258.9792 | 72.2224 | 59.3990 |
| 14 | 23.7749 | -91.2953 | -57.6083 | 35.6223 | 104.1349 | 67.9921 |
| 15 | -35.6223 | -104.1349 | -67.9921 | 105.0151 | 117.0777 | 78.8406 |
| 16 | -105.0151 | -117.0777 | -78.8406 | 184.8797 | 129.4161 | 89.6285 |
| 17 | -184.8797 | -129.4161 | -89.6285 | -34.0147 | 112.8099 | 95.8912 |
| 18 | 34.0147 | -112.8099 | -95.8912 | 58.7151 | 126.5927 | 108.2707 |
| 19 | -58.7151 | -126.5927 | -108.2707 | 168.8673 | 139.9256 | 120.7410 |
| 20 | -168.8673 | -139.9256 | -120.7410 | 235.9277 | 116.7866 | 104.0176 |
| 21 | -294.2538 | -69.1868 | -67.9356 | 266.0058 | -13.6488 | 3.0021 |
| 22 | -266.0058 | 13.6488 | -3.0021 | 169.4506 | -9.1785 | 3.8718 |
| 23 | -228.6217 | 12.3838 | -3.7230 | 127.5116 | -7.3158 | 5.7386 |
| 24 | -183.3946 | 10.5169 | -5.1388 | 81.0584 | -4.9477 | 8.6248 |
| 25 | -133.6423 | 8.1474 | -7.3718 | 31.2113 | -2.0400 | 12.3118 |
| 26 | -81.2430 | 5.2885 | -10.2283 | -20.7536 | 1.4279 | 16.9042 |
| 27 | -27.2719 | 1.9113 | -13.9271 | -73.3277 | 5.4761 | 22.2787 |
| 28 | 26.9998 | -2.0085 | -18.4065 | -124.9452 | 10.1234 | 28.1761 |
| 29 | 80.1732 | -6.4914 | -23.6603 | -173.8799 | 15.3803 | 34.5994 |
| 30 | 208.2576 | -9.5783 | -29.9560 | -218.3988 | 21.2536 | 41.5608 |
| 31 | 254.2967 | -15.9529 | -37.4394 | -256.6856 | 27.7763 | 49.0043 |
| 32 | 371.9438 | -30.7031 | -45.2955 | -286.8287 | 34.9297 | 56.8463 |
| 33 | 385.3388 | -41.6186 | -56.2766 | -388.8818 | 52.1197 | 67.5478 |
| 34 | 388.8818 | -52.1197 | -67.5478 | -383.4822 | 62.2359 | 78.3569 |
| 35 | 383.4822 | -62.2359 | -78.3569 | -369.6551 | 71.9881 | 88.6609 |
| 36 | 369.6551 | -71.9881 | -88.6609 | -337.6673 | 82.2066 | 99.0653 |
| 37 | 337.6673 | -82.2066 | -99.0653 | -285.9987 | 92.8258 | 109.3224 |
| 38 | 285.9987 | -92.8258 | -109.3224 | -213.2767 | 103.8365 | 119.5441 |
| 39 | 213.2767 | -103.8365 | -119.5441 | -118.4918 | 115.1799 | 129.3842 |
| 40 | 118.4918 | -115.1799 | -129.3842 | -0.3075 | 109.6884 | 139.8866 |

## PRETENSADO

### TRAZADO

El trazado del pretensado en alzado se define en los planos del proyecto mediante una sucesión de tramos formados por recta y parábolas con continuidad en la pendiente. En planta el trazado puede ser recto o curvo, permitiéndose variaciones del radio de curvatura.

Los 2 extremos del trazado son anclajes de tipo activo.

### CÁLCULO DEL PRETENSADO

El cálculo de la fuerza de pretensado se realiza con un programa de cálculo automático que considera las pérdidas de tensión instantáneas y diferidas, de acuerdo con la normativa vigente (EHE). El programa calcula, además, un sistema de fuerzas equivalentes a la introducción del pretensado en la estructura, para su consideración en el modelo de análisis estructural del tablero.

El programa permite la determinación de las pérdidas de la fuerza de pretensado asociadas a los siguientes aspectos:

Pérdidas instantáneas

a.- Pérdidas por rozamiento.
b.- Pérdidas de penetración de cuña en anclajes.
c.- Pérdidas por acortamiento elástico del hormigón.

Pérdidas diferidas

d.- Pérdidas por retracción del hormigón.
e.- Pérdidas por fluencia del hormigón.
f.- Pérdidas por relajación del acero de pretensado.

### CÁLCULO ESTRUCTURAL

La acción del pretensado sobre la estructura se realiza considerándolo como un sistema de fuerzas equivalentes, constituido por las fuerzas de anclaje y las de interacción (de desviación o repartidas).

Los resultados del programa de cálculo del pretensado son los siguientes:

a. Definición del trazado del pretensado, mediante su excentricidad y cotas respecto a la fibra superior e inferior del elemento.

b. Listados de tensiones en los cables y de las pérdidas instantáneas y diferidas en cada punto.

c. Longitud afectada por la penetración de las cuñas en anclajes.

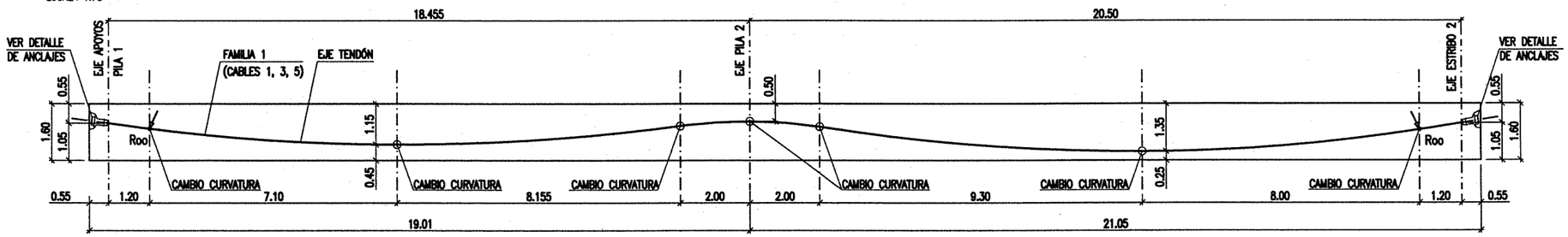
d. Alargamiento de los cables al tesar.

e. Fuerzas equivalentes del pretensado en los nudos de los elementos por los que pasan los cables del pretensado.

f. Esfuerzos isostáticos de pretensado en los nudos de los elementos atravesados por el trazado.

Al igual que con cualquier estado de cargas introducido en el programa general de análisis estructural, posteriormente se obtienen las reacciones, desplazamientos, esfuerzos y tensiones en todo punto de la estructura.

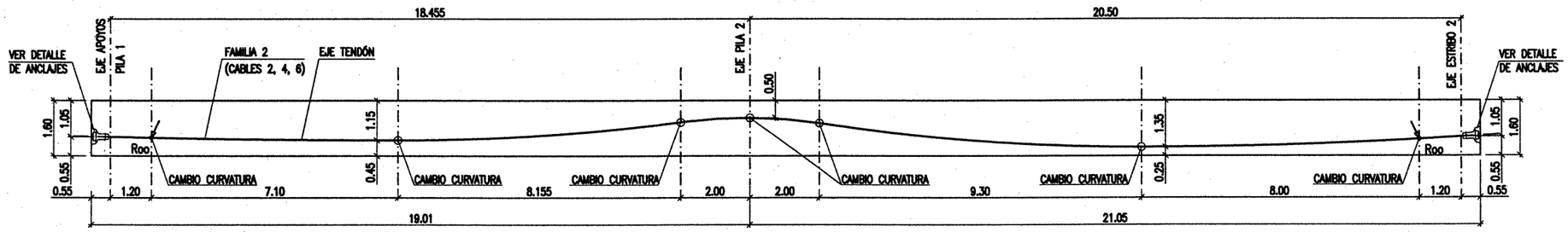
## SECCIÓN LONGITUDINAL
ESCALA 1:75




| TRAZADO DE LA FAMILIA 1 (CABLES 1, 3 Y 5) TRAMO 1 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xv/Lv | 0.000 | 0.050 | 0.100 | 0.150 | 0.200 | 0.250 | 0.300 | 0.350 | 0.400 | 0.450 | 0.500 | 0.550 | 0.600 | 0.650 | 0.700 | 0.750 | 0.800 | 0.850 | 0.900 | 0.950 | 1.000 |
| X | 0.000 | 0.923 | 1.845 | 2.768 | 3.691 | 4.614 | 5.536 | 6.459 | 7.382 | 8.305 | 9.228 | 10.150 | 11.073 | 11.996 | 12.919 | 13.841 | 14.764 | 15.687 | 16.610 | 17.532 | 18.455 |
| Y | 1.050 | 0.933 | 0.821 | 0.722 | 0.639 | 0.571 | 0.518 | 0.480 | 0.457 | 0.450 | 0.457 | 0.477 | 0.510 | 0.557 | 0.617 | 0.691 | 0.778 | 0.878 | 0.991 | 1.073 | 1.100 |

| TRAZADO DE LA FAMILIA 1 (CABLES 1, 3 Y 5) TRAMO 2 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xv/Lv | 0.000 | 0.050 | 0.100 | 0.150 | 0.200 | 0.250 | 0.300 | 0.350 | 0.400 | 0.450 | 0.500 | 0.550 | 0.600 | 0.650 | 0.700 | 0.750 | 0.800 | 0.850 | 0.900 | 0.950 | 1.000 |
| X | 18.455 | 19.480 | 20.505 | 21.530 | 22.555 | 23.580 | 24.605 | 25.630 | 26.655 | 27.680 | 28.705 | 29.730 | 30.755 | 31.780 | 32.805 | 33.830 | 34.855 | 35.880 | 36.905 | 37.930 | 38.955 |
| Y | 1.100 | 1.060 | 0.942 | 0.797 | 0.669 | 0.558 | 0.465 | 0.388 | 0.328 | 0.285 | 0.259 | 0.250 | 0.260 | 0.289 | 0.339 | 0.410 | 0.500 | 0.611 | 0.742 | 0.892 | 1.050 |

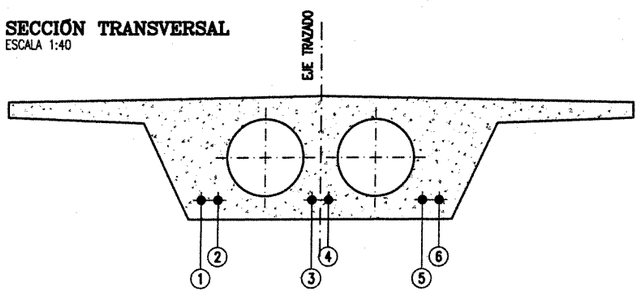
## SECCIÓN LONGITUDINAL
ESCALA 1:75




| TRAZADO DE LA FAMILIA 2 (CABLES 2, 4 Y 6) TRAMO 1 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xv/Lv | 0.000 | 0.050 | 0.100 | 0.150 | 0.200 | 0.250 | 0.300 | 0.350 | 0.400 | 0.450 | 0.500 | 0.550 | 0.600 | 0.650 | 0.700 | 0.750 | 0.800 | 0.850 | 0.900 | 0.950 | 1.000 |
| X | 0.000 | 0.923 | 1.845 | 2.768 | 3.691 | 4.614 | 5.536 | 6.459 | 7.382 | 8.305 | 9.228 | 10.150 | 11.073 | 11.996 | 12.919 | 13.841 | 14.764 | 15.687 | 16.610 | 17.532 | 18.455 |
| Y | 0.550 | 0.531 | 0.512 | 0.495 | 0.481 | 0.470 | 0.461 | 0.455 | 0.451 | 0.450 | 0.457 | 0.477 | 0.510 | 0.557 | 0.617 | 0.691 | 0.778 | 0.878 | 0.991 | 1.073 | 1.100 |

| TRAZADO DE LA FAMILIA 2 (CABLES 2, 4 Y 6) TRAMO 2 | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Xv/Lv | 0.000 | 0.050 | 0.100 | 0.150 | 0.200 | 0.250 | 0.300 | 0.350 | 0.400 | 0.450 | 0.500 | 0.550 | 0.600 | 0.650 | 0.700 | 0.750 | 0.800 | 0.850 | 0.900 | 0.950 | 1.000 |
| X | 18.455 | 19.480 | 20.505 | 21.530 | 22.555 | 23.580 | 24.605 | 25.630 | 26.655 | 27.680 | 28.705 | 29.730 | 30.755 | 31.780 | 32.805 | 33.830 | 34.855 | 35.880 | 36.905 | 37.930 | 38.955 |
| Y | 1.100 | 1.060 | 0.942 | 0.797 | 0.669 | 0.558 | 0.465 | 0.388 | 0.328 | 0.285 | 0.259 | 0.250 | 0.254 | 0.265 | 0.284 | 0.310 | 0.344 | 0.385 | 0.434 | 0.491 | 0.550 |

## SECCIÓN TRANSVERSAL
ESCALA 1:40




### ETAPAS DEL TESADO

EL TESADO DEL PRETENSADO SE REALIZARÁ EN 2 FASES

**FASE 1 (Para descimbrado)**

Cuando el hormigón haya alcanzado una resistencia característica a compresión de 220 Kp/cm2. siempre que pasen como mínimo 5 días desde el hormigonado.

Se tesarán todos los cables desde los anclajes activos con una tensión unitaria de 85.2 Kp/mm2 , lo cual equivale a una fuerza de tesado de 286.3 T/tendón.

El alargamiento total previsto para las distintas familias es:
Familia 1 167 mm
Familia 2 170 mm

El tesado se aplicará de forma simétrica sobre la estructura.
(orden de tesado = 3, 4, 2, 5, 1, 6)

INYECCIÓN La inyección se efectuará con mortero de cemento tipo I/35 A, con aditivo expansivo y una presión mínima de 6 atmosferas.

**FASE 2 (Tesado Final)**

Cuando el hormigón haya alcanzado una resistencia característica a compresión de 300 Kp/cm2. siempre que pasen como mínimo 7 días desde el hormigonado.

Se tesarán todos los cables desde los anclajes activos con una tensión unitaria de 142 Kp/mm2, lo cual equivale a una fuerza de tesado de 477.1 T/tendón.

El alargamiento total previsto para las distintas familias es:
Familia 1 273 mm
Familia 2 277 mm

En el cálculo de los alargamientos se ha considerado un módulo de deformación de los cables de 19000 Kp/mm2 los coeficientes de rozamiento
$\mu = 0.21$ $\frac{K}{\mu} = 0.006$

### DEFINICIÓN DEL POSTENSADO

1.- EL POSTENSADO ESTÁ DEFINIDO POR 6 TENDONES DE 24 TORONES DE DIÁMETRO 0.6" (SEGÚN ESPECIFICACIONES DE NORMATIVA UNE 36-098-93)

2.- LAS CARACTERÍSTICAS DE CADA TENDÓN SON:
- Area de acero = 3360 mm2.
- Diámetro Vaina = 110 mm.
- Placas de anclaje Tipo CR-32 o similar de 350x350 mm2. (Todos los anclajes son activos)
- Carga de rotura = 638 T.

3.- CARACTERÍSTICAS DEL ACERO :
fpy,k ≥ 17.100 Kp/cm2.
fp, max ≥ 19.000 Kp/cm2.
Relajación a 1000 h. y 20°C bajo una tensión = 0.7 fp max
$\rho_{1000} \leq 0.02$

NOTA:
LOS CABLES SE COLOCARÁN PARALELOS AL EJE DEL TABLERO.

### NIVELES DE CONTROL Y COEFICIENTES DE SEGURIDAD ADOPTADOS

| HORMIGONES | | | |
|---|---|---|---|
| ELEMENTO ESTRUCTURAL | TIPO | CONTROL | γ |
| TABLERO PRETENSADO | HP-40/B/20/IIb | ESTADÍSTICO | 1.50 |
| ALZADOS DE PILAS | HA-30/B/20/IIb | ESTADÍSTICO | 1.50 |
| ALZADO DE ESTRIBOS Y ALETAS | HA-25/B/20/IIb | ESTADÍSTICO | 1.50 |
| ZAPATAS, ENCEPADOS Y PILOTES | HA-25/B/20/IIa | ESTADÍSTICO | 1.50 |
| NIVELACIÓN | HM-15 | - | 1.50 |

| ACEROS | | | |
|---|---|---|---|
| ACEROS | TIPO | CONTROL | γ |
| ACERO PARA ARMAR CORRUGADO | B 500 S | NORMAL | 1.15 |
| ACERO PARA TESAR | Y 1860 S7 | NORMAL | 1.15 |

EJECUCIÓN DE LA OBRA

TODOS LOS ELEMENTOS CONTROL INTENSO.
COEFICIENTES DE MAYORACIÓN DE LAS ACCIONES SEGÚN EHE.

RECUBRIMIENTO NOMINAL DE LAS ARMADURAS:
-TABLERO: 35mm.
-ALZADOS DE PILAS: 35mm.
-ALZADOS DE ESTRIBOS Y ALETAS: 35mm.
-ZAPATAS, ENCEPADOS Y PILOTES: 30mm

GIF Gestor de Infraestructuras Ferroviarias

TÍTULO PROYECTO DE CONSTRUCCIÓN DE PLATAFORMA
LINEA DE ALTA VELOCIDAD
MADRID - ZARAGOZA - BARCELONA - FRONTERA FRANCESA
TRAMO: CASTELLBISBAL-PAPIOL

AUTOR Intraesa Ingeniería de Trazados y Estructuras — INGENIEROS CONSULTORES

ESCALA 1:75 Numérica | Gráfica 0

FECHA MARZO 2004

TÍTULO DEL PLANO
VIADUCTO SOBRE VIAS DE ANCHO IBÉRICO (VIA P-M)
TABLERO. DEFINICIÓN Y PRETENSADO (I)

Nº DE PLANO 2.9.1.5
Hoja 19 de

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Referencia del Proyecto:

PUERTO-MARTORELL (FAMILIA 1)

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PROGRAMA DE CALCULO DE PRETENSADO EN NERVIOS DE UN EMPARRILLADO

DATOS GENERALES DE PRETENSADO

NUMERO DE NERVIOS = 1
NUMERO DE VANOS = 2
NUMERO DE SECCIONES POR VANO = 21
NUMERO DE MATERIALES = 3
LUZ DEL VANO = 1 L (m) = 18.45
LUZ DEL VANO = 2 L (m) = 20.50

COEFICIENTE DE ROZAMIENTO EN CURVA = 0.21
COEFICIENTE DE DESV. PARASITAS = 0.0060
RELAJACION = 0.04
RETRACCION mm/m = 0.290
COEF. FLUENCIA = 2.300

ACERO DE PRETENSADO (Kp/mm2)

LIMITE DE PROPORCIONALIDAD AL 0,2% = 170.00
TENSION DE ROTURA = 190.00
MODULO DE DEFORMACION = 19000.00

HORMIGON

MODULO DE DEFORMACION DURANTE TESADO (Kp/cm2) = 255000.00
MODULO DE DEFORMACION A 28 DIAS (Kp/cm2) = 310000.00



CARACTERISTICAS MECANICAS DE LA SECCION 1

AREA DE LA SECCION (m2) = 5.905
INERCIA DE LA SECCION (m2) = 1.4893
V_SUP. DE LA SECCION (m2) = 0.67
V_INF. DE LA SECCION (m2) = 0.93
CANTO DE LA SECCION (m2) = 1.60

CARACTERISTICAS MECANICAS DE LA SECCION 2

AREA DE LA SECCION (m2) = 7.476
INERCIA DE LA SECCION (m2) = 1.6074
V_SUP. DE LA SECCION (m2) = 0.70
V_INF. DE LA SECCION (m2) = 0.90
CANTO DE LA SECCION (m2) = 1.60

CARACTERISTICAS MECANICAS DE LA SECCION 3

AREA DE LA SECCION (m2) = 1.000
INERCIA DE LA SECCION (m2) = 2.0000
V_SUP. DE LA SECCION (m2) = 0.70
V_INF. DE LA SECCION (m2) = 0.90
CANTO DE LA SECCION (m2) = 1.60

DEFINICION DEL TRAZADO DEL NERVIO = 1 VANO = 1

Parametros de la parabola = 1
A = 0.00000 B = -0.12632 C = -0.55000
Origen = 0.00 Final = 1.20
Parametros de la parabola = 2
A = 0.00890 B = -0.14766 C = -0.53719
Origen = 1.20 Final = 8.30
Parametros de la parabola = 4
A = 0.00785 B = -0.13029 C = -0.60929
Origen = 8.30 Final = 16.45
Parametros de la parabola = 5
A = -0.03200 B = 1.18127 C = -11.40013
Origen = 16.45 Final = 18.45

(origen en inicio vano)

DEFINICION DEL TRAZADO DEL NERVIO = 1 VANO = 2

Parametros de la parabola = 2
A = -0.03761 B = 0.00000 C = -0.50000
Origen = 0.00 Final = 2.00
Parametros de la parabola = 3
A = 0.00809 B = -0.18280 C = -0.31720
Origen = 2.00 Final = 11.30
Parametros de la parabola = 5
A = 0.00962 B = -0.21731 C = -0.12221
Origen = 11.30 Final = 19.30
Parametros de la parabola = 6
A = 0.00000 B = 0.15385 C = -3.70385
Origen = 19.30 Final = 20.50

(origen en inicio vano)



DEFINICION DEL TRAZADO DEL NERVIO= 1

| I | S | Ysup | Yinf | EXC | ALPHA_IZ | ALPHA_DE | CURV |
|---|---|---|---|---|---|---|---|
| 1 | 0.000 | -0.550 | 1.050 | 0.150 | 0.0000 | 0.8403 | 0.0000 |
| 2 | 0.923 | -0.667 | 0.933 | 0.033 | 0.0008 | 0.8394 | 0.0000 |
| 3 | 1.845 | -0.779 | 0.821 | -0.106 | 0.0126 | 0.8277 | 0.0178 |
| 4 | 2.768 | -0.878 | 0.722 | -0.204 | 0.0290 | 0.8113 | 0.0178 |
| 5 | 3.691 | -0.961 | 0.639 | -0.288 | 0.0455 | 0.7948 | 0.0178 |
| 6 | 4.614 | -1.029 | 0.571 | -0.356 | 0.0619 | 0.7784 | 0.0178 |
| 7 | 5.536 | -1.082 | 0.518 | -0.409 | 0.0784 | 0.7619 | 0.0178 |
| 8 | 6.459 | -1.120 | 0.480 | -0.446 | 0.0948 | 0.7455 | 0.0178 |
| 9 | 7.382 | -1.143 | 0.457 | -0.469 | 0.1112 | 0.7291 | 0.0178 |
| 10 | 8.305 | -1.150 | 0.450 | -0.476 | 0.1276 | 0.7126 | 0.0157 |
| 11 | 9.228 | -1.143 | 0.457 | -0.470 | 0.1422 | 0.6981 | 0.0157 |
| 12 | 10.150 | -1.123 | 0.477 | -0.450 | 0.1567 | 0.6836 | 0.0157 |
| 13 | 11.073 | -1.090 | 0.510 | -0.416 | 0.1712 | 0.6691 | 0.0157 |
| 14 | 11.996 | -1.043 | 0.557 | -0.369 | 0.1857 | 0.6546 | 0.0157 |
| 15 | 12.919 | -0.983 | 0.617 | -0.309 | 0.2002 | 0.6401 | 0.0157 |
| 16 | 13.841 | -0.909 | 0.691 | -0.235 | 0.2147 | 0.6256 | 0.0157 |
| 17 | 14.764 | -0.822 | 0.778 | -0.149 | 0.2292 | 0.6111 | 0.0157 |
| 18 | 15.687 | -0.722 | 0.878 | -0.048 | 0.2437 | 0.5966 | 0.0157 |
| 19 | 16.610 | -0.609 | 0.991 | 0.064 | 0.2657 | 0.5746 | -0.0640 |
| 20 | 17.532 | -0.527 | 1.073 | 0.146 | 0.3248 | 0.5155 | -0.0640 |
| 21 | 18.455 | -0.500 | 1.100 | 0.200 | 0.3839 | 0.4564 | -0.0752 |
| 22 | 19.480 | -0.540 | 1.060 | 0.134 | 0.4611 | 0.3792 | -0.0752 |
| 23 | 20.505 | -0.658 | 0.942 | 0.016 | 0.5352 | 0.3051 | 0.0162 |
| 24 | 21.530 | -0.803 | 0.797 | -0.129 | 0.5518 | 0.2885 | 0.0162 |
| 25 | 22.555 | -0.931 | 0.669 | -0.257 | 0.5684 | 0.2719 | 0.0162 |
| 26 | 23.580 | -1.042 | 0.558 | -0.368 | 0.5850 | 0.2552 | 0.0162 |
| 27 | 24.605 | -1.135 | 0.465 | -0.462 | 0.6016 | 0.2386 | 0.0162 |
| 28 | 25.630 | -1.212 | 0.388 | -0.539 | 0.6183 | 0.2220 | 0.0162 |
| 29 | 26.655 | -1.272 | 0.328 | -0.599 | 0.6349 | 0.2053 | 0.0162 |
| 30 | 27.680 | -1.315 | 0.285 | -0.642 | 0.6515 | 0.1888 | 0.0162 |
| 31 | 28.705 | -1.341 | 0.259 | -0.668 | 0.6681 | 0.1722 | 0.0162 |
| 32 | 29.730 | -1.350 | 0.250 | -0.676 | 0.6847 | 0.1556 | 0.0162 |
| 33 | 30.755 | -1.340 | 0.260 | -0.667 | 0.7044 | 0.1359 | 0.0192 |
| 34 | 31.780 | -1.311 | 0.289 | -0.637 | 0.7241 | 0.1162 | 0.0192 |
| 35 | 32.805 | -1.261 | 0.339 | -0.587 | 0.7439 | 0.0964 | 0.0192 |
| 36 | 33.830 | -1.190 | 0.410 | -0.517 | 0.7636 | 0.0767 | 0.0192 |
| 37 | 34.855 | -1.100 | 0.500 | -0.426 | 0.7833 | 0.0570 | 0.0192 |
| 38 | 35.880 | -0.989 | 0.611 | -0.316 | 0.8031 | 0.0372 | 0.0192 |
| 39 | 36.905 | -0.858 | 0.742 | -0.185 | 0.8227 | 0.0175 | 0.0192 |
| 40 | 37.930 | -0.708 | 0.892 | -0.008 | 0.8394 | 0.0009 | 0.0000 |
| 41 | 38.955 | -0.550 | 1.050 | 0.150 | 0.8403 | 0.0000 | 0.0000 |

SECCIONES INICIAL Y FINAL DEL TRAZADO = 1 41
NUMERO DE VANOS INICIAL Y FINAL DEL TRAZADO = 1 2
PENDIENTE INICIAL DEL TRAZADO = -0.12632
PENDIENTE FINAL DEL TRAZADO = 0.15385

ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

NUMERO DE CABLES = 6

TENSION EN ANCLAJE IZQUIERDO (Kp/mm2) = 142.00
TESAMOS POR LA IZQUIERDA (SI=1) = 1
TENSION EN ANCLAJE DERECHO (Kp/mm2) = 142.00
TESAMOS POR LA DERECHA (SI=1) = 1

PROPORCION DE TESADO EN LA PRIMERA FASE 0.60
AREA DE PRETENSADO (cm2) = 100.80
PENETRACION DE CUNA EN EXTREMO 1 (mm) = 5.000
PENETRACION DE CUNA EN EXTREMO 2 (mm) = 5.000

LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-1 (m) = 11.27
LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-2 (m) = 10.94

TENSION EN LOS CABLES. PERDIDAS INSTANT. (Kp/mm2)

| I | X | To | P_ROZ | P_CUNA | P_ELAS | Ti |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 85.20 | 0.00 | 8.44 | 0.35 | 76.41 |
| 2 | 0.92 | 85.20 | 0.11 | 8.21 | 0.36 | 76.52 |
| 3 | 1.85 | 85.20 | 0.42 | 7.59 | 0.43 | 76.76 |
| 4 | 2.77 | 85.20 | 0.81 | 6.81 | 0.48 | 77.10 |
| 5 | 3.69 | 85.20 | 1.20 | 6.03 | 0.55 | 77.42 |
| 6 | 4.61 | 85.20 | 1.59 | 5.26 | 0.62 | 77.73 |
| 7 | 5.54 | 85.20 | 1.97 | 4.49 | 0.69 | 78.04 |
| 8 | 6.46 | 85.20 | 2.36 | 3.73 | 0.75 | 78.37 |
| 9 | 7.38 | 85.20 | 2.74 | 2.96 | 0.79 | 78.71 |
| 10 | 8.30 | 85.20 | 3.12 | 2.20 | 0.80 | 79.08 |
| 11 | 9.23 | 85.20 | 3.46 | 1.51 | 0.80 | 79.43 |
| 12 | 10.15 | 85.20 | 3.81 | 0.83 | 0.77 | 79.80 |
| 13 | 11.07 | 85.20 | 4.15 | 0.00 | 0.72 | 80.33 |
| 14 | 12.00 | 85.20 | 4.49 | 0.00 | 0.66 | 80.05 |
| 15 | 12.92 | 85.20 | 4.83 | 0.00 | 0.59 | 79.79 |
| 16 | 13.84 | 85.20 | 5.16 | 0.00 | 0.52 | 79.52 |
| 17 | 14.76 | 85.20 | 5.50 | 0.00 | 0.46 | 79.24 |
| 18 | 15.69 | 85.20 | 5.84 | 0.00 | 0.42 | 78.94 |
| 19 | 16.61 | 85.20 | 6.29 | 0.00 | 0.43 | 78.48 |
| 20 | 17.53 | 85.20 | 7.36 | 0.00 | 0.40 | 77.45 |
| 21 | 18.46 | 85.20 | 8.41 | 0.00 | 0.42 | 76.37 |
| 22 | 19.48 | 85.20 | 8.43 | 0.00 | 0.44 | 76.33 |
| 23 | 20.51 | 85.20 | 7.12 | 0.00 | 0.41 | 77.66 |
| 24 | 21.53 | 85.20 | 6.75 | 0.00 | 0.44 | 78.01 |
| 25 | 22.56 | 85.20 | 6.37 | 0.00 | 0.53 | 78.30 |
| 26 | 23.58 | 85.20 | 6.00 | 0.00 | 0.65 | 78.56 |
| 27 | 24.61 | 85.20 | 5.62 | 0.00 | 0.78 | 78.80 |
| 28 | 25.63 | 85.20 | 5.23 | 0.00 | 0.91 | 79.05 |
| 29 | 26.66 | 85.20 | 4.85 | 0.00 | 1.03 | 79.32 |
| 30 | 27.68 | 85.20 | 4.47 | 0.00 | 1.13 | 79.61 |
| 31 | 28.71 | 85.20 | 4.08 | 0.00 | 1.19 | 79.93 |
| 32 | 29.73 | 85.20 | 3.69 | 1.30 | 1.20 | 79.01 |
| 33 | 30.76 | 85.20 | 3.25 | 2.19 | 1.17 | 78.60 |
| 34 | 31.78 | 85.20 | 2.80 | 3.08 | 1.10 | 78.22 |
| 35 | 32.81 | 85.20 | 2.35 | 3.98 | 0.99 | 77.88 |
| 36 | 33.83 | 85.20 | 1.90 | 4.88 | 0.86 | 77.56 |
| 37 | 34.86 | 85.20 | 1.45 | 5.79 | 0.71 | 77.25 |
| 38 | 35.88 | 85.20 | 0.99 | 6.70 | 0.57 | 76.93 |
| 39 | 36.91 | 85.20 | 0.53 | 7.62 | 0.41 | 76.63 |
| 40 | 37.93 | 85.20 | 0.13 | 8.43 | 0.32 | 76.32 |
| 41 | 38.96 | 85.20 | 0.00 | 8.68 | 0.35 | 76.16 |

ALARGAMIENTO DE LOS CABLES (sobre embolo)= 167.0 mm

ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES. PERDIDAS DIFERIDAS (Kp/mm2)

| I | S | Ti | P_RETRA | P_FLUE | P_RELAJ. |
|---|---|---|---|---|---|
| 1 | 0.00 | 76.41 | 0.00 | 0.00 | 0.00 |
| 2 | 0.92 | 76.52 | 0.00 | 0.00 | 0.00 |
| 3 | 1.85 | 76.76 | 0.00 | 0.00 | 0.00 |
| 4 | 2.77 | 77.10 | 0.00 | 0.00 | 0.00 |
| 5 | 3.69 | 77.42 | 0.00 | 0.00 | 0.00 |
| 6 | 4.61 | 77.73 | 0.00 | 0.00 | 0.00 |
| 7 | 5.54 | 78.04 | 0.00 | 0.00 | 0.00 |
| 8 | 6.46 | 78.37 | 0.00 | 0.00 | 0.00 |
| 9 | 7.38 | 78.71 | 0.00 | 0.00 | 0.00 |
| 10 | 8.30 | 79.08 | 0.00 | 0.00 | 0.00 |
| 11 | 9.23 | 79.43 | 0.00 | 0.00 | 0.00 |
| 12 | 10.15 | 79.80 | 0.00 | 0.00 | 0.00 |
| 13 | 11.07 | 80.33 | 0.00 | 0.00 | 0.00 |
| 14 | 12.00 | 80.05 | 0.00 | 0.00 | 0.00 |
| 15 | 12.92 | 79.79 | 0.00 | 0.00 | 0.00 |
| 16 | 13.84 | 79.52 | 0.00 | 0.00 | 0.00 |
| 17 | 14.76 | 79.24 | 0.00 | 0.00 | 0.00 |
| 18 | 15.69 | 78.94 | 0.00 | 0.00 | 0.00 |
| 19 | 16.61 | 78.48 | 0.00 | 0.00 | 0.00 |
| 20 | 17.53 | 77.45 | 0.00 | 0.00 | 0.00 |
| 21 | 18.46 | 76.37 | 0.00 | 0.00 | 0.00 |
| 22 | 19.48 | 76.33 | 0.00 | 0.00 | 0.00 |
| 23 | 20.51 | 77.66 | 0.00 | 0.00 | 0.00 |
| 24 | 21.53 | 78.01 | 0.00 | 0.00 | 0.00 |
| 25 | 22.56 | 78.30 | 0.00 | 0.00 | 0.00 |
| 26 | 23.58 | 78.56 | 0.00 | 0.00 | 0.00 |
| 27 | 24.61 | 78.80 | 0.00 | 0.00 | 0.00 |
| 28 | 25.63 | 79.05 | 0.00 | 0.00 | 0.00 |
| 29 | 26.66 | 79.32 | 0.00 | 0.00 | 0.00 |
| 30 | 27.68 | 79.61 | 0.00 | 0.00 | 0.00 |
| 31 | 28.71 | 79.93 | 0.00 | 0.00 | 0.00 |
| 32 | 29.73 | 79.01 | 0.00 | 0.00 | 0.00 |
| 33 | 30.76 | 78.60 | 0.00 | 0.00 | 0.00 |
| 34 | 31.78 | 78.22 | 0.00 | 0.00 | 0.00 |
| 35 | 32.81 | 77.88 | 0.00 | 0.00 | 0.00 |
| 36 | 33.83 | 77.56 | 0.00 | 0.00 | 0.00 |
| 37 | 34.86 | 77.25 | 0.00 | 0.00 | 0.00 |
| 38 | 35.88 | 76.93 | 0.00 | 0.00 | 0.00 |
| 39 | 36.91 | 76.63 | 0.00 | 0.00 | 0.00 |
| 40 | 37.93 | 76.32 | 0.00 | 0.00 | 0.00 |
| 41 | 38.96 | 76.16 | 0.00 | 0.00 | 0.00 |



ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES (Kp/mm2)

| I | S | To | APi | Ti | APf | Tf |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 85.20 | 8.79 | 76.41 | 0.00 | 76.41 |
| 2 | 0.92 | 85.20 | 8.68 | 76.52 | 0.00 | 76.52 |
| 3 | 1.85 | 85.20 | 8.44 | 76.76 | 0.00 | 76.76 |
| 4 | 2.77 | 85.20 | 8.10 | 77.10 | 0.00 | 77.10 |
| 5 | 3.69 | 85.20 | 7.78 | 77.42 | 0.00 | 77.42 |
| 6 | 4.61 | 85.20 | 7.47 | 77.73 | 0.00 | 77.73 |
| 7 | 5.54 | 85.20 | 7.16 | 78.04 | 0.00 | 78.04 |
| 8 | 6.46 | 85.20 | 6.83 | 78.37 | 0.00 | 78.37 |
| 9 | 7.38 | 85.20 | 6.49 | 78.71 | 0.00 | 78.71 |
| 10 | 8.30 | 85.20 | 6.12 | 79.08 | 0.00 | 79.08 |
| 11 | 9.23 | 85.20 | 5.77 | 79.43 | 0.00 | 79.43 |
| 12 | 10.15 | 85.20 | 5.40 | 79.80 | 0.00 | 79.80 |
| 13 | 11.07 | 85.20 | 4.87 | 80.33 | 0.00 | 80.33 |
| 14 | 12.00 | 85.20 | 5.15 | 80.05 | 0.00 | 80.05 |
| 15 | 12.92 | 85.20 | 5.41 | 79.79 | 0.00 | 79.79 |
| 16 | 13.84 | 85.20 | 5.68 | 79.52 | 0.00 | 79.52 |
| 17 | 14.76 | 85.20 | 5.96 | 79.24 | 0.00 | 79.24 |
| 18 | 15.69 | 85.20 | 6.26 | 78.94 | 0.00 | 78.94 |
| 19 | 16.61 | 85.20 | 6.72 | 78.48 | 0.00 | 78.48 |
| 20 | 17.53 | 85.20 | 7.75 | 77.45 | 0.00 | 77.45 |
| 21 | 18.46 | 85.20 | 8.83 | 76.37 | 0.00 | 76.37 |
| 22 | 19.48 | 85.20 | 8.87 | 76.33 | 0.00 | 76.33 |
| 23 | 20.51 | 85.20 | 7.54 | 77.66 | 0.00 | 77.66 |
| 24 | 21.53 | 85.20 | 7.19 | 78.01 | 0.00 | 78.01 |
| 25 | 22.56 | 85.20 | 6.90 | 78.30 | 0.00 | 78.30 |
| 26 | 23.58 | 85.20 | 6.64 | 78.56 | 0.00 | 78.56 |
| 27 | 24.61 | 85.20 | 6.40 | 78.80 | 0.00 | 78.80 |
| 28 | 25.63 | 85.20 | 6.15 | 79.05 | 0.00 | 79.05 |
| 29 | 26.66 | 85.20 | 5.88 | 79.32 | 0.00 | 79.32 |
| 30 | 27.68 | 85.20 | 5.59 | 79.61 | 0.00 | 79.61 |
| 31 | 28.71 | 85.20 | 5.27 | 79.93 | 0.00 | 79.93 |
| 32 | 29.73 | 85.20 | 6.19 | 79.01 | 0.00 | 79.01 |
| 33 | 30.76 | 85.20 | 6.60 | 78.60 | 0.00 | 78.60 |
| 34 | 31.78 | 85.20 | 6.98 | 78.22 | 0.00 | 78.22 |
| 35 | 32.81 | 85.20 | 7.32 | 77.88 | 0.00 | 77.88 |
| 36 | 33.83 | 85.20 | 7.64 | 77.56 | 0.00 | 77.56 |
| 37 | 34.86 | 85.20 | 7.95 | 77.25 | 0.00 | 77.25 |
| 38 | 35.88 | 85.20 | 8.27 | 76.93 | 0.00 | 76.93 |
| 39 | 36.91 | 85.20 | 8.57 | 76.63 | 0.00 | 76.63 |
| 40 | 37.93 | 85.20 | 8.88 | 76.32 | 0.00 | 76.32 |
| 41 | 38.96 | 85.20 | 9.04 | 76.16 | 0.00 | 76.16 |

ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

FUERZAS EN LOS CABLES (T, m)

| I | S(m) | Pi (T) | Mpi (mT) | Upi (T/m) | Pf (T) | Mpf (mT) | Upf (T/m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 770.2 | -115.53 | 0.00 | 770.2 | -115.53 | 0.00 |
| 2 | 0.92 | 771.3 | -25.79 | 0.00 | 771.3 | -25.79 | 0.00 |
| 3 | 1.85 | 773.7 | 81.94 | 13.77 | 773.7 | 81.94 | 13.77 |
| 4 | 2.77 | 777.1 | 158.76 | 13.83 | 777.1 | 158.76 | 13.83 |
| 5 | 3.69 | 780.3 | 224.38 | 13.88 | 780.3 | 224.38 | 13.88 |
| 6 | 4.61 | 783.5 | 278.63 | 13.94 | 783.5 | 278.63 | 13.94 |
| 7 | 5.54 | 786.7 | 321.41 | 14.00 | 786.7 | 321.41 | 14.00 |
| 8 | 6.46 | 790.0 | 352.60 | 14.05 | 790.0 | 352.60 | 14.05 |
| 9 | 7.38 | 793.4 | 372.11 | 14.12 | 793.4 | 372.11 | 14.12 |
| 10 | 8.30 | 797.1 | 379.81 | 12.51 | 797.1 | 379.81 | 12.51 |
| 11 | 9.23 | 800.6 | 376.09 | 12.57 | 800.6 | 376.09 | 12.57 |
| 12 | 10.15 | 804.4 | 361.67 | 12.63 | 804.4 | 361.67 | 12.63 |
| 13 | 11.07 | 809.7 | 336.96 | 12.71 | 809.7 | 336.96 | 12.71 |
| 14 | 12.00 | 806.9 | 298.00 | 12.67 | 806.9 | 298.00 | 12.67 |
| 15 | 12.92 | 804.2 | 248.57 | 12.62 | 804.2 | 248.57 | 12.62 |
| 16 | 13.84 | 801.5 | 188.76 | 12.58 | 801.5 | 188.76 | 12.58 |
| 17 | 14.76 | 798.7 | 118.65 | 12.54 | 798.7 | 118.65 | 12.54 |
| 18 | 15.69 | 795.7 | 38.38 | 12.49 | 795.7 | 38.38 | 12.49 |
| 19 | 16.61 | 791.1 | -51.02 | -50.64 | 791.1 | -51.02 | -50.64 |
| 20 | 17.53 | 780.7 | -114.17 | -49.97 | 780.7 | -114.17 | -49.97 |
| 21 | 18.46 | 769.8 | -153.97 | -57.91 | 769.8 | -153.97 | -57.91 |
| 22 | 19.48 | 769.5 | -103.10 | -57.88 | 769.5 | -103.10 | -57.88 |
| 23 | 20.51 | 782.8 | -12.18 | 12.66 | 782.8 | -12.18 | 12.66 |
| 24 | 21.53 | 786.3 | 101.69 | 12.72 | 786.3 | 101.69 | 12.72 |
| 25 | 22.56 | 789.3 | 203.00 | 12.77 | 789.3 | 203.00 | 12.77 |
| 26 | 23.58 | 791.9 | 291.48 | 12.81 | 791.9 | 291.48 | 12.81 |
| 27 | 24.61 | 794.4 | 366.97 | 12.85 | 794.4 | 366.97 | 12.85 |
| 28 | 25.63 | 796.9 | 429.40 | 12.89 | 796.9 | 429.40 | 12.89 |
| 29 | 26.66 | 799.5 | 478.73 | 12.93 | 799.5 | 478.73 | 12.93 |
| 30 | 27.68 | 802.4 | 514.90 | 12.98 | 802.4 | 514.90 | 12.98 |
| 31 | 28.71 | 805.7 | 537.87 | 13.03 | 805.7 | 537.87 | 13.03 |
| 32 | 29.73 | 796.4 | 538.78 | 12.88 | 796.4 | 538.78 | 12.88 |
| 33 | 30.76 | 792.2 | 528.33 | 15.24 | 792.2 | 528.33 | 15.24 |
| 34 | 31.78 | 788.5 | 502.31 | 15.16 | 788.5 | 502.31 | 15.16 |
| 35 | 32.81 | 785.0 | 460.84 | 15.10 | 785.0 | 460.84 | 15.10 |
| 36 | 33.83 | 781.8 | 404.06 | 15.03 | 781.8 | 404.06 | 15.03 |
| 37 | 34.86 | 778.7 | 332.04 | 14.97 | 778.7 | 332.04 | 14.97 |
| 38 | 35.88 | 775.5 | 244.88 | 14.91 | 775.5 | 244.88 | 14.91 |
| 39 | 36.91 | 772.5 | 142.86 | 14.86 | 772.5 | 142.86 | 14.86 |
| 40 | 37.93 | 769.3 | 5.92 | 0.00 | 769.3 | 5.92 | 0.00 |
| 41 | 38.96 | 767.7 | -115.16 | 0.00 | 767.7 | -115.16 | 0.00 |



ETAPA DE TESADO INICIAL

FUERZAS HORIZONTALES DE DESVIACION

| I | S(m) | R(m) | Ti (T) | Uh(T/m) | Tf(T) | Uh(T/m) |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 1100.0 | 770.19 | -0.70 | 770.19 | -0.70 |
| 2 | 0.92 | 1100.0 | 771.28 | -0.70 | 771.28 | -0.70 |
| 3 | 1.85 | 1100.0 | 773.72 | -0.70 | 773.72 | -0.70 |
| 4 | 2.77 | 1100.0 | 777.13 | -0.71 | 777.13 | -0.71 |
| 5 | 3.69 | 1100.0 | 780.35 | -0.71 | 780.35 | -0.71 |
| 6 | 4.61 | 1100.0 | 783.49 | -0.71 | 783.49 | -0.71 |
| 7 | 5.54 | 1100.0 | 786.67 | -0.72 | 786.67 | -0.72 |
| 8 | 6.46 | 1100.0 | 789.95 | -0.72 | 789.95 | -0.72 |
| 9 | 7.38 | 1100.0 | 793.41 | -0.72 | 793.41 | -0.72 |
| 10 | 8.30 | 1100.0 | 797.08 | -0.73 | 797.08 | -0.73 |
| 11 | 9.23 | 1100.0 | 800.63 | -0.73 | 800.63 | -0.73 |
| 12 | 10.15 | 1100.0 | 804.37 | -0.73 | 804.37 | -0.73 |
| 13 | 11.07 | 1100.0 | 809.71 | -0.73 | 809.71 | -0.73 |
| 14 | 12.00 | 1100.0 | 806.94 | -0.73 | 806.94 | -0.73 |
| 15 | 12.92 | 1100.0 | 804.24 | -0.73 | 804.24 | -0.73 |
| 16 | 13.84 | 1100.0 | 801.54 | -0.73 | 801.54 | -0.73 |
| 17 | 14.76 | 1100.0 | 798.74 | -0.72 | 798.74 | -0.72 |
| 18 | 15.69 | 1100.0 | 795.72 | -0.72 | 795.72 | -0.72 |
| 19 | 16.61 | 1100.0 | 791.10 | -0.71 | 791.10 | -0.71 |
| 20 | 17.53 | 1100.0 | 780.66 | -0.70 | 780.66 | -0.70 |
| 21 | 18.46 | 1100.0 | 769.83 | -0.70 | 769.83 | -0.70 |
| 22 | 19.48 | 1100.0 | 769.46 | -0.71 | 769.46 | -0.71 |
| 23 | 20.51 | 1100.0 | 782.84 | -0.71 | 782.84 | -0.71 |
| 24 | 21.53 | 1100.0 | 786.31 | -0.72 | 786.31 | -0.72 |
| 25 | 22.56 | 1100.0 | 789.25 | -0.72 | 789.25 | -0.72 |
| 26 | 23.58 | 1100.0 | 791.87 | -0.72 | 791.87 | -0.72 |
| 27 | 24.61 | 1100.0 | 794.35 | -0.72 | 794.35 | -0.72 |
| 28 | 25.63 | 1100.0 | 796.86 | -0.73 | 796.86 | -0.73 |
| 29 | 26.66 | 1100.0 | 799.52 | -0.73 | 799.52 | -0.73 |
| 30 | 27.68 | 1100.0 | 802.43 | -0.73 | 802.43 | -0.73 |
| 31 | 28.71 | 1100.0 | 805.70 | -0.73 | 805.70 | -0.73 |
| 32 | 29.73 | 1100.0 | 796.43 | -0.72 | 796.43 | -0.72 |
| 33 | 30.76 | 1100.0 | 792.24 | -0.72 | 792.24 | -0.72 |
| 34 | 31.78 | 1100.0 | 788.46 | -0.72 | 788.46 | -0.72 |
| 35 | 32.81 | 1100.0 | 785.01 | -0.71 | 785.01 | -0.71 |
| 36 | 33.83 | 1100.0 | 781.81 | -0.71 | 781.81 | -0.71 |
| 37 | 34.86 | 1100.0 | 778.69 | -0.71 | 778.69 | -0.71 |
| 38 | 35.88 | 1100.0 | 775.48 | -0.70 | 775.48 | -0.70 |
| 39 | 36.91 | 1100.0 | 772.47 | -0.70 | 772.47 | -0.70 |
| 40 | 37.93 | 1100.0 | 769.31 | -0.70 | 769.31 | -0.70 |
| 41 | 38.96 | 1100.0 | 767.71 | -0.35 | 767.71 | -0.35 |

TESADO DEFINITIVO

PRETENSADO EN EL NERVIO = 1

NUMERO DE CABLES = 6

TENSION EN ANCLAJE IZQUIERDO (Kp/mm2) = 142.00
TESAMOS POR LA IZQUIERDA (SI=1) = 1
TENSION EN ANCLAJE DERECHO (Kp/mm2) = 142.00
TESAMOS POR LA DERECHA (SI=1) = 1

PROPORCION DE TESADO EN LA PRIMERA FASE 0.60
AREA DE PRETENSADO (cm2) = 100.80
PENETRACION DE CUNA EN EXTREMO 1 (mm) = 5.000
PENETRACION DE CUNA EN EXTREMO 2 (mm) = 5.000

LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-1 (m) = 8.72
LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-2 (m) = 8.47

TENSION EN LOS CABLES. PERDIDAS INSTANT. (Kp/mm2)

| I | X | To | P_ROZ | P_CUNA | P_ELAS | Ti |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 142.00 | 0.00 | 10.91 | 0.61 | 130.49 |
| 2 | 0.92 | 142.00 | 0.19 | 10.53 | 0.62 | 130.66 |
| 3 | 1.85 | 142.00 | 0.70 | 9.50 | 0.73 | 131.07 |
| 4 | 2.77 | 142.00 | 1.35 | 8.20 | 0.82 | 131.63 |
| 5 | 3.69 | 142.00 | 2.00 | 6.90 | 0.94 | 132.16 |
| 6 | 4.61 | 142.00 | 2.65 | 5.62 | 1.06 | 132.67 |
| 7 | 5.54 | 142.00 | 3.29 | 4.33 | 1.18 | 133.20 |
| 8 | 6.46 | 142.00 | 3.93 | 3.05 | 1.28 | 133.74 |
| 9 | 7.38 | 142.00 | 4.56 | 1.78 | 1.35 | 134.31 |
| 10 | 8.30 | 142.00 | 5.19 | 0.00 | 1.38 | 135.43 |
| 11 | 9.23 | 142.00 | 5.77 | 0.00 | 1.35 | 134.88 |
| 12 | 10.15 | 142.00 | 6.34 | 0.00 | 1.30 | 134.36 |
| 13 | 11.07 | 142.00 | 6.91 | 0.00 | 1.21 | 133.88 |
| 14 | 12.00 | 142.00 | 7.48 | 0.00 | 1.10 | 133.42 |
| 15 | 12.92 | 142.00 | 8.04 | 0.00 | 0.98 | 132.98 |
| 16 | 13.84 | 142.00 | 8.61 | 0.00 | 0.86 | 132.53 |
| 17 | 14.76 | 142.00 | 9.17 | 0.00 | 0.77 | 132.07 |
| 18 | 15.69 | 142.00 | 9.73 | 0.00 | 0.71 | 131.57 |
| 19 | 16.61 | 142.00 | 10.49 | 0.00 | 0.71 | 130.80 |
| 20 | 17.53 | 142.00 | 12.26 | 0.00 | 0.66 | 129.08 |
| 21 | 18.46 | 142.00 | 14.01 | 0.00 | 0.70 | 127.29 |
| 22 | 19.48 | 142.00 | 14.05 | 0.00 | 0.73 | 127.22 |
| 23 | 20.51 | 142.00 | 11.87 | 0.00 | 0.69 | 129.44 |
| 24 | 21.53 | 142.00 | 11.25 | 0.00 | 0.74 | 130.01 |
| 25 | 22.56 | 142.00 | 10.62 | 0.00 | 0.88 | 130.50 |
| 26 | 23.58 | 142.00 | 9.99 | 0.00 | 1.08 | 130.93 |
| 27 | 24.61 | 142.00 | 9.36 | 0.00 | 1.30 | 131.34 |
| 28 | 25.63 | 142.00 | 8.72 | 0.00 | 1.52 | 131.76 |
| 29 | 26.66 | 142.00 | 8.08 | 0.00 | 1.72 | 132.20 |
| 30 | 27.68 | 142.00 | 7.45 | 0.00 | 1.88 | 132.68 |
| 31 | 28.71 | 142.00 | 6.80 | 0.00 | 1.98 | 133.22 |
| 32 | 29.73 | 142.00 | 6.15 | 0.00 | 2.03 | 133.82 |
| 33 | 30.76 | 142.00 | 5.41 | 0.00 | 2.00 | 134.59 |
| 34 | 31.78 | 142.00 | 4.67 | 1.88 | 1.87 | 133.57 |
| 35 | 32.81 | 142.00 | 3.92 | 3.38 | 1.69 | 133.01 |
| 36 | 33.83 | 142.00 | 3.17 | 4.89 | 1.46 | 132.48 |
| 37 | 34.86 | 142.00 | 2.41 | 6.40 | 1.21 | 131.97 |
| 38 | 35.88 | 142.00 | 1.65 | 7.92 | 0.98 | 131.45 |
| 39 | 36.91 | 142.00 | 0.89 | 9.45 | 0.71 | 130.96 |
| 40 | 37.93 | 142.00 | 0.21 | 10.80 | 0.55 | 130.44 |
| 41 | 38.96 | 142.00 | 0.00 | 11.22 | 0.60 | 130.17 |

ALARGAMIENTO DE LOS CABLES (sobre embolo)= 273.1 mm

TENSION EN LOS CABLES. PERDIDAS INSTANT. (Kp/mm2)

| I | X | To | P_ROZ | P_CUNA | P_ELAS | Ti |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 142.00 | 0.00 | 10.91 | 0.61 | 130.49 |
| 2 | 0.92 | 142.00 | 0.19 | 10.53 | 0.62 | 130.66 |
| 3 | 1.85 | 142.00 | 0.70 | 9.50 | 0.73 | 131.07 |
| 4 | 2.77 | 142.00 | 1.35 | 8.20 | 0.82 | 131.63 |
| 5 | 3.69 | 142.00 | 2.00 | 6.90 | 0.94 | 132.16 |
| 6 | 4.61 | 142.00 | 2.65 | 5.62 | 1.06 | 132.67 |
| 7 | 5.54 | 142.00 | 3.29 | 4.33 | 1.18 | 133.20 |
| 8 | 6.46 | 142.00 | 3.93 | 3.05 | 1.28 | 133.74 |
| 9 | 7.38 | 142.00 | 4.56 | 1.78 | 1.35 | 134.31 |
| 10 | 8.30 | 142.00 | 5.19 | 0.00 | 1.38 | 135.43 |
| 11 | 9.23 | 142.00 | 5.77 | 0.00 | 1.35 | 134.88 |
| 12 | 10.15 | 142.00 | 6.34 | 0.00 | 1.30 | 134.36 |
| 13 | 11.07 | 142.00 | 6.91 | 0.00 | 1.21 | 133.88 |
| 14 | 12.00 | 142.00 | 7.48 | 0.00 | 1.10 | 133.42 |
| 15 | 12.92 | 142.00 | 8.04 | 0.00 | 0.98 | 132.98 |
| 16 | 13.84 | 142.00 | 8.61 | 0.00 | 0.86 | 132.53 |
| 17 | 14.76 | 142.00 | 9.17 | 0.00 | 0.77 | 132.07 |
| 18 | 15.69 | 142.00 | 9.73 | 0.00 | 0.71 | 131.57 |
| 19 | 16.61 | 142.00 | 10.49 | 0.00 | 0.71 | 130.80 |
| 20 | 17.53 | 142.00 | 12.26 | 0.00 | 0.66 | 129.08 |
| 21 | 18.46 | 142.00 | 14.01 | 0.00 | 0.70 | 127.29 |
| 22 | 19.48 | 142.00 | 14.05 | 0.00 | 0.73 | 127.22 |
| 23 | 20.51 | 142.00 | 11.87 | 0.00 | 0.69 | 129.44 |
| 24 | 21.53 | 142.00 | 11.25 | 0.00 | 0.74 | 130.01 |
| 25 | 22.56 | 142.00 | 10.62 | 0.00 | 0.88 | 130.50 |
| 26 | 23.58 | 142.00 | 9.99 | 0.00 | 1.08 | 130.93 |
| 27 | 24.61 | 142.00 | 9.36 | 0.00 | 1.30 | 131.34 |
| 28 | 25.63 | 142.00 | 8.72 | 0.00 | 1.52 | 131.76 |
| 29 | 26.66 | 142.00 | 8.08 | 0.00 | 1.72 | 132.20 |
| 30 | 27.68 | 142.00 | 7.45 | 0.00 | 1.88 | 132.68 |
| 31 | 28.71 | 142.00 | 6.80 | 0.00 | 1.98 | 133.22 |
| 32 | 29.73 | 142.00 | 6.15 | 0.00 | 2.03 | 133.82 |
| 33 | 30.76 | 142.00 | 5.41 | 0.00 | 2.00 | 134.59 |
| 34 | 31.78 | 142.00 | 4.67 | 1.88 | 1.87 | 133.57 |
| 35 | 32.81 | 142.00 | 3.92 | 3.38 | 1.69 | 133.01 |
| 36 | 33.83 | 142.00 | 3.17 | 4.89 | 1.46 | 132.48 |
| 37 | 34.86 | 142.00 | 2.41 | 6.40 | 1.21 | 131.97 |
| 38 | 35.88 | 142.00 | 1.65 | 7.92 | 0.98 | 131.45 |
| 39 | 36.91 | 142.00 | 0.89 | 9.45 | 0.71 | 130.96 |
| 40 | 37.93 | 142.00 | 0.21 | 10.80 | 0.55 | 130.44 |
| 41 | 38.96 | 142.00 | 0.00 | 11.22 | 0.60 | 130.17 |

ALARGAMIENTO DE LOS CABLES (sobre embolo)= 272.9 mm

PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES. PERDIDAS DIFERIDAS (Kp/mm2)

| I | S | Ti | P_RETRA | P_FLUE | P_RELAJ. |
|---|---|---|---|---|---|
| 1 | 0.00 | 130.49 | 5.51 | 3.00 | 5.02 |
| 2 | 0.92 | 130.66 | 5.51 | 2.84 | 5.01 |
| 3 | 1.85 | 131.07 | 5.51 | 2.96 | 5.04 |
| 4 | 2.77 | 131.63 | 5.51 | 2.79 | 5.05 |
| 5 | 3.69 | 132.16 | 5.51 | 2.65 | 5.06 |
| 6 | 4.61 | 132.67 | 5.51 | 2.56 | 5.07 |
| 7 | 5.54 | 133.20 | 5.51 | 2.51 | 5.09 |
| 8 | 6.46 | 133.74 | 5.51 | 2.50 | 5.11 |
| 9 | 7.38 | 134.31 | 5.51 | 2.53 | 5.13 |
| 10 | 8.30 | 135.43 | 5.51 | 2.63 | 5.19 |
| 11 | 9.23 | 134.88 | 5.51 | 2.68 | 5.17 |
| 12 | 10.15 | 134.36 | 5.51 | 2.77 | 5.15 |
| 13 | 11.07 | 133.88 | 5.51 | 2.87 | 5.14 |
| 14 | 12.00 | 133.42 | 5.51 | 2.99 | 5.14 |
| 15 | 12.92 | 132.98 | 5.51 | 3.11 | 5.13 |
| 16 | 13.84 | 132.53 | 5.51 | 3.20 | 5.12 |
| 17 | 14.76 | 132.07 | 5.51 | 3.24 | 5.10 |
| 18 | 15.69 | 131.57 | 5.51 | 3.21 | 5.08 |
| 19 | 16.61 | 130.80 | 5.51 | 3.06 | 5.04 |
| 20 | 17.53 | 129.08 | 5.51 | 2.38 | 4.91 |
| 21 | 18.46 | 127.29 | 5.51 | 1.87 | 4.80 |
| 22 | 19.48 | 127.22 | 5.51 | 2.76 | 4.87 |
| 23 | 20.51 | 129.44 | 5.51 | 3.10 | 4.98 |
| 24 | 21.53 | 130.01 | 5.51 | 3.21 | 5.02 |
| 25 | 22.56 | 130.50 | 5.51 | 3.19 | 5.03 |
| 26 | 23.58 | 130.93 | 5.51 | 3.08 | 5.04 |
| 27 | 24.61 | 131.34 | 5.51 | 2.92 | 5.05 |
| 28 | 25.63 | 131.76 | 5.51 | 2.75 | 5.05 |
| 29 | 26.66 | 132.20 | 5.51 | 2.59 | 5.05 |
| 30 | 27.68 | 132.68 | 5.51 | 2.46 | 5.06 |
| 31 | 28.71 | 133.22 | 5.51 | 2.37 | 5.08 |
| 32 | 29.73 | 133.82 | 5.51 | 2.34 | 5.10 |
| 33 | 30.76 | 134.59 | 5.51 | 2.36 | 5.13 |
| 34 | 31.78 | 133.57 | 5.51 | 2.29 | 5.09 |
| 35 | 32.81 | 133.01 | 5.51 | 2.29 | 5.06 |
| 36 | 33.83 | 132.48 | 5.51 | 2.35 | 5.05 |
| 37 | 34.86 | 131.97 | 5.51 | 2.45 | 5.03 |
| 38 | 35.88 | 131.45 | 5.51 | 2.61 | 5.03 |
| 39 | 36.91 | 130.96 | 5.51 | 2.47 | 4.99 |
| 40 | 37.93 | 130.44 | 5.51 | 2.46 | 4.97 |
| 41 | 38.96 | 130.17 | 5.51 | 2.76 | 4.99 |



PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES (Kp/mm2)

| I | S | To | APi | Ti | APf | Tf |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 142.00 | 11.51 | 130.49 | 13.52 | 116.96 |
| 2 | 0.92 | 142.00 | 11.34 | 130.66 | 13.37 | 117.30 |
| 3 | 1.85 | 142.00 | 10.93 | 131.07 | 13.51 | 117.56 |
| 4 | 2.77 | 142.00 | 10.37 | 131.63 | 13.34 | 118.28 |
| 5 | 3.69 | 142.00 | 9.84 | 132.16 | 13.22 | 118.94 |
| 6 | 4.61 | 142.00 | 9.33 | 132.67 | 13.14 | 119.54 |
| 7 | 5.54 | 142.00 | 8.80 | 133.20 | 13.10 | 120.09 |
| 8 | 6.46 | 142.00 | 8.26 | 133.74 | 13.12 | 120.62 |
| 9 | 7.38 | 142.00 | 7.69 | 134.31 | 13.18 | 121.13 |
| 10 | 8.30 | 142.00 | 6.57 | 135.43 | 13.33 | 122.10 |
| 11 | 9.23 | 142.00 | 7.12 | 134.88 | 13.36 | 121.52 |
| 12 | 10.15 | 142.00 | 7.64 | 134.36 | 13.43 | 120.93 |
| 13 | 11.07 | 142.00 | 8.12 | 133.88 | 13.53 | 120.35 |
| 14 | 12.00 | 142.00 | 8.58 | 133.42 | 13.64 | 119.78 |
| 15 | 12.92 | 142.00 | 9.02 | 132.98 | 13.75 | 119.23 |
| 16 | 13.84 | 142.00 | 9.47 | 132.53 | 13.83 | 118.70 |
| 17 | 14.76 | 142.00 | 9.93 | 132.07 | 13.86 | 118.21 |
| 18 | 15.69 | 142.00 | 10.43 | 131.57 | 13.80 | 117.77 |
| 19 | 16.61 | 142.00 | 11.20 | 130.80 | 13.60 | 117.20 |
| 20 | 17.53 | 142.00 | 12.92 | 129.08 | 12.81 | 116.27 |
| 21 | 18.46 | 142.00 | 14.71 | 127.29 | 12.18 | 115.10 |
| 22 | 19.48 | 142.00 | 14.78 | 127.22 | 13.14 | 114.09 |
| 23 | 20.51 | 142.00 | 12.56 | 129.44 | 13.59 | 115.85 |
| 24 | 21.53 | 142.00 | 11.99 | 130.01 | 13.73 | 116.28 |
| 25 | 22.56 | 142.00 | 11.50 | 130.50 | 13.73 | 116.77 |
| 26 | 23.58 | 142.00 | 11.07 | 130.93 | 13.63 | 117.30 |
| 27 | 24.61 | 142.00 | 10.66 | 131.34 | 13.48 | 117.86 |
| 28 | 25.63 | 142.00 | 10.24 | 131.76 | 13.31 | 118.44 |
| 29 | 26.66 | 142.00 | 9.80 | 132.20 | 13.15 | 119.04 |
| 30 | 27.68 | 142.00 | 9.32 | 132.68 | 13.03 | 119.65 |
| 31 | 28.71 | 142.00 | 8.78 | 133.22 | 12.96 | 120.26 |
| 32 | 29.73 | 142.00 | 8.18 | 133.82 | 12.95 | 120.87 |
| 33 | 30.76 | 142.00 | 7.41 | 134.59 | 13.00 | 121.59 |
| 34 | 31.78 | 142.00 | 8.43 | 133.57 | 12.88 | 120.69 |
| 35 | 32.81 | 142.00 | 8.99 | 133.01 | 12.87 | 120.14 |
| 36 | 33.83 | 142.00 | 9.52 | 132.48 | 12.90 | 119.58 |
| 37 | 34.86 | 142.00 | 10.03 | 131.97 | 13.00 | 118.98 |
| 38 | 35.88 | 142.00 | 10.55 | 131.45 | 13.15 | 118.30 |
| 39 | 36.91 | 142.00 | 11.04 | 130.96 | 12.97 | 117.99 |
| 40 | 37.93 | 142.00 | 11.56 | 130.44 | 12.95 | 117.49 |
| 41 | 38.96 | 142.00 | 11.83 | 130.17 | 13.26 | 116.91 |

PRETENSADO EN EL NERVIO = 1

FUERZAS EN LOS CABLES (T, m)

| I | S(m) | Pi (T) | Mpi (mT) | Upi (T/m) | Pf (T) | Mpf (mT) | Upf (T/m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 1315.3 | -197.29 | 0.00 | 1179.0 | -176.85 | 0.00 |
| 2 | 0.92 | 1317.1 | -44.05 | 0.00 | 1182.4 | -39.54 | 0.00 |
| 3 | 1.85 | 1321.1 | 139.92 | 23.50 | 1185.0 | 125.50 | 21.08 |
| 4 | 2.77 | 1326.8 | 271.06 | 23.61 | 1192.3 | 243.58 | 21.21 |
| 5 | 3.69 | 1332.1 | 383.04 | 23.70 | 1198.9 | 344.72 | 21.33 |
| 6 | 4.61 | 1337.4 | 475.60 | 23.79 | 1204.9 | 428.50 | 21.44 |
| 7 | 5.54 | 1342.6 | 548.55 | 23.89 | 1210.5 | 494.58 | 21.54 |
| 8 | 6.46 | 1348.1 | 601.73 | 23.98 | 1215.8 | 542.70 | 21.63 |
| 9 | 7.38 | 1353.8 | 634.95 | 24.09 | 1221.0 | 572.65 | 21.72 |
| 10 | 8.30 | 1365.1 | 650.47 | 21.43 | 1230.8 | 586.47 | 19.32 |
| 11 | 9.23 | 1359.6 | 638.65 | 21.34 | 1224.9 | 575.39 | 19.23 |
| 12 | 10.15 | 1354.4 | 608.97 | 21.26 | 1219.0 | 548.10 | 19.14 |
| 13 | 11.07 | 1349.5 | 561.60 | 21.18 | 1213.2 | 504.85 | 19.04 |
| 14 | 12.00 | 1344.9 | 496.66 | 21.11 | 1207.4 | 445.89 | 18.95 |
| 15 | 12.92 | 1340.4 | 414.29 | 21.04 | 1201.8 | 371.46 | 18.87 |
| 16 | 13.84 | 1335.9 | 314.60 | 20.97 | 1196.5 | 281.77 | 18.78 |
| 17 | 14.76 | 1331.2 | 197.75 | 20.90 | 1191.6 | 177.00 | 18.70 |
| 18 | 15.69 | 1326.2 | 63.96 | 20.82 | 1187.1 | 57.26 | 18.64 |
| 19 | 16.61 | 1318.5 | -85.04 | -84.39 | 1181.4 | -76.20 | -75.62 |
| 20 | 17.53 | 1301.1 | -190.28 | -83.28 | 1172.0 | -171.41 | -75.02 |
| 21 | 18.46 | 1283.1 | -256.61 | -96.51 | 1160.3 | -232.05 | -87.28 |
| 22 | 19.48 | 1282.4 | -171.83 | -96.47 | 1150.0 | -154.08 | -86.50 |
| 23 | 20.51 | 1304.7 | -20.30 | 21.11 | 1167.7 | -18.16 | 18.89 |
| 24 | 21.53 | 1310.5 | 169.48 | 21.20 | 1172.1 | 151.57 | 18.96 |
| 25 | 22.56 | 1315.4 | 338.33 | 21.28 | 1177.0 | 302.73 | 19.04 |
| 26 | 23.58 | 1319.8 | 485.80 | 21.35 | 1182.4 | 435.22 | 19.13 |
| 27 | 24.61 | 1323.9 | 611.62 | 21.42 | 1188.0 | 548.84 | 19.22 |
| 28 | 25.63 | 1328.1 | 715.67 | 21.48 | 1193.9 | 643.37 | 19.31 |
| 29 | 26.66 | 1332.5 | 797.89 | 21.56 | 1199.9 | 718.49 | 19.41 |
| 30 | 27.68 | 1337.4 | 858.17 | 21.63 | 1206.0 | 773.87 | 19.51 |
| 31 | 28.71 | 1342.8 | 896.45 | 21.72 | 1212.2 | 809.24 | 19.61 |
| 32 | 29.73 | 1348.9 | 912.53 | 21.82 | 1218.4 | 824.24 | 19.71 |
| 33 | 30.76 | 1356.6 | 904.71 | 26.09 | 1225.6 | 817.34 | 23.57 |
| 34 | 31.78 | 1346.4 | 857.77 | 25.89 | 1216.6 | 775.03 | 23.40 |
| 35 | 32.81 | 1340.7 | 787.07 | 25.78 | 1211.0 | 710.94 | 23.29 |
| 36 | 33.83 | 1335.4 | 690.20 | 25.68 | 1205.4 | 622.97 | 23.18 |
| 37 | 34.86 | 1330.3 | 567.25 | 25.58 | 1199.3 | 511.38 | 23.06 |
| 38 | 35.88 | 1325.0 | 418.40 | 25.48 | 1192.5 | 376.55 | 22.93 |
| 39 | 36.91 | 1320.1 | 244.13 | 25.39 | 1189.3 | 219.95 | 22.87 |
| 40 | 37.93 | 1314.8 | 10.11 | 0.00 | 1184.3 | 9.11 | 0.00 |
| 41 | 38.96 | 1312.1 | -196.82 | 0.00 | 1178.5 | -176.77 | 0.00 |



FUERZAS HORIZONTALES DE DESVIACION

| I | S(m) | R(m) | Ti (T) | Uh(T/m) | Tf(T) | Uh(T/m) |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 1100.0 | 1315.29 | -1.20 | 1178.98 | -1.07 |
| 2 | 0.92 | 1100.0 | 1317.10 | -1.20 | 1182.36 | -1.08 |
| 3 | 1.85 | 1100.0 | 1321.15 | -1.20 | 1185.00 | -1.08 |
| 4 | 2.77 | 1100.0 | 1326.81 | -1.21 | 1192.30 | -1.09 |
| 5 | 3.69 | 1100.0 | 1332.14 | -1.21 | 1198.89 | -1.09 |
| 6 | 4.61 | 1100.0 | 1337.36 | -1.22 | 1204.92 | -1.10 |
| 7 | 5.54 | 1100.0 | 1342.62 | -1.22 | 1210.53 | -1.10 |
| 8 | 6.46 | 1100.0 | 1348.08 | -1.23 | 1215.84 | -1.11 |
| 9 | 7.38 | 1100.0 | 1353.83 | -1.24 | 1220.99 | -1.11 |
| 10 | 8.30 | 1100.0 | 1365.11 | -1.24 | 1230.78 | -1.12 |
| 11 | 9.23 | 1100.0 | 1359.56 | -1.23 | 1224.89 | -1.11 |
| 12 | 10.15 | 1100.0 | 1354.38 | -1.23 | 1219.00 | -1.11 |
| 13 | 11.07 | 1100.0 | 1349.52 | -1.22 | 1213.15 | -1.10 |
| 14 | 12.00 | 1100.0 | 1344.90 | -1.22 | 1207.41 | -1.10 |
| 15 | 12.92 | 1100.0 | 1340.40 | -1.22 | 1201.82 | -1.09 |
| 16 | 13.84 | 1100.0 | 1335.91 | -1.21 | 1196.51 | -1.09 |
| 17 | 14.76 | 1100.0 | 1331.23 | -1.21 | 1191.57 | -1.08 |
| 18 | 15.69 | 1100.0 | 1326.20 | -1.20 | 1187.12 | -1.08 |
| 19 | 16.61 | 1100.0 | 1318.50 | -1.19 | 1181.38 | -1.07 |
| 20 | 17.53 | 1100.0 | 1301.10 | -1.17 | 1172.02 | -1.06 |
| 21 | 18.46 | 1100.0 | 1283.06 | -1.17 | 1160.25 | -1.05 |
| 22 | 19.48 | 1100.0 | 1282.43 | -1.18 | 1149.99 | -1.05 |
| 23 | 20.51 | 1100.0 | 1304.73 | -1.19 | 1167.72 | -1.06 |
| 24 | 21.53 | 1100.0 | 1310.51 | -1.19 | 1172.07 | -1.07 |
| 25 | 22.56 | 1100.0 | 1315.42 | -1.20 | 1177.01 | -1.07 |
| 26 | 23.58 | 1100.0 | 1319.79 | -1.20 | 1182.37 | -1.08 |
| 27 | 24.61 | 1100.0 | 1323.92 | -1.21 | 1188.03 | -1.08 |
| 28 | 25.63 | 1100.0 | 1328.10 | -1.21 | 1193.91 | -1.09 |
| 29 | 26.66 | 1100.0 | 1332.54 | -1.21 | 1199.94 | -1.09 |
| 30 | 27.68 | 1100.0 | 1337.38 | -1.22 | 1206.02 | -1.10 |
| 31 | 28.71 | 1100.0 | 1342.83 | -1.22 | 1212.19 | -1.10 |
| 32 | 29.73 | 1100.0 | 1348.92 | -1.23 | 1218.40 | -1.11 |
| 33 | 30.76 | 1100.0 | 1356.63 | -1.23 | 1225.61 | -1.11 |
| 34 | 31.78 | 1100.0 | 1346.43 | -1.22 | 1216.56 | -1.10 |
| 35 | 32.81 | 1100.0 | 1340.72 | -1.22 | 1211.02 | -1.10 |
| 36 | 33.83 | 1100.0 | 1335.44 | -1.21 | 1205.37 | -1.09 |
| 37 | 34.86 | 1100.0 | 1330.30 | -1.21 | 1199.28 | -1.09 |
| 38 | 35.88 | 1100.0 | 1325.01 | -1.20 | 1192.47 | -1.08 |
| 39 | 36.91 | 1100.0 | 1320.05 | -1.20 | 1189.31 | -1.08 |
| 40 | 37.93 | 1100.0 | 1314.83 | -1.19 | 1184.31 | -1.07 |
| 41 | 38.96 | 1100.0 | 1312.14 | -0.60 | 1178.46 | -0.54 |

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Referencia del Proyecto:

VIAD. PUERTO-MARTORELL (FAMILIA 2)

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PROGRAMA DE CALCULO DE PRETENSADO EN NERVIOS DE UN EMPARRILLADO

DATOS GENERALES DE PRETENSADO

NUMERO DE NERVIOS = 1
NUMERO DE VANOS = 2
NUMERO DE SECCIONES POR VANO = 21
NUMERO DE MATERIALES = 3
LUZ DEL VANO = 1 L (m) = 18.45
LUZ DEL VANO = 2 L (m) = 20.50

COEFICIENTE DE ROZAMIENTO EN CURVA = 0.21
COEFICIENTE DE DESV. PARASITAS = 0.0060
RELAJACION = 0.04
RETRACCION mm/m = 0.290
COEF. FLUENCIA = 2.300

ACERO DE PRETENSADO (Kp/mm2)

LIMITE DE PROPORCIONALIDAD AL 0,2% = 170.00
TENSION DE ROTURA = 190.00
MODULO DE DEFORMACION = 19000.00

HORMIGON

MODULO DE DEFORMACION DURANTE TESADO (Kp/cm2) = 255000.00
MODULO DE DEFORMACION A 28 DIAS (Kp/cm2) = 310000.00



CARACTERISTICAS MECANICAS DE LA SECCION 1

AREA DE LA SECCION (m2) = 5.905
INERCIA DE LA SECCION (m2) = 1.4893
V_SUP. DE LA SECCION (m2) = 0.67
V_INF. DE LA SECCION (m2) = 0.93
CANTO DE LA SECCION (m2) = 1.60

CARACTERISTICAS MECANICAS DE LA SECCION 2

AREA DE LA SECCION (m2) = 7.476
INERCIA DE LA SECCION (m2) = 1.6074
V_SUP. DE LA SECCION (m2) = 0.70
V_INF. DE LA SECCION (m2) = 0.90
CANTO DE LA SECCION (m2) = 1.60

CARACTERISTICAS MECANICAS DE LA SECCION 3

AREA DE LA SECCION (m2) = 1.000
INERCIA DE LA SECCION (m2) = 2.0000
V_SUP. DE LA SECCION (m2) = 0.70
V_INF. DE LA SECCION (m2) = 0.90
CANTO DE LA SECCION (m2) = 1.60

DEFINICION DEL TRAZADO DEL NERVIO = 1 VANO = 1

Parametros de la parabola = 1
A = 0.00000 B = -0.02105 C = -1.05000
Origen = 0.00 Final = 1.20
Parametros de la parabola = 2
A = 0.00148 B = -0.02461 C = -1.04787
Origen = 1.20 Final = 8.30
Parametros de la parabola = 4
A = 0.00785 B = -0.13029 C = -0.60929
Origen = 8.30 Final = 16.45
Parametros de la parabola = 5
A = -0.03200 B = 1.18127 C = -11.40013
Origen = 16.45 Final = 18.45

(origen en inicio vano)

DEFINICION DEL TRAZADO DEL NERVIO = 1 VANO = 2

Parametros de la parabola = 2
A = -0.03761 B = 0.00000 C = -0.50000
Origen = 0.00 Final = 2.00
Parametros de la parabola = 3
A = 0.00809 B = -0.18280 C = -0.31720
Origen = 2.00 Final = 11.30
Parametros de la parabola = 5
A = 0.00361 B = -0.08149 C = -0.88958
Origen = 11.30 Final = 19.30
Parametros de la parabola = 6
A = 0.00000 B = 0.05769 C = -2.23269
Origen = 19.30 Final = 20.50

(origen en inicio vano)



DEFINICION DEL TRAZADO DEL NERVIO= 1

| I | S | Ysup | Yinf | EXC | ALPHA_IZ | ALPHA_DE | CURV |
|---|---|---|---|---|---|---|---|
| 1 | 0.000 | -1.050 | 0.550 | -0.350 | 0.0000 | 0.6400 | 0.0000 |
| 2 | 0.923 | -1.069 | 0.531 | -0.369 | 0.0008 | 0.6392 | 0.0000 |
| 3 | 1.845 | -1.088 | 0.512 | -0.415 | 0.0031 | 0.6369 | 0.0030 |
| 4 | 2.768 | -1.105 | 0.495 | -0.431 | 0.0060 | 0.6341 | 0.0030 |
| 5 | 3.691 | -1.119 | 0.481 | -0.445 | 0.0088 | 0.6312 | 0.0030 |
| 6 | 4.614 | -1.130 | 0.470 | -0.456 | 0.0117 | 0.6283 | 0.0030 |
| 7 | 5.536 | -1.139 | 0.461 | -0.465 | 0.0145 | 0.6255 | 0.0030 |
| 8 | 6.459 | -1.145 | 0.455 | -0.471 | 0.0174 | 0.6226 | 0.0030 |
| 9 | 7.382 | -1.149 | 0.451 | -0.475 | 0.0203 | 0.6198 | 0.0030 |
| 10 | 8.305 | -1.150 | 0.450 | -0.476 | 0.0232 | 0.6168 | 0.0157 |
| 11 | 9.228 | -1.143 | 0.457 | -0.470 | 0.0377 | 0.6023 | 0.0157 |
| 12 | 10.150 | -1.123 | 0.477 | -0.450 | 0.0522 | 0.5878 | 0.0157 |
| 13 | 11.073 | -1.090 | 0.510 | -0.416 | 0.0667 | 0.5733 | 0.0157 |
| 14 | 11.996 | -1.043 | 0.557 | -0.369 | 0.0812 | 0.5588 | 0.0157 |
| 15 | 12.919 | -0.983 | 0.617 | -0.309 | 0.0957 | 0.5443 | 0.0157 |
| 16 | 13.841 | -0.909 | 0.691 | -0.235 | 0.1103 | 0.5298 | 0.0157 |
| 17 | 14.764 | -0.822 | 0.778 | -0.149 | 0.1248 | 0.5153 | 0.0157 |
| 18 | 15.687 | -0.722 | 0.878 | -0.048 | 0.1393 | 0.5007 | 0.0157 |
| 19 | 16.610 | -0.609 | 0.991 | 0.064 | 0.1613 | 0.4788 | -0.0640 |
| 20 | 17.532 | -0.527 | 1.073 | 0.146 | 0.2203 | 0.4197 | -0.0640 |
| 21 | 18.455 | -0.500 | 1.100 | 0.200 | 0.2795 | 0.3606 | -0.0752 |
| 22 | 19.480 | -0.540 | 1.060 | 0.134 | 0.3566 | 0.2834 | -0.0752 |
| 23 | 20.505 | -0.658 | 0.942 | 0.016 | 0.4307 | 0.2093 | 0.0162 |
| 24 | 21.530 | -0.803 | 0.797 | -0.129 | 0.4473 | 0.1927 | 0.0162 |
| 25 | 22.555 | -0.931 | 0.669 | -0.257 | 0.4640 | 0.1761 | 0.0162 |
| 26 | 23.580 | -1.042 | 0.558 | -0.368 | 0.4806 | 0.1594 | 0.0162 |
| 27 | 24.605 | -1.135 | 0.465 | -0.462 | 0.4972 | 0.1428 | 0.0162 |
| 28 | 25.630 | -1.212 | 0.388 | -0.539 | 0.5138 | 0.1262 | 0.0162 |
| 29 | 26.655 | -1.272 | 0.328 | -0.599 | 0.5305 | 0.1096 | 0.0162 |
| 30 | 27.680 | -1.315 | 0.285 | -0.642 | 0.5470 | 0.0930 | 0.0162 |
| 31 | 28.705 | -1.341 | 0.259 | -0.668 | 0.5636 | 0.0764 | 0.0162 |
| 32 | 29.730 | -1.350 | 0.250 | -0.676 | 0.5802 | 0.0598 | 0.0162 |
| 33 | 30.755 | -1.346 | 0.254 | -0.673 | 0.5879 | 0.0521 | 0.0072 |
| 34 | 31.780 | -1.335 | 0.265 | -0.662 | 0.5954 | 0.0447 | 0.0072 |
| 35 | 32.805 | -1.316 | 0.284 | -0.643 | 0.6029 | 0.0371 | 0.0072 |
| 36 | 33.830 | -1.290 | 0.310 | -0.617 | 0.6103 | 0.0297 | 0.0072 |
| 37 | 34.855 | -1.256 | 0.344 | -0.583 | 0.6177 | 0.0223 | 0.0072 |
| 38 | 35.880 | -1.215 | 0.385 | -0.541 | 0.6251 | 0.0149 | 0.0072 |
| 39 | 36.905 | -1.166 | 0.434 | -0.492 | 0.6326 | 0.0074 | 0.0072 |
| 40 | 37.930 | -1.109 | 0.491 | -0.409 | 0.6390 | 0.0010 | 0.0000 |
| 41 | 38.955 | -1.050 | 0.550 | -0.350 | 0.6400 | 0.0000 | 0.0000 |

SECCIONES INICIAL Y FINAL DEL TRAZADO = 1 41
NUMERO DE VANOS INICIAL Y FINAL DEL TRAZADO = 1 2
PENDIENTE INICIAL DEL TRAZADO = -0.02105
PENDIENTE FINAL DEL TRAZADO = 0.05769

ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

NUMERO DE CABLES = 6

TENSION EN ANCLAJE IZQUIERDO (Kp/mm2) = 142.00
TESAMOS POR LA IZQUIERDA (SI=1) = 1
TENSION EN ANCLAJE DERECHO (Kp/mm2) = 142.00
TESAMOS POR LA DERECHA (SI=1) = 1

PROPORCION DE TESADO EN LA PRIMERA FASE 0.60
AREA DE PRETENSADO (cm2) = 100.80
PENETRACION DE CUNA EN EXTREMO 1 (mm) = 5.000
PENETRACION DE CUNA EN EXTREMO 2 (mm) = 5.000

LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-1 (m) = 13.93
LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-2 (m) = 13.26

TENSION EN LOS CABLES. PERDIDAS INSTANT. (Kp/mm2)

| I | X | To | P_ROZ | P_CUNA | P_ELAS | Ti |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 85.20 | 0.00 | 6.84 | 0.51 | 77.84 |
| 2 | 0.92 | 85.20 | 0.11 | 6.61 | 0.58 | 77.89 |
| 3 | 1.85 | 85.20 | 0.25 | 6.34 | 0.70 | 77.91 |
| 4 | 2.77 | 85.20 | 0.40 | 6.04 | 0.73 | 78.03 |
| 5 | 3.69 | 85.20 | 0.55 | 5.74 | 0.75 | 78.16 |
| 6 | 4.61 | 85.20 | 0.70 | 5.44 | 0.76 | 78.29 |
| 7 | 5.54 | 85.20 | 0.85 | 5.14 | 0.78 | 78.43 |
| 8 | 6.46 | 85.20 | 1.00 | 4.85 | 0.79 | 78.56 |
| 9 | 7.38 | 85.20 | 1.15 | 4.55 | 0.80 | 78.71 |
| 10 | 8.30 | 85.20 | 1.30 | 4.25 | 0.80 | 78.85 |
| 11 | 9.23 | 85.20 | 1.65 | 3.54 | 0.79 | 79.21 |
| 12 | 10.15 | 85.20 | 2.00 | 2.84 | 0.77 | 79.59 |
| 13 | 11.07 | 85.20 | 2.35 | 2.14 | 0.72 | 79.99 |
| 14 | 12.00 | 85.20 | 2.70 | 1.45 | 0.66 | 80.39 |
| 15 | 12.92 | 85.20 | 3.04 | 0.75 | 0.59 | 80.81 |
| 16 | 13.84 | 85.20 | 3.39 | 0.00 | 0.53 | 81.28 |
| 17 | 14.76 | 85.20 | 3.73 | 0.00 | 0.47 | 81.00 |
| 18 | 15.69 | 85.20 | 4.08 | 0.00 | 0.43 | 80.69 |
| 19 | 16.61 | 85.20 | 4.54 | 0.00 | 0.43 | 80.22 |
| 20 | 17.53 | 85.20 | 5.63 | 0.00 | 0.41 | 79.16 |
| 21 | 18.46 | 85.20 | 6.70 | 0.00 | 0.43 | 78.07 |
| 22 | 19.48 | 85.20 | 6.87 | 0.00 | 0.44 | 77.89 |
| 23 | 20.51 | 85.20 | 5.54 | 0.00 | 0.42 | 79.24 |
| 24 | 21.53 | 85.20 | 5.16 | 0.00 | 0.45 | 79.59 |
| 25 | 22.56 | 85.20 | 4.77 | 0.00 | 0.54 | 79.89 |
| 26 | 23.58 | 85.20 | 4.39 | 0.00 | 0.66 | 80.16 |
| 27 | 24.61 | 85.20 | 4.00 | 0.00 | 0.79 | 80.41 |
| 28 | 25.63 | 85.20 | 3.61 | 0.00 | 0.93 | 80.66 |
| 29 | 26.66 | 85.20 | 3.22 | 0.00 | 1.05 | 80.93 |
| 30 | 27.68 | 85.20 | 2.83 | 1.52 | 1.13 | 79.73 |
| 31 | 28.71 | 85.20 | 2.43 | 2.31 | 1.18 | 79.28 |
| 32 | 29.73 | 85.20 | 2.04 | 3.10 | 1.19 | 78.87 |
| 33 | 30.76 | 85.20 | 1.79 | 3.59 | 1.18 | 78.64 |
| 34 | 31.78 | 85.20 | 1.55 | 4.06 | 1.15 | 78.43 |
| 35 | 32.81 | 85.20 | 1.31 | 4.54 | 1.11 | 78.23 |
| 36 | 33.83 | 85.20 | 1.08 | 5.02 | 1.05 | 78.05 |
| 37 | 34.86 | 85.20 | 0.84 | 5.50 | 0.98 | 77.88 |
| 38 | 35.88 | 85.20 | 0.59 | 5.98 | 0.90 | 77.72 |
| 39 | 36.91 | 85.20 | 0.35 | 6.47 | 0.75 | 77.63 |
| 40 | 37.93 | 85.20 | 0.13 | 6.92 | 0.58 | 77.57 |
| 41 | 38.96 | 85.20 | 0.00 | 7.17 | 0.51 | 77.52 |

ALARGAMIENTO DE LOS CABLES (sobre embolo)= 169.6 mm

ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES. PERDIDAS DIFERIDAS (Kp/mm2)

| I | S | Ti | P_RETRA | P_FLUE | P_RELAJ. |
|---|---|---|---|---|---|
| 1 | 0.00 | 77.84 | 0.00 | 0.00 | 0.00 |
| 2 | 0.92 | 77.89 | 0.00 | 0.00 | 0.00 |
| 3 | 1.85 | 77.91 | 0.00 | 0.00 | 0.00 |
| 4 | 2.77 | 78.03 | 0.00 | 0.00 | 0.00 |
| 5 | 3.69 | 78.16 | 0.00 | 0.00 | 0.00 |
| 6 | 4.61 | 78.29 | 0.00 | 0.00 | 0.00 |
| 7 | 5.54 | 78.43 | 0.00 | 0.00 | 0.00 |
| 8 | 6.46 | 78.56 | 0.00 | 0.00 | 0.00 |
| 9 | 7.38 | 78.71 | 0.00 | 0.00 | 0.00 |
| 10 | 8.30 | 78.85 | 0.00 | 0.00 | 0.00 |
| 11 | 9.23 | 79.21 | 0.00 | 0.00 | 0.00 |
| 12 | 10.15 | 79.59 | 0.00 | 0.00 | 0.00 |
| 13 | 11.07 | 79.99 | 0.00 | 0.00 | 0.00 |
| 14 | 12.00 | 80.39 | 0.00 | 0.00 | 0.00 |
| 15 | 12.92 | 80.81 | 0.00 | 0.00 | 0.00 |
| 16 | 13.84 | 81.28 | 0.00 | 0.00 | 0.00 |
| 17 | 14.76 | 81.00 | 0.00 | 0.00 | 0.00 |
| 18 | 15.69 | 80.69 | 0.00 | 0.00 | 0.00 |
| 19 | 16.61 | 80.22 | 0.00 | 0.00 | 0.00 |
| 20 | 17.53 | 79.16 | 0.00 | 0.00 | 0.00 |
| 21 | 18.46 | 78.07 | 0.00 | 0.00 | 0.00 |
| 22 | 19.48 | 77.89 | 0.00 | 0.00 | 0.00 |
| 23 | 20.51 | 79.24 | 0.00 | 0.00 | 0.00 |
| 24 | 21.53 | 79.59 | 0.00 | 0.00 | 0.00 |
| 25 | 22.56 | 79.89 | 0.00 | 0.00 | 0.00 |
| 26 | 23.58 | 80.16 | 0.00 | 0.00 | 0.00 |
| 27 | 24.61 | 80.41 | 0.00 | 0.00 | 0.00 |
| 28 | 25.63 | 80.66 | 0.00 | 0.00 | 0.00 |
| 29 | 26.66 | 80.93 | 0.00 | 0.00 | 0.00 |
| 30 | 27.68 | 79.73 | 0.00 | 0.00 | 0.00 |
| 31 | 28.71 | 79.28 | 0.00 | 0.00 | 0.00 |
| 32 | 29.73 | 78.87 | 0.00 | 0.00 | 0.00 |
| 33 | 30.76 | 78.64 | 0.00 | 0.00 | 0.00 |
| 34 | 31.78 | 78.43 | 0.00 | 0.00 | 0.00 |
| 35 | 32.81 | 78.23 | 0.00 | 0.00 | 0.00 |
| 36 | 33.83 | 78.05 | 0.00 | 0.00 | 0.00 |
| 37 | 34.86 | 77.88 | 0.00 | 0.00 | 0.00 |
| 38 | 35.88 | 77.72 | 0.00 | 0.00 | 0.00 |
| 39 | 36.91 | 77.63 | 0.00 | 0.00 | 0.00 |
| 40 | 37.93 | 77.57 | 0.00 | 0.00 | 0.00 |
| 41 | 38.96 | 77.52 | 0.00 | 0.00 | 0.00 |



ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES (Kp/mm2)

| I | S | To | APi | Ti | APf | Tf |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 85.20 | 7.36 | 77.84 | 0.00 | 77.84 |
| 2 | 0.92 | 85.20 | 7.31 | 77.89 | 0.00 | 77.89 |
| 3 | 1.85 | 85.20 | 7.29 | 77.91 | 0.00 | 77.91 |
| 4 | 2.77 | 85.20 | 7.17 | 78.03 | 0.00 | 78.03 |
| 5 | 3.69 | 85.20 | 7.04 | 78.16 | 0.00 | 78.16 |
| 6 | 4.61 | 85.20 | 6.91 | 78.29 | 0.00 | 78.29 |
| 7 | 5.54 | 85.20 | 6.77 | 78.43 | 0.00 | 78.43 |
| 8 | 6.46 | 85.20 | 6.64 | 78.56 | 0.00 | 78.56 |
| 9 | 7.38 | 85.20 | 6.49 | 78.71 | 0.00 | 78.71 |
| 10 | 8.30 | 85.20 | 6.35 | 78.85 | 0.00 | 78.85 |
| 11 | 9.23 | 85.20 | 5.99 | 79.21 | 0.00 | 79.21 |
| 12 | 10.15 | 85.20 | 5.61 | 79.59 | 0.00 | 79.59 |
| 13 | 11.07 | 85.20 | 5.21 | 79.99 | 0.00 | 79.99 |
| 14 | 12.00 | 85.20 | 4.81 | 80.39 | 0.00 | 80.39 |
| 15 | 12.92 | 85.20 | 4.39 | 80.81 | 0.00 | 80.81 |
| 16 | 13.84 | 85.20 | 3.92 | 81.28 | 0.00 | 81.28 |
| 17 | 14.76 | 85.20 | 4.20 | 81.00 | 0.00 | 81.00 |
| 18 | 15.69 | 85.20 | 4.51 | 80.69 | 0.00 | 80.69 |
| 19 | 16.61 | 85.20 | 4.98 | 80.22 | 0.00 | 80.22 |
| 20 | 17.53 | 85.20 | 6.04 | 79.16 | 0.00 | 79.16 |
| 21 | 18.46 | 85.20 | 7.13 | 78.07 | 0.00 | 78.07 |
| 22 | 19.48 | 85.20 | 7.31 | 77.89 | 0.00 | 77.89 |
| 23 | 20.51 | 85.20 | 5.96 | 79.24 | 0.00 | 79.24 |
| 24 | 21.53 | 85.20 | 5.61 | 79.59 | 0.00 | 79.59 |
| 25 | 22.56 | 85.20 | 5.31 | 79.89 | 0.00 | 79.89 |
| 26 | 23.58 | 85.20 | 5.04 | 80.16 | 0.00 | 80.16 |
| 27 | 24.61 | 85.20 | 4.79 | 80.41 | 0.00 | 80.41 |
| 28 | 25.63 | 85.20 | 4.54 | 80.66 | 0.00 | 80.66 |
| 29 | 26.66 | 85.20 | 4.27 | 80.93 | 0.00 | 80.93 |
| 30 | 27.68 | 85.20 | 5.47 | 79.73 | 0.00 | 79.73 |
| 31 | 28.71 | 85.20 | 5.92 | 79.28 | 0.00 | 79.28 |
| 32 | 29.73 | 85.20 | 6.33 | 78.87 | 0.00 | 78.87 |
| 33 | 30.76 | 85.20 | 6.56 | 78.64 | 0.00 | 78.64 |
| 34 | 31.78 | 85.20 | 6.77 | 78.43 | 0.00 | 78.43 |
| 35 | 32.81 | 85.20 | 6.97 | 78.23 | 0.00 | 78.23 |
| 36 | 33.83 | 85.20 | 7.15 | 78.05 | 0.00 | 78.05 |
| 37 | 34.86 | 85.20 | 7.32 | 77.88 | 0.00 | 77.88 |
| 38 | 35.88 | 85.20 | 7.48 | 77.72 | 0.00 | 77.72 |
| 39 | 36.91 | 85.20 | 7.57 | 77.63 | 0.00 | 77.63 |
| 40 | 37.93 | 85.20 | 7.63 | 77.57 | 0.00 | 77.57 |
| 41 | 38.96 | 85.20 | 7.68 | 77.52 | 0.00 | 77.52 |

ETAPA DE TESADO INICIAL

PRETENSADO EN EL NERVIO = 1

FUERZAS EN LOS CABLES (T, m)

| I | S(m) | Pi (T) | Mpi (mT) | Upi (T/m) | Pf (T) | Mpf (mT) | Upf (T/m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 784.7 | 274.63 | 0.00 | 784.7 | 274.63 | 0.00 |
| 2 | 0.92 | 785.1 | 290.04 | 0.00 | 785.1 | 290.04 | 0.00 |
| 3 | 1.85 | 785.3 | 325.70 | 2.33 | 785.3 | 325.70 | 2.33 |
| 4 | 2.77 | 786.6 | 339.13 | 2.33 | 786.6 | 339.13 | 2.33 |
| 5 | 3.69 | 787.9 | 350.61 | 2.34 | 787.9 | 350.61 | 2.34 |
| 6 | 4.61 | 789.2 | 360.15 | 2.34 | 789.2 | 360.15 | 2.34 |
| 7 | 5.54 | 790.5 | 367.75 | 2.34 | 790.5 | 367.75 | 2.34 |
| 8 | 6.46 | 791.9 | 373.38 | 2.35 | 791.9 | 373.38 | 2.35 |
| 9 | 7.38 | 793.4 | 377.04 | 2.35 | 793.4 | 377.04 | 2.35 |
| 10 | 8.30 | 794.8 | 378.73 | 12.48 | 794.8 | 378.73 | 12.48 |
| 11 | 9.23 | 798.4 | 375.07 | 12.53 | 798.4 | 375.07 | 12.53 |
| 12 | 10.15 | 802.3 | 360.72 | 12.59 | 802.3 | 360.72 | 12.59 |
| 13 | 11.07 | 806.3 | 335.52 | 12.66 | 806.3 | 335.52 | 12.66 |
| 14 | 12.00 | 810.4 | 299.26 | 12.72 | 810.4 | 299.26 | 12.72 |
| 15 | 12.92 | 814.5 | 251.75 | 12.79 | 814.5 | 251.75 | 12.79 |
| 16 | 13.84 | 819.3 | 192.95 | 12.86 | 819.3 | 192.95 | 12.86 |
| 17 | 14.76 | 816.5 | 121.28 | 12.82 | 816.5 | 121.28 | 12.82 |
| 18 | 15.69 | 813.4 | 39.23 | 12.77 | 813.4 | 39.23 | 12.77 |
| 19 | 16.61 | 808.6 | -52.16 | -51.76 | 808.6 | -52.16 | -51.76 |
| 20 | 17.53 | 798.0 | -116.70 | -51.08 | 798.0 | -116.70 | -51.08 |
| 21 | 18.46 | 786.9 | -157.38 | -59.19 | 786.9 | -157.38 | -59.19 |
| 22 | 19.48 | 785.1 | -105.19 | -59.06 | 785.1 | -105.19 | -59.06 |
| 23 | 20.51 | 798.7 | -12.43 | 12.92 | 798.7 | -12.43 | 12.92 |
| 24 | 21.53 | 802.3 | 103.75 | 12.98 | 802.3 | 103.75 | 12.98 |
| 25 | 22.56 | 805.3 | 207.12 | 13.03 | 805.3 | 207.12 | 13.03 |
| 26 | 23.58 | 808.0 | 297.40 | 13.07 | 808.0 | 297.40 | 13.07 |
| 27 | 24.61 | 810.5 | 374.43 | 13.11 | 810.5 | 374.43 | 13.11 |
| 28 | 25.63 | 813.1 | 438.13 | 13.15 | 813.1 | 438.13 | 13.15 |
| 29 | 26.66 | 815.8 | 488.46 | 13.20 | 815.8 | 488.46 | 13.20 |
| 30 | 27.68 | 803.6 | 515.68 | 13.00 | 803.6 | 515.68 | 13.00 |
| 31 | 28.71 | 799.1 | 533.49 | 12.93 | 799.1 | 533.49 | 12.93 |
| 32 | 29.73 | 795.0 | 537.82 | 12.86 | 795.0 | 537.82 | 12.86 |
| 33 | 30.76 | 792.7 | 533.39 | 5.72 | 792.7 | 533.39 | 5.72 |
| 34 | 31.78 | 790.6 | 523.13 | 5.70 | 790.6 | 523.13 | 5.70 |
| 35 | 32.81 | 788.6 | 507.03 | 5.69 | 788.6 | 507.03 | 5.69 |
| 36 | 33.83 | 786.8 | 485.14 | 5.67 | 786.8 | 485.14 | 5.67 |
| 37 | 34.86 | 785.1 | 457.46 | 5.66 | 785.1 | 457.46 | 5.66 |
| 38 | 35.88 | 783.4 | 424.02 | 5.65 | 783.4 | 424.02 | 5.65 |
| 39 | 36.91 | 782.5 | 385.12 | 5.64 | 782.5 | 385.12 | 5.64 |
| 40 | 37.93 | 781.9 | 319.92 | 0.00 | 781.9 | 319.92 | 0.00 |
| 41 | 38.96 | 781.4 | 273.47 | 0.00 | 781.4 | 273.47 | 0.00 |



ETAPA DE TESADO INICIAL

FUERZAS HORIZONTALES DE DESVIACION

| I | S(m) | R(m) | Ti (T) | Uh(T/m) | Tf(T) | Uh(T/m) |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 1100.0 | 784.65 | -0.71 | 784.65 | -0.71 |
| 2 | 0.92 | 1100.0 | 785.11 | -0.71 | 785.11 | -0.71 |
| 3 | 1.85 | 1100.0 | 785.33 | -0.71 | 785.33 | -0.71 |
| 4 | 2.77 | 1100.0 | 786.59 | -0.72 | 786.59 | -0.72 |
| 5 | 3.69 | 1100.0 | 787.88 | -0.72 | 787.88 | -0.72 |
| 6 | 4.61 | 1100.0 | 789.20 | -0.72 | 789.20 | -0.72 |
| 7 | 5.54 | 1100.0 | 790.55 | -0.72 | 790.55 | -0.72 |
| 8 | 6.46 | 1100.0 | 791.93 | -0.72 | 791.93 | -0.72 |
| 9 | 7.38 | 1100.0 | 793.35 | -0.72 | 793.35 | -0.72 |
| 10 | 8.30 | 1100.0 | 794.82 | -0.72 | 794.82 | -0.72 |
| 11 | 9.23 | 1100.0 | 798.45 | -0.73 | 798.45 | -0.73 |
| 12 | 10.15 | 1100.0 | 802.27 | -0.73 | 802.27 | -0.73 |
| 13 | 11.07 | 1100.0 | 806.25 | -0.73 | 806.25 | -0.73 |
| 14 | 12.00 | 1100.0 | 810.36 | -0.74 | 810.36 | -0.74 |
| 15 | 12.92 | 1100.0 | 814.53 | -0.74 | 814.53 | -0.74 |
| 16 | 13.84 | 1100.0 | 819.32 | -0.74 | 819.32 | -0.74 |
| 17 | 14.76 | 1100.0 | 816.45 | -0.74 | 816.45 | -0.74 |
| 18 | 15.69 | 1100.0 | 813.36 | -0.74 | 813.36 | -0.74 |
| 19 | 16.61 | 1100.0 | 808.64 | -0.73 | 808.64 | -0.73 |
| 20 | 17.53 | 1100.0 | 797.97 | -0.72 | 797.97 | -0.72 |
| 21 | 18.46 | 1100.0 | 786.91 | -0.71 | 786.91 | -0.71 |
| 22 | 19.48 | 1100.0 | 785.09 | -0.72 | 785.09 | -0.72 |
| 23 | 20.51 | 1100.0 | 798.74 | -0.73 | 798.74 | -0.73 |
| 24 | 21.53 | 1100.0 | 802.29 | -0.73 | 802.29 | -0.73 |
| 25 | 22.56 | 1100.0 | 805.29 | -0.73 | 805.29 | -0.73 |
| 26 | 23.58 | 1100.0 | 807.97 | -0.74 | 807.97 | -0.74 |
| 27 | 24.61 | 1100.0 | 810.49 | -0.74 | 810.49 | -0.74 |
| 28 | 25.63 | 1100.0 | 813.05 | -0.74 | 813.05 | -0.74 |
| 29 | 26.66 | 1100.0 | 815.77 | -0.74 | 815.77 | -0.74 |
| 30 | 27.68 | 1100.0 | 803.65 | -0.73 | 803.65 | -0.73 |
| 31 | 28.71 | 1100.0 | 799.14 | -0.72 | 799.14 | -0.72 |
| 32 | 29.73 | 1100.0 | 795.00 | -0.72 | 795.00 | -0.72 |
| 33 | 30.76 | 1100.0 | 792.68 | -0.72 | 792.68 | -0.72 |
| 34 | 31.78 | 1100.0 | 790.57 | -0.72 | 790.57 | -0.72 |
| 35 | 32.81 | 1100.0 | 788.59 | -0.72 | 788.59 | -0.72 |
| 36 | 33.83 | 1100.0 | 786.77 | -0.71 | 786.77 | -0.71 |
| 37 | 34.86 | 1100.0 | 785.06 | -0.71 | 785.06 | -0.71 |
| 38 | 35.88 | 1100.0 | 783.44 | -0.71 | 783.44 | -0.71 |
| 39 | 36.91 | 1100.0 | 782.51 | -0.71 | 782.51 | -0.71 |
| 40 | 37.93 | 1100.0 | 781.94 | -0.71 | 781.94 | -0.71 |
| 41 | 38.96 | 1100.0 | 781.36 | -0.36 | 781.36 | -0.36 |

TESADO DEFINITIVO

PRETENSADO EN EL NERVIO = 1

NUMERO DE CABLES = 6

TENSION EN ANCLAJE IZQUIERDO (Kp/mm2) = 142.00
TESAMOS POR LA IZQUIERDA (SI=1) = 1
TENSION EN ANCLAJE DERECHO (Kp/mm2) = 142.00
TESAMOS POR LA DERECHA (SI=1) = 1

PROPORCION DE TESADO EN LA PRIMERA FASE 0.60
AREA DE PRETENSADO (cm2) = 100.80
PENETRACION DE CUNA EN EXTREMO 1 (mm) = 5.000
PENETRACION DE CUNA EN EXTREMO 2 (mm) = 5.000

LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-1 (m) = 11.46
LONGITUD AFECT. POR PENETRAC. DE CUNA EXTR-2 (m) = 10.81

TENSION EN LOS CABLES. PERDIDAS INSTANT. (Kp/mm2)

| I | X | To | P_ROZ | P_CUNA | P_ELAS | Ti |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 142.00 | 0.00 | 8.31 | 0.88 | 132.81 |
| 2 | 0.92 | 142.00 | 0.19 | 7.93 | 1.00 | 132.88 |
| 3 | 1.85 | 142.00 | 0.42 | 7.47 | 1.20 | 132.91 |
| 4 | 2.77 | 142.00 | 0.67 | 6.97 | 1.24 | 133.12 |
| 5 | 3.69 | 142.00 | 0.92 | 6.47 | 1.27 | 133.33 |
| 6 | 4.61 | 142.00 | 1.17 | 5.98 | 1.30 | 133.55 |
| 7 | 5.54 | 142.00 | 1.42 | 5.48 | 1.33 | 133.77 |
| 8 | 6.46 | 142.00 | 1.66 | 4.98 | 1.35 | 134.00 |
| 9 | 7.38 | 142.00 | 1.91 | 4.49 | 1.36 | 134.24 |
| 10 | 8.30 | 142.00 | 2.16 | 3.99 | 1.37 | 134.48 |
| 11 | 9.23 | 142.00 | 2.75 | 2.82 | 1.36 | 135.08 |
| 12 | 10.15 | 142.00 | 3.33 | 1.65 | 1.31 | 135.71 |
| 13 | 11.07 | 142.00 | 3.92 | 0.00 | 1.23 | 136.85 |
| 14 | 12.00 | 142.00 | 4.50 | 0.00 | 1.12 | 136.38 |
| 15 | 12.92 | 142.00 | 5.07 | 0.00 | 1.00 | 135.93 |
| 16 | 13.84 | 142.00 | 5.65 | 0.00 | 0.88 | 135.47 |
| 17 | 14.76 | 142.00 | 6.22 | 0.00 | 0.78 | 135.00 |
| 18 | 15.69 | 142.00 | 6.79 | 0.00 | 0.72 | 134.48 |
| 19 | 16.61 | 142.00 | 7.57 | 0.00 | 0.72 | 133.70 |
| 20 | 17.53 | 142.00 | 9.38 | 0.00 | 0.68 | 131.94 |
| 21 | 18.46 | 142.00 | 11.17 | 0.00 | 0.72 | 130.11 |
| 22 | 19.48 | 142.00 | 11.45 | 0.00 | 0.74 | 129.81 |
| 23 | 20.51 | 142.00 | 9.23 | 0.00 | 0.70 | 132.07 |
| 24 | 21.53 | 142.00 | 8.59 | 0.00 | 0.75 | 132.65 |
| 25 | 22.56 | 142.00 | 7.95 | 0.00 | 0.90 | 133.15 |
| 26 | 23.58 | 142.00 | 7.31 | 0.00 | 1.10 | 133.59 |
| 27 | 24.61 | 142.00 | 6.67 | 0.00 | 1.32 | 134.01 |
| 28 | 25.63 | 142.00 | 6.02 | 0.00 | 1.55 | 134.43 |
| 29 | 26.66 | 142.00 | 5.36 | 0.00 | 1.75 | 134.88 |
| 30 | 27.68 | 142.00 | 4.71 | 0.00 | 1.92 | 135.37 |
| 31 | 28.71 | 142.00 | 4.05 | 0.00 | 2.02 | 135.92 |
| 32 | 29.73 | 142.00 | 3.39 | 2.04 | 2.04 | 134.53 |
| 33 | 30.76 | 142.00 | 2.99 | 2.85 | 2.02 | 134.14 |
| 34 | 31.78 | 142.00 | 2.59 | 3.64 | 1.97 | 133.80 |
| 35 | 32.81 | 142.00 | 2.19 | 4.45 | 1.89 | 133.47 |
| 36 | 33.83 | 142.00 | 1.79 | 5.24 | 1.79 | 133.17 |
| 37 | 34.86 | 142.00 | 1.39 | 6.04 | 1.67 | 132.89 |
| 38 | 35.88 | 142.00 | 0.99 | 6.85 | 1.54 | 132.63 |
| 39 | 36.91 | 142.00 | 0.59 | 7.65 | 1.28 | 132.48 |
| 40 | 37.93 | 142.00 | 0.21 | 8.40 | 0.99 | 132.39 |
| 41 | 38.96 | 142.00 | 0.00 | 8.83 | 0.88 | 132.30 |

ALARGAMIENTO DE LOS CABLES (sobre embolo)= 276.8 mm

TENSION EN LOS CABLES. PERDIDAS INSTANT. (Kp/mm2)

| I | X | To | P_ROZ | P_CUNA | P_ELAS | Ti |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 142.00 | 0.00 | 8.31 | 0.88 | 132.81 |
| 2 | 0.92 | 142.00 | 0.19 | 7.93 | 1.00 | 132.88 |
| 3 | 1.85 | 142.00 | 0.42 | 7.47 | 1.20 | 132.91 |
| 4 | 2.77 | 142.00 | 0.67 | 6.97 | 1.24 | 133.12 |
| 5 | 3.69 | 142.00 | 0.92 | 6.47 | 1.27 | 133.33 |
| 6 | 4.61 | 142.00 | 1.17 | 5.98 | 1.30 | 133.55 |
| 7 | 5.54 | 142.00 | 1.42 | 5.48 | 1.33 | 133.77 |
| 8 | 6.46 | 142.00 | 1.66 | 4.98 | 1.35 | 134.00 |
| 9 | 7.38 | 142.00 | 1.91 | 4.49 | 1.36 | 134.24 |
| 10 | 8.30 | 142.00 | 2.16 | 3.99 | 1.37 | 134.48 |
| 11 | 9.23 | 142.00 | 2.75 | 2.82 | 1.36 | 135.08 |
| 12 | 10.15 | 142.00 | 3.33 | 1.65 | 1.31 | 135.71 |
| 13 | 11.07 | 142.00 | 3.92 | 0.00 | 1.23 | 136.85 |
| 14 | 12.00 | 142.00 | 4.50 | 0.00 | 1.12 | 136.38 |
| 15 | 12.92 | 142.00 | 5.07 | 0.00 | 1.00 | 135.93 |
| 16 | 13.84 | 142.00 | 5.65 | 0.00 | 0.88 | 135.47 |
| 17 | 14.76 | 142.00 | 6.22 | 0.00 | 0.78 | 135.00 |
| 18 | 15.69 | 142.00 | 6.79 | 0.00 | 0.72 | 134.48 |
| 19 | 16.61 | 142.00 | 7.57 | 0.00 | 0.72 | 133.70 |
| 20 | 17.53 | 142.00 | 9.38 | 0.00 | 0.68 | 131.94 |
| 21 | 18.46 | 142.00 | 11.17 | 0.00 | 0.72 | 130.11 |
| 22 | 19.48 | 142.00 | 11.45 | 0.00 | 0.74 | 129.81 |
| 23 | 20.51 | 142.00 | 9.23 | 0.00 | 0.70 | 132.07 |
| 24 | 21.53 | 142.00 | 8.59 | 0.00 | 0.75 | 132.65 |
| 25 | 22.56 | 142.00 | 7.95 | 0.00 | 0.90 | 133.15 |
| 26 | 23.58 | 142.00 | 7.31 | 0.00 | 1.10 | 133.59 |
| 27 | 24.61 | 142.00 | 6.67 | 0.00 | 1.32 | 134.01 |
| 28 | 25.63 | 142.00 | 6.02 | 0.00 | 1.55 | 134.43 |
| 29 | 26.66 | 142.00 | 5.36 | 0.00 | 1.75 | 134.88 |
| 30 | 27.68 | 142.00 | 4.71 | 0.00 | 1.92 | 135.37 |
| 31 | 28.71 | 142.00 | 4.05 | 0.00 | 2.02 | 135.92 |
| 32 | 29.73 | 142.00 | 3.39 | 2.04 | 2.04 | 134.53 |
| 33 | 30.76 | 142.00 | 2.99 | 2.85 | 2.02 | 134.14 |
| 34 | 31.78 | 142.00 | 2.59 | 3.64 | 1.97 | 133.80 |
| 35 | 32.81 | 142.00 | 2.19 | 4.45 | 1.89 | 133.47 |
| 36 | 33.83 | 142.00 | 1.79 | 5.24 | 1.79 | 133.17 |
| 37 | 34.86 | 142.00 | 1.39 | 6.04 | 1.67 | 132.89 |
| 38 | 35.88 | 142.00 | 0.99 | 6.85 | 1.54 | 132.63 |
| 39 | 36.91 | 142.00 | 0.59 | 7.65 | 1.28 | 132.48 |
| 40 | 37.93 | 142.00 | 0.21 | 8.40 | 0.99 | 132.39 |
| 41 | 38.96 | 142.00 | 0.00 | 8.83 | 0.88 | 132.30 |

ALARGAMIENTO DE LOS CABLES (sobre embolo)= 276.8 mm

PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES. PERDIDAS DIFERIDAS (Kp/mm2)

| I | S | Ti | P_RETRA | P_FLUE | P_RELAJ. |
|---|---|---|---|---|---|
| 1 | 0.00 | 132.81 | 5.51 | 5.40 | 5.30 |
| 2 | 0.92 | 132.88 | 5.51 | 3.87 | 5.18 |
| 3 | 1.85 | 132.91 | 5.51 | 4.04 | 5.20 |
| 4 | 2.77 | 133.12 | 5.51 | 3.62 | 5.17 |
| 5 | 3.69 | 133.33 | 5.51 | 3.26 | 5.15 |
| 6 | 4.61 | 133.55 | 5.51 | 2.95 | 5.14 |
| 7 | 5.54 | 133.77 | 5.51 | 2.71 | 5.13 |
| 8 | 6.46 | 134.00 | 5.51 | 2.55 | 5.12 |
| 9 | 7.38 | 134.24 | 5.51 | 2.48 | 5.13 |
| 10 | 8.30 | 134.48 | 5.51 | 2.50 | 5.14 |
| 11 | 9.23 | 135.08 | 5.51 | 2.60 | 5.17 |
| 12 | 10.15 | 135.71 | 5.51 | 2.72 | 5.21 |
| 13 | 11.07 | 136.85 | 5.51 | 2.90 | 5.26 |
| 14 | 12.00 | 136.38 | 5.51 | 3.01 | 5.26 |
| 15 | 12.92 | 135.93 | 5.51 | 3.12 | 5.25 |
| 16 | 13.84 | 135.47 | 5.51 | 3.22 | 5.24 |
| 17 | 14.76 | 135.00 | 5.51 | 3.27 | 5.22 |
| 18 | 15.69 | 134.48 | 5.51 | 3.26 | 5.20 |
| 19 | 16.61 | 133.70 | 5.51 | 3.15 | 5.16 |
| 20 | 17.53 | 131.94 | 5.51 | 2.50 | 5.04 |
| 21 | 18.46 | 130.11 | 5.51 | 2.02 | 4.93 |
| 22 | 19.48 | 129.81 | 5.51 | 2.88 | 4.98 |
| 23 | 20.51 | 132.07 | 5.51 | 3.17 | 5.10 |
| 24 | 21.53 | 132.65 | 5.51 | 3.23 | 5.12 |
| 25 | 22.56 | 133.15 | 5.51 | 3.19 | 5.14 |
| 26 | 23.58 | 133.59 | 5.51 | 3.07 | 5.15 |
| 27 | 24.61 | 134.01 | 5.51 | 2.92 | 5.15 |
| 28 | 25.63 | 134.43 | 5.51 | 2.75 | 5.16 |
| 29 | 26.66 | 134.88 | 5.51 | 2.61 | 5.16 |
| 30 | 27.68 | 135.37 | 5.51 | 2.49 | 5.17 |
| 31 | 28.71 | 135.92 | 5.51 | 2.42 | 5.19 |
| 32 | 29.73 | 134.53 | 5.51 | 2.27 | 5.12 |
| 33 | 30.76 | 134.14 | 5.51 | 2.26 | 5.11 |
| 34 | 31.78 | 133.80 | 5.51 | 2.38 | 5.10 |
| 35 | 32.81 | 133.47 | 5.51 | 2.61 | 5.11 |
| 36 | 33.83 | 133.17 | 5.51 | 2.94 | 5.12 |
| 37 | 34.86 | 132.89 | 5.51 | 3.34 | 5.14 |
| 38 | 35.88 | 132.63 | 5.51 | 3.78 | 5.17 |
| 39 | 36.91 | 132.48 | 5.51 | 3.80 | 5.16 |
| 40 | 37.93 | 132.39 | 5.51 | 3.64 | 5.15 |
| 41 | 38.96 | 132.30 | 5.51 | 3.47 | 5.13 |



PRETENSADO EN EL NERVIO = 1

TENSION EN LOS CABLES (Kp/mm2)

| I | S | To | APi | Ti | APf | Tf |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 142.00 | 9.19 | 132.81 | 16.21 | 116.59 |
| 2 | 0.92 | 142.00 | 9.12 | 132.88 | 14.56 | 118.32 |
| 3 | 1.85 | 142.00 | 9.09 | 132.91 | 14.75 | 118.16 |
| 4 | 2.77 | 142.00 | 8.88 | 133.12 | 14.31 | 118.81 |
| 5 | 3.69 | 142.00 | 8.67 | 133.33 | 13.92 | 119.41 |
| 6 | 4.61 | 142.00 | 8.45 | 133.55 | 13.59 | 119.95 |
| 7 | 5.54 | 142.00 | 8.23 | 133.77 | 13.35 | 120.42 |
| 8 | 6.46 | 142.00 | 8.00 | 134.00 | 13.19 | 120.81 |
| 9 | 7.38 | 142.00 | 7.76 | 134.24 | 13.12 | 121.12 |
| 10 | 8.30 | 142.00 | 7.52 | 134.48 | 13.15 | 121.33 |
| 11 | 9.23 | 142.00 | 6.92 | 135.08 | 13.28 | 121.80 |
| 12 | 10.15 | 142.00 | 6.29 | 135.71 | 13.44 | 122.27 |
| 13 | 11.07 | 142.00 | 5.15 | 136.85 | 13.67 | 123.18 |
| 14 | 12.00 | 142.00 | 5.62 | 136.38 | 13.77 | 122.61 |
| 15 | 12.92 | 142.00 | 6.07 | 135.93 | 13.88 | 122.05 |
| 16 | 13.84 | 142.00 | 6.53 | 135.47 | 13.96 | 121.50 |
| 17 | 14.76 | 142.00 | 7.00 | 135.00 | 14.01 | 120.99 |
| 18 | 15.69 | 142.00 | 7.52 | 134.48 | 13.97 | 120.51 |
| 19 | 16.61 | 142.00 | 8.30 | 133.70 | 13.82 | 119.88 |
| 20 | 17.53 | 142.00 | 10.06 | 131.94 | 13.05 | 118.89 |
| 21 | 18.46 | 142.00 | 11.89 | 130.11 | 12.45 | 117.66 |
| 22 | 19.48 | 142.00 | 12.19 | 129.81 | 13.37 | 116.44 |
| 23 | 20.51 | 142.00 | 9.93 | 132.07 | 13.77 | 118.30 |
| 24 | 21.53 | 142.00 | 9.35 | 132.65 | 13.87 | 118.79 |
| 25 | 22.56 | 142.00 | 8.85 | 133.15 | 13.84 | 119.31 |
| 26 | 23.58 | 142.00 | 8.41 | 133.59 | 13.73 | 119.86 |
| 27 | 24.61 | 142.00 | 7.99 | 134.01 | 13.58 | 120.43 |
| 28 | 25.63 | 142.00 | 7.57 | 134.43 | 13.42 | 121.01 |
| 29 | 26.66 | 142.00 | 7.12 | 134.88 | 13.28 | 121.60 |
| 30 | 27.68 | 142.00 | 6.63 | 135.37 | 13.17 | 122.20 |
| 31 | 28.71 | 142.00 | 6.08 | 135.92 | 13.12 | 122.80 |
| 32 | 29.73 | 142.00 | 7.47 | 134.53 | 12.90 | 121.63 |
| 33 | 30.76 | 142.00 | 7.86 | 134.14 | 12.88 | 121.27 |
| 34 | 31.78 | 142.00 | 8.20 | 133.80 | 12.99 | 120.80 |
| 35 | 32.81 | 142.00 | 8.53 | 133.47 | 13.23 | 120.24 |
| 36 | 33.83 | 142.00 | 8.83 | 133.17 | 13.57 | 119.60 |
| 37 | 34.86 | 142.00 | 9.11 | 132.89 | 13.99 | 118.90 |
| 38 | 35.88 | 142.00 | 9.37 | 132.63 | 14.45 | 118.17 |
| 39 | 36.91 | 142.00 | 9.52 | 132.48 | 14.48 | 118.00 |
| 40 | 37.93 | 142.00 | 9.61 | 132.39 | 14.29 | 118.10 |
| 41 | 38.96 | 142.00 | 9.70 | 132.30 | 14.11 | 118.19 |

PRETENSADO EN EL NERVIO = 1

FUERZAS EN LOS CABLES (T, m)

| I | S(m) | Pi (T) | Mpi (mT) | Upi (T/m) | Pf (T) | Mpf (mT) | Upf (T/m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 1338.7 | 468.54 | 0.00 | 1175.3 | 411.34 | 0.00 |
| 2 | 0.92 | 1339.4 | 494.82 | 0.00 | 1192.6 | 440.59 | 0.00 |
| 3 | 1.85 | 1339.8 | 555.64 | 3.97 | 1191.1 | 493.99 | 3.53 |
| 4 | 2.77 | 1341.9 | 578.52 | 3.98 | 1197.6 | 516.33 | 3.55 |
| 5 | 3.69 | 1344.0 | 598.08 | 3.99 | 1203.7 | 535.65 | 3.57 |
| 6 | 4.61 | 1346.2 | 614.34 | 3.99 | 1209.1 | 551.80 | 3.59 |
| 7 | 5.54 | 1348.4 | 627.26 | 4.00 | 1213.9 | 564.67 | 3.60 |
| 8 | 6.46 | 1350.7 | 636.84 | 4.01 | 1217.8 | 574.17 | 3.61 |
| 9 | 7.38 | 1353.1 | 643.06 | 4.01 | 1220.9 | 580.21 | 3.62 |
| 10 | 8.30 | 1355.5 | 645.92 | 21.28 | 1223.0 | 582.77 | 19.20 |
| 11 | 9.23 | 1361.6 | 639.60 | 21.37 | 1227.8 | 576.74 | 19.27 |
| 12 | 10.15 | 1368.0 | 615.08 | 21.47 | 1232.5 | 554.16 | 19.35 |
| 13 | 11.07 | 1379.4 | 574.05 | 21.65 | 1241.7 | 516.71 | 19.49 |
| 14 | 12.00 | 1374.7 | 507.68 | 21.58 | 1235.9 | 456.40 | 19.40 |
| 15 | 12.92 | 1370.1 | 423.48 | 21.51 | 1230.2 | 380.24 | 19.31 |
| 16 | 13.84 | 1365.5 | 321.58 | 21.44 | 1224.8 | 288.43 | 19.23 |
| 17 | 14.76 | 1360.8 | 202.14 | 21.36 | 1219.6 | 181.16 | 19.14 |
| 18 | 15.69 | 1355.6 | 65.38 | 21.28 | 1214.8 | 58.59 | 19.07 |
| 19 | 16.61 | 1347.7 | -86.93 | -86.27 | 1208.4 | -77.94 | -77.35 |
| 20 | 17.53 | 1330.0 | -194.50 | -85.13 | 1198.4 | -175.27 | -76.71 |
| 21 | 18.46 | 1311.5 | -262.30 | -98.65 | 1186.0 | -237.20 | -89.21 |
| 22 | 19.48 | 1308.5 | -175.32 | -98.43 | 1173.7 | -157.26 | -88.29 |
| 23 | 20.51 | 1331.2 | -20.71 | 21.53 | 1192.4 | -18.55 | 19.29 |
| 24 | 21.53 | 1337.1 | 172.92 | 21.63 | 1197.4 | 154.84 | 19.37 |
| 25 | 22.56 | 1342.2 | 345.20 | 21.71 | 1202.7 | 309.33 | 19.46 |
| 26 | 23.58 | 1346.6 | 495.67 | 21.78 | 1208.2 | 444.73 | 19.54 |
| 27 | 24.61 | 1350.8 | 624.05 | 21.85 | 1213.9 | 560.81 | 19.64 |
| 28 | 25.63 | 1355.1 | 730.22 | 21.92 | 1219.8 | 657.32 | 19.73 |
| 29 | 26.66 | 1359.6 | 814.10 | 21.99 | 1225.8 | 733.95 | 19.83 |
| 30 | 27.68 | 1364.6 | 875.60 | 22.07 | 1231.8 | 790.39 | 19.93 |
| 31 | 28.71 | 1370.1 | 914.67 | 22.16 | 1237.9 | 826.37 | 20.02 |
| 32 | 29.73 | 1356.0 | 917.36 | 21.94 | 1226.0 | 829.41 | 19.83 |
| 33 | 30.76 | 1352.2 | 909.87 | 9.75 | 1222.4 | 822.51 | 8.82 |
| 34 | 31.78 | 1348.7 | 892.43 | 9.73 | 1217.7 | 805.76 | 8.78 |
| 35 | 32.81 | 1345.4 | 865.02 | 9.70 | 1212.0 | 779.27 | 8.74 |
| 36 | 33.83 | 1342.4 | 827.74 | 9.68 | 1205.6 | 743.38 | 8.69 |
| 37 | 34.86 | 1339.6 | 780.58 | 9.66 | 1198.5 | 698.39 | 8.64 |
| 38 | 35.88 | 1336.9 | 723.56 | 9.64 | 1191.2 | 644.71 | 8.59 |
| 39 | 36.91 | 1335.4 | 657.23 | 9.63 | 1189.5 | 585.42 | 8.58 |
| 40 | 37.93 | 1334.5 | 546.00 | 0.00 | 1190.4 | 487.05 | 0.00 |
| 41 | 38.96 | 1333.6 | 466.75 | 0.00 | 1191.3 | 416.96 | 0.00 |



FUERZAS HORIZONTALES DE DESVIACION

| I | S(m) | R(m) | Ti (T) | Uh(T/m) | Tf(T) | Uh(T/m) |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 1100.0 | 1338.70 | -1.22 | 1175.26 | -1.08 |
| 2 | 0.92 | 1100.0 | 1339.43 | -1.22 | 1192.64 | -1.08 |
| 3 | 1.85 | 1100.0 | 1339.75 | -1.22 | 1191.09 | -1.09 |
| 4 | 2.77 | 1100.0 | 1341.85 | -1.22 | 1197.62 | -1.09 |
| 5 | 3.69 | 1100.0 | 1343.99 | -1.22 | 1203.68 | -1.10 |
| 6 | 4.61 | 1100.0 | 1346.18 | -1.22 | 1209.15 | -1.10 |
| 7 | 5.54 | 1100.0 | 1348.43 | -1.23 | 1213.88 | -1.11 |
| 8 | 6.46 | 1100.0 | 1350.73 | -1.23 | 1217.81 | -1.11 |
| 9 | 7.38 | 1100.0 | 1353.10 | -1.23 | 1220.86 | -1.11 |
| 10 | 8.30 | 1100.0 | 1355.54 | -1.24 | 1223.02 | -1.11 |
| 11 | 9.23 | 1100.0 | 1361.59 | -1.24 | 1227.77 | -1.12 |
| 12 | 10.15 | 1100.0 | 1367.96 | -1.25 | 1232.48 | -1.12 |
| 13 | 11.07 | 1100.0 | 1379.45 | -1.25 | 1241.65 | -1.13 |
| 14 | 12.00 | 1100.0 | 1374.72 | -1.25 | 1235.88 | -1.12 |
| 15 | 12.92 | 1100.0 | 1370.13 | -1.24 | 1230.23 | -1.12 |
| 16 | 13.84 | 1100.0 | 1365.53 | -1.24 | 1224.77 | -1.11 |
| 17 | 14.76 | 1100.0 | 1360.76 | -1.23 | 1219.58 | -1.11 |
| 18 | 15.69 | 1100.0 | 1355.61 | -1.23 | 1214.75 | -1.10 |
| 19 | 16.61 | 1100.0 | 1347.74 | -1.22 | 1208.43 | -1.09 |
| 20 | 17.53 | 1100.0 | 1329.95 | -1.20 | 1198.43 | -1.08 |
| 21 | 18.46 | 1100.0 | 1311.52 | -1.19 | 1185.99 | -1.07 |
| 22 | 19.48 | 1100.0 | 1308.49 | -1.20 | 1173.74 | -1.08 |
| 23 | 20.51 | 1100.0 | 1331.24 | -1.21 | 1192.42 | -1.09 |
| 24 | 21.53 | 1100.0 | 1337.15 | -1.22 | 1197.36 | -1.09 |
| 25 | 22.56 | 1100.0 | 1342.15 | -1.22 | 1202.66 | -1.10 |
| 26 | 23.58 | 1100.0 | 1346.61 | -1.23 | 1208.22 | -1.10 |
| 27 | 24.61 | 1100.0 | 1350.82 | -1.23 | 1213.94 | -1.11 |
| 28 | 25.63 | 1100.0 | 1355.08 | -1.23 | 1219.80 | -1.11 |
| 29 | 26.66 | 1100.0 | 1359.62 | -1.24 | 1225.76 | -1.12 |
| 30 | 27.68 | 1100.0 | 1364.56 | -1.24 | 1231.77 | -1.12 |
| 31 | 28.71 | 1100.0 | 1370.12 | -1.24 | 1237.86 | -1.12 |
| 32 | 29.73 | 1100.0 | 1356.05 | -1.23 | 1226.04 | -1.11 |
| 33 | 30.76 | 1100.0 | 1352.18 | -1.23 | 1222.35 | -1.11 |
| 34 | 31.78 | 1100.0 | 1348.66 | -1.22 | 1217.68 | -1.10 |
| 35 | 32.81 | 1100.0 | 1345.38 | -1.22 | 1212.01 | -1.10 |
| 36 | 33.83 | 1100.0 | 1342.38 | -1.22 | 1205.56 | -1.09 |
| 37 | 34.86 | 1100.0 | 1339.55 | -1.22 | 1198.52 | -1.09 |
| 38 | 35.88 | 1100.0 | 1336.88 | -1.21 | 1191.20 | -1.08 |
| 39 | 36.91 | 1100.0 | 1335.39 | -1.21 | 1189.47 | -1.08 |
| 40 | 37.93 | 1100.0 | 1334.52 | -1.21 | 1190.45 | -1.08 |
| 41 | 38.96 | 1100.0 | 1333.57 | -0.61 | 1191.32 | -0.54 |

## VERIFICACIÓN DE LOS ESTADOS LÍMITES DE SERVICIO

### TENSIONES NORMALES (ESTADO LÍMITE DE FISURACIÓN)

En el tablero se han comprobado las siguientes condiciones, de acuerdo con la EHE (artículo 49) y el Model Code del CEB de 1990:

a. Hipótesis de carga de construcción:

a.1. Considerando peso propio y el 60 % del pretensado total para el descimbrado del tablero:

$\sigma_{t,\,max} < 0$ Kp/cm$^2$
$\sigma_{c,max} < 0{,}60\ f_{ck,5} \approx 0{,}30$ fck = 120 Kp/cm$^2$

(El hormigón deberá alcanzar una resistencia a compresión antes del 1$^{er}$ tesado superior a 220 Kp/cm$^2$)

a2. Considerando peso propio y el 100 % del pretensado inicial (con su valor característico superior):

$\sigma_{t,\,max} < f_{ctk} = 24{,}6$ Kp/cm$^2$
$\sigma_{c,max} < 0{,}60\ f_{ck} = 240$ Kp/cm$^2$

b. Hipótesis de carga permanente, considerando peso propio, carga permanente y pretensado final (con su valor característico superior e inferior):

$\sigma_{t,\,max} < 0$ Kp/cm$^2$
$\sigma_{c,max} < 0{,}40\ f_{ck} = 160$ Kp/cm$^2$

c. Hipótesis de combinación frecuente:

La normativa EHE exige que: $\sigma_{t,\,max} < f_{ctk} = 24{,}6$ Kp/cm$^2$

Al tratarse de puentes de ferrocarril se ha procurado que bajo cargas frecuentes las fibras más solicitadas estén siempre comprimidas.

d. Hipótesis de combinación característica:

La normativa EHE exige que se verifique:

$$\sigma_{c,max} < 0{,}60\ f_{ck} = 240\ \text{Kp/cm}^2$$

y se compruebe el ELS de fisuración (ambiente IIb), de modo que el máximo ancho de fisura $w_{max}$ verifique:

$$w_{max} < w_k = 0.2\ \text{mm}$$

Los puentes de ferrocarril están sometidos a un nivel de cargas importante, mucho más agresivo que en el caso de los puentes de carretera. Por este motivo, se ha dimensionado el pretensado de forma más conservadora a la establecida en la EHE, no admitiendo fisuración bajo la combinación característica de cargas.

$\sigma_{t,\,max} < f_{ctk} = 24.6$ Kp/cm$^2$

Todas las verificaciones donde aparecen las cargas de uso, se han realizado tanto para las sobrecargas de la normativa IPF como para las definidas en el Eurocódigo 1.

En los siguientes listados se han incluido, además de aquellas combinaciones requeridas por la Normativa, otras combinaciones adicionales con el valor del pretensado característico (sin minorar) para estimar los valores medios en la sección bajo las combinaciones de carga cuasi-permanentes, frecuentes y características.

Los valores representativos de las acciones se han obtenido de acuerdo con las especificaciones de las normativas vigentes, tomándose los siguientes valores de los coeficientes $\psi$:

| Acción | $\psi_0$ | $\psi_1$ | $\psi_2$ |
|---|---|---|---|
| Sobrecargas de uso | 0.8 | 0.8 (a) 0.6 (b) 0.4 (c) | 0 |
| Viento | 0.6 | 0.5 | 0.2 |
| Temperatura | 0.6 | 0.5 | 0.2 |

(a) Una vía cargada (b) dos vías cargadas (c) 0.4 tres o más vías cargadas

COMBINACION 1 G1 + PRETII

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -140.099 | -294.077 | -147.441 | -284.637 |
| 2 | -147.379 | -284.582 | -183.546 | -371.281 |
| 3 | -183.513 | -371.253 | -184.466 | -369.942 |
| 4 | -184.995 | -370.486 | -186.328 | -368.652 |
| 5 | -186.858 | -369.183 | -188.577 | -366.818 |
| 6 | -189.124 | -367.378 | -191.237 | -364.471 |
| 7 | -191.837 | -365.074 | -194.332 | -361.642 |
| 8 | -194.996 | -362.314 | -197.919 | -358.294 |
| 9 | -198.661 | -359.047 | -202.029 | -354.416 |
| 10 | -202.872 | -355.251 | -207.987 | -348.217 |
| 11 | -209.222 | -349.462 | -218.167 | -337.159 |
| 12 | -219.545 | -338.531 | -232.479 | -320.742 |
| 13 | -233.976 | -322.231 | -249.812 | -300.451 |
| 14 | -252.754 | -303.391 | -276.518 | -270.707 |
| 15 | -275.845 | -270.028 | -303.438 | -232.078 |
| 16 | -302.757 | -231.389 | -334.136 | -188.231 |
| 17 | -333.384 | -187.464 | -368.449 | -139.236 |
| 18 | -367.535 | -138.321 | -405.231 | -86.475 |
| 19 | -403.650 | -84.888 | -411.057 | -74.701 |
| 20 | -407.575 | -71.219 | -326.019 | -61.030 |
| 21 | -322.937 | -58.155 | -406.656 | -63.488 |
| 22 | -406.225 | -63.055 | -385.160 | -92.027 |
| 23 | -389.808 | -96.685 | -339.928 | -165.288 |
| 24 | -341.019 | -166.374 | -295.732 | -228.661 |
| 25 | -296.445 | -229.382 | -256.098 | -284.874 |
| 26 | -256.586 | -285.370 | -221.259 | -333.958 |
| 27 | -221.646 | -334.342 | -191.338 | -376.027 |
| 28 | -191.723 | -376.446 | -166.349 | -411.346 |
| 29 | -166.836 | -411.863 | -146.286 | -440.126 |
| 30 | -146.939 | -440.813 | -139.253 | -451.383 |
| 31 | -135.584 | -447.705 | -129.343 | -456.289 |
| 32 | -127.887 | -454.876 | -124.926 | -458.948 |
| 33 | -123.890 | -457.911 | -123.257 | -458.781 |
| 34 | -122.433 | -457.948 | -124.188 | -455.534 |
| 35 | -123.532 | -454.883 | -127.623 | -449.256 |
| 36 | -127.133 | -448.737 | -133.695 | -439.711 |
| 37 | -133.288 | -439.301 | -142.369 | -426.812 |
| 38 | -142.016 | -426.416 | -153.309 | -410.884 |
| 39 | -153.287 | -410.846 | -132.620 | -301.998 |
| 40 | -132.612 | -301.979 | -139.700 | -292.865 |

COMBINACION 2 G1 + PRETII + 0.4 TEMP + SCMAX*0.05

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -140.099 | -294.076 | -149.735 | -281.688 |
| 2 | -149.765 | -281.515 | -188.491 | -364.479 |
| 3 | -188.458 | -364.451 | -191.863 | -359.769 |
| 4 | -192.393 | -360.311 | -196.163 | -355.126 |
| 5 | -196.693 | -355.656 | -200.835 | -349.959 |
| 6 | -201.382 | -350.519 | -205.904 | -344.299 |
| 7 | -206.504 | -344.902 | -211.395 | -338.175 |
| 8 | -212.059 | -338.847 | -217.360 | -331.556 |
| 9 | -218.103 | -332.309 | -223.837 | -324.422 |
| 10 | -224.681 | -325.256 | -232.148 | -314.986 |
| 11 | -233.384 | -316.231 | -244.669 | -300.709 |
| 12 | -246.047 | -302.081 | -261.305 | -281.096 |
| 13 | -262.802 | -282.585 | -280.950 | -257.625 |
| 14 | -283.893 | -260.565 | -309.953 | -224.722 |
| 15 | -309.280 | -224.042 | -339.155 | -182.954 |
| 16 | -338.474 | -182.265 | -372.122 | -135.987 |
| 17 | -371.368 | -135.221 | -408.689 | -83.891 |
| 18 | -407.794 | -82.949 | -447.771 | -27.966 |
| 19 | -446.214 | -26.347 | -455.940 | -12.970 |
| 20 | -452.472 | -9.468 | -371.476 | -2.585 |
| 21 | -368.408 | 0.307 | -451.546 | -1.747 |
| 22 | -451.123 | -1.303 | -427.702 | -33.515 |
| 23 | -432.372 | -38.143 | -380.167 | -109.945 |
| 24 | -381.278 | -111.004 | -333.688 | -176.458 |
| 25 | -334.434 | -177.133 | -291.830 | -235.730 |
| 26 | -292.330 | -236.208 | -254.741 | -287.908 |
| 27 | -255.128 | -288.292 | -222.540 | -333.113 |
| 28 | -222.925 | -333.532 | -195.254 | -371.590 |
| 29 | -195.741 | -372.108 | -172.879 | -403.551 |
| 30 | -173.532 | -404.238 | -163.516 | -418.013 |
| 31 | -159.847 | -414.335 | -151.257 | -426.149 |
| 32 | -149.801 | -424.736 | -144.476 | -432.060 |
| 33 | -143.440 | -431.023 | -140.425 | -435.170 |
| 34 | -139.601 | -434.335 | -138.954 | -435.225 |
| 35 | -138.299 | -434.573 | -139.973 | -432.271 |
| 36 | -139.483 | -431.751 | -143.610 | -426.074 |
| 37 | -143.204 | -425.663 | -149.833 | -416.545 |
| 38 | -149.480 | -416.150 | -158.303 | -404.015 |
| 39 | -158.281 | -403.978 | -135.035 | -298.893 |
| 40 | -135.026 | -298.874 | -139.706 | -292.858 |

COMBINACION 3 G1 + PRETII + SCMIN*0.05

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -140.099 | -294.077 | -147.511 | -284.547 |
| 2 | -147.357 | -284.610 | -183.500 | -371.344 |
| 3 | -183.467 | -371.316 | -184.398 | -370.036 |
| 4 | -184.927 | -370.580 | -186.237 | -368.778 |
| 5 | -186.766 | -369.309 | -188.463 | -366.975 |
| 6 | -189.010 | -367.535 | -191.100 | -364.660 |
| 7 | -191.700 | -365.262 | -194.173 | -361.862 |
| 8 | -194.837 | -362.534 | -197.736 | -358.546 |
| 9 | -198.479 | -359.298 | -201.823 | -354.698 |
| 10 | -202.667 | -355.533 | -207.759 | -348.530 |
| 11 | -208.994 | -349.776 | -217.916 | -337.505 |
| 12 | -219.295 | -338.876 | -232.205 | -321.119 |
| 13 | -233.702 | -322.608 | -249.515 | -300.859 |
| 14 | -252.458 | -303.799 | -276.199 | -271.147 |
| 15 | -275.526 | -270.468 | -303.095 | -232.549 |
| 16 | -302.415 | -231.860 | -333.771 | -188.733 |
| 17 | -333.018 | -187.966 | -368.061 | -139.769 |
| 18 | -367.128 | -138.881 | -404.759 | -87.124 |
| 19 | -403.154 | -85.570 | -410.446 | -75.540 |
| 20 | -406.950 | -72.078 | -325.271 | -61.991 |
| 21 | -322.177 | -59.132 | -406.070 | -64.294 |
| 22 | -405.630 | -63.874 | -384.743 | -92.600 |
| 23 | -389.370 | -97.288 | -339.621 | -165.710 |
| 24 | -340.693 | -166.823 | -295.498 | -228.982 |
| 25 | -296.177 | -229.750 | -255.861 | -285.201 |
| 26 | -256.336 | -285.713 | -221.026 | -334.278 |
| 27 | -221.413 | -334.662 | -191.121 | -376.325 |
| 28 | -191.507 | -376.744 | -166.149 | -411.621 |
| 29 | -166.636 | -412.138 | -146.103 | -440.377 |
| 30 | -146.756 | -441.064 | -139.087 | -451.612 |
| 31 | -135.417 | -447.934 | -129.193 | -456.495 |
| 32 | -127.737 | -455.082 | -124.793 | -459.131 |
| 33 | -123.757 | -458.094 | -123.141 | -458.942 |
| 34 | -122.317 | -458.108 | -124.089 | -455.671 |
| 35 | -123.433 | -455.020 | -127.540 | -449.372 |
| 36 | -127.049 | -448.851 | -133.628 | -439.803 |
| 37 | -133.222 | -439.392 | -142.319 | -426.880 |
| 38 | -141.966 | -426.485 | -153.276 | -410.929 |
| 39 | -153.253 | -410.892 | -132.604 | -302.019 |
| 40 | -132.596 | -301.999 | -139.700 | -292.865 |

COMBINACION 4 G1 + PRETI

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -239.176 | -502.049 | -224.227 | -521.270 |
| 2 | -224.110 | -521.163 | -261.300 | -705.401 |
| 3 | -261.214 | -705.322 | -243.950 | -729.067 |
| 4 | -244.824 | -729.948 | -232.249 | -747.244 |
| 5 | -233.117 | -748.113 | -225.219 | -758.976 |
| 6 | -226.130 | -759.879 | -222.924 | -764.289 |
| 7 | -223.913 | -765.278 | -225.405 | -763.225 |
| 8 | -226.504 | -764.333 | -232.721 | -755.782 |
| 9 | -233.956 | -757.033 | -244.964 | -741.893 |
| 10 | -246.367 | -743.278 | -260.239 | -724.198 |
| 11 | -265.612 | -729.553 | -299.012 | -683.615 |
| 12 | -297.442 | -682.041 | -341.056 | -622.057 |
| 13 | -339.700 | -620.683 | -393.583 | -546.574 |
| 14 | -392.387 | -545.359 | -456.460 | -457.235 |
| 15 | -455.342 | -456.100 | -529.592 | -353.979 |
| 16 | -528.453 | -352.835 | -612.807 | -236.817 |
| 17 | -611.551 | -235.540 | -705.860 | -105.829 |
| 18 | -704.335 | -104.307 | -806.776 | 36.588 |
| 19 | -804.141 | 39.232 | -860.429 | 116.648 |
| 20 | -854.625 | 122.452 | -758.987 | 175.514 |
| 21 | -753.932 | 180.410 | -844.359 | 123.325 |
| 22 | -843.640 | 124.042 | -756.901 | 4.744 |
| 23 | -764.646 | -3.024 | -635.209 | -181.048 |
| 24 | -637.027 | -182.853 | -519.913 | -343.928 |
| 25 | -521.104 | -345.129 | -416.927 | -488.412 |
| 26 | -417.725 | -489.253 | -326.595 | -614.591 |
| 27 | -327.232 | -615.252 | -249.118 | -722.687 |
| 28 | -249.784 | -723.347 | -184.524 | -813.105 |
| 29 | -185.365 | -813.931 | -132.888 | -886.107 |
| 30 | -133.977 | -887.244 | -94.068 | -942.133 |
| 31 | -95.550 | -943.655 | -68.249 | -981.205 |
| 32 | -70.172 | -983.149 | -63.756 | -991.974 |
| 33 | -60.639 | -988.830 | -60.641 | -988.828 |
| 34 | -59.297 | -987.433 | -68.279 | -975.080 |
| 35 | -67.220 | -973.990 | -85.239 | -949.208 |
| 36 | -84.443 | -948.376 | -111.614 | -911.005 |
| 37 | -110.969 | -910.348 | -147.449 | -860.173 |
| 38 | -146.873 | -859.578 | -192.152 | -797.303 |
| 39 | -192.151 | -797.297 | -189.888 | -562.723 |
| 40 | -189.908 | -562.724 | -238.528 | -500.213 |

COMBINACION 5 G1 + PRETI + 0.4 TEMP

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -239.176 | -502.049 | -226.500 | -518.347 |
| 2 | -226.383 | -518.240 | -266.027 | -698.900 |
| 3 | -265.941 | -698.821 | -251.040 | -719.315 |
| 4 | -251.915 | -720.195 | -241.703 | -734.242 |
| 5 | -242.572 | -735.110 | -237.037 | -742.723 |
| 6 | -237.947 | -743.626 | -237.103 | -744.787 |
| 7 | -238.093 | -745.775 | -241.949 | -740.472 |
| 8 | -243.048 | -741.580 | -251.624 | -729.784 |
| 9 | -252.860 | -731.033 | -266.230 | -712.644 |
| 10 | -267.633 | -714.029 | -283.868 | -691.699 |
| 11 | -289.241 | -697.054 | -325.005 | -647.865 |
| 12 | -323.435 | -646.291 | -369.410 | -583.058 |
| 13 | -368.054 | -581.685 | -424.301 | -504.325 |
| 14 | -423.105 | -503.110 | -489.541 | -411.736 |
| 15 | -488.423 | -410.602 | -565.035 | -305.233 |
| 16 | -563.895 | -304.089 | -650.611 | -184.822 |
| 17 | -649.354 | -183.545 | -746.027 | -50.585 |
| 18 | -744.501 | -49.063 | -849.303 | 95.079 |
| 19 | -846.668 | 97.722 | -905.317 | 178.386 |
| 20 | -899.514 | 184.190 | -804.456 | 233.973 |
| 21 | -799.403 | 238.872 | -889.248 | 185.064 |
| 22 | -888.530 | 185.782 | -799.428 | 63.233 |
| 23 | -807.173 | 55.466 | -675.373 | -125.808 |
| 24 | -677.191 | -127.612 | -557.715 | -291.936 |
| 25 | -558.906 | -293.138 | -452.366 | -439.669 |
| 26 | -453.164 | -440.511 | -359.672 | -569.098 |
| 27 | -360.309 | -569.759 | -279.832 | -680.444 |
| 28 | -280.498 | -681.105 | -212.875 | -774.111 |
| 29 | -213.716 | -774.938 | -158.877 | -850.361 |
| 30 | -159.966 | -851.499 | -117.696 | -909.636 |
| 31 | -119.178 | -911.158 | -89.514 | -951.957 |
| 32 | -91.438 | -953.901 | -82.660 | -965.974 |
| 33 | -79.543 | -962.830 | -77.183 | -966.076 |
| 34 | -75.840 | -964.681 | -82.457 | -955.580 |
| 35 | -81.399 | -954.489 | -97.056 | -932.955 |
| 36 | -96.260 | -932.123 | -121.069 | -898.002 |
| 37 | -120.423 | -897.344 | -154.542 | -850.419 |
| 38 | -153.965 | -849.824 | -196.881 | -790.800 |
| 39 | -196.880 | -790.792 | -192.166 | -559.793 |
| 40 | -192.187 | -559.795 | -238.533 | -500.207 |

COMBINACION 6 G1 + G2 + PRETI + 0.6 TEMP

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -239.194 | -502.026 | -256.007 | -480.409 |
| 2 | -255.897 | -480.294 | -322.950 | -620.609 |
| 3 | -322.867 | -620.526 | -329.797 | -610.996 |
| 4 | -330.673 | -611.874 | -337.869 | -601.977 |
| 5 | -338.737 | -602.847 | -346.197 | -592.587 |
| 6 | -347.109 | -593.488 | -354.848 | -582.845 |
| 7 | -355.839 | -583.831 | -363.869 | -572.787 |
| 8 | -364.972 | -573.889 | -373.309 | -562.422 |
| 9 | -374.546 | -563.670 | -383.263 | -551.680 |
| 10 | -384.666 | -553.065 | -391.833 | -543.208 |
| 11 | -397.207 | -548.561 | -419.479 | -517.928 |
| 12 | -417.906 | -516.359 | -446.002 | -477.717 |
| 13 | -444.642 | -476.348 | -478.569 | -429.687 |
| 14 | -477.372 | -428.473 | -517.086 | -373.851 |
| 15 | -515.965 | -372.721 | -561.450 | -310.163 |
| 16 | -560.311 | -309.018 | -611.487 | -238.632 |
| 17 | -610.223 | -237.365 | -666.921 | -159.385 |
| 18 | -665.396 | -157.862 | -725.856 | -74.707 |
| 19 | -723.216 | -72.071 | -733.075 | -58.511 |
| 20 | -727.271 | -52.707 | -587.515 | -44.951 |
| 21 | -582.350 | -40.196 | -726.739 | -38.446 |
| 22 | -726.021 | -37.728 | -694.522 | -81.050 |
| 23 | -702.277 | -88.806 | -622.607 | -198.381 |
| 24 | -624.424 | -200.186 | -551.632 | -300.303 |
| 25 | -552.828 | -301.497 | -487.516 | -391.325 |
| 26 | -488.322 | -392.156 | -430.628 | -471.506 |
| 27 | -431.267 | -472.165 | -381.139 | -541.108 |
| 28 | -381.808 | -541.765 | -339.091 | -600.517 |
| 29 | -339.926 | -601.352 | -304.541 | -650.020 |
| 30 | -305.628 | -651.160 | -277.362 | -690.036 |
| 31 | -278.849 | -691.551 | -257.733 | -720.594 |
| 32 | -259.666 | -722.525 | -253.983 | -730.340 |
| 33 | -250.865 | -727.200 | -246.166 | -733.663 |
| 34 | -244.825 | -732.264 | -243.657 | -733.871 |
| 35 | -242.599 | -732.780 | -245.038 | -729.424 |
| 36 | -244.237 | -728.599 | -250.369 | -720.165 |
| 37 | -249.726 | -719.506 | -259.721 | -705.758 |
| 38 | -259.136 | -705.175 | -272.466 | -686.842 |
| 39 | -272.466 | -686.833 | -231.215 | -509.588 |
| 40 | -231.231 | -509.595 | -238.626 | -500.087 |

COMBINACION 7 G1 + 1.1 PRETI + 0.4 TEMP

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -263.064 | -552.292 | -245.967 | -574.274 |
| 2 | -245.697 | -574.338 | -286.476 | -777.253 |
| 3 | -286.117 | -777.530 | -267.544 | -803.075 |
| 4 | -268.141 | -804.546 | -255.173 | -822.382 |
| 5 | -255.688 | -823.944 | -248.322 | -834.075 |
| 6 | -248.811 | -835.774 | -247.072 | -838.166 |
| 7 | -247.600 | -840.024 | -251.505 | -834.653 |
| 8 | -252.124 | -836.682 | -261.706 | -823.504 |
| 9 | -262.462 | -825.707 | -277.810 | -804.598 |
| 10 | -278.749 | -806.953 | -297.750 | -780.820 |
| 11 | -303.069 | -787.523 | -344.061 | -731.143 |
| 12 | -341.772 | -730.184 | -394.513 | -657.646 |
| 13 | -392.498 | -656.855 | -457.065 | -568.052 |
| 14 | -455.276 | -567.367 | -531.580 | -462.420 |
| 15 | -529.936 | -461.743 | -617.972 | -340.661 |
| 16 | -616.371 | -339.880 | -716.067 | -202.761 |
| 17 | -714.408 | -201.738 | -825.611 | -48.793 |
| 18 | -823.734 | -47.391 | -944.431 | 118.612 |
| 19 | -941.413 | 121.355 | -1011.983 | 218.415 |
| 20 | -1005.560 | 224.746 | -906.907 | 285.664 |
| 21 | -901.420 | 291.144 | -994.729 | 226.342 |
| 22 | -993.889 | 227.062 | -890.197 | 84.448 |
| 23 | -898.551 | 75.675 | -748.515 | -130.680 |
| 24 | -750.268 | -133.004 | -614.319 | -319.984 |
| 25 | -615.282 | -321.784 | -494.104 | -488.449 |
| 26 | -494.540 | -489.982 | -388.259 | -636.158 |
| 27 | -388.450 | -637.586 | -297.041 | -763.307 |
| 28 | -297.189 | -764.837 | -220.485 | -870.334 |
| 29 | -220.768 | -872.127 | -158.700 | -957.494 |
| 30 | -159.210 | -959.690 | -111.551 | -1025.238 |
| 31 | -112.464 | -1027.899 | -79.265 | -1073.561 |
| 32 | -80.654 | -1076.698 | -71.037 | -1089.926 |
| 33 | -66.883 | -1087.466 | -64.938 | -1090.141 |
| 34 | -62.761 | -1089.568 | -71.318 | -1077.800 |
| 35 | -69.504 | -1077.494 | -88.638 | -1051.177 |
| 36 | -87.177 | -1051.067 | -117.029 | -1010.009 |
| 37 | -115.824 | -1009.967 | -156.577 | -953.917 |
| 38 | -155.559 | -953.790 | -206.663 | -883.503 |
| 39 | -206.415 | -883.836 | -206.108 | -622.555 |
| 40 | -206.045 | -622.666 | -262.373 | -550.244 |

COMBINACION 8 G1 + G2 + 1.1 PRETI + 0.60 TEMP

TENSIONES CON AXIL INICIAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -263.111 | -552.232 | -274.580 | -537.486 |
| 2 | -274.458 | -537.361 | -341.796 | -701.168 |
| 3 | -341.704 | -701.077 | -344.270 | -697.548 |
| 4 | -345.234 | -698.514 | -349.105 | -693.191 |
| 5 | -350.060 | -694.147 | -355.230 | -687.036 |
| 6 | -356.234 | -688.027 | -362.722 | -679.104 |
| 7 | -363.812 | -680.189 | -371.629 | -669.437 |
| 8 | -372.842 | -670.651 | -382.007 | -658.046 |
| 9 | -383.367 | -659.418 | -393.962 | -644.847 |
| 10 | -395.505 | -646.370 | -405.403 | -632.756 |
| 11 | -411.314 | -638.645 | -438.841 | -600.786 |
| 12 | -437.111 | -599.059 | -472.049 | -551.006 |
| 13 | -470.553 | -549.501 | -512.921 | -491.229 |
| 14 | -511.605 | -489.894 | -561.346 | -421.481 |
| 15 | -560.114 | -420.237 | -617.211 | -341.708 |
| 16 | -615.958 | -340.449 | -680.325 | -251.920 |
| 17 | -678.936 | -250.525 | -750.393 | -152.245 |
| 18 | -748.715 | -150.570 | -825.310 | -45.224 |
| 19 | -822.406 | -42.324 | -844.434 | -12.027 |
| 20 | -838.049 | -5.643 | -694.760 | 12.903 |
| 21 | -689.102 | 18.163 | -835.180 | 6.903 |
| 22 | -834.390 | 7.691 | -786.524 | -58.141 |
| 23 | -795.053 | -66.674 | -695.545 | -203.533 |
| 24 | -697.544 | -205.519 | -606.848 | -330.260 |
| 25 | -608.163 | -331.575 | -526.944 | -443.281 |
| 26 | -527.829 | -444.197 | -456.233 | -542.668 |
| 27 | -456.935 | -543.392 | -394.908 | -628.703 |
| 28 | -395.644 | -629.425 | -343.016 | -701.809 |
| 29 | -343.935 | -702.726 | -300.619 | -762.301 |
| 30 | -301.816 | -763.555 | -267.578 | -810.644 |
| 31 | -269.213 | -812.311 | -244.087 | -846.869 |
| 32 | -246.214 | -848.993 | -239.314 | -858.482 |
| 33 | -235.884 | -855.026 | -231.310 | -861.317 |
| 34 | -229.836 | -859.779 | -230.392 | -859.013 |
| 35 | -229.228 | -857.813 | -234.998 | -849.878 |
| 36 | -234.118 | -848.969 | -245.197 | -833.731 |
| 37 | -244.489 | -833.005 | -261.066 | -810.206 |
| 38 | -260.423 | -809.563 | -281.917 | -780.001 |
| 39 | -281.918 | -779.990 | -245.070 | -572.460 |
| 40 | -245.089 | -572.467 | -262.466 | -550.124 |

COMBINACION 9 G1 + G2 + PRETD

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.664 | -440.044 | -229.957 | -413.954 |
| 2 | -228.458 | -412.449 | -293.903 | -524.883 |
| 3 | -289.749 | -520.729 | -299.326 | -507.557 |
| 4 | -299.623 | -507.848 | -308.040 | -496.272 |
| 5 | -308.452 | -496.674 | -315.669 | -486.749 |
| 6 | -316.223 | -487.323 | -322.184 | -479.124 |
| 7 | -322.933 | -479.876 | -327.605 | -473.450 |
| 8 | -328.562 | -474.419 | -331.975 | -469.725 |
| 9 | -333.150 | -470.924 | -335.346 | -467.904 |
| 10 | -336.769 | -469.322 | -335.965 | -470.428 |
| 11 | -341.026 | -475.484 | -351.525 | -461.044 |
| 12 | -350.894 | -460.426 | -364.949 | -441.096 |
| 13 | -364.700 | -440.867 | -382.571 | -416.288 |
| 14 | -382.541 | -416.264 | -404.476 | -386.096 |
| 15 | -404.432 | -386.060 | -430.593 | -350.079 |
| 16 | -430.261 | -349.738 | -460.576 | -308.045 |
| 17 | -459.622 | -307.088 | -493.632 | -260.311 |
| 18 | -491.669 | -258.349 | -527.123 | -209.587 |
| 19 | -523.109 | -205.577 | -513.462 | -218.846 |
| 20 | -509.592 | -214.976 | -373.212 | -216.262 |
| 21 | -368.263 | -211.747 | -510.530 | -199.374 |
| 22 | -507.519 | -196.361 | -502.231 | -203.635 |
| 23 | -511.338 | -212.739 | -461.082 | -281.861 |
| 24 | -464.145 | -284.917 | -418.337 | -347.919 |
| 25 | -419.215 | -348.800 | -379.549 | -403.356 |
| 26 | -378.948 | -402.778 | -345.832 | -448.325 |
| 27 | -344.401 | -446.881 | -317.482 | -483.905 |
| 28 | -315.733 | -482.203 | -294.311 | -511.667 |
| 29 | -292.717 | -510.118 | -275.808 | -533.374 |
| 30 | -274.739 | -532.294 | -261.573 | -550.402 |
| 31 | -261.298 | -550.116 | -251.305 | -563.861 |
| 32 | -252.016 | -564.528 | -251.769 | -564.868 |
| 33 | -248.952 | -562.008 | -246.886 | -564.849 |
| 34 | -245.951 | -563.914 | -244.255 | -566.248 |
| 35 | -244.017 | -565.984 | -242.899 | -567.521 |
| 36 | -243.297 | -567.859 | -243.333 | -567.809 |
| 37 | -244.170 | -568.673 | -245.847 | -566.367 |
| 38 | -247.011 | -567.522 | -247.672 | -566.613 |
| 39 | -252.399 | -571.331 | -206.538 | -432.548 |
| 40 | -210.325 | -436.323 | -208.951 | -438.090 |

COMBINACION 10 G1 + G2 + PRETD + TEMP + 0.80 SCMAX-IPF

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.862 | -439.789 | -272.020 | -359.872 |
| 2 | -273.090 | -355.066 | -381.608 | -404.257 |
| 3 | -377.490 | -400.052 | -423.530 | -336.730 |
| 4 | -423.862 | -336.975 | -463.882 | -281.932 |
| 5 | -464.292 | -282.337 | -498.274 | -235.599 |
| 6 | -498.852 | -236.140 | -526.741 | -197.782 |
| 7 | -527.513 | -198.502 | -549.293 | -168.547 |
| 8 | -550.262 | -169.499 | -565.924 | -147.957 |
| 9 | -567.103 | -149.152 | -576.711 | -135.938 |
| 10 | -578.138 | -137.350 | -579.909 | -134.915 |
| 11 | -584.968 | -139.973 | -593.198 | -128.653 |
| 12 | -592.567 | -128.037 | -599.510 | -118.488 |
| 13 | -599.259 | -118.262 | -605.167 | -110.135 |
| 14 | -605.124 | -110.131 | -610.175 | -103.184 |
| 15 | -610.112 | -103.174 | -614.561 | -97.054 |
| 16 | -614.230 | -96.713 | -617.991 | -91.541 |
| 17 | -616.970 | -90.675 | -636.256 | -64.150 |
| 18 | -634.597 | -61.770 | -655.135 | -33.523 |
| 19 | -651.498 | -28.995 | -627.270 | -62.318 |
| 20 | -623.996 | -57.628 | -486.701 | -70.349 |
| 21 | -481.940 | -65.591 | -624.593 | -42.494 |
| 22 | -621.992 | -38.919 | -631.488 | -25.858 |
| 23 | -640.943 | -34.485 | -605.934 | -82.636 |
| 24 | -609.318 | -85.250 | -578.598 | -127.501 |
| 25 | -580.017 | -127.637 | -563.556 | -150.278 |
| 26 | -566.276 | -145.132 | -562.585 | -150.209 |
| 27 | -561.153 | -148.767 | -557.670 | -153.558 |
| 28 | -555.938 | -151.833 | -551.970 | -157.290 |
| 29 | -550.384 | -155.730 | -544.943 | -163.213 |
| 30 | -543.879 | -162.126 | -536.200 | -172.688 |
| 31 | -535.925 | -172.403 | -525.428 | -186.839 |
| 32 | -526.140 | -187.506 | -519.393 | -196.785 |
| 33 | -516.553 | -193.957 | -502.019 | -213.947 |
| 34 | -501.069 | -213.032 | -480.918 | -240.748 |
| 35 | -480.684 | -240.478 | -455.154 | -275.591 |
| 36 | -455.495 | -276.008 | -425.117 | -317.789 |
| 37 | -425.955 | -318.652 | -391.233 | -366.408 |
| 38 | -392.315 | -367.676 | -350.572 | -425.087 |
| 39 | -355.308 | -429.792 | -259.050 | -365.034 |
| 40 | -262.782 | -368.878 | -209.100 | -437.899 |

COMBINACION 11 G1 + G2 + PRETD + TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.666 | -440.042 | -235.641 | -406.646 |
| 2 | -234.143 | -405.141 | -305.720 | -508.630 |
| 3 | -301.567 | -504.475 | -317.052 | -483.177 |
| 4 | -317.351 | -483.466 | -331.675 | -463.765 |
| 5 | -332.088 | -464.167 | -345.212 | -446.117 |
| 6 | -345.766 | -446.690 | -357.633 | -430.369 |
| 7 | -358.382 | -431.121 | -368.964 | -416.566 |
| 8 | -369.920 | -417.536 | -379.233 | -404.728 |
| 9 | -380.409 | -405.926 | -388.511 | -394.782 |
| 10 | -389.935 | -396.199 | -395.037 | -389.182 |
| 11 | -400.099 | -394.237 | -416.508 | -371.668 |
| 12 | -415.877 | -371.051 | -435.836 | -343.600 |
| 13 | -435.587 | -343.372 | -459.366 | -310.666 |
| 14 | -459.337 | -310.641 | -487.178 | -272.350 |
| 15 | -487.134 | -272.314 | -519.199 | -228.212 |
| 16 | -518.867 | -227.873 | -555.086 | -178.059 |
| 17 | -554.131 | -177.103 | -594.049 | -122.201 |
| 18 | -592.085 | -120.240 | -633.440 | -63.361 |
| 19 | -629.426 | -59.352 | -625.684 | -64.498 |
| 20 | -621.815 | -60.628 | -486.883 | -70.114 |
| 21 | -481.940 | -65.591 | -622.755 | -45.023 |
| 22 | -619.744 | -42.010 | -608.546 | -57.412 |
| 23 | -617.654 | -66.515 | -561.492 | -143.760 |
| 24 | -564.555 | -146.816 | -512.841 | -217.941 |
| 25 | -513.719 | -218.822 | -468.148 | -281.499 |
| 26 | -467.548 | -280.920 | -428.524 | -334.593 |
| 27 | -427.093 | -333.149 | -394.267 | -378.298 |
| 28 | -392.517 | -376.597 | -365.189 | -414.183 |
| 29 | -363.595 | -412.634 | -340.782 | -444.010 |
| 30 | -339.713 | -442.931 | -320.644 | -469.158 |
| 31 | -320.369 | -468.872 | -304.468 | -490.742 |
| 32 | -305.180 | -491.408 | -299.029 | -499.868 |
| 33 | -296.212 | -497.008 | -288.242 | -507.970 |
| 34 | -287.307 | -507.035 | -279.700 | -517.497 |
| 35 | -279.464 | -517.231 | -272.442 | -526.889 |
| 36 | -272.839 | -527.227 | -266.968 | -535.302 |
| 37 | -267.807 | -536.165 | -263.578 | -541.981 |
| 38 | -264.741 | -543.136 | -259.493 | -550.355 |
| 39 | -264.221 | -555.071 | -212.235 | -425.224 |
| 40 | -216.021 | -428.999 | -208.964 | -438.073 |

COMBINACION 12 G1 + G2 + PRETD + SCMAX-IPF + 0.6 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.911 | -439.727 | -278.841 | -351.102 |
| 2 | -280.553 | -345.471 | -395.853 | -384.665 |
| 3 | -391.744 | -380.449 | -443.059 | -309.871 |
| 4 | -443.398 | -310.105 | -487.479 | -249.477 |
| 5 | -487.889 | -249.883 | -524.723 | -199.222 |
| 6 | -525.306 | -199.756 | -554.838 | -159.138 |
| 7 | -555.617 | -159.849 | -577.832 | -129.296 |
| 8 | -578.804 | -130.243 | -593.694 | -109.764 |
| 9 | -594.873 | -110.959 | -602.495 | -100.475 |
| 10 | -603.923 | -101.886 | -602.497 | -103.847 |
| 11 | -607.556 | -108.906 | -611.377 | -103.650 |
| 12 | -610.746 | -103.034 | -612.073 | -101.208 |
| 13 | -611.822 | -100.983 | -610.899 | -102.252 |
| 14 | -610.852 | -102.252 | -607.843 | -106.391 |
| 15 | -607.775 | -106.388 | -602.959 | -113.011 |
| 16 | -602.629 | -112.670 | -595.913 | -121.906 |
| 17 | -594.877 | -121.062 | -606.642 | -104.881 |
| 18 | -605.058 | -102.397 | -618.031 | -84.554 |
| 19 | -614.489 | -79.895 | -582.777 | -123.512 |
| 20 | -579.653 | -118.616 | -441.187 | -128.867 |
| 21 | -436.469 | -124.054 | -580.163 | -103.602 |
| 22 | -577.664 | -99.886 | -594.698 | -76.459 |
| 23 | -604.238 | -84.967 | -576.880 | -122.595 |
| 24 | -580.345 | -125.099 | -557.236 | -156.882 |
| 25 | -558.790 | -156.833 | -551.968 | -166.215 |
| 26 | -555.518 | -159.928 | -563.024 | -149.606 |
| 27 | -561.591 | -148.165 | -567.807 | -139.616 |
| 28 | -566.079 | -137.885 | -570.314 | -132.060 |
| 29 | -568.730 | -130.497 | -569.993 | -128.760 |
| 30 | -568.932 | -127.670 | -566.461 | -131.067 |
| 31 | -566.185 | -130.784 | -559.403 | -140.112 |
| 32 | -560.114 | -140.779 | -555.580 | -147.015 |
| 33 | -552.734 | -144.195 | -538.921 | -163.194 |
| 34 | -537.968 | -162.284 | -517.045 | -191.060 |
| 35 | -516.810 | -190.791 | -489.016 | -229.019 |
| 36 | -489.342 | -229.456 | -455.199 | -276.415 |
| 37 | -456.037 | -277.278 | -416.054 | -332.269 |
| 38 | -417.116 | -333.565 | -368.613 | -400.274 |
| 39 | -373.351 | -404.977 | -268.475 | -352.915 |
| 40 | -272.194 | -356.777 | -209.129 | -437.862 |

COMBINACION 13  G1 + G2 + PRETD + 0.60 SCMAX-IPF + 0.2 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.812 | -439.854 | -258.378 | -377.412 |
| 2 | -258.806 | -373.432 | -353.182 | -443.353 |
| 3 | -349.055 | -439.161 | -382.730 | -392.846 |
| 4 | -383.052 | -393.103 | -411.922 | -353.396 |
| 5 | -412.332 | -353.801 | -436.375 | -320.734 |
| 6 | -436.946 | -321.284 | -456.105 | -294.932 |
| 7 | -456.871 | -295.661 | -471.123 | -276.059 |
| 8 | -472.090 | -277.015 | -481.445 | -264.148 |
| 9 | -482.622 | -265.345 | -487.129 | -259.146 |
| 10 | -488.555 | -260.561 | -486.433 | -263.479 |
| 11 | -491.492 | -268.536 | -497.039 | -260.907 |
| 12 | -496.408 | -260.291 | -501.882 | -252.763 |
| 13 | -501.631 | -252.536 | -507.280 | -244.766 |
| 14 | -507.241 | -244.756 | -513.264 | -236.472 |
| 15 | -513.206 | -236.456 | -519.836 | -227.337 |
| 16 | -519.505 | -226.996 | -526.657 | -217.159 |
| 17 | -525.653 | -216.270 | -545.371 | -189.151 |
| 18 | -543.636 | -186.875 | -564.657 | -157.963 |
| 19 | -560.927 | -153.564 | -537.096 | -186.341 |
| 20 | -533.673 | -181.855 | -395.809 | -187.209 |
| 21 | -390.999 | -182.516 | -534.353 | -166.607 |
| 22 | -531.650 | -163.172 | -540.700 | -150.725 |
| 23 | -550.068 | -159.472 | -514.495 | -208.398 |
| 24 | -517.799 | -211.123 | -486.556 | -254.094 |
| 25 | -487.840 | -254.416 | -468.825 | -280.568 |
| 26 | -470.714 | -276.566 | -462.917 | -287.290 |
| 27 | -461.484 | -285.849 | -455.391 | -294.229 |
| 28 | -453.655 | -292.509 | -448.572 | -299.501 |
| 29 | -446.984 | -297.943 | -441.923 | -304.904 |
| 30 | -440.859 | -303.818 | -435.055 | -311.800 |
| 31 | -434.779 | -311.515 | -427.657 | -321.311 |
| 32 | -428.368 | -321.978 | -426.494 | -324.556 |
| 33 | -423.660 | -321.720 | -415.490 | -332.956 |
| 34 | -414.544 | -332.037 | -402.257 | -348.936 |
| 35 | -402.021 | -348.669 | -385.843 | -370.921 |
| 36 | -386.197 | -371.318 | -366.671 | -398.174 |
| 37 | -367.509 | -399.037 | -345.134 | -429.810 |
| 38 | -346.237 | -431.049 | -318.345 | -469.411 |
| 39 | -323.078 | -474.120 | -242.789 | -385.941 |
| 40 | -246.535 | -389.767 | -209.055 | -437.956 |

COMBINACION 14  G1 + G2 + PRETD + SCMIN-IPF

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.664 | -440.044 | -225.855 | -419.227 |
| 2 | -221.212 | -421.766 | -278.829 | -545.616 |
| 3 | -274.676 | -541.460 | -276.712 | -538.659 |
| 4 | -277.010 | -538.949 | -277.891 | -537.739 |
| 5 | -278.304 | -538.140 | -277.983 | -538.581 |
| 6 | -278.537 | -539.155 | -276.961 | -541.322 |
| 7 | -277.710 | -542.074 | -274.838 | -546.024 |
| 8 | -275.794 | -546.994 | -271.304 | -553.170 |
| 9 | -272.479 | -554.369 | -264.930 | -564.752 |
| 10 | -266.354 | -566.169 | -255.329 | -581.333 |
| 11 | -260.392 | -586.385 | -260.183 | -586.673 |
| 12 | -259.551 | -586.057 | -262.438 | -582.086 |
| 13 | -262.188 | -581.859 | -268.398 | -573.319 |
| 14 | -268.368 | -573.295 | -278.110 | -559.897 |
| 15 | -278.066 | -559.860 | -291.556 | -541.306 |
| 16 | -291.222 | -540.969 | -308.383 | -517.367 |
| 17 | -307.431 | -516.406 | -327.811 | -488.377 |
| 18 | -319.529 | -495.105 | -326.949 | -484.900 |
| 19 | -315.062 | -491.719 | -252.882 | -577.240 |
| 20 | -244.257 | -579.911 | -53.688 | -627.080 |
| 21 | -44.587 | -627.903 | -261.501 | -541.880 |
| 22 | -255.677 | -542.739 | -327.513 | -443.937 |
| 23 | -329.572 | -462.736 | -330.541 | -461.402 |
| 24 | -326.963 | -473.593 | -313.350 | -492.316 |
| 25 | -303.092 | -508.512 | -275.128 | -546.973 |
| 26 | -270.446 | -552.008 | -244.561 | -587.611 |
| 27 | -243.131 | -586.166 | -223.441 | -613.246 |
| 28 | -221.690 | -611.547 | -207.497 | -631.069 |
| 29 | -205.902 | -629.521 | -196.220 | -642.837 |
| 30 | -195.150 | -641.758 | -189.209 | -649.929 |
| 31 | -188.934 | -649.644 | -186.178 | -653.434 |
| 32 | -186.888 | -654.103 | -193.883 | -644.483 |
| 33 | -191.067 | -641.622 | -196.233 | -634.516 |
| 34 | -195.298 | -633.582 | -200.836 | -625.965 |
| 35 | -200.599 | -625.699 | -206.709 | -617.296 |
| 36 | -207.107 | -617.634 | -214.375 | -607.637 |
| 37 | -215.213 | -608.501 | -224.123 | -596.245 |
| 38 | -225.287 | -597.400 | -233.187 | -586.535 |
| 39 | -237.914 | -591.253 | -199.559 | -441.522 |
| 40 | -203.346 | -445.296 | -208.936 | -438.109 |

COMBINACION 15 G1 + G2 + PRETD + 0.60 SCMIN-IPF

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.664 | -440.044 | -227.496 | -417.118 |
| 2 | -224.111 | -418.040 | -284.859 | -537.323 |
| 3 | -280.705 | -533.167 | -285.758 | -526.218 |
| 4 | -286.056 | -526.509 | -289.950 | -521.152 |
| 5 | -290.363 | -521.554 | -293.057 | -517.849 |
| 6 | -293.611 | -518.422 | -295.051 | -516.442 |
| 7 | -295.799 | -517.195 | -295.945 | -516.994 |
| 8 | -296.901 | -517.964 | -295.572 | -519.792 |
| 9 | -296.747 | -520.992 | -293.097 | -526.013 |
| 10 | -294.520 | -527.430 | -287.583 | -536.971 |
| 11 | -292.645 | -542.024 | -296.719 | -536.421 |
| 12 | -296.088 | -535.805 | -303.442 | -525.690 |
| 13 | -303.193 | -525.462 | -314.066 | -510.507 |
| 14 | -314.037 | -510.483 | -328.656 | -490.376 |
| 15 | -328.612 | -490.340 | -347.171 | -464.815 |
| 16 | -346.838 | -464.477 | -369.260 | -433.638 |
| 17 | -368.308 | -432.679 | -394.140 | -397.151 |
| 18 | -388.385 | -400.403 | -407.019 | -374.774 |
| 19 | -398.281 | -377.262 | -357.114 | -433.882 |
| 20 | -350.391 | -433.937 | -181.498 | -462.753 |
| 21 | -174.057 | -461.440 | -361.113 | -404.877 |
| 22 | -356.414 | -404.188 | -397.400 | -347.816 |
| 23 | -402.279 | -362.737 | -382.757 | -389.586 |
| 24 | -381.835 | -398.123 | -355.345 | -434.557 |
| 25 | -349.542 | -444.627 | -316.897 | -489.526 |
| 26 | -313.847 | -492.316 | -285.069 | -531.896 |
| 27 | -283.639 | -530.452 | -261.058 | -561.510 |
| 28 | -259.307 | -559.810 | -242.223 | -583.308 |
| 29 | -240.628 | -581.759 | -228.056 | -599.052 |
| 30 | -226.986 | -597.972 | -218.155 | -610.118 |
| 31 | -217.880 | -609.833 | -212.229 | -617.605 |
| 32 | -212.939 | -618.273 | -217.037 | -612.637 |
| 33 | -214.221 | -609.776 | -216.494 | -606.649 |
| 34 | -215.559 | -605.715 | -218.204 | -602.078 |
| 35 | -217.966 | -601.813 | -221.185 | -597.386 |
| 36 | -221.583 | -597.724 | -225.958 | -591.707 |
| 37 | -226.796 | -592.569 | -232.813 | -584.294 |
| 38 | -233.977 | -585.449 | -238.981 | -578.566 |
| 39 | -243.708 | -583.285 | -202.351 | -437.932 |
| 40 | -206.138 | -441.707 | -208.942 | -438.101 |

COMBINACION 16 G1 + G2 + PRETD + SCMAX-EC1 + 0.6 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.872 | -439.776 | -285.852 | -342.089 |
| 2 | -286.199 | -338.211 | -407.098 | -369.198 |
| 3 | -402.945 | -365.042 | -458.922 | -288.053 |
| 4 | -459.221 | -288.342 | -507.241 | -222.296 |
| 5 | -507.654 | -222.699 | -547.710 | -167.607 |
| 6 | -548.264 | -168.179 | -580.308 | -124.107 |
| 7 | -581.057 | -124.859 | -605.063 | -91.843 |
| 8 | -606.020 | -92.811 | -621.986 | -70.853 |
| 9 | -623.161 | -72.051 | -631.146 | -61.069 |
| 10 | -632.570 | -62.487 | -630.778 | -64.951 |
| 11 | -635.840 | -70.005 | -638.588 | -66.225 |
| 12 | -637.958 | -65.608 | -637.496 | -66.243 |
| 13 | -637.247 | -66.014 | -633.791 | -70.767 |
| 14 | -633.762 | -70.743 | -627.068 | -79.949 |
| 15 | -627.024 | -79.914 | -617.812 | -92.584 |
| 16 | -617.479 | -92.244 | -605.648 | -108.517 |
| 17 | -604.691 | -107.564 | -594.695 | -121.312 |
| 18 | -597.885 | -112.262 | -603.426 | -104.641 |
| 19 | -605.783 | -91.870 | -580.673 | -126.406 |
| 20 | -579.152 | -119.306 | -441.187 | -128.867 |
| 21 | -436.469 | -124.054 | -577.864 | -106.763 |
| 22 | -577.151 | -100.591 | -578.719 | -98.435 |
| 23 | -593.656 | -99.522 | -563.093 | -141.558 |
| 24 | -571.575 | -137.160 | -565.312 | -145.775 |
| 25 | -566.866 | -145.725 | -580.740 | -126.643 |
| 26 | -580.391 | -125.719 | -592.701 | -108.788 |
| 27 | -591.271 | -107.345 | -601.355 | -93.475 |
| 28 | -599.607 | -91.772 | -606.793 | -81.889 |
| 29 | -605.199 | -80.339 | -608.491 | -75.811 |
| 30 | -607.422 | -74.731 | -606.058 | -76.607 |
| 31 | -605.783 | -76.322 | -599.165 | -85.425 |
| 32 | -599.876 | -86.091 | -594.589 | -93.364 |
| 33 | -591.770 | -90.506 | -576.276 | -111.817 |
| 34 | -575.340 | -110.883 | -551.824 | -143.226 |
| 35 | -551.587 | -142.961 | -520.274 | -186.027 |
| 36 | -520.667 | -186.372 | -482.077 | -239.448 |
| 37 | -482.915 | -240.311 | -437.546 | -302.710 |
| 38 | -438.703 | -303.874 | -383.904 | -379.243 |
| 39 | -388.633 | -383.959 | -276.239 | -342.933 |
| 40 | -280.022 | -346.713 | -209.120 | -437.873 |

COMBINACION 17 G1 + G2 + PRETD + TEMP + 0.80 SCMAX-EC1

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.832 | -439.829 | -277.628 | -352.661 |
| 2 | -277.607 | -349.258 | -390.604 | -391.884 |
| 3 | -386.451 | -387.727 | -436.221 | -319.276 |
| 4 | -436.520 | -319.564 | -479.691 | -260.188 |
| 5 | -480.104 | -260.590 | -516.664 | -210.307 |
| 6 | -517.219 | -210.879 | -547.117 | -169.758 |
| 7 | -547.866 | -170.509 | -571.078 | -138.585 |
| 8 | -572.035 | -139.553 | -588.557 | -116.829 |
| 9 | -589.734 | -118.026 | -599.632 | -104.413 |
| 10 | -601.056 | -105.830 | -602.533 | -103.798 |
| 11 | -607.595 | -108.852 | -614.967 | -98.713 |
| 12 | -614.336 | -98.096 | -619.848 | -90.516 |
| 13 | -619.599 | -90.287 | -623.481 | -84.947 |
| 14 | -623.452 | -84.923 | -625.555 | -82.031 |
| 15 | -625.510 | -81.995 | -626.443 | -80.712 |
| 16 | -626.111 | -80.373 | -625.778 | -80.830 |
| 17 | -624.822 | -79.877 | -626.700 | -77.294 |
| 18 | -628.858 | -69.663 | -643.451 | -49.593 |
| 19 | -644.533 | -38.574 | -625.586 | -64.633 |
| 20 | -623.596 | -58.179 | -486.701 | -70.349 |
| 21 | -481.940 | -65.591 | -622.755 | -45.023 |
| 22 | -621.582 | -39.483 | -618.705 | -43.440 |
| 23 | -632.477 | -46.129 | -594.904 | -97.806 |
| 24 | -602.302 | -94.899 | -585.059 | -118.616 |
| 25 | -586.478 | -118.751 | -586.573 | -118.621 |
| 26 | -586.174 | -117.765 | -586.327 | -117.555 |
| 27 | -584.897 | -116.111 | -584.508 | -116.645 |
| 28 | -582.760 | -114.943 | -581.153 | -117.152 |
| 29 | -579.559 | -115.604 | -575.741 | -120.854 |
| 30 | -574.672 | -119.775 | -567.878 | -129.119 |
| 31 | -567.603 | -128.834 | -557.238 | -143.090 |
| 32 | -557.950 | -143.756 | -550.600 | -153.865 |
| 33 | -547.782 | -151.006 | -531.903 | -172.846 |
| 34 | -530.967 | -171.912 | -508.742 | -202.480 |
| 35 | -508.505 | -202.214 | -480.161 | -241.198 |
| 36 | -480.555 | -241.541 | -446.619 | -288.216 |
| 37 | -447.457 | -289.079 | -408.426 | -342.761 |
| 38 | -409.584 | -343.923 | -362.805 | -408.262 |
| 39 | -367.533 | -412.978 | -265.261 | -357.048 |
| 40 | -269.044 | -360.827 | -209.093 | -437.908 |

COMBINACION 18 G1 + G2 + PRETD + 0.60 SCMAX-EC1 + 0.2 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.789 | -439.884 | -262.585 | -372.004 |
| 2 | -262.193 | -369.076 | -359.930 | -434.073 |
| 3 | -355.776 | -429.918 | -392.247 | -379.756 |
| 4 | -392.546 | -380.046 | -423.779 | -337.088 |
| 5 | -424.191 | -337.490 | -450.167 | -301.765 |
| 6 | -450.721 | -302.338 | -471.387 | -273.915 |
| 7 | -472.136 | -274.667 | -487.462 | -253.587 |
| 8 | -488.419 | -254.556 | -498.420 | -240.801 |
| 9 | -499.595 | -242.000 | -504.320 | -235.503 |
| 10 | -505.743 | -236.920 | -503.401 | -240.141 |
| 11 | -508.463 | -245.196 | -513.366 | -238.452 |
| 12 | -512.735 | -237.835 | -517.135 | -231.783 |
| 13 | -516.887 | -231.554 | -521.016 | -225.875 |
| 14 | -520.986 | -225.851 | -524.799 | -220.607 |
| 15 | -524.755 | -220.571 | -528.747 | -215.080 |
| 16 | -528.415 | -214.740 | -532.498 | -209.125 |
| 17 | -531.542 | -208.172 | -538.204 | -199.009 |
| 18 | -539.332 | -192.795 | -555.894 | -170.016 |
| 19 | -555.703 | -160.749 | -535.833 | -188.077 |
| 20 | -533.372 | -182.269 | -395.809 | -187.209 |
| 21 | -390.999 | -182.516 | -532.974 | -168.504 |
| 22 | -531.343 | -163.595 | -531.113 | -163.911 |
| 23 | -543.718 | -168.205 | -506.223 | -219.775 |
| 24 | -512.537 | -218.360 | -491.402 | -247.429 |
| 25 | -492.685 | -247.751 | -486.088 | -256.825 |
| 26 | -485.638 | -256.040 | -480.723 | -262.800 |
| 27 | -479.292 | -261.357 | -475.520 | -266.544 |
| 28 | -473.772 | -264.842 | -470.460 | -269.397 |
| 29 | -468.866 | -267.848 | -465.022 | -273.134 |
| 30 | -463.953 | -272.054 | -458.813 | -279.124 |
| 31 | -458.538 | -278.839 | -451.515 | -288.498 |
| 32 | -452.226 | -289.165 | -449.899 | -292.365 |
| 33 | -447.081 | -289.507 | -437.903 | -302.130 |
| 34 | -436.968 | -301.196 | -423.125 | -320.235 |
| 35 | -422.888 | -319.970 | -404.598 | -345.125 |
| 36 | -404.993 | -345.467 | -382.798 | -375.994 |
| 37 | -383.635 | -376.857 | -358.029 | -412.075 |
| 38 | -359.189 | -413.235 | -327.520 | -456.792 |
| 39 | -332.248 | -461.509 | -247.447 | -379.951 |
| 40 | -251.232 | -383.729 | -209.050 | -437.962 |

COMBINACION 19 G1 + G2 + PRETD + SCMIN-EC1

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.663 | -440.046 | -221.105 | -425.334 |
| 2 | -217.762 | -426.201 | -271.665 | -555.469 |
| 3 | -267.510 | -551.315 | -265.972 | -553.431 |
| 4 | -266.270 | -553.721 | -263.572 | -557.432 |
| 5 | -263.985 | -557.834 | -260.089 | -563.192 |
| 6 | -260.643 | -563.766 | -255.492 | -570.851 |
| 7 | -256.239 | -571.604 | -249.783 | -580.484 |
| 8 | -250.740 | -581.453 | -243.042 | -592.041 |
| 9 | -244.217 | -593.240 | -235.294 | -605.512 |
| 10 | -236.717 | -606.931 | -224.798 | -623.324 |
| 11 | -229.858 | -628.380 | -229.230 | -629.244 |
| 12 | -228.600 | -628.627 | -231.550 | -624.569 |
| 13 | -231.301 | -624.340 | -238.052 | -615.055 |
| 14 | -238.023 | -615.031 | -248.826 | -600.172 |
| 15 | -248.782 | -600.136 | -263.804 | -579.475 |
| 16 | -263.472 | -579.136 | -282.648 | -552.762 |
| 17 | -281.694 | -551.805 | -297.824 | -529.620 |
| 18 | -295.480 | -528.181 | -288.558 | -537.702 |
| 19 | -284.069 | -534.346 | -225.054 | -615.513 |
| 20 | -220.897 | -612.039 | -40.767 | -643.692 |
| 21 | -35.570 | -639.496 | -237.812 | -574.461 |
| 22 | -234.632 | -571.683 | -291.957 | -492.840 |
| 23 | -300.637 | -502.531 | -304.249 | -497.564 |
| 24 | -306.910 | -501.173 | -289.173 | -525.567 |
| 25 | -289.378 | -527.374 | -258.085 | -570.413 |
| 26 | -257.238 | -570.175 | -232.231 | -604.568 |
| 27 | -230.800 | -603.125 | -211.993 | -628.992 |
| 28 | -210.244 | -627.291 | -196.927 | -645.605 |
| 29 | -195.333 | -644.057 | -186.530 | -656.164 |
| 30 | -185.461 | -655.084 | -180.400 | -662.046 |
| 31 | -180.125 | -661.760 | -178.249 | -664.340 |
| 32 | -178.960 | -665.008 | -186.837 | -654.173 |
| 33 | -184.020 | -651.313 | -190.063 | -643.002 |
| 34 | -189.128 | -642.067 | -195.553 | -633.231 |
| 35 | -195.315 | -632.967 | -202.304 | -623.355 |
| 36 | -202.701 | -623.693 | -210.850 | -612.486 |
| 37 | -211.688 | -613.349 | -221.479 | -599.883 |
| 38 | -222.642 | -601.038 | -231.423 | -588.961 |
| 39 | -236.150 | -593.679 | -198.710 | -442.614 |
| 40 | -202.497 | -446.389 | -208.934 | -438.112 |

COMBINACION 20 G1 + G2 + PRETD + 0.60 SCMIN-EC1

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -209.664 | -440.044 | -224.646 | -420.782 |
| 2 | -222.041 | -420.701 | -280.560 | -543.235 |
| 3 | -276.406 | -539.081 | -279.314 | -535.081 |
| 4 | -279.612 | -535.372 | -281.359 | -532.968 |
| 5 | -281.772 | -533.370 | -282.321 | -532.615 |
| 6 | -282.875 | -533.189 | -282.169 | -534.160 |
| 7 | -282.917 | -534.913 | -280.912 | -537.670 |
| 8 | -281.869 | -538.639 | -278.615 | -543.115 |
| 9 | -279.790 | -544.314 | -275.315 | -550.469 |
| 10 | -276.738 | -551.888 | -269.264 | -562.166 |
| 11 | -274.325 | -567.221 | -278.148 | -561.964 |
| 12 | -277.517 | -561.347 | -284.909 | -551.180 |
| 13 | -284.661 | -550.951 | -295.859 | -535.548 |
| 14 | -295.830 | -535.524 | -311.086 | -514.542 |
| 15 | -311.042 | -514.506 | -330.520 | -487.716 |
| 16 | -330.188 | -487.377 | -353.819 | -454.875 |
| 17 | -352.865 | -453.918 | -376.147 | -421.896 |
| 18 | -373.956 | -420.248 | -383.984 | -406.456 |
| 19 | -379.685 | -402.838 | -340.417 | -456.846 |
| 20 | -336.375 | -453.214 | -173.746 | -472.720 |
| 21 | -168.647 | -468.396 | -346.899 | -424.426 |
| 22 | -343.787 | -421.554 | -376.066 | -377.158 |
| 23 | -384.918 | -386.614 | -366.982 | -411.283 |
| 24 | -369.804 | -414.671 | -340.839 | -454.508 |
| 25 | -341.313 | -455.944 | -306.671 | -503.590 |
| 26 | -305.922 | -503.217 | -277.672 | -542.071 |
| 27 | -276.241 | -540.628 | -254.189 | -570.957 |
| 28 | -252.439 | -569.256 | -235.881 | -592.030 |
| 29 | -234.287 | -590.481 | -222.241 | -607.048 |
| 30 | -221.172 | -605.968 | -212.869 | -617.388 |
| 31 | -212.594 | -617.102 | -207.471 | -624.148 |
| 32 | -208.182 | -624.816 | -212.810 | -618.451 |
| 33 | -209.993 | -615.591 | -212.792 | -611.741 |
| 34 | -211.858 | -610.806 | -215.033 | -606.438 |
| 35 | -214.796 | -606.174 | -218.542 | -601.021 |
| 36 | -218.940 | -601.359 | -223.843 | -594.615 |
| 37 | -224.681 | -595.479 | -231.226 | -586.476 |
| 38 | -232.390 | -587.631 | -237.923 | -580.022 |
| 39 | -242.650 | -584.740 | -201.841 | -438.587 |
| 40 | -205.628 | -442.362 | -208.941 | -438.103 |

COMBINACION 21 G1 + G2 + 0.9 PRETD

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.700 | -396.037 | -213.648 | -363.960 |
| 2 | -212.300 | -362.606 | -277.254 | -454.872 |
| 3 | -273.515 | -451.133 | -286.836 | -432.811 |
| 4 | -287.104 | -433.072 | -298.369 | -417.579 |
| 5 | -298.739 | -417.942 | -307.916 | -405.322 |
| 6 | -308.414 | -405.839 | -315.449 | -396.162 |
| 7 | -316.123 | -396.839 | -320.989 | -390.146 |
| 8 | -321.851 | -391.018 | -324.574 | -387.272 |
| 9 | -325.633 | -388.351 | -326.250 | -387.502 |
| 10 | -327.530 | -388.778 | -324.438 | -393.032 |
| 11 | -328.992 | -397.582 | -335.059 | -389.237 |
| 12 | -334.492 | -388.682 | -342.754 | -377.319 |
| 13 | -342.529 | -377.113 | -353.210 | -362.424 |
| 14 | -353.184 | -362.402 | -366.515 | -344.067 |
| 15 | -366.475 | -344.035 | -382.602 | -321.854 |
| 16 | -382.303 | -321.548 | -401.158 | -295.616 |
| 17 | -400.299 | -294.755 | -421.465 | -265.644 |
| 18 | -419.697 | -263.879 | -441.164 | -234.355 |
| 19 | -437.550 | -230.748 | -417.331 | -258.557 |
| 20 | -413.848 | -255.074 | -280.577 | -265.754 |
| 21 | -276.100 | -261.720 | -416.976 | -237.890 |
| 22 | -414.267 | -235.179 | -423.079 | -223.060 |
| 23 | -431.277 | -231.252 | -398.271 | -276.647 |
| 24 | -401.028 | -279.397 | -370.780 | -320.999 |
| 25 | -371.571 | -321.790 | -345.602 | -357.508 |
| 26 | -345.062 | -356.987 | -323.745 | -386.305 |
| 27 | -322.457 | -385.006 | -305.472 | -408.368 |
| 28 | -303.897 | -406.836 | -290.612 | -425.109 |
| 29 | -289.176 | -423.717 | -278.704 | -438.119 |
| 30 | -277.742 | -437.148 | -269.392 | -448.632 |
| 31 | -269.144 | -448.376 | -262.403 | -457.647 |
| 32 | -263.043 | -458.247 | -263.824 | -457.174 |
| 33 | -261.289 | -454.600 | -259.188 | -457.488 |
| 34 | -258.347 | -456.646 | -255.332 | -460.793 |
| 35 | -255.118 | -460.555 | -251.381 | -465.696 |
| 36 | -251.739 | -466.000 | -247.790 | -471.430 |
| 37 | -248.544 | -472.207 | -244.826 | -477.321 |
| 38 | -245.872 | -478.363 | -239.990 | -486.453 |
| 39 | -244.244 | -490.700 | -194.809 | -377.819 |
| 40 | -198.216 | -381.218 | -188.078 | -394.253 |

COMBINACION 22 G1 + G2 + 0.9 PRETD + TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.701 | -396.035 | -219.332 | -356.653 |
| 2 | -217.985 | -355.298 | -289.071 | -438.619 |
| 3 | -285.333 | -434.879 | -304.563 | -408.430 |
| 4 | -304.832 | -408.691 | -322.004 | -385.072 |
| 5 | -322.375 | -385.434 | -337.458 | -364.690 |
| 6 | -337.957 | -365.205 | -350.898 | -347.407 |
| 7 | -351.572 | -348.083 | -362.348 | -333.263 |
| 8 | -363.210 | -334.134 | -371.833 | -322.274 |
| 9 | -372.892 | -323.352 | -379.415 | -314.380 |
| 10 | -380.696 | -315.655 | -383.510 | -311.786 |
| 11 | -388.064 | -316.336 | -400.043 | -299.861 |
| 12 | -399.474 | -299.308 | -413.641 | -279.823 |
| 13 | -413.416 | -279.617 | -430.006 | -256.801 |
| 14 | -429.980 | -256.779 | -449.217 | -230.320 |
| 15 | -449.177 | -230.288 | -471.208 | -199.988 |
| 16 | -470.909 | -199.683 | -495.668 | -165.629 |
| 17 | -494.808 | -164.770 | -521.881 | -127.534 |
| 18 | -520.114 | -125.769 | -547.481 | -88.129 |
| 19 | -543.867 | -84.522 | -529.554 | -104.209 |
| 20 | -526.071 | -100.726 | -394.248 | -119.606 |
| 21 | -389.776 | -115.565 | -529.201 | -83.540 |
| 22 | -526.492 | -80.828 | -529.394 | -76.836 |
| 23 | -537.593 | -85.027 | -498.682 | -138.545 |
| 24 | -501.438 | -141.296 | -465.284 | -191.021 |
| 25 | -466.075 | -191.812 | -434.201 | -235.651 |
| 26 | -433.662 | -235.129 | -406.437 | -272.573 |
| 27 | -405.149 | -271.274 | -382.257 | -302.760 |
| 28 | -380.682 | -301.229 | -361.490 | -327.626 |
| 29 | -360.054 | -326.233 | -343.678 | -348.756 |
| 30 | -342.715 | -347.785 | -328.462 | -367.388 |
| 31 | -328.215 | -367.131 | -315.566 | -384.528 |
| 32 | -316.207 | -385.127 | -311.083 | -392.174 |
| 33 | -308.549 | -389.600 | -300.543 | -400.610 |
| 34 | -299.703 | -399.767 | -290.778 | -412.042 |
| 35 | -290.565 | -411.803 | -280.923 | -425.064 |
| 36 | -281.281 | -425.369 | -271.426 | -438.922 |
| 37 | -272.180 | -439.699 | -262.557 | -452.935 |
| 38 | -263.603 | -453.977 | -251.811 | -470.194 |
| 39 | -256.067 | -474.439 | -200.505 | -370.496 |
| 40 | -203.912 | -373.894 | -188.091 | -394.236 |

COMBINACION 23 G1 + G2 + 0.9 PRETD + SCMAX-IPF + 0.6 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.946 | -395.720 | -262.533 | -301.109 |
| 2 | -264.395 | -295.627 | -379.203 | -314.654 |
| 3 | -375.509 | -310.852 | -430.569 | -235.125 |
| 4 | -430.879 | -235.329 | -477.808 | -170.784 |
| 5 | -478.177 | -171.150 | -516.970 | -117.795 |
| 6 | -517.497 | -118.271 | -548.104 | -76.176 |
| 7 | -548.807 | -76.812 | -571.216 | -45.992 |
| 8 | -572.094 | -46.841 | -586.294 | -27.310 |
| 9 | -587.355 | -28.385 | -593.399 | -20.073 |
| 10 | -594.684 | -21.343 | -590.970 | -26.451 |
| 11 | -595.522 | -31.004 | -594.912 | -31.844 |
| 12 | -594.344 | -31.289 | -589.878 | -37.431 |
| 13 | -589.651 | -37.229 | -581.539 | -48.387 |
| 14 | -581.495 | -48.390 | -569.882 | -64.361 |
| 15 | -569.818 | -64.362 | -554.968 | -84.787 |
| 16 | -554.671 | -84.479 | -536.495 | -109.477 |
| 17 | -535.554 | -108.730 | -534.474 | -110.215 |
| 18 | -533.087 | -107.926 | -532.072 | -109.322 |
| 19 | -528.931 | -105.065 | -486.646 | -163.222 |
| 20 | -483.910 | -158.713 | -348.551 | -178.359 |
| 21 | -344.305 | -174.027 | -486.609 | -142.119 |
| 22 | -484.411 | -138.705 | -515.546 | -95.883 |
| 23 | -524.177 | -103.480 | -514.070 | -117.381 |
| 24 | -517.228 | -119.579 | -509.679 | -129.962 |
| 25 | -511.146 | -129.823 | -518.021 | -120.367 |
| 26 | -521.632 | -114.137 | -540.937 | -87.586 |
| 27 | -539.647 | -86.290 | -555.796 | -64.079 |
| 28 | -554.244 | -62.518 | -566.615 | -45.503 |
| 29 | -565.189 | -44.096 | -572.890 | -33.505 |
| 30 | -571.934 | -32.524 | -574.280 | -29.298 |
| 31 | -574.031 | -29.043 | -570.501 | -33.898 |
| 32 | -571.141 | -34.498 | -567.635 | -39.320 |
| 33 | -565.070 | -36.787 | -551.223 | -55.833 |
| 34 | -550.363 | -55.016 | -528.122 | -85.606 |
| 35 | -527.912 | -85.363 | -497.498 | -127.194 |
| 36 | -497.783 | -127.598 | -459.657 | -180.036 |
| 37 | -460.411 | -180.812 | -415.033 | -243.223 |
| 38 | -415.977 | -244.405 | -360.931 | -320.114 |
| 39 | -365.196 | -324.345 | -256.745 | -298.187 |
| 40 | -260.085 | -301.672 | -188.255 | -394.025 |

COMBINACION 24 G1 + G2 + 0.9 PRETD + TEMP + 0.80 SCMAX-IPF

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.898 | -395.783 | -255.712 | -309.879 |
| 2 | -256.932 | -305.223 | -364.958 | -334.246 |
| 3 | -361.256 | -330.457 | -411.040 | -261.985 |
| 4 | -411.342 | -262.199 | -454.210 | -203.239 |
| 5 | -454.580 | -203.604 | -490.521 | -154.171 |
| 6 | -491.043 | -154.656 | -520.006 | -114.821 |
| 7 | -520.704 | -115.465 | -542.677 | -85.243 |
| 8 | -543.551 | -86.097 | -558.524 | -65.504 |
| 9 | -559.585 | -66.579 | -567.615 | -55.536 |
| 10 | -568.900 | -56.806 | -568.381 | -57.519 |
| 11 | -572.934 | -62.072 | -576.733 | -56.847 |
| 12 | -576.164 | -56.293 | -577.315 | -54.710 |
| 13 | -577.088 | -54.508 | -575.807 | -56.270 |
| 14 | -575.766 | -56.268 | -572.214 | -61.155 |
| 15 | -572.154 | -61.149 | -566.570 | -68.830 |
| 16 | -566.272 | -68.523 | -558.573 | -79.112 |
| 17 | -557.647 | -78.343 | -564.089 | -69.484 |
| 18 | -562.626 | -67.299 | -569.175 | -58.291 |
| 19 | -565.940 | -54.165 | -531.139 | -102.028 |
| 20 | -528.253 | -97.725 | -394.065 | -119.841 |
| 21 | -389.776 | -115.565 | -531.039 | -81.011 |
| 22 | -528.739 | -77.737 | -552.336 | -45.283 |
| 23 | -560.881 | -52.998 | -543.123 | -77.422 |
| 24 | -546.201 | -79.730 | -531.041 | -100.581 |
| 25 | -532.373 | -100.628 | -529.609 | -104.430 |
| 26 | -532.390 | -99.341 | -540.498 | -88.189 |
| 27 | -539.209 | -86.892 | -545.659 | -78.021 |
| 28 | -544.102 | -76.466 | -548.270 | -70.733 |
| 29 | -546.843 | -69.329 | -547.839 | -67.959 |
| 30 | -546.882 | -66.980 | -544.019 | -70.918 |
| 31 | -543.771 | -70.662 | -536.526 | -80.626 |
| 32 | -537.167 | -81.225 | -531.448 | -89.091 |
| 33 | -528.889 | -86.550 | -514.321 | -106.587 |
| 34 | -513.465 | -105.765 | -491.996 | -135.292 |
| 35 | -491.785 | -135.050 | -463.636 | -173.766 |
| 36 | -463.936 | -174.150 | -429.574 | -221.411 |
| 37 | -430.329 | -222.187 | -390.212 | -277.362 |
| 38 | -391.176 | -278.516 | -342.890 | -344.928 |
| 39 | -347.154 | -349.161 | -247.320 | -310.305 |
| 40 | -250.673 | -313.773 | -188.227 | -394.062 |

COMBINACION 25 G1 + G2 + 0.9 PRETD + 0.60 SCMAX-IPF + 0.2 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.847 | -395.847 | -242.070 | -327.419 |
| 2 | -242.647 | -323.588 | -336.532 | -373.341 |
| 3 | -332.821 | -369.565 | -370.240 | -318.100 |
| 4 | -370.532 | -318.328 | -402.251 | -274.703 |
| 5 | -402.620 | -275.068 | -428.621 | -239.307 |
| 6 | -429.137 | -239.800 | -449.370 | -211.971 |
| 7 | -450.062 | -212.624 | -464.508 | -192.755 |
| 8 | -465.379 | -193.613 | -474.045 | -181.695 |
| 9 | -475.105 | -182.771 | -478.033 | -178.744 |
| 10 | -479.316 | -180.016 | -474.906 | -186.083 |
| 11 | -479.458 | -190.635 | -480.574 | -189.101 |
| 12 | -480.006 | -188.547 | -479.686 | -188.986 |
| 13 | -479.461 | -188.782 | -477.920 | -190.901 |
| 14 | -477.883 | -190.894 | -475.303 | -194.443 |
| 15 | -475.248 | -194.431 | -471.845 | -199.112 |
| 16 | -471.547 | -198.805 | -467.239 | -204.730 |
| 17 | -466.330 | -203.938 | -473.203 | -194.485 |
| 18 | -471.665 | -192.405 | -478.698 | -182.732 |
| 19 | -475.368 | -178.734 | -440.965 | -226.051 |
| 20 | -437.930 | -221.953 | -303.174 | -236.701 |
| 21 | -298.835 | -232.489 | -440.800 | -205.124 |
| 22 | -438.397 | -201.991 | -461.549 | -170.149 |
| 23 | -470.006 | -177.984 | -451.685 | -203.183 |
| 24 | -454.682 | -205.602 | -438.999 | -227.173 |
| 25 | -440.195 | -227.406 | -434.877 | -234.721 |
| 26 | -436.828 | -230.774 | -440.829 | -225.271 |
| 27 | -439.540 | -223.974 | -443.381 | -218.692 |
| 28 | -441.820 | -217.142 | -444.873 | -212.943 |
| 29 | -443.443 | -211.542 | -444.820 | -209.649 |
| 30 | -443.862 | -208.672 | -442.874 | -210.030 |
| 31 | -442.625 | -209.775 | -438.756 | -215.096 |
| 32 | -439.396 | -215.697 | -438.549 | -216.861 |
| 33 | -435.996 | -214.312 | -427.792 | -225.596 |
| 34 | -426.940 | -224.769 | -413.335 | -243.481 |
| 35 | -413.122 | -243.241 | -394.324 | -269.095 |
| 36 | -394.639 | -269.459 | -371.128 | -301.795 |
| 37 | -371.882 | -302.572 | -344.113 | -340.765 |
| 38 | -345.099 | -341.890 | -310.663 | -389.251 |
| 39 | -314.924 | -393.489 | -231.059 | -331.212 |
| 40 | -234.426 | -334.662 | -188.182 | -394.119 |

COMBINACION 26 G1 + G2 + 0.9 PRETD + SCMIN-IPF

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.699 | -396.037 | -209.547 | -369.234 |
| 2 | -205.054 | -371.923 | -262.180 | -475.604 |
| 3 | -258.442 | -471.864 | -264.222 | -463.914 |
| 4 | -264.491 | -464.174 | -268.220 | -459.045 |
| 5 | -268.591 | -459.408 | -270.229 | -457.154 |
| 6 | -270.728 | -457.671 | -270.227 | -458.360 |
| 7 | -270.901 | -459.037 | -268.222 | -462.720 |
| 8 | -269.083 | -463.593 | -263.904 | -470.717 |
| 9 | -264.961 | -471.796 | -255.834 | -484.350 |
| 10 | -257.115 | -485.625 | -243.801 | -503.937 |
| 11 | -248.358 | -508.484 | -243.718 | -514.866 |
| 12 | -243.148 | -514.313 | -240.243 | -518.309 |
| 13 | -240.018 | -518.105 | -239.037 | -519.454 |
| 14 | -239.010 | -519.433 | -240.148 | -517.867 |
| 15 | -240.109 | -517.835 | -243.565 | -513.082 |
| 16 | -243.264 | -512.778 | -248.965 | -504.937 |
| 17 | -248.108 | -504.074 | -255.643 | -493.710 |
| 18 | -247.558 | -500.634 | -240.990 | -509.668 |
| 19 | -229.504 | -516.889 | -156.752 | -616.950 |
| 20 | -148.513 | -620.009 | 38.947 | -676.571 |
| 21 | 47.577 | -677.876 | -167.948 | -580.397 |
| 22 | -162.424 | -581.556 | -248.361 | -463.361 |
| 23 | -249.511 | -481.248 | -267.731 | -456.188 |
| 24 | -263.846 | -468.073 | -265.793 | -465.396 |
| 25 | -255.448 | -481.503 | -241.181 | -501.125 |
| 26 | -236.560 | -506.217 | -222.474 | -525.591 |
| 27 | -221.187 | -524.290 | -211.431 | -537.709 |
| 28 | -209.855 | -536.180 | -203.797 | -544.511 |
| 29 | -202.361 | -543.120 | -199.116 | -547.582 |
| 30 | -198.153 | -546.612 | -197.028 | -548.160 |
| 31 | -196.780 | -547.903 | -197.276 | -547.220 |
| 32 | -197.915 | -547.822 | -205.938 | -536.789 |
| 33 | -203.403 | -534.214 | -208.535 | -527.156 |
| 34 | -207.693 | -526.314 | -211.914 | -520.509 |
| 35 | -211.701 | -520.270 | -215.191 | -515.471 |
| 36 | -215.548 | -515.776 | -218.832 | -511.259 |
| 37 | -219.586 | -512.035 | -223.103 | -507.199 |
| 38 | -224.149 | -508.240 | -225.505 | -506.376 |
| 39 | -229.759 | -510.622 | -187.829 | -386.794 |
| 40 | -191.237 | -390.191 | -188.062 | -394.273 |

COMBINACION 27 G1 + G2 + 0.9 PRETD + 0.60 SCMIN-IPF

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.700 | -396.037 | -211.187 | -367.125 |
| 2 | -207.952 | -368.196 | -268.209 | -467.311 |
| 3 | -264.471 | -463.572 | -273.268 | -451.473 |
| 4 | -273.536 | -451.734 | -280.280 | -442.459 |
| 5 | -280.650 | -442.822 | -285.304 | -436.421 |
| 6 | -285.802 | -436.938 | -288.316 | -433.481 |
| 7 | -288.990 | -434.158 | -289.329 | -433.690 |
| 8 | -290.191 | -434.562 | -288.172 | -437.338 |
| 9 | -289.230 | -438.418 | -284.000 | -445.611 |
| 10 | -285.281 | -446.886 | -276.056 | -459.575 |
| 11 | -280.611 | -464.124 | -280.254 | -464.615 |
| 12 | -279.685 | -464.061 | -281.247 | -461.913 |
| 13 | -281.023 | -461.708 | -284.706 | -456.642 |
| 14 | -284.679 | -456.621 | -290.695 | -448.347 |
| 15 | -290.656 | -448.314 | -299.180 | -436.591 |
| 16 | -298.880 | -436.286 | -309.842 | -421.208 |
| 17 | -308.984 | -420.347 | -321.972 | -402.484 |
| 18 | -316.414 | -405.932 | -321.059 | -399.543 |
| 19 | -312.722 | -402.432 | -260.983 | -473.593 |
| 20 | -254.647 | -474.035 | -88.863 | -512.244 |
| 21 | -81.893 | -511.414 | -267.559 | -443.394 |
| 22 | -263.161 | -443.006 | -318.248 | -367.240 |
| 23 | -322.217 | -381.250 | -319.947 | -384.371 |
| 24 | -318.719 | -392.603 | -307.788 | -407.637 |
| 25 | -301.898 | -417.617 | -282.949 | -443.678 |
| 26 | -279.960 | -446.526 | -262.983 | -469.876 |
| 27 | -261.695 | -468.577 | -249.047 | -485.973 |
| 28 | -247.472 | -484.443 | -238.523 | -496.751 |
| 29 | -237.087 | -495.359 | -230.952 | -503.797 |
| 30 | -229.988 | -502.827 | -225.973 | -508.348 |
| 31 | -225.726 | -508.092 | -223.327 | -511.391 |
| 32 | -223.967 | -511.992 | -229.092 | -504.943 |
| 33 | -226.557 | -502.368 | -228.796 | -499.289 |
| 34 | -227.955 | -498.447 | -229.282 | -496.623 |
| 35 | -229.068 | -496.384 | -229.667 | -495.561 |
| 36 | -230.025 | -495.865 | -230.416 | -495.327 |
| 37 | -231.170 | -496.104 | -231.792 | -495.248 |
| 38 | -232.838 | -496.290 | -231.299 | -498.407 |
| 39 | -235.553 | -502.653 | -190.621 | -383.204 |
| 40 | -194.028 | -386.602 | -188.068 | -394.265 |

COMBINACION 28 G1 + G2 + 0.9 PRETD + SCMAX-EC1 + 0.6 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.908 | -395.769 | -269.543 | -292.096 |
| 2 | -270.041 | -288.368 | -390.449 | -299.186 |
| 3 | -386.711 | -295.446 | -446.433 | -213.307 |
| 4 | -446.702 | -213.566 | -497.570 | -143.603 |
| 5 | -497.941 | -143.966 | -539.956 | -86.180 |
| 6 | -540.456 | -86.694 | -573.573 | -41.146 |
| 7 | -574.248 | -41.821 | -598.447 | -8.539 |
| 8 | -599.309 | -9.410 | -614.585 | 11.601 |
| 9 | -615.644 | 10.522 | -622.050 | 19.333 |
| 10 | -623.331 | 18.058 | -619.251 | 12.445 |
| 11 | -623.806 | 7.896 | -622.123 | 5.581 |
| 12 | -621.555 | 6.137 | -615.301 | -2.466 |
| 13 | -615.077 | -2.260 | -604.431 | -16.902 |
| 14 | -604.404 | -16.880 | -589.107 | -37.919 |
| 15 | -589.067 | -37.888 | -569.820 | -64.360 |
| 16 | -569.521 | -64.054 | -546.230 | -96.087 |
| 17 | -545.368 | -95.231 | -522.528 | -126.645 |
| 18 | -525.914 | -117.792 | -517.466 | -129.410 |
| 19 | -520.225 | -117.040 | -484.542 | -166.116 |
| 20 | -483.408 | -159.403 | -348.551 | -178.359 |
| 21 | -344.305 | -174.027 | -484.311 | -145.280 |
| 22 | -483.899 | -139.409 | -499.567 | -117.860 |
| 23 | -513.594 | -118.035 | -500.282 | -136.344 |
| 24 | -508.459 | -131.640 | -517.755 | -118.855 |
| 25 | -519.222 | -118.715 | -546.793 | -80.796 |
| 26 | -546.505 | -79.928 | -570.615 | -46.768 |
| 27 | -569.327 | -45.470 | -589.345 | -17.937 |
| 28 | -587.771 | -16.405 | -603.093 | 4.669 |
| 29 | -601.658 | 6.062 | -611.388 | 19.444 |
| 30 | -610.425 | 20.415 | -613.877 | 25.162 |
| 31 | -613.629 | 25.419 | -610.263 | 20.790 |
| 32 | -610.904 | 20.190 | -606.643 | 14.330 |
| 33 | -604.106 | 16.902 | -588.578 | -4.456 |
| 34 | -587.736 | -3.615 | -562.902 | -37.771 |
| 35 | -562.689 | -37.532 | -528.756 | -84.202 |
| 36 | -529.109 | -84.513 | -486.535 | -143.068 |
| 37 | -487.289 | -143.845 | -436.525 | -213.664 |
| 38 | -437.565 | -214.715 | -376.223 | -299.083 |
| 39 | -380.478 | -303.327 | -264.509 | -288.205 |
| 40 | -267.913 | -291.608 | -188.247 | -394.036 |

COMBINACION 29 G1 + G2 + 0.9 PRETD + TEMP + 0.80 SCMAX-EC1

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.867 | -395.822 | -261.320 | -302.669 |
| 2 | -261.449 | -299.415 | -373.955 | -321.872 |
| 3 | -370.217 | -318.131 | -423.731 | -244.530 |
| 4 | -424.001 | -244.789 | -470.020 | -181.495 |
| 5 | -470.391 | -181.857 | -508.910 | -128.879 |
| 6 | -509.410 | -129.394 | -540.382 | -86.797 |
| 7 | -541.057 | -87.472 | -564.462 | -55.281 |
| 8 | -565.324 | -56.152 | -581.157 | -34.375 |
| 9 | -582.216 | -35.453 | -590.536 | -24.011 |
| 10 | -591.817 | -25.286 | -591.006 | -26.402 |
| 11 | -595.561 | -30.952 | -598.501 | -26.907 |
| 12 | -597.934 | -26.352 | -597.652 | -26.739 |
| 13 | -597.428 | -26.533 | -594.121 | -31.082 |
| 14 | -594.094 | -31.061 | -587.594 | -40.001 |
| 15 | -587.553 | -39.970 | -578.452 | -52.488 |
| 16 | -578.152 | -52.183 | -566.361 | -68.401 |
| 17 | -565.499 | -67.544 | -554.532 | -82.628 |
| 18 | -556.887 | -75.192 | -557.491 | -74.362 |
| 19 | -558.975 | -63.744 | -529.456 | -104.344 |
| 20 | -527.852 | -98.277 | -394.065 | -119.841 |
| 21 | -389.776 | -115.565 | -529.201 | -83.540 |
| 22 | -528.329 | -78.301 | -539.554 | -62.863 |
| 23 | -552.416 | -64.641 | -532.093 | -92.592 |
| 24 | -539.186 | -89.379 | -537.502 | -91.695 |
| 25 | -538.834 | -91.742 | -552.626 | -72.772 |
| 26 | -552.288 | -71.974 | -564.241 | -55.535 |
| 27 | -562.953 | -54.236 | -572.498 | -41.108 |
| 28 | -570.924 | -39.576 | -577.453 | -30.596 |
| 29 | -576.018 | -29.202 | -578.638 | -25.600 |
| 30 | -577.674 | -24.629 | -575.696 | -27.350 |
| 31 | -575.449 | -27.093 | -568.336 | -36.876 |
| 32 | -568.977 | -37.475 | -562.655 | -46.170 |
| 33 | -560.118 | -43.598 | -544.204 | -65.486 |
| 34 | -543.363 | -64.644 | -519.820 | -97.025 |
| 35 | -519.607 | -96.785 | -488.643 | -139.373 |
| 36 | -488.997 | -139.682 | -451.077 | -191.837 |
| 37 | -451.831 | -192.613 | -407.405 | -253.715 |
| 38 | -408.446 | -254.764 | -355.123 | -328.103 |
| 39 | -359.379 | -332.347 | -253.531 | -302.319 |
| 40 | -256.935 | -305.722 | -188.220 | -394.070 |

COMBINACION 30 G1 + G2 + 0.9 PRETD + 0.60 SCMAX-EC1 + 0.2 TEMP

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.824 | -395.877 | -246.276 | -322.011 |
| 2 | -246.035 | -319.233 | -343.280 | -364.062 |
| 3 | -339.542 | -360.321 | -379.758 | -305.010 |
| 4 | -380.026 | -305.270 | -414.108 | -258.394 |
| 5 | -414.479 | -258.757 | -442.413 | -220.338 |
| 6 | -442.912 | -220.853 | -464.652 | -190.953 |
| 7 | -465.326 | -191.630 | -480.847 | -170.283 |
| 8 | -481.709 | -171.154 | -491.020 | -158.348 |
| 9 | -492.078 | -159.426 | -495.223 | -155.100 |
| 10 | -496.504 | -156.377 | -491.874 | -162.745 |
| 11 | -496.428 | -167.295 | -496.900 | -166.646 |
| 12 | -496.333 | -166.091 | -494.940 | -168.006 |
| 13 | -494.716 | -167.800 | -491.655 | -172.010 |
| 14 | -491.629 | -171.989 | -486.838 | -178.578 |
| 15 | -486.798 | -178.546 | -480.756 | -186.856 |
| 16 | -480.457 | -186.550 | -473.080 | -196.696 |
| 17 | -472.219 | -195.839 | -466.036 | -204.342 |
| 18 | -467.361 | -198.324 | -469.934 | -194.784 |
| 19 | -470.144 | -185.919 | -439.702 | -227.788 |
| 20 | -437.629 | -222.367 | -303.174 | -236.701 |
| 21 | -298.835 | -232.489 | -439.421 | -207.020 |
| 22 | -438.090 | -202.413 | -451.961 | -183.335 |
| 23 | -463.657 | -186.717 | -443.412 | -214.561 |
| 24 | -449.421 | -212.840 | -443.844 | -220.509 |
| 25 | -445.041 | -220.742 | -452.140 | -210.978 |
| 26 | -451.751 | -210.249 | -458.636 | -200.780 |
| 27 | -457.348 | -199.482 | -463.510 | -191.007 |
| 28 | -461.936 | -189.475 | -466.760 | -182.840 |
| 29 | -465.325 | -181.447 | -467.918 | -177.880 |
| 30 | -466.956 | -176.908 | -466.632 | -177.354 |
| 31 | -466.383 | -177.098 | -462.613 | -182.284 |
| 32 | -463.253 | -182.884 | -461.954 | -184.671 |
| 33 | -459.418 | -182.099 | -450.205 | -194.770 |
| 34 | -449.364 | -193.928 | -434.203 | -214.780 |
| 35 | -433.989 | -214.542 | -413.079 | -243.300 |
| 36 | -413.434 | -243.609 | -387.255 | -279.614 |
| 37 | -388.009 | -280.392 | -357.009 | -323.029 |
| 38 | -358.050 | -324.076 | -319.838 | -376.632 |
| 39 | -324.093 | -380.878 | -235.717 | -325.222 |
| 40 | -239.123 | -328.624 | -188.177 | -394.125 |

COMBINACION 31 G1 + G2 + 0.9 PRETD + SCMIN-EC1

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.699 | -396.039 | -204.797 | -375.341 |
| 2 | -201.604 | -376.358 | -255.015 | -485.459 |
| 3 | -251.276 | -481.719 | -253.483 | -478.685 |
| 4 | -253.750 | -478.946 | -253.902 | -478.738 |
| 5 | -254.272 | -479.102 | -252.336 | -481.765 |
| 6 | -252.834 | -482.282 | -248.756 | -487.889 |
| 7 | -249.430 | -488.566 | -243.168 | -497.180 |
| 8 | -244.029 | -498.051 | -235.642 | -509.587 |
| 9 | -236.700 | -510.666 | -226.198 | -525.110 |
| 10 | -227.478 | -526.387 | -213.270 | -545.928 |
| 11 | -217.824 | -550.479 | -212.765 | -557.437 |
| 12 | -212.197 | -556.883 | -209.355 | -560.792 |
| 13 | -209.131 | -560.586 | -208.691 | -561.191 |
| 14 | -208.665 | -561.169 | -210.865 | -558.142 |
| 15 | -210.825 | -558.111 | -215.813 | -551.251 |
| 16 | -215.514 | -550.945 | -223.230 | -540.332 |
| 17 | -222.371 | -539.472 | -225.656 | -534.954 |
| 18 | -223.509 | -533.711 | -202.599 | -562.470 |
| 19 | -198.510 | -559.516 | -128.924 | -655.223 |
| 20 | -125.153 | -652.136 | 51.868 | -693.183 |
| 21 | 56.594 | -689.469 | -144.259 | -612.978 |
| 22 | -141.379 | -610.501 | -212.805 | -512.264 |
| 23 | -220.576 | -521.043 | -241.439 | -492.349 |
| 24 | -243.793 | -495.653 | -241.617 | -498.647 |
| 25 | -241.734 | -500.365 | -224.138 | -524.566 |
| 26 | -223.351 | -524.384 | -210.145 | -542.548 |
| 27 | -208.857 | -541.249 | -199.982 | -553.455 |
| 28 | -198.408 | -551.923 | -193.228 | -559.048 |
| 29 | -191.792 | -557.656 | -189.426 | -560.909 |
| 30 | -188.463 | -559.939 | -188.218 | -560.276 |
| 31 | -187.971 | -560.019 | -189.347 | -558.126 |
| 32 | -189.987 | -558.727 | -198.892 | -546.479 |
| 33 | -196.357 | -543.905 | -202.365 | -535.641 |
| 34 | -201.524 | -534.800 | -206.630 | -527.776 |
| 35 | -206.416 | -527.539 | -210.785 | -521.530 |
| 36 | -211.143 | -521.834 | -215.307 | -516.107 |
| 37 | -216.061 | -516.883 | -220.458 | -510.836 |
| 38 | -221.504 | -511.878 | -223.741 | -508.801 |
| 39 | -227.995 | -513.048 | -186.980 | -387.885 |
| 40 | -190.387 | -391.283 | -188.061 | -394.275 |

COMBINACION 32 G1 + G2 + 0.9 PRETD + 0.60 SCMIN-EC1

TENSIONES CON AXIL FINAL

| Barra | TS_1 | TI_1 | TS_2 | T1_2 |
|---|---|---|---|---|
| 1 | -188.699 | -396.038 | -208.337 | -370.789 |
| 2 | -205.882 | -370.857 | -263.910 | -473.224 |
| 3 | -260.172 | -469.484 | -266.824 | -460.335 |
| 4 | -267.092 | -460.597 | -271.689 | -454.274 |
| 5 | -272.059 | -454.637 | -274.567 | -451.188 |
| 6 | -275.066 | -451.704 | -275.434 | -451.198 |
| 7 | -276.107 | -451.876 | -274.296 | -454.367 |
| 8 | -275.158 | -455.237 | -271.215 | -460.661 |
| 9 | -272.273 | -461.740 | -266.219 | -470.067 |
| 10 | -267.499 | -471.343 | -257.737 | -484.770 |
| 11 | -262.291 | -489.321 | -261.683 | -490.157 |
| 12 | -261.115 | -489.602 | -262.714 | -487.403 |
| 13 | -262.490 | -487.197 | -266.499 | -481.684 |
| 14 | -266.472 | -481.662 | -273.125 | -472.512 |
| 15 | -273.085 | -472.480 | -282.528 | -459.492 |
| 16 | -282.230 | -459.186 | -294.402 | -442.445 |
| 17 | -293.542 | -441.585 | -303.980 | -427.230 |
| 18 | -301.984 | -425.778 | -298.025 | -431.224 |
| 19 | -294.126 | -428.009 | -244.287 | -496.556 |
| 20 | -240.631 | -493.311 | -81.110 | -522.211 |
| 21 | -76.483 | -518.370 | -253.346 | -462.943 |
| 22 | -250.534 | -460.372 | -296.914 | -396.582 |
| 23 | -304.856 | -405.127 | -304.171 | -406.069 |
| 24 | -306.687 | -409.151 | -293.282 | -427.588 |
| 25 | -293.669 | -428.935 | -272.724 | -457.742 |
| 26 | -272.036 | -457.425 | -255.585 | -480.051 |
| 27 | -254.297 | -478.753 | -242.178 | -495.420 |
| 28 | -240.604 | -493.889 | -232.181 | -505.473 |
| 29 | -230.746 | -504.080 | -225.138 | -511.793 |
| 30 | -224.175 | -510.823 | -220.688 | -515.618 |
| 31 | -220.440 | -515.362 | -218.569 | -517.935 |
| 32 | -219.209 | -518.535 | -224.865 | -510.757 |
| 33 | -222.329 | -508.183 | -225.094 | -504.381 |
| 34 | -224.253 | -503.539 | -226.111 | -500.983 |
| 35 | -225.897 | -500.746 | -227.024 | -499.196 |
| 36 | -227.381 | -499.501 | -228.301 | -498.236 |
| 37 | -229.054 | -499.013 | -230.205 | -497.430 |
| 38 | -231.251 | -498.472 | -230.241 | -499.862 |
| 39 | -234.495 | -504.108 | -190.111 | -383.859 |
| 40 | -193.519 | -387.257 | -188.068 | -394.266 |

## ESTADO LÍMITE DE DEFORMACIONES

En el presente apartado se calcula el valor de la flecha máxima, comprobándose que la relación flecha/luz se encuentra por debajo del valor 1/2000.

En este apartado se ha comprobado también que el giro en el extremo del tablero es inferior a $3{,}5 \cdot 10^{-3}$ radianes. Así como que el valor de alabeo de la vía para los trenes tipo es inferior al marcado por la BIAPF en su artículo 4.2.1.1.2

## ESTADO LÍMITE DE VIBRACIONES

En este apartado se comprueba que la primera frecuencia de vibración en el modo de flexión se encuentra dentro del rango de valores admitidos por el EC-1.

También se verifica que la primera frecuencia natural de torsión del puente es un 20% mayor que la primera frecuencia natural de flexión. En este caso, según el articulo 6.4.4 de la BIAPF, no es necesario realizar las comprobaciones dinámicas del tablero, al cumplirse éstas automáticamente.

Se calcula asimismo el valor del coeficiente de impacto según IPF y EC-1.

## VERIFICACIÓN DEL E.L.U DE ROTURA POR TENSIONES NORMALES

### FLEXIÓN LONGITUDINAL

En este apartado se comprueba el Estado Límite Último de rotura por flexión longitudinal de acuerdo con los criterios de la Normativa española vigente (EHE)

Los cálculos realizados han sido los siguientes:

1. Cálculo de la envolvente de esfuerzos flectores longitudinales para las distintas acciones consideradas en el proyecto del tablero. Los esfuerzos de cálculo se han combinado de acuerdo con los criterios del apartado 2 de este Anejo.

   La envolvente de esfuerzos flectores positivos se muestra en las tablas y gráficos adjuntos con la notación $\mathbf{M_{d,\,pos}}$ . La envolvente de flectores negativos se denota como $\mathbf{M_{d,neg}}$.

2. Cálculo del momento último respuesta para cada una de las secciones (nudos de las barras) en las que se ha discretizado el tablero. El momento último respuesta se ha calculado considerando las distintas capas de armado y la posible tensión previa de las mismas. El cálculo se realiza con un programa de cálculo automático que permite obtener el momento último respuesta y los diagramas momento curvatura considerando las curvas tensión-deformación no lineales de los materiales (acero y hormigón).

Los momentos últimos de respuesta de cada sección se han calculado para un momento positivo ($\mathbf{M_{u,pos}}$) y para un momento negativo ($\mathbf{M_{u,neg}}$). De un modo análogo se calculan los momentos de descompresión y de fisuración de la sección (momentos totales sobre la sección).

Las unidades de trabajo para los momentos son (mT).

COMBINACION 33 1.35(G1+G2)+1.5(SCMAX-IPF)+ MHIPER-PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 1.498 | 297.913 | 253.337 | -413.528 | -250.277 | -233.971 |
| 2 | 424.593 | 261.535 | 233.713 | -792.934 | -218.757 | -208.029 |
| 3 | 793.083 | 218.747 | 207.894 | -1108.898 | -185.531 | -182.326 |
| 4 | 1109.042 | 185.490 | 182.037 | -1374.559 | -152.332 | -156.617 |
| 5 | 1374.556 | 152.373 | 156.616 | -1589.931 | -119.259 | -131.263 |
| 6 | 1590.006 | 119.270 | 130.725 | -1755.213 | -86.224 | -105.335 |
| 7 | 1755.308 | 86.247 | 104.559 | -1870.380 | -53.239 | -79.213 |
| 8 | 1870.427 | 53.275 | 78.724 | -1935.308 | -20.425 | -53.531 |
| 9 | 1935.297 | 20.399 | 53.348 | -1949.974 | 12.289 | -28.114 |
| 10 | 1949.994 | -12.350 | 27.427 | -1914.465 | 33.185 | -2.121 |
| 11 | 1914.459 | -33.163 | 1.282 | -1828.728 | 54.185 | 24.036 |
| 12 | 1828.712 | -54.167 | -24.504 | -1692.825 | 75.167 | 50.943 |
| 13 | 1692.794 | -75.189 | -51.093 | -1506.635 | 90.630 | 71.123 |
| 14 | 1506.571 | -90.543 | -71.651 | -1269.904 | 111.693 | 98.338 |
| 15 | 1269.814 | -111.695 | -98.782 | -983.010 | 133.107 | 125.521 |
| 16 | 983.025 | -133.121 | -125.521 | -646.012 | 155.093 | 152.432 |
| 17 | 645.737 | -155.106 | -152.994 | -327.600 | 104.044 | 110.001 |
| 18 | 328.859 | -101.011 | -109.900 | 20.177 | 138.866 | 122.664 |
| 19 | -18.619 | -135.288 | -119.565 | 398.683 | 315.128 | 130.572 |
| 20 | -396.211 | -220.055 | -25.975 | 735.887 | 378.165 | 12.691 |
| 21 | -735.722 | 409.627 | 8.872 | 329.516 | -304.652 | -125.657 |
| 22 | -327.819 | 214.440 | 26.143 | -113.664 | -35.753 | -51.055 |
| 23 | 115.110 | 38.748 | 54.252 | -518.483 | -30.263 | -42.376 |
| 24 | 519.822 | 32.818 | 45.099 | -885.332 | -26.096 | -33.289 |
| 25 | 887.577 | 30.146 | 37.277 | -1249.573 | -129.877 | -131.197 |
| 26 | 1263.315 | 144.368 | 144.087 | -1613.906 | -122.353 | -115.380 |
| 27 | 1613.910 | 122.311 | 115.384 | -1902.467 | -100.292 | -86.868 |
| 28 | 1902.495 | 100.362 | 86.355 | -2129.188 | -78.093 | -57.908 |
| 29 | 2129.172 | 78.003 | 57.337 | -2293.765 | -55.433 | -28.984 |
| 30 | 2293.796 | 55.460 | 28.354 | -2396.466 | -32.675 | -0.030 |
| 31 | 2396.470 | 32.597 | -0.772 | -2437.125 | -9.740 | 28.995 |
| 32 | 2437.165 | 9.684 | -28.985 | -2415.735 | 20.001 | 57.280 |
| 33 | 2415.674 | -19.914 | -58.621 | -2332.383 | 49.897 | 87.058 |
| 34 | 2332.323 | -49.842 | -87.842 | -2187.077 | 79.895 | 116.136 |
| 35 | 2187.107 | -79.994 | -115.989 | -1979.880 | 109.897 | 144.416 |
| 36 | 1979.694 | -109.829 | -145.553 | -1710.515 | 139.576 | 174.127 |
| 37 | 1710.493 | -139.570 | -174.139 | -1379.355 | 169.120 | 202.796 |
| 38 | 1379.015 | -169.141 | -203.413 | -985.763 | 196.651 | 232.241 |
| 39 | 985.804 | -196.681 | -232.212 | -527.968 | 234.155 | 261.145 |
| 40 | 527.743 | -234.139 | -261.144 | -2.228 | 299.208 | 290.404 |

COMBINACION 34 1.35(G1+G2)+1.5(SCMIN-IPF)+ MHIPER-PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.652 | 113.233 | 7.886 | -242.767 | -73.392 | -6.598 |
| 2 | 231.945 | 62.154 | 7.067 | -428.565 | -41.583 | -6.024 |
| 3 | 428.569 | 41.580 | 6.197 | -592.800 | -30.572 | -5.295 |
| 4 | 592.810 | 30.560 | 5.437 | -726.889 | -19.598 | -4.637 |
| 5 | 726.896 | 19.621 | 4.638 | -830.869 | -8.700 | -3.930 |
| 6 | 830.852 | 8.698 | 4.028 | -904.695 | 2.158 | -3.387 |
| 7 | 904.695 | -2.157 | 3.520 | -948.369 | 12.959 | -2.926 |
| 8 | 948.359 | -12.952 | 3.009 | -960.739 | 30.899 | -6.657 |
| 9 | 960.717 | -30.894 | 6.692 | -936.856 | 43.255 | -3.986 |
| 10 | 936.864 | -43.303 | 4.157 | -881.263 | 43.823 | -1.473 |
| 11 | 881.272 | -43.806 | 1.738 | -793.936 | 44.484 | 0.964 |
| 12 | 793.916 | -44.419 | -0.784 | -674.941 | 45.103 | 3.541 |
| 13 | 674.918 | -45.143 | -3.472 | -524.147 | 44.020 | 4.123 |
| 14 | 524.141 | -44.047 | -3.824 | -341.482 | 44.885 | 6.719 |
| 15 | 341.473 | -44.922 | -6.390 | -127.084 | 46.014 | 9.445 |
| 16 | 127.086 | -46.033 | -9.445 | 119.047 | 47.675 | 12.573 |
| 17 | -119.043 | -47.633 | -11.717 | 396.878 | 50.281 | 15.046 |
| 18 | -417.820 | -100.389 | -61.336 | 773.527 | 132.741 | 64.899 |
| 19 | -799.630 | -191.857 | -124.527 | 1268.935 | 396.470 | 159.554 |
| 20 | -1284.698 | -440.546 | -207.421 | 1835.679 | 553.938 | 156.884 |
| 21 | -1850.604 | 638.700 | 225.474 | 1162.529 | -467.277 | -255.913 |
| 22 | -1171.856 | 449.816 | 236.677 | 560.482 | -235.238 | -227.199 |
| 23 | -583.833 | 185.890 | 174.705 | 98.314 | -133.921 | -122.211 |
| 24 | -120.321 | 91.274 | 78.292 | -264.918 | -91.580 | -77.131 |
| 25 | 228.014 | 25.366 | 12.504 | -508.191 | -26.929 | -11.696 |
| 26 | 494.649 | 12.468 | -1.366 | -722.820 | -14.497 | 2.004 |
| 27 | 722.833 | 14.443 | -1.999 | -913.780 | -16.461 | 2.516 |
| 28 | 913.730 | 16.533 | -2.305 | -1067.596 | -18.304 | 2.644 |
| 29 | 1067.544 | 18.219 | -2.422 | -1184.119 | -19.683 | 2.660 |
| 30 | 1184.122 | 19.716 | -2.477 | -1263.550 | -20.966 | 2.650 |
| 31 | 1263.557 | 20.941 | -2.421 | -1305.808 | -22.141 | 2.596 |
| 32 | 1305.847 | 22.125 | -2.586 | -1310.886 | -16.476 | 2.745 |
| 33 | 1310.926 | 16.508 | -2.467 | -1278.798 | -10.540 | 2.636 |
| 34 | 1278.799 | 10.597 | -2.476 | -1209.505 | -4.582 | 2.753 |
| 35 | 1209.530 | 4.434 | -2.774 | -1102.934 | 1.441 | 3.128 |
| 36 | 1102.986 | -1.324 | -2.837 | -959.315 | 7.030 | 3.304 |
| 37 | 959.292 | -7.022 | -3.311 | -778.469 | 12.527 | 3.927 |
| 38 | 778.466 | -12.538 | -3.563 | -560.406 | 15.998 | 4.351 |
| 39 | 560.413 | -16.018 | -4.395 | -302.364 | 29.461 | 5.424 |
| 40 | 302.372 | -29.442 | -5.220 | -1.591 | 70.617 | 6.501 |

COMBINACION 35 1.35(G1+G2)+1.5(SCMAX-EC1)+ MHIPER-PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 1.367 | 296.256 | 199.072 | -437.674 | -284.774 | -97.084 |
| 2 | 444.042 | 291.167 | 97.365 | -830.208 | -244.170 | -86.489 |
| 3 | 830.211 | 244.164 | 86.593 | -1161.477 | -206.722 | -75.731 |
| 4 | 1161.488 | 206.702 | 75.772 | -1440.061 | -169.299 | -65.188 |
| 5 | 1440.065 | 169.326 | 65.189 | -1666.119 | -131.973 | -54.587 |
| 6 | 1666.102 | 131.977 | 54.525 | -1839.632 | -94.707 | -43.497 |
| 7 | 1839.632 | 94.717 | 43.388 | -1960.637 | -57.520 | -32.451 |
| 8 | 1960.633 | 57.532 | 32.375 | -2029.079 | -20.482 | -21.865 |
| 9 | 2029.059 | 20.476 | 21.834 | -2044.937 | 16.449 | -11.205 |
| 10 | 2044.943 | -16.497 | 11.102 | -2008.200 | 41.594 | -0.059 |
| 11 | 2008.204 | -41.580 | -0.053 | -1918.917 | 66.834 | 10.987 |
| 12 | 1918.904 | -66.784 | -11.049 | -1777.086 | 92.036 | 22.786 |
| 13 | 1777.066 | -92.073 | -22.805 | -1582.510 | 91.909 | 25.119 |
| 14 | 1582.504 | -91.881 | -25.191 | -1333.626 | 117.222 | 37.339 |
| 15 | 1333.613 | -117.247 | -37.401 | -1032.237 | 142.876 | 49.334 |
| 16 | 1032.246 | -142.891 | -49.334 | -678.279 | 169.087 | 61.476 |
| 17 | 678.266 | -169.076 | -61.596 | -288.005 | 161.731 | 139.678 |
| 18 | 305.085 | -120.874 | -108.657 | 68.585 | 168.227 | 127.452 |
| 19 | -47.476 | -120.022 | -86.186 | 405.658 | 208.043 | 12.682 |
| 20 | -397.872 | -217.169 | -20.512 | 735.887 | 378.165 | 12.691 |
| 21 | -735.722 | 409.627 | 8.872 | 337.133 | -196.984 | -6.907 |
| 22 | -329.518 | 211.217 | 20.138 | -60.704 | -42.589 | -51.572 |
| 23 | 80.035 | 82.841 | 88.091 | -472.785 | -62.915 | -68.205 |
| 24 | 490.755 | 97.644 | 98.479 | -912.100 | -182.960 | -69.188 |
| 25 | 914.345 | 187.010 | 73.177 | -1344.935 | -162.040 | -60.736 |
| 26 | 1345.754 | 162.937 | 61.514 | -1712.272 | -138.413 | -49.425 |
| 27 | 1712.281 | 138.362 | 49.430 | -2013.662 | -113.808 | -37.661 |
| 28 | 2013.621 | 113.878 | 37.620 | -2250.096 | -89.130 | -25.585 |
| 29 | 2250.047 | 89.041 | 25.562 | -2421.365 | -64.007 | -13.548 |
| 30 | 2421.372 | 64.041 | 13.504 | -2527.709 | -38.688 | -1.391 |
| 31 | 2527.716 | 38.645 | 1.358 | -2568.914 | -13.230 | 10.292 |
| 32 | 2568.956 | 13.201 | -10.282 | -2545.027 | 18.985 | 22.291 |
| 33 | 2545.058 | -18.934 | -22.372 | -2456.194 | 51.397 | 34.980 |
| 34 | 2456.194 | -51.338 | -35.016 | -2302.352 | 83.831 | 46.637 |
| 35 | 2302.374 | -83.970 | -46.624 | -2083.486 | 116.384 | 58.639 |
| 36 | 2083.522 | -116.276 | -58.615 | -1799.601 | 148.594 | 70.845 |
| 37 | 1799.578 | -148.593 | -70.853 | -1450.589 | 180.651 | 82.961 |
| 38 | 1450.565 | -180.662 | -82.765 | -1036.446 | 210.633 | 94.998 |
| 39 | 1036.455 | -210.654 | -95.029 | -554.711 | 250.651 | 107.003 |
| 40 | 554.704 | -250.633 | -106.832 | -2.198 | 318.107 | 119.155 |

COMBINACION 36 1.35(G1+G2)+1.5(SCMIN-EC1)+ MHIPER-PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.653 | 131.694 | 8.185 | -261.736 | -93.975 | -6.990 |
| 2 | 255.392 | 87.597 | 7.049 | -475.501 | -67.026 | -6.006 |
| 3 | 475.502 | 67.021 | 6.129 | -663.213 | -56.013 | -5.227 |
| 4 | 663.221 | 55.995 | 5.295 | -820.767 | -45.033 | -4.495 |
| 5 | 820.772 | 45.058 | 4.496 | -948.215 | -34.137 | -3.787 |
| 6 | 948.196 | 34.142 | 3.763 | -1045.509 | -23.286 | -3.122 |
| 7 | 1045.506 | 23.293 | 3.067 | -1112.673 | -12.491 | -2.473 |
| 8 | 1112.666 | 12.502 | 2.431 | -1149.728 | -1.851 | -1.882 |
| 9 | 1149.708 | 1.847 | 1.865 | -1156.633 | 8.639 | -1.326 |
| 10 | 1156.636 | -8.687 | 1.275 | -1133.401 | 7.332 | -0.749 |
| 11 | 1133.402 | -7.320 | 0.703 | -1080.043 | 6.121 | -0.153 |
| 12 | 1080.027 | -6.068 | 0.131 | -996.556 | 4.877 | 0.469 |
| 13 | 996.536 | -4.915 | -0.476 | -882.904 | 3.790 | 1.159 |
| 14 | 882.898 | -3.769 | -1.182 | -739.138 | 2.731 | 1.968 |
| 15 | 739.127 | -2.757 | -1.984 | -565.220 | 1.973 | 2.903 |
| 16 | 565.229 | -1.987 | -2.902 | -361.179 | 1.756 | 3.981 |
| 17 | 361.176 | -1.740 | -4.015 | -127.004 | 2.516 | 5.278 |
| 18 | 125.743 | -5.545 | -5.364 | 141.353 | 36.020 | 6.833 |
| 19 | -142.937 | -39.600 | -9.992 | 445.735 | 212.679 | 11.649 |
| 20 | -446.689 | -215.347 | -14.617 | 786.615 | 387.135 | 16.400 |
| 21 | -788.093 | 423.332 | 22.076 | 376.023 | -209.573 | -18.785 |
| 22 | -376.586 | 208.513 | 17.593 | 9.015 | -0.722 | -15.821 |
| 23 | -10.417 | -2.259 | 12.468 | -314.073 | 4.265 | -10.975 |
| 24 | 312.747 | -6.871 | 8.254 | -597.393 | 6.564 | -7.049 |
| 25 | 595.162 | -10.536 | 3.025 | -838.553 | 8.974 | -2.082 |
| 26 | 837.720 | -9.830 | 1.250 | -1043.029 | 7.802 | -0.520 |
| 27 | 1043.038 | -7.854 | 0.525 | -1211.126 | 5.834 | 0.027 |
| 28 | 1211.081 | -5.763 | -0.025 | -1342.094 | 3.993 | 0.433 |
| 29 | 1342.043 | -4.082 | -0.409 | -1435.767 | 2.616 | 0.709 |
| 30 | 1435.772 | -2.582 | -0.704 | -1492.357 | 1.335 | 0.941 |
| 31 | 1492.364 | -1.375 | -0.912 | -1511.731 | 0.179 | 1.122 |
| 32 | 1511.773 | -0.206 | -1.112 | -1493.915 | 5.853 | 1.314 |
| 33 | 1493.953 | -5.806 | -1.297 | -1438.958 | 11.774 | 1.533 |
| 34 | 1438.961 | -11.717 | -1.512 | -1346.788 | 17.730 | 1.808 |
| 35 | 1346.810 | -17.872 | -1.806 | -1217.364 | 23.743 | 2.187 |
| 36 | 1217.416 | -23.633 | -2.077 | -1050.877 | 29.339 | 2.574 |
| 37 | 1050.854 | -29.337 | -2.582 | -847.156 | 34.844 | 3.217 |
| 38 | 847.153 | -34.854 | -2.962 | -606.206 | 38.314 | 3.767 |
| 39 | 606.212 | -38.335 | -3.803 | -325.298 | 51.779 | 4.835 |
| 40 | 325.306 | -51.761 | -4.651 | -1.641 | 92.937 | 5.935 |

RESPUESTA SECCIONAL A FLEXION (mT)

| Isec | Sx(is) | Mu,pos | Mu,neg | Mcr,pos | Mcr,neg | Mdec,pos | Mdec,neg |
|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 2013.77 | -1792.85 | 1190.50 | -996.42 | 787.90 | -480.34 |
| 2 | 0.92 | 2239.23 | -1576.73 | 1346.47 | -837.10 | 943.14 | -321.09 |
| 3 | 1.85 | 2458.72 | -1362.33 | 1591.62 | -756.90 | 1227.00 | -260.11 |
| 4 | 2.77 | 2651.80 | -1189.19 | 1728.68 | -627.38 | 1363.06 | -130.26 |
| 5 | 3.69 | 2818.83 | -1043.07 | 1848.40 | -515.90 | 1481.81 | -18.36 |
| 6 | 4.61 | 2952.48 | -929.06 | 1945.63 | -426.90 | 1578.19 | 71.07 |
| 7 | 5.54 | 3059.27 | -839.35 | 2024.96 | -355.80 | 1656.80 | 142.59 |
| 8 | 6.46 | 3135.51 | -776.18 | 2083.62 | -304.91 | 1714.93 | 193.80 |
| 9 | 7.38 | 3184.45 | -737.10 | 2123.81 | -272.03 | 1754.77 | 226.89 |
| 10 | 8.31 | 3199.03 | -726.58 | 2140.24 | -261.94 | 1771.09 | 237.04 |
| 11 | 9.23 | 3177.67 | -748.86 | 2145.26 | -275.31 | 1776.29 | 223.57 |
| 12 | 10.15 | 3108.41 | -806.01 | 2091.83 | -322.46 | 1723.36 | 176.11 |
| 13 | 11.07 | 2994.91 | -901.06 | 2007.77 | -399.67 | 1640.08 | 98.45 |
| 14 | 12.00 | 2834.04 | -1038.44 | 1890.41 | -509.33 | 1523.76 | -11.76 |
| 15 | 12.92 | 2629.86 | -1217.89 | 1742.16 | -649.19 | 1376.69 | -152.13 |
| 16 | 13.84 | 2379.77 | -1443.86 | 1560.65 | -821.47 | 1196.44 | -324.76 |
| 17 | 14.76 | 2088.14 | -1714.53 | 1348.87 | -1023.38 | 985.83 | -526.70 |
| 18 | 15.69 | 1756.79 | -2030.76 | 1107.87 | -1253.91 | 745.80 | -756.73 |
| 19 | 16.61 | 1387.51 | -2393.08 | 838.81 | -1509.60 | 477.33 | -1011.17 |
| 20 | 17.53 | 1123.61 | -2658.79 | 647.33 | -1691.15 | 285.96 | -1191.35 |
| 21 | 18.45 | 1034.50 | -2763.63 | 488.81 | -1662.21 | 87.11 | -1142.79 |
| 22 | 19.48 | 1158.63 | -2611.43 | 669.50 | -1633.40 | 308.13 | -1133.85 |
| 23 | 20.50 | 1543.38 | -2232.45 | 946.15 | -1386.21 | 584.48 | -888.42 |
| 24 | 21.53 | 2021.19 | -1770.99 | 1287.60 | -1058.08 | 924.78 | -561.35 |
| 25 | 22.56 | 2450.06 | -1372.82 | 1592.63 | -765.50 | 1228.07 | -268.73 |
| 26 | 23.58 | 2826.37 | -1037.78 | 1858.19 | -511.39 | 1491.55 | -13.82 |
| 27 | 24.60 | 3144.50 | -766.31 | 2080.40 | -299.26 | 1711.64 | 199.49 |
| 28 | 25.63 | 3409.72 | -555.11 | 2264.04 | -124.67 | 1893.23 | 375.43 |
| 29 | 26.66 | 3617.51 | -406.62 | 2407.26 | 10.64 | 2034.68 | 512.01 |
| 30 | 27.68 | 3767.07 | -309.93 | 2510.88 | 107.45 | 2136.95 | 609.85 |
| 31 | 28.70 | 3857.99 | -255.09 | 2575.99 | 166.57 | 2201.20 | 669.65 |
| 32 | 29.73 | 3889.92 | -236.43 | 2603.20 | 188.48 | 2228.11 | 691.81 |
| 33 | 30.75 | 3863.80 | -250.50 | 2568.80 | 167.39 | 2193.95 | 670.53 |
| 34 | 31.78 | 3793.18 | -292.11 | 2512.46 | 120.27 | 2138.27 | 622.88 |
| 35 | 32.81 | 3674.17 | -366.36 | 2425.14 | 42.82 | 2052.04 | 544.59 |
| 36 | 33.83 | 3503.62 | -482.16 | 2304.55 | -67.34 | 1932.94 | 433.33 |
| 37 | 34.85 | 3289.15 | -642.80 | 2155.55 | -206.13 | 1785.68 | 293.33 |
| 38 | 35.88 | 3027.87 | -858.60 | 1975.49 | -376.37 | 1607.53 | 121.90 |
| 39 | 36.90 | 2722.78 | -1125.81 | 1776.93 | -579.47 | 1410.90 | -82.18 |
| 40 | 37.93 | 2373.63 | -1451.69 | 1441.89 | -745.12 | 1038.03 | -229.04 |
| 41 | 38.96 | 2013.31 | -1792.51 | 1189.09 | -995.56 | 786.49 | -479.48 |

## CÁLCULO DEL COEFICIENTE DE IMPACTO

**PROYECTO:** L.A.V. Madrid-Zaragoza-Barcelona-Frontera Francesa. Tramo: Castellbisbal-Papiol.
**O.F. :** VIADUCTO PUERTO MARTORELL. TRAMO EN LOSA POSTESADA.

## CÁLCULO DEL COEFICIENTE DE IMPACTO

| | |
|---|---|
| Frecuencia fundamental | 5.88 Hz |
| Luz del vano intermedio | 20.5 m |
| Longitud total del tablero | 38.96 m |

**COEFICIENTE DE IMPACTO SEGÚN IPF-75**

v (km/h)* = 200

*Para luces iguales o menores de 6 metros*
l = 66.0
**$\phi$ = 1.66**

*Para luces mayores de 6 metros en tramos simplemente apoyados*
l = 33.0
**$\phi$ = 1.33**

*En general para tramos apoyados continuos*
$\mu$ = 0.230
l = 18.2
**$\phi$ = 1.18**

* La validez de las expresiones de la IPF-75 se limita a trenes con velocidades de circulación inferior a 200 km/h

**Valores de k en función del número de vanos**

| | Número de vanos | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| k | 1 | 1.2 | 1.3 | 1.4 | 1.5 |

**COEFICIENTE DE IMPACTO SEGÚN EUROCÓDIGO 1.**

**DETERMINACIÓN DE L$\phi$**

Número de vanos del tablero = 2
k = 1.2
Lm = 19.48
L$\phi$ = 23.38

*Vías con grado de mantenimiento bueno*
**$\phi$2 = 1.13**

*Vías con grado de mantenimiento normal*
**$\phi$3 = 1.20**

NOTA: La validez de aplicación de las fórmulas del eurocódigo se limita a trenes con velocidades de circulación inferiores a 200 km/h.

## FLEXIÓN TRANSVERSAL

La flexión transversal en el tablero se ha determinado a partir del modelo de cálculo de emparrillado expuesto en el apartado 3.2

La armadura de flexión calculada debe sumarse a la armadura de rasante del voladizo obtenida a partir del cortante total sobre la sección y de la aplicación de la regla de cosido en el plano de unión del voladizo con el núcleo de la sección transversal.

# Flexión transversal en voladizo

| Geometría | | |
|---|---|---|
| Ancho del voladizo | 1.78 | m |
| Espesor en arranque | 0.3 | m |
| Espesor en extremo | 0.2 | m |
| Ancho de barrera | 1.2 | m |
| Espesor de pavimento | 0 | m |
| Peso de barrera | 1 | T/m |
| Ancho de via | 1.668 | m |
| Distancia de eje de via a borde de voladizo | 4.1 | m |

| | Arranque | | |
|---|---|---|---|
| Esfuerzos | **Momento** | **Cortante** | **Axil** |
| Peso propio | 0.9 | 1.1 | 0.0 |
| Carga pavimento | 0.0 | 0.0 | 0.0 |
| Carga barrera | 1.2 | 1.0 | 0.0 |
| Sobrecarga uniforme | 0.1 | 0.3 | 0.0 |
| Descarrilamiento | 10.5 | 21.9 | 0.0 |

| ELS | Momento | Cortante | Axil |
|---|---|---|---|
| g1+g2 | 2.1 | 2.1 | 0.0 |
| g+q | 2.2 | 2.4 | 0.0 |
| g1+g2+(q)*0.8 | 3.2 | 2.3 | 0.0 |

| ELU | Momento | Cortante | Axil | As,nec |
|---|---|---|---|---|
| g1+g2+q+Q+Impacto | 6.1 | 6.5 | 0.0 | 6.2 |
| g1+g2+q+descarrilamiento | 14.8 | 26.4 | 0.0 | 11.8 |

| DIMENSIONAMIENTO A FLEXIÓN | | |
|---|---|---|
| Md, pos | 14.8 | mT |
| As,flex | 11.8 | cm2/m |
| As,min geom | 3 | cm2/m |

| VERIFICACIÓN A CORTANTE | | |
|---|---|---|
| Vd | 26.4 | T |
| fck | 40.0 | T/m2 |
| psi | 1.82 | |
| p1 | 0.004 | |
| Vcu | 16.38 | T |
| Vsu | 10.0 | T |
| Ast | 11.1 | cm2/m |

## TRAVIESAS DE APOYO

En este apartado se incluyen los resultados del cálculo de la flexión transversal que se produce en las traviesas de apoyo en estribos y pilas.

La determinación de los esfuerzos de flexión y cortante se realizan a partir de las reacciones que se han calculado en el apartado 3 de este anejo.

# Traviesa de tablero sobre estribo y pila fija

**VIADUCTO PUERTO-MARTORELL**

## TRAVIESA CON 2 APOYOS

**Estribo 1**

| | |
|---|---|
| Reaccion Vertical | |
| Peso propio | 131.9 |
| Carga permanente | 90.3 |
| Pretensado | 57.7 |
| Sobrecarga uniforme FC | 104.8 |
| Carga puntual | 0.0 |
| Gradiente térmico | 12.9 |

| | |
|---|---|
| Fondo de la sección | 4.7 |
| Separación entre apoyos | 3.2 |
| Ancho total del tablero | 8.2 |
| Ancho traviesa | 1.5 |
| Canto | 1.60 |
| fck, hormigón (MPa) | 40.00 |
| Psi | 1.36 |
| pho | 0.00 |
| Vcu | 53.5 |

| | | | |
|---|---|---|---|
| geq | 60.2 | | |
| qeq | 22.5 | | |
| qd | 115.1 | | |
| | | **As,nec** | |
| Md, pos | 147.3 | 28.5 | cm2 |
| Md, neg | 83.4 | 16.1 | cm2 |
| | | **As,nec** | |
| Vd | 184.1 | | |
| Vsu | 182.7 | 31.8 | cm2/m |
| Asuspensión | | 13.7 | cm2/m |
| Astotal | | 45.5 | cm2/m |

# Traviesa de tablero sobre pila

**VIADUCTO PUERTO-MARTORELL**

## TRAVIESA CON 2 APOYOS

**PILA 2**

| | | | |
|---|---|---|---|
| Reaccion Vertical | | | |
| Peso propio | 377.5 | | |
| Carga permanente | 280.2 | | |
| Pretensado | -121.9 | | |
| Sobrecarga uniforme FC | 290.2 | | |
| Carga puntual | 0.0 | | |
| Gradiente térmico | 0.0 | | |
| | | | |
| Fondo de la sección | 3.5 | | |
| Separación entre apoyos | 2.4 | | |
| Ancho total del tablero | 8.2 | | |
| Ancho traviesa | 3.0 | | |
| Canto | 1.60 | | |
| fck, hormigón (MPa) | 40.00 | | |
| Psi | 1.36 | | |
| pho | 0.00 | | |
| Vcu | 100.2 | | |
| | | | |
| geq | 155.3 | | |
| qeq | 84.1 | | |
| qd | 335.8 | | |
| | | **As,nec** | |
| Md, pos | 241.8 | 46.8 | cm2 |
| Md, neg | 176.3 | 34.1 | cm2 |
| | | | |
| | | **As,nec** | |
| Vd | 403.0 | | |
| Vsu | 302.8 | 52.7 | cm2/m |
| Asuspensión | | 40.0 | cm2/m |
| Astotal | | 92.7 | cm2/m |

## INTRODUCCIÓN DEL PRETENSADO

La regularización de las tensiones normales en el tablero inducidas por el pretensado produce tracciones en la zona de anclajes, cuyo efecto se puede estudiar a partir de dos análisis independientes:

- Estudio de la la introducción de una fuerza puntual en el anclaje, que permite el cálculo de los refuerzos de armadura en la zona inmediatamente detrás de la placa de anclaje.

- En las zonas de estribos la fuerza rasante se incrementa por el efecto de introducción de pretensado, cuyo valor total se reparte en planta, a efectos de cálculo, con un ángulo de aproximadamente 35 °. El efecto de esta regularización de tensiones se puede abordar a partir del método de bielas y tirantes, cuyo modelo sería análogo al que se emplea para el cálculo de vigas de gran canto.

En la hoja siguiente se detallan los cálculos de las armaduras a colocar en la zona de introducción de la fuerza de pretensado.

## Geometría de la sección

| | |
|---|---|
| Ancho total | 8.20 m |
| Ancho del fondo | 3.45 m |
| Voladizo | 1.78 m |
| Canto de tablero | 1.60 m |
| Espesor en arranque de voladizo | 0.30 m |
| Espesor en extremo de voladizo | 0.20 m |
| Número de anclajes | 6.00 m |
| Distancia entre anclajes extremos | 3.12 m |
| Distancia horizontal entre parejas de anclajes consecutivos | 1.45 m |
| Distancia horizontal entre dos placas del mismo nervio | 0.22 |
| Distancia vertical entre anclajes consecutivos | 0.50 m |
| Área de la sección | 5.91 m2 |
| Altura media de las placas de anclaje | 0.8 m |

## Pretensado

| | |
|---|---|
| Fuerza de pretensado | 638.0 T/anclaje |
| Dimensión de la placa de anclaje | 0.35 m |
| Diámetro de la vaina | 0.11 m |
| Número de cables | 6 |
| Numero de cables por agrupación | 2 |

## 1era Regularización de tensiones de pretensado

### Opción de armado por anclaje

| | | | nº cercos d16 | d20 | d25 |
|---|---|---|---|---|---|
| Armadura (cercos por anclaje) | 59.8 | cm2/anclaje | 15 | 10 | 6 |

### Opción de armado cada dos anclajes

| | | | | d 20 | d 25 | |
|---|---|---|---|---|---|---|
| Armadura horizontal | 92.4 | cm2 | 3 capas de | 10 | 6 | por/capa |

| | | | nº cercos d16 | d20 | d25 | |
|---|---|---|---|---|---|---|
| Armadura vertical | 56.1 | cm2 | 14 | 9 | 6 | por 2 cables |

## 2ª regularización de tensiones

| | | | | | | |
|---|---|---|---|---|---|---|
| Zona de regularización de tensiones | 4.5 | m | | | | |
| Rasante de diseño | 648.3 | T/m2 | | | | |
| Tension rasante media en plano de voladizo | 212.7 | T/m2 | | | | |
| Rasante de agotamiento del hormigón | 666.7 | T/m2 | | | | |
| Armadura de rasante total en plano de voladizo Ssu | 23.9 | cm2/m | a repartir en dos caras en | 4.5 m/tab | | |
| Armadura de viga de regularización (viga de gran canto) T1d | 43.7 | cm2 | a repartir en 2 caras y long. en | 0.5 m | equivalente a | 96.6 cm2/m tab |
| Armadura de viga de regularización (viga de gran canto) T2d | 54.6 | cm2 | a repartir en 2 caras y long. en | 1.6 m | equivalente a | 34.5 cm2/m tab |
| Armadura de flexión horizontal en voladizo T3d | 23.7 | cm2 | a repartir en dos caras en | 1.4 m/tab | equivalente a | 17.4 cm2/m tab |

## VERIFICACIÓN DEL E.L.U DE ROTURA POR TENSIONES TANGENCIALES

### EVALUACIÓN DEL E.L.U. DE CORTANTE

En este apartado se comprueba el Estado Límite Último de rotura por cortante de acuerdo con los criterios de la Normativa española vigente (EHE, artículo 44)

Los cálculos realizados han sido los siguientes:

- Cálculo de la envolvente de esfuerzos cortantes para las distintas acciones consideradas en el proyecto del tablero. Los esfuerzos de cálculo se han combinado de acuerdo con los criterios del apartado 2 de este Anejo.

  La envolvente de esfuerzos flectores positivos se muestra en los listados adjuntos con la notación $\mathbf{V_{rd}}$ , conjuntamente con el esfuerzo flector y torsor concomitantes.

  Donde

  $$\mathbf{V_{rd} = V_d + V_{pd} + V_{cd}}$$

  donde,

  $V_{rd}$ = Valor del esfuerzo cortante efectivo calculado como:
  $V_d$ = Valor de cálculo del esfuerzo cortante producido por las acciones exteriores
  $V_{pd}$ = Valor de cálculo del esfuerzo cortante producido por el pretensado.
  $V_{cd}$ = Valor de cálculo del la componente paralela a la sección de las tensiones normales en piezas de sección variable

- Comprobación del agotamiento por compresión oblicua en el alma.

  $$\mathbf{V_{rd} \leq V_{u1}}$$

  $V_{u1}$ = Esfuerzo cortante de agotamiento por compresión oblicua del alma.

- Comprobación del agotamiento por tracción en el alma.

  $$\mathbf{V_{rd} \leq V_{u2}}$$

  $V_{u2}$ = Esfuerzo cortante de agotamiento por tracción en el alma.

- El cálculo de todos los parámetros resistentes se ha realizado de forma automática. Posteriormente se ha determinado la armadura de cortante necesaria $\mathbf{A_{sc}}$ por criterios resistentes y se comprueba que verifica los criterios de armadura mínima a cortante (el máximo de los dos valores es el que aparece en los listados).

COMBINACION 37  1.35 (G1 + G2) + 1.5 (SCVMAX-IPF) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -230.586 | 314.835 | 251.948 | -36.391 | -261.548 | -232.685 |
| 2 | 29.397 | 262.047 | 233.277 | -191.364 | -219.271 | -207.595 |
| 3 | 171.345 | 220.840 | 208.853 | -347.985 | -188.314 | -183.857 |
| 4 | 316.899 | 190.850 | 185.839 | -408.801 | -159.424 | -145.489 |
| 5 | 426.821 | 162.105 | 164.447 | -497.884 | -137.145 | -134.216 |
| 6 | 494.988 | 137.474 | 134.157 | -557.185 | -115.264 | -122.612 |
| 7 | 553.938 | 115.587 | 122.516 | -587.648 | -93.743 | -111.063 |
| 8 | 584.180 | 94.120 | 110.994 | -590.446 | -72.732 | -99.824 |
| 9 | 586.842 | 73.154 | 99.800 | -567.152 | -52.266 | -88.544 |
| 10 | 563.530 | 52.786 | 88.458 | -515.438 | -44.190 | -77.006 |
| 11 | 511.863 | 44.728 | 76.921 | -468.430 | -36.393 | -65.597 |
| 12 | 464.984 | 37.053 | 65.555 | -410.673 | -29.178 | -53.261 |
| 13 | 407.413 | 29.823 | 53.937 | -435.248 | -29.930 | -51.813 |
| 14 | 432.274 | 30.640 | 52.511 | -363.749 | -23.171 | -39.929 |
| 15 | 361.121 | 23.965 | 40.693 | -287.644 | -16.790 | -28.221 |
| 16 | 285.421 | 17.593 | 29.092 | -209.124 | -10.458 | -16.481 |
| 17 | 207.331 | 11.303 | 17.307 | -129.149 | -3.768 | -6.553 |
| 18 | 127.843 | 4.662 | 7.552 | -45.093 | 31.924 | 1.458 |
| 19 | 54.062 | -30.405 | -5.025 | 71.747 | 205.379 | 9.727 |
| 20 | -68.267 | -204.205 | -8.153 | 434.332 | 301.632 | -77.487 |
| 21 | -1347.846 | 655.526 | 246.134 | 856.072 | -468.561 | -258.900 |
| 22 | -860.547 | 468.789 | 259.527 | 500.777 | -236.954 | -229.960 |
| 23 | -513.994 | 237.675 | 232.320 | 288.172 | -211.632 | -203.040 |
| 24 | -310.945 | 212.967 | 205.672 | 108.375 | -189.239 | -176.584 |
| 25 | -140.115 | 191.173 | 180.353 | -43.529 | -168.700 | -151.477 |
| 26 | 3.219 | 171.269 | 156.245 | -169.685 | -149.254 | -127.580 |
| 27 | 120.971 | 152.623 | 133.373 | -262.462 | -131.173 | -110.461 |
| 28 | 206.573 | 135.364 | 117.191 | -325.871 | -114.095 | -90.352 |
| 29 | 263.711 | 119.269 | 98.116 | -363.906 | -97.884 | -71.593 |
| 30 | 296.772 | 103.767 | 80.433 | -568.791 | -86.441 | -83.067 |
| 31 | 306.699 | 89.159 | 64.075 | -568.724 | -77.465 | -72.492 |
| 32 | 564.331 | 78.004 | 73.182 | -562.391 | -61.597 | -61.725 |
| 33 | 557.914 | 62.190 | 62.467 | -523.530 | -45.261 | -50.778 |
| 34 | 519.196 | 45.741 | 51.622 | -456.087 | -28.604 | -40.510 |
| 35 | 452.013 | 29.275 | 41.408 | -360.439 | -12.141 | -30.046 |
| 36 | -6.386 | 13.187 | 10.137 | -237.181 | 4.112 | -19.957 |
| 37 | -62.055 | 2.325 | 5.028 | -89.180 | 20.094 | -9.599 |
| 38 | -118.973 | -7.307 | 0.999 | 190.949 | 25.448 | 5.007 |
| 39 | -179.546 | -13.641 | -2.353 | 168.921 | 39.037 | 6.228 |
| 40 | -170.504 | -28.821 | -4.760 | 230.052 | 80.312 | 7.421 |

COMBINACION 38  1.35 (G1 + G2) + 1.5 (SCVMIN-IPF) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -231.428 | 106.496 | 7.886 | 148.845 | -61.626 | -6.398 |
| 2 | -148.662 | 69.663 | 6.882 | 134.440 | -39.106 | -3.814 |
| 3 | -150.840 | 48.947 | 5.997 | 63.730 | -24.787 | -0.136 |
| 4 | -109.772 | 37.693 | 5.210 | -6.284 | -9.097 | 4.752 |
| 5 | 50.677 | 21.121 | 9.322 | -71.724 | 7.873 | 10.849 |
| 6 | 122.589 | 3.188 | 2.262 | -128.806 | 26.099 | 18.224 |
| 7 | 429.951 | -16.496 | -34.098 | -173.836 | 45.679 | 26.929 |
| 8 | 508.079 | -38.734 | -45.538 | -203.429 | 66.400 | 36.823 |
| 9 | 556.326 | -60.719 | -56.735 | -214.287 | 88.249 | 47.924 |
| 10 | 575.407 | -82.377 | -68.025 | -199.324 | 99.446 | 60.457 |
| 11 | 258.210 | -93.092 | -52.074 | -186.980 | 112.044 | 74.341 |
| 12 | 243.093 | -106.486 | -66.310 | -141.884 | 126.819 | 80.663 |
| 13 | 194.150 | -122.134 | -73.512 | -74.482 | 137.593 | 93.490 |
| 14 | 121.716 | -133.663 | -87.313 | 13.586 | 154.823 | 113.922 |
| 15 | 27.745 | -151.591 | -108.651 | 123.046 | 173.002 | 135.347 |
| 16 | -88.247 | -170.502 | -131.051 | 255.407 | 192.469 | 157.848 |
| 17 | -228.137 | -190.599 | -154.013 | 413.429 | 213.581 | 181.015 |
| 18 | -393.505 | -212.328 | -178.703 | 601.996 | 264.991 | 205.849 |
| 19 | -590.207 | -264.266 | -203.746 | 926.368 | 459.546 | 231.086 |
| 20 | -922.324 | -459.319 | -230.500 | 1265.410 | 615.223 | 229.265 |
| 21 | -411.882 | 334.966 | -78.171 | 34.795 | -196.755 | -6.284 |
| 22 | -38.688 | 198.038 | 8.099 | -71.805 | 11.769 | -2.915 |
| 23 | 67.468 | -10.456 | -0.090 | -124.406 | 17.791 | 8.706 |
| 24 | 125.890 | -16.765 | -7.607 | -183.835 | 22.368 | 17.737 |
| 25 | 185.878 | -21.408 | -16.726 | -246.413 | 26.319 | 28.319 |
| 26 | 249.014 | -25.475 | -27.379 | -310.988 | 30.473 | 38.911 |
| 27 | 314.079 | -29.616 | -38.016 | -374.511 | 35.149 | 49.257 |
| 28 | 378.037 | -34.332 | -48.425 | -433.355 | 40.587 | 59.782 |
| 29 | 437.196 | -39.698 | -59.027 | -483.469 | 46.706 | 70.379 |
| 30 | 487.587 | -46.077 | -69.684 | -521.245 | 53.692 | 81.090 |
| 31 | 525.549 | -53.140 | -80.474 | -543.713 | 61.234 | 91.667 |
| 32 | 548.128 | -60.595 | -91.107 | -563.787 | 75.903 | 102.474 |
| 33 | 568.086 | -75.336 | -102.029 | -554.360 | 91.242 | 113.829 |
| 34 | 558.561 | -90.914 | -113.416 | -523.354 | 107.882 | 140.845 |
| 35 | 522.889 | -106.795 | -124.344 | -489.500 | 129.473 | 161.430 |
| 36 | 547.734 | -124.220 | -157.583 | -421.463 | 152.222 | 184.437 |
| 37 | 470.994 | -148.171 | -180.811 | -316.721 | 176.210 | 207.870 |
| 38 | 354.711 | -173.404 | -205.813 | -164.540 | 199.630 | 233.156 |
| 39 | 189.377 | -197.851 | -231.565 | -37.431 | 234.776 | 260.649 |
| 40 | 46.076 | -234.194 | -259.984 | 229.437 | 299.418 | 289.196 |

COMBINACION 39  1.35 (G1 + G2) + 1.5 (SCVMAX-IPF) + V_Pd

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 1.497 | 314.835 | 251.948 | -424.389 | -261.548 | -232.685 |
| 2 | 417.395 | 262.047 | 233.277 | -786.224 | -219.271 | -207.595 |
| 3 | 766.205 | 220.840 | 208.853 | -1074.544 | -188.314 | -183.857 |
| 4 | 1043.458 | 190.850 | 185.839 | -1247.280 | -159.424 | -145.489 |
| 5 | 1265.300 | 162.105 | 164.447 | -1428.640 | -137.145 | -134.216 |
| 6 | 1425.744 | 137.474 | 134.157 | -1560.676 | -115.264 | -122.612 |
| 7 | 1557.429 | 115.587 | 122.516 | -1644.382 | -93.743 | -111.063 |
| 8 | 1640.914 | 94.120 | 110.994 | -1680.905 | -72.732 | -99.824 |
| 9 | 1677.301 | 73.154 | 99.800 | -1671.708 | -52.266 | -88.544 |
| 10 | 1668.086 | 52.786 | 88.458 | -1618.371 | -44.190 | -77.006 |
| 11 | 1614.796 | 44.728 | 76.921 | -1522.471 | -36.393 | -65.597 |
| 12 | 1519.025 | 37.053 | 65.555 | -1385.625 | -29.178 | -53.261 |
| 13 | 1382.365 | 29.823 | 53.937 | -1300.380 | -29.930 | -51.813 |
| 14 | 1297.406 | 30.640 | 52.511 | -1087.740 | -23.171 | -39.929 |
| 15 | 1085.112 | 23.965 | 40.693 | -838.808 | -16.790 | -28.221 |
| 16 | 836.585 | 17.593 | 29.092 | -555.950 | -10.458 | -16.481 |
| 17 | 554.157 | 11.303 | 17.307 | -241.201 | -3.768 | -6.553 |
| 18 | 239.895 | 4.662 | 7.552 | 103.222 | 31.924 | 1.458 |
| 19 | -94.253 | -30.405 | -5.025 | 404.708 | 205.379 | 9.727 |
| 20 | -401.228 | -204.205 | -8.153 | 882.549 | 301.632 | -77.487 |
| 21 | -1796.063 | 655.526 | 246.134 | 1153.963 | -468.561 | -258.900 |
| 22 | -1158.438 | 468.789 | 259.527 | 536.199 | -236.954 | -229.960 |
| 23 | -549.416 | 237.675 | 232.320 | -8.639 | -211.632 | -203.040 |
| 24 | -14.134 | 212.967 | 205.672 | -483.278 | -189.239 | -176.584 |
| 25 | 451.538 | 191.173 | 180.353 | -888.969 | -168.700 | -151.477 |
| 26 | 848.659 | 171.269 | 156.245 | -1226.861 | -149.254 | -127.580 |
| 27 | 1178.147 | 152.623 | 133.373 | -1490.099 | -131.173 | -110.461 |
| 28 | 1434.210 | 135.364 | 117.191 | -1684.398 | -114.095 | -90.352 |
| 29 | 1622.238 | 119.269 | 98.116 | -1815.707 | -97.884 | -71.593 |
| 30 | 1748.573 | 103.767 | 80.433 | -2078.102 | -86.441 | -83.067 |
| 31 | 1816.010 | 89.159 | 64.075 | -2100.952 | -77.465 | -72.492 |
| 32 | 2096.559 | 78.004 | 73.182 | -2068.442 | -61.597 | -61.725 |
| 33 | 2063.965 | 62.190 | 62.467 | -1979.910 | -45.261 | -50.778 |
| 34 | 1975.576 | 45.741 | 51.622 | -1834.447 | -28.604 | -40.510 |
| 35 | 1830.373 | 29.275 | 41.408 | -1631.841 | -12.141 | -30.046 |
| 36 | 1265.016 | 13.187 | 10.137 | -1371.647 | 4.112 | -19.957 |
| 37 | 1072.411 | 2.325 | 5.028 | -1055.568 | 20.094 | -9.599 |
| 38 | 847.415 | -7.307 | 0.999 | -582.021 | 25.448 | 5.007 |
| 39 | 593.424 | -13.641 | -2.353 | -312.816 | 39.037 | 6.228 |
| 40 | 311.234 | -28.821 | -4.760 | -1.616 | 80.312 | 7.421 |

COMBINACION 40  1.35 (G1 + G2) + 1.5 (SCVMIN-IPF) + V_Pd

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.655 | 106.496 | 7.886 | -239.153 | -61.626 | -6.398 |
| 2 | 239.336 | 69.663 | 6.882 | -460.420 | -39.106 | -3.814 |
| 3 | 444.020 | 48.947 | 5.997 | -662.829 | -24.787 | -0.136 |
| 4 | 616.787 | 37.693 | 5.210 | -844.763 | -9.097 | 4.752 |
| 5 | 889.156 | 21.121 | 9.322 | -1002.480 | 7.873 | 10.849 |
| 6 | 1053.345 | 3.188 | 2.262 | -1132.298 | 26.099 | 18.224 |
| 7 | 1433.442 | -16.496 | -34.098 | -1230.570 | 45.679 | 26.929 |
| 8 | 1564.813 | -38.734 | -45.538 | -1293.888 | 66.400 | 36.823 |
| 9 | 1646.785 | -60.719 | -56.735 | -1318.843 | 88.249 | 47.924 |
| 10 | 1679.963 | -82.377 | -68.025 | -1302.257 | 99.446 | 60.457 |
| 11 | 1361.143 | -93.092 | -52.074 | -1241.021 | 112.044 | 74.341 |
| 12 | 1297.134 | -106.486 | -66.310 | -1116.836 | 126.819 | 80.663 |
| 13 | 1169.102 | -122.134 | -73.512 | -939.614 | 137.593 | 93.490 |
| 14 | 986.849 | -133.663 | -87.313 | -710.405 | 154.823 | 113.922 |
| 15 | 751.736 | -151.591 | -108.651 | -428.118 | 173.002 | 135.347 |
| 16 | 462.917 | -170.502 | -131.051 | -91.419 | 192.469 | 157.848 |
| 17 | 118.688 | -190.599 | -154.013 | 301.378 | 213.581 | 181.015 |
| 18 | -281.453 | -212.328 | -178.703 | 750.311 | 264.991 | 205.849 |
| 19 | -738.522 | -264.266 | -203.746 | 1259.329 | 459.546 | 231.086 |
| 20 | -1255.285 | -459.319 | -230.500 | 1713.627 | 615.223 | 229.265 |
| 21 | -860.099 | 334.966 | -78.171 | 332.686 | -196.755 | -6.284 |
| 22 | -336.579 | 198.038 | 8.099 | -36.383 | 11.769 | -2.915 |
| 23 | 32.047 | -10.456 | -0.090 | -421.217 | 17.791 | 8.706 |
| 24 | 422.701 | -16.765 | -7.607 | -775.488 | 22.368 | 17.737 |
| 25 | 777.531 | -21.408 | -16.726 | -1091.853 | 26.319 | 28.319 |
| 26 | 1094.454 | -25.475 | -27.379 | -1368.164 | 30.473 | 38.911 |
| 27 | 1371.255 | -29.616 | -38.016 | -1602.147 | 35.149 | 49.257 |
| 28 | 1605.674 | -34.332 | -48.425 | -1791.882 | 40.587 | 59.782 |
| 29 | 1795.723 | -39.698 | -59.027 | -1935.270 | 46.706 | 70.379 |
| 30 | 1939.388 | -46.077 | -69.684 | -2030.556 | 53.692 | 81.090 |
| 31 | 2034.860 | -53.140 | -80.474 | -2075.941 | 61.234 | 91.667 |
| 32 | 2080.356 | -60.595 | -91.107 | -2069.837 | 75.903 | 102.474 |
| 33 | 2074.137 | -75.336 | -102.029 | -2010.740 | 91.242 | 113.829 |
| 34 | 2014.941 | -90.914 | -113.416 | -1901.714 | 107.881 | 140.845 |
| 35 | 1901.249 | -106.795 | -124.344 | -1760.902 | 129.473 | 161.430 |
| 36 | 1819.136 | -124.220 | -157.583 | -1555.929 | 152.222 | 184.437 |
| 37 | 1605.460 | -148.171 | -180.811 | -1283.109 | 176.210 | 207.870 |
| 38 | 1321.099 | -173.404 | -205.813 | -937.510 | 199.630 | 233.156 |
| 39 | 962.347 | -197.851 | -231.565 | -519.169 | 234.776 | 260.649 |
| 40 | 527.814 | -234.194 | -259.984 | -2.231 | 299.418 | 289.196 |

COMBINACION 41  1.35 (G1 + G2) + 1.5 (SCVMAX-EC1) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -231.092 | 328.903 | 98.088 | -56.063 | -291.186 | -96.774 |
| 2 | 55.639 | 291.195 | 96.936 | -234.989 | -244.207 | -86.064 |
| 3 | 233.784 | 244.315 | 86.166 | -433.505 | -206.884 | -75.306 |
| 4 | 431.633 | 207.012 | 75.342 | -598.627 | -169.602 | -64.761 |
| 5 | 596.195 | 169.843 | 64.760 | -544.653 | -136.020 | -120.554 |
| 6 | 505.743 | 139.811 | 122.854 | -594.438 | -110.539 | -105.719 |
| 7 | 550.979 | 115.073 | 108.517 | -612.792 | -86.022 | -91.448 |
| 8 | 566.101 | 91.351 | 95.059 | -602.269 | -62.637 | -78.156 |
| 9 | 553.784 | 68.692 | 82.562 | -565.879 | -40.333 | -65.615 |
| 10 | 516.863 | 47.214 | 70.375 | -502.336 | -30.906 | -53.370 |
| 11 | 454.009 | 38.482 | 58.730 | -485.604 | -26.159 | -45.951 |
| 12 | 439.031 | 34.521 | 52.133 | -422.634 | -18.290 | -34.048 |
| 13 | 378.923 | 27.261 | 41.651 | -354.779 | -11.213 | -23.463 |
| 14 | 314.841 | 20.888 | 31.593 | -285.175 | -5.045 | -13.317 |
| 15 | 249.873 | 15.385 | 22.156 | -216.590 | 0.418 | -4.419 |
| 16 | 186.638 | 10.483 | 14.070 | -44.017 | 0.705 | 4.575 |
| 17 | 127.081 | 5.874 | 6.743 | -44.096 | 1.639 | 6.206 |
| 18 | 72.070 | 1.115 | 1.174 | -40.027 | 32.222 | 7.868 |
| 19 | 51.148 | -30.579 | -5.602 | 71.747 | 205.379 | 9.727 |
| 20 | -69.002 | -204.245 | -8.261 | 994.384 | 249.393 | -41.342 |
| 21 | -1091.983 | 628.993 | 189.934 | 849.204 | -496.194 | -109.082 |
| 22 | -849.477 | 496.206 | 109.120 | 517.133 | -264.812 | -97.344 |
| 23 | -517.923 | 264.847 | 97.394 | 327.584 | -239.831 | -86.406 |
| 24 | -328.957 | 239.939 | 86.569 | 168.818 | -217.856 | -75.849 |
| 25 | -170.745 | 217.977 | 76.064 | 35.252 | -197.745 | -66.130 |
| 26 | -37.678 | 197.839 | 66.415 | -76.227 | -178.647 | -57.201 |
| 27 | 73.289 | 178.847 | 57.553 | -166.857 | -160.229 | -48.823 |
| 28 | 163.491 | 160.491 | 49.249 | -237.159 | -142.171 | -40.815 |
| 29 | 233.374 | 142.612 | 41.298 | -287.324 | -124.535 | -32.973 |
| 30 | 283.242 | 124.826 | 33.533 | -317.616 | -107.005 | -25.260 |
| 31 | 313.322 | 107.334 | 25.882 | -328.836 | -89.941 | -17.839 |
| 32 | 324.443 | 90.480 | 18.529 | -337.316 | -66.656 | -10.301 |
| 33 | 332.839 | 67.249 | 11.043 | -319.114 | -43.497 | -2.697 |
| 34 | 302.026 | 46.525 | 32.610 | -287.724 | -20.533 | -13.827 |
| 35 | 232.425 | 29.517 | 23.860 | -194.371 | -3.677 | -4.856 |
| 36 | 143.752 | 13.635 | 15.537 | 176.793 | 4.383 | 2.780 |
| 37 | 53.714 | -0.055 | 9.058 | 189.894 | 10.166 | 3.619 |
| 38 | -192.603 | -9.375 | -2.278 | 214.546 | 13.948 | 4.331 |
| 39 | -216.475 | -12.979 | -3.201 | 180.738 | 27.539 | 5.548 |
| 40 | -181.787 | -26.523 | -4.138 | 230.079 | 68.814 | 6.734 |

COMBINACION 42  1.35 (G1 + G2) + 1.5 (SCVMIN-EC1) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -231.433 | 86.975 | 6.681 | 167.524 | -49.254 | -5.509 |
| 2 | -166.677 | 50.142 | 5.688 | 188.456 | -28.563 | -4.708 |
| 3 | -186.879 | 29.425 | 4.834 | 166.029 | -17.409 | -4.028 |
| 4 | -163.838 | 18.170 | 4.093 | 153.562 | -6.215 | -3.352 |
| 5 | -150.868 | 6.969 | 3.364 | -134.515 | 6.686 | 11.486 |
| 6 | -148.256 | -4.234 | 2.716 | -207.029 | 26.398 | 19.044 |
| 7 | 174.835 | -24.667 | 4.315 | -197.150 | 51.870 | 2.427 |
| 8 | 200.697 | -51.339 | -2.479 | -206.097 | 78.791 | 9.116 |
| 9 | 209.735 | -78.327 | -9.134 | -196.643 | 106.062 | 15.746 |
| 10 | 200.305 | -105.612 | -15.816 | -163.257 | 121.991 | 22.496 |
| 11 | 166.831 | -121.630 | -22.568 | -135.436 | 138.691 | 29.299 |
| 12 | 138.845 | -138.314 | -28.834 | -94.421 | 155.955 | 36.776 |
| 13 | 97.572 | -155.693 | -36.342 | 45.893 | 155.573 | 38.181 |
| 14 | -43.038 | -155.342 | -37.836 | 118.906 | 173.740 | 46.156 |
| 15 | -116.408 | -173.518 | -45.865 | 208.754 | 192.794 | 54.910 |
| 16 | -206.646 | -192.649 | -54.642 | 317.853 | 213.130 | 63.983 |
| 17 | -316.202 | -213.023 | -63.832 | 449.500 | 235.188 | 74.066 |
| 18 | -448.291 | -235.107 | -73.913 | 610.040 | 287.634 | 84.785 |
| 19 | -609.330 | -287.591 | -84.703 | 905.279 | 483.386 | 96.244 |
| 20 | -905.033 | -483.372 | -96.208 | 1070.502 | 584.764 | 172.481 |
| 21 | -803.312 | 291.531 | -37.969 | 35.601 | -196.797 | -6.485 |
| 22 | -38.688 | 198.038 | 8.099 | -68.543 | 11.593 | -3.627 |
| 23 | 56.005 | -9.842 | 6.059 | -82.826 | 15.414 | 3.537 |
| 24 | 41.413 | -11.936 | 4.339 | -124.266 | 18.747 | 9.304 |
| 25 | 27.482 | -11.784 | 2.823 | -175.081 | 21.700 | 16.314 |
| 26 | 17.823 | -10.492 | 1.487 | -234.253 | 25.145 | 24.749 |
| 27 | 275.727 | -13.559 | -14.734 | -298.669 | 29.473 | 33.751 |
| 28 | 345.918 | -18.571 | -24.617 | -364.139 | 34.966 | 43.622 |
| 29 | 416.146 | -24.676 | -35.289 | -426.010 | 41.623 | 54.233 |
| 30 | 481.697 | -32.287 | -46.689 | -479.691 | 49.654 | 65.618 |
| 31 | 537.848 | -41.151 | -58.947 | -521.099 | 58.788 | 77.772 |
| 32 | 580.387 | -50.958 | -71.509 | -561.812 | 75.635 | 90.424 |
| 33 | 603.623 | -71.613 | -89.714 | -599.529 | 94.523 | 108.212 |
| 34 | 603.730 | -94.196 | -107.799 | -576.543 | 116.531 | 125.608 |
| 35 | 580.524 | -116.144 | -125.248 | -531.733 | 137.748 | 142.261 |
| 36 | 535.295 | -137.345 | -141.926 | -451.249 | 159.487 | 159.200 |
| 37 | 454.222 | -159.221 | -158.974 | -333.738 | 181.831 | 176.159 |
| 38 | 336.009 | -181.735 | -175.803 | -261.620 | 210.900 | 94.612 |
| 39 | 263.125 | -210.764 | -94.550 | -72.532 | 250.759 | 106.524 |
| 40 | 73.046 | -250.718 | -106.312 | 229.469 | 318.439 | 118.588 |

COMBINACION 43  1.35 (G1 + G2) + 1.5 (SCVMAX-EC1) + V_Pd

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.991 | 328.903 | 98.088 | -444.061 | -291.186 | -96.774 |
| 2 | 443.637 | 291.195 | 96.936 | -829.849 | -244.207 | -86.064 |
| 3 | 828.644 | 244.315 | 86.166 | -1160.064 | -206.884 | -75.306 |
| 4 | 1158.192 | 207.012 | 75.342 | -1437.106 | -169.602 | -64.761 |
| 5 | 1434.674 | 169.843 | 64.760 | -1475.409 | -136.020 | -120.554 |
| 6 | 1436.499 | 139.811 | 122.854 | -1597.929 | -110.539 | -105.719 |
| 7 | 1554.470 | 115.073 | 108.517 | -1669.526 | -86.022 | -91.448 |
| 8 | 1622.835 | 91.351 | 95.059 | -1692.728 | -62.637 | -78.156 |
| 9 | 1644.243 | 68.692 | 82.562 | -1670.435 | -40.333 | -65.615 |
| 10 | 1621.419 | 47.214 | 70.375 | -1605.269 | -30.906 | -53.370 |
| 11 | 1556.942 | 38.482 | 58.730 | -1539.645 | -26.159 | -45.951 |
| 12 | 1493.072 | 34.521 | 52.133 | -1397.586 | -18.290 | -34.048 |
| 13 | 1353.875 | 27.261 | 41.651 | -1219.911 | -11.213 | -23.463 |
| 14 | 1179.973 | 20.889 | 31.593 | -1009.166 | -5.045 | -13.317 |
| 15 | 973.864 | 15.385 | 22.156 | -767.754 | 0.418 | -4.419 |
| 16 | 737.802 | 10.483 | 14.070 | -390.843 | 0.705 | 4.575 |
| 17 | 473.907 | 5.874 | 6.743 | -156.148 | 1.639 | 6.206 |
| 18 | 184.122 | 1.115 | 1.174 | 108.288 | 32.222 | 7.868 |
| 19 | -97.167 | -30.579 | -5.602 | 404.708 | 205.379 | 9.727 |
| 20 | -401.963 | -204.245 | -8.261 | 1442.601 | 249.393 | -41.342 |
| 21 | -1540.200 | 628.993 | 189.934 | 1147.095 | -496.194 | -109.082 |
| 22 | -1147.368 | 496.206 | 109.120 | 552.555 | -264.812 | -97.344 |
| 23 | -553.345 | 264.847 | 97.394 | 30.773 | -239.831 | -86.406 |
| 24 | -32.146 | 239.939 | 86.569 | -422.835 | -217.856 | -75.849 |
| 25 | 420.908 | 217.977 | 76.064 | -810.188 | -197.745 | -66.130 |
| 26 | 807.762 | 197.839 | 66.415 | -1133.403 | -178.647 | -57.201 |
| 27 | 1130.465 | 178.847 | 57.553 | -1394.494 | -160.229 | -48.823 |
| 28 | 1391.128 | 160.491 | 49.249 | -1595.686 | -142.171 | -40.815 |
| 29 | 1591.901 | 142.612 | 41.298 | -1739.125 | -124.535 | -32.973 |
| 30 | 1735.043 | 124.826 | 33.533 | -1826.927 | -107.005 | -25.260 |
| 31 | 1822.633 | 107.334 | 25.882 | -1861.064 | -89.941 | -17.839 |
| 32 | 1856.671 | 90.480 | 18.529 | -1843.367 | -66.656 | -10.301 |
| 33 | 1838.890 | 67.249 | 11.043 | -1775.494 | -43.497 | -2.697 |
| 34 | 1758.406 | 46.525 | 32.610 | -1666.084 | -20.533 | -13.827 |
| 35 | 1610.785 | 29.517 | 23.860 | -1465.773 | -3.677 | -4.856 |
| 36 | 1415.154 | 13.635 | 15.537 | -957.673 | 4.383 | 2.780 |
| 37 | 1188.180 | -0.055 | 9.058 | -776.494 | 10.166 | 3.619 |
| 38 | 773.785 | -9.375 | -2.278 | -558.423 | 13.948 | 4.331 |
| 39 | 556.495 | -12.979 | -3.201 | -301.000 | 27.539 | 5.548 |
| 40 | 299.951 | -26.523 | -4.138 | -1.589 | 68.814 | 6.734 |

COMBINACION 44  1.35 (G1 + G2) + 1.5 (SCVMIN-EC1) + V_Pd

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | 0.650 | 86.975 | 6.681 | -220.474 | -49.254 | -5.509 |
| 2 | 221.321 | 50.142 | 5.688 | -406.404 | -28.563 | -4.708 |
| 3 | 407.981 | 29.425 | 4.834 | -560.530 | -17.409 | -4.028 |
| 4 | 562.721 | 18.170 | 4.093 | -684.917 | -6.215 | -3.352 |
| 5 | 687.611 | 6.969 | 3.364 | -1065.271 | 6.686 | 11.486 |
| 6 | 782.500 | -4.234 | 2.716 | -1210.520 | 26.398 | 19.044 |
| 7 | 1178.326 | -24.667 | 4.315 | -1253.884 | 51.870 | 2.427 |
| 8 | 1257.431 | -51.339 | -2.479 | -1296.556 | 78.791 | 9.116 |
| 9 | 1300.194 | -78.327 | -9.134 | -1301.199 | 106.062 | 15.746 |
| 10 | 1304.861 | -105.612 | -15.816 | -1266.190 | 121.991 | 22.496 |
| 11 | 1269.764 | -121.630 | -22.568 | -1189.477 | 138.691 | 29.299 |
| 12 | 1192.886 | -138.314 | -28.834 | -1069.373 | 155.955 | 36.776 |
| 13 | 1072.524 | -155.693 | -36.342 | -819.239 | 155.573 | 38.181 |
| 14 | 822.094 | -155.342 | -37.836 | -605.085 | 173.740 | 46.156 |
| 15 | 607.583 | -173.518 | -45.865 | -342.410 | 192.794 | 54.910 |
| 16 | 344.518 | -192.649 | -54.642 | -28.973 | 213.130 | 63.983 |
| 17 | 30.624 | -213.023 | -63.832 | 337.448 | 235.188 | 74.066 |
| 18 | -336.239 | -235.107 | -73.913 | 758.354 | 287.634 | 84.785 |
| 19 | -757.645 | -287.591 | -84.703 | 1238.239 | 483.386 | 96.244 |
| 20 | -1237.994 | -483.372 | -96.208 | 1518.719 | 584.764 | 172.481 |
| 21 | -1251.529 | 291.531 | -37.969 | 333.492 | -196.797 | -6.485 |
| 22 | -336.579 | 198.038 | 8.099 | -33.121 | 11.593 | -3.627 |
| 23 | 20.583 | -9.842 | 6.059 | -379.636 | 15.414 | 3.537 |
| 24 | 338.224 | -11.936 | 4.339 | -715.919 | 18.747 | 9.304 |
| 25 | 619.135 | -11.784 | 2.823 | -1020.521 | 21.700 | 16.314 |
| 26 | 863.263 | -10.492 | 1.487 | -1291.429 | 25.145 | 24.749 |
| 27 | 1332.903 | -13.559 | -14.734 | -1526.306 | 29.473 | 33.751 |
| 28 | 1573.555 | -18.571 | -24.617 | -1722.666 | 34.966 | 43.622 |
| 29 | 1774.673 | -24.676 | -35.289 | -1877.811 | 41.623 | 54.233 |
| 30 | 1933.498 | -32.287 | -46.689 | -1989.002 | 49.654 | 65.618 |
| 31 | 2047.159 | -41.151 | -58.947 | -2053.327 | 58.788 | 77.772 |
| 32 | 2112.615 | -50.958 | -71.509 | -2067.863 | 75.635 | 90.424 |
| 33 | 2109.674 | -71.613 | -89.714 | -2055.909 | 94.523 | 108.212 |
| 34 | 2060.110 | -94.196 | -107.799 | -1954.903 | 116.531 | 125.608 |
| 35 | 1958.884 | -116.144 | -125.248 | -1803.135 | 137.748 | 142.261 |
| 36 | 1806.697 | -137.345 | -141.926 | -1585.715 | 159.487 | 159.200 |
| 37 | 1588.688 | -159.221 | -158.974 | -1300.126 | 181.831 | 176.159 |
| 38 | 1302.397 | -181.735 | -175.803 | -1034.590 | 210.900 | 94.612 |
| 39 | 1036.095 | -210.764 | -94.550 | -554.270 | 250.759 | 106.524 |
| 40 | 554.784 | -250.718 | -106.312 | -2.199 | 318.439 | 118.588 |

DIMENSIONAMIENTO A CORTANTE SEGUN NORMATIVA EHE

Angulo de la biela comprimida(sex.) = 35.00

| SEC | Vd (T) | Nd (T) | Vul (T) | Vcu (T) | Vsu (T) | Asc (cm2/m) | Dec (m) | th | the | rho | psi | d (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 315. | 2321. | 3166. | 154. | 289. | 41.6 | 0.6 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 2 | 262. | 2310. | 3166. | 153. | 289. | 41.6 | 0.5 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 3 | 221. | 2285. | 1137. | 66. | 155. | 22.3 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 4 | 191. | 2287. | 1137. | 66. | 124. | 17.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 5 | 162. | 2289. | 1137. | 66. | 104. | 14.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 6 | 137. | 2293. | 1137. | 67. | 104. | 14.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 7 | 116. | 2297. | 1137. | 67. | 104. | 14.9 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 8 | 94. | 2303. | 1137. | 67. | 104. | 14.9 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 9 | 73. | 2310. | 1137. | 67. | 104. | 14.9 | 0.4 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 10 | 82. | 2318. | 1137. | 67. | 104. | 14.9 | 0.5 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 11 | 93. | 2348. | 1137. | 68. | 104. | 14.9 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 12 | 106. | 2344. | 1137. | 68. | 104. | 14.9 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 13 | 122. | 2343. | 1137. | 68. | 104. | 14.9 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 14 | 134. | 2343. | 1137. | 68. | 104. | 14.9 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 15 | 152. | 2342. | 1137. | 68. | 104. | 14.9 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 16 | 171. | 2340. | 1137. | 68. | 104. | 14.9 | 0.6 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 17 | 191. | 2335. | 1137. | 68. | 123. | 17.7 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 18 | 212. | 2323. | 1137. | 67. | 145. | 20.9 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 19 | 264. | 2300. | 1137. | 67. | 198. | 28.5 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 20 | 459. | 2277. | 1137. | 66. | 393. | 56.6 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 21 | 656. | 2241. | 3166. | 150. | 506. | 72.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 22 | 469. | 2223. | 1137. | 65. | 404. | 58.2 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 23 | 238. | 2277. | 1137. | 66. | 172. | 24.7 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 24 | 213. | 2295. | 1137. | 67. | 146. | 21.1 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 25 | 191. | 2300. | 1137. | 67. | 124. | 17.9 | 0.6 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 26 | 171. | 2297. | 1137. | 67. | 105. | 15.1 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 27 | 153. | 2288. | 1137. | 66. | 104. | 14.9 | 1.0 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 28 | 135. | 2278. | 1137. | 66. | 104. | 14.9 | 1.0 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 29 | 119. | 2269. | 1137. | 66. | 104. | 14.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 30 | 104. | 2263. | 1137. | 66. | 104. | 14.9 | 0.8 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 31 | 89. | 2261. | 1137. | 66. | 104. | 14.9 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 32 | 78. | 2265. | 1137. | 66. | 104. | 14.9 | 0.6 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 33 | 75. | 2248. | 1137. | 65. | 104. | 14.9 | 0.5 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 34 | 91. | 2243. | 1137. | 65. | 104. | 14.9 | 0.7 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 35 | 107. | 2241. | 1137. | 65. | 104. | 14.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 36 | 124. | 2243. | 1137. | 65. | 104. | 14.9 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 37 | 148. | 2248. | 1137. | 65. | 104. | 14.9 | 1.0 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 38 | 173. | 2255. | 1137. | 66. | 108. | 15.5 | 1.0 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 39 | 198. | 2283. | 1137. | 66. | 132. | 19.0 | 0.9 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 40 | 234. | 2311. | 3166. | 153. | 289. | 41.6 | 0.4 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |
| 41 | 299. | 2311. | 3166. | 153. | 289. | 41.6 | 0.5 | 35.0 | 26.6 | 0.02 | 1.38 | 1.35 |

La armadura así obtenida se debe dividir en los 3 nervios que componen la sección.
Cada nervio contendrá 2 ramas.

## EVALUACIÓN DEL E.L.U. DE TORSIÓN

En este apartado se comprueba el Estado Límite Último de rotura por esfuerzo torsor de acuerdo con los criterios de la Normativa española vigente (EHE artículo 45)

Los esfuerzos torsores de cálculo se han obtenido del modelo de emparrillado plano definido en el capítulo tres. La verificación del ELU de Torsión se ha llevado a cabo a partir de los esfuerzos obtenidos en el nervio mas solicitado.

A continuación exponemos el valor de los esfuerzos máximos y la armadura necesaria para resistir estos esfuerzos.

COMBINACION 45  1.35 (G1 + G2) + 1.5 (SCTMAX-IPF) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -230.607 | 291.676 | 249.947 | -15.468 | -239.393 | -230.687 |
| 2 | 9.113 | 239.844 | 231.404 | -146.737 | -197.779 | -205.973 |
| 3 | 128.533 | 199.206 | 207.506 | -287.584 | -167.004 | -182.422 |
| 4 | 253.954 | 167.372 | 184.841 | -381.193 | -135.527 | -160.129 |
| 5 | 344.421 | 138.798 | 163.787 | -443.286 | -107.302 | -139.376 |
| 6 | 390.868 | 109.557 | 143.718 | -535.799 | -111.290 | -122.018 |
| 7 | 381.169 | 77.783 | 124.898 | -567.421 | -90.266 | -111.331 |
| 8 | 569.142 | 90.051 | 112.259 | -572.119 | -69.665 | -101.089 |
| 9 | 573.900 | 69.410 | 102.199 | -551.217 | -49.525 | -90.944 |
| 10 | 553.049 | 49.282 | 92.151 | -502.187 | -41.689 | -80.699 |
| 11 | 503.992 | 41.381 | 82.053 | -457.932 | -34.050 | -70.729 |
| 12 | 459.668 | 33.784 | 72.264 | -402.805 | -26.912 | -61.162 |
| 13 | 404.406 | 26.553 | 62.873 | -429.686 | -27.664 | -61.943 |
| 14 | 431.166 | 27.297 | 63.769 | -360.018 | -20.832 | -52.381 |
| 15 | 361.331 | 20.478 | 54.360 | -285.099 | -14.306 | -43.081 |
| 16 | 286.206 | 13.895 | 45.255 | -206.960 | -7.763 | -33.837 |
| 17 | 207.882 | 7.331 | 36.058 | -126.496 | -0.799 | -26.498 |
| 18 | 127.146 | 0.357 | 28.982 | -40.889 | 35.226 | -21.164 |
| 19 | 41.314 | -35.690 | 23.737 | 151.403 | 213.226 | -18.987 |
| 20 | -520.868 | -234.799 | 22.571 | 444.975 | 305.757 | -105.748 |
| 21 | -963.296 | 625.642 | 236.466 | 457.555 | -437.534 | -251.212 |
| 22 | -461.621 | 437.741 | 251.904 | 135.877 | -207.169 | -223.954 |
| 23 | -147.871 | 207.818 | 225.862 | -43.328 | -183.151 | -198.402 |
| 24 | 22.624 | 184.369 | 201.305 | -190.071 | -162.144 | -174.261 |
| 25 | 161.223 | 163.900 | 178.145 | -309.378 | -143.067 | -151.506 |
| 26 | 272.751 | 145.392 | 156.210 | -403.563 | -125.168 | -130.015 |
| 27 | 359.272 | 128.221 | 136.383 | -446.960 | -104.505 | -114.171 |
| 28 | 422.108 | 111.947 | 117.784 | -497.776 | -97.638 | -105.092 |
| 29 | 499.637 | 97.620 | 106.359 | -535.169 | -90.247 | -96.211 |
| 30 | 537.185 | 89.996 | 97.653 | -556.040 | -82.098 | -87.472 |
| 31 | 558.169 | 81.802 | 89.073 | -557.873 | -73.611 | -79.201 |
| 32 | 560.081 | 73.435 | 80.957 | -554.028 | -58.143 | -70.826 |
| 33 | 556.193 | 57.926 | 72.740 | -518.011 | -42.112 | -62.376 |
| 34 | 520.168 | 41.689 | 64.477 | -453.475 | -25.668 | -54.691 |
| 35 | 455.552 | 25.337 | 56.944 | -360.515 | -9.318 | -46.907 |
| 36 | 362.465 | 9.040 | 49.409 | -239.480 | 6.921 | -39.588 |
| 37 | 241.090 | -7.299 | 42.176 | -92.864 | 22.991 | -32.106 |
| 38 | 94.218 | -23.507 | 35.085 | 40.061 | 33.860 | -28.485 |
| 39 | -39.104 | -34.302 | 31.368 | 101.514 | 52.792 | -25.682 |
| 40 | -100.976 | -53.290 | 28.941 | 230.041 | 91.226 | -24.518 |

COMBINACION 46  1.35 (G1 + G2) + 1.5 (SCTMIN-IPF) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -231.194 | 193.773 | 8.914 | 77.328 | -139.613 | -7.520 |
| 2 | -68.716 | 156.578 | 10.624 | -50.439 | -123.764 | -3.316 |
| 3 | 49.653 | 123.352 | 6.059 | -220.132 | -98.209 | 3.717 |
| 4 | 219.043 | 97.788 | -1.185 | -382.471 | -70.815 | 12.622 |
| 5 | 381.153 | 70.477 | -10.289 | -489.740 | -41.053 | 2.109 |
| 6 | 476.181 | 41.924 | 0.818 | -604.242 | -14.150 | 15.851 |
| 7 | 589.124 | 15.233 | -12.925 | -681.335 | 12.281 | 29.805 |
| 8 | 665.148 | -10.925 | -26.752 | -722.720 | 38.058 | 43.381 |
| 9 | 705.935 | -36.457 | -40.190 | -730.215 | 63.185 | 56.878 |
| 10 | 713.275 | -61.275 | -53.745 | -701.686 | 75.821 | 70.723 |
| 11 | 684.994 | -73.695 | -67.534 | -683.921 | 86.733 | 83.067 |
| 12 | 667.860 | -84.291 | -79.739 | -635.952 | 98.332 | 96.377 |
| 13 | 620.877 | -95.724 | -92.938 | -516.654 | 99.991 | 99.324 |
| 14 | 502.895 | -97.131 | -95.892 | -430.011 | 117.799 | 118.910 |
| 15 | 456.687 | -111.664 | -110.774 | -343.494 | 136.074 | 139.610 |
| 16 | 365.899 | -130.413 | -131.962 | -198.572 | 153.919 | 161.552 |
| 17 | 251.627 | -150.336 | -154.786 | -84.649 | 173.544 | 182.971 |
| 18 | 112.531 | -171.769 | -178.183 | 60.769 | 223.588 | 205.453 |
| 19 | -46.082 | -222.686 | -203.357 | 343.089 | 416.945 | 229.471 |
| 20 | -338.392 | -416.677 | -228.706 | 994.151 | 535.095 | 207.258 |
| 21 | -677.127 | 408.179 | -53.608 | 734.094 | -320.271 | -1.547 |
| 22 | -364.071 | 300.759 | 6.653 | 520.614 | -103.538 | 1.930 |
| 23 | -120.164 | 81.318 | 1.996 | -6.366 | -67.800 | 8.018 |
| 24 | 5.630 | 67.330 | -5.272 | -122.990 | -55.749 | 16.807 |
| 25 | 121.939 | 55.277 | -14.252 | -232.396 | -44.587 | 27.073 |
| 26 | 231.079 | 44.066 | -24.684 | -334.239 | -33.481 | 37.277 |
| 27 | 332.714 | 33.047 | -35.036 | -426.310 | -22.120 | 47.237 |
| 28 | 424.565 | 21.724 | -45.156 | -505.819 | -10.259 | 57.418 |
| 29 | 503.857 | 10.017 | -55.511 | -569.589 | 2.020 | 67.766 |
| 30 | 567.499 | -2.438 | -66.014 | -614.888 | 14.922 | 78.333 |
| 31 | 612.709 | -15.328 | -76.748 | -639.597 | 28.131 | 88.790 |
| 32 | 637.417 | -28.356 | -87.376 | -430.774 | 20.582 | 101.136 |
| 33 | 655.170 | -48.438 | -98.409 | -468.707 | 44.630 | 119.587 |
| 34 | 527.726 | -37.170 | -102.723 | -479.532 | 70.134 | 133.185 |
| 35 | 521.746 | -61.620 | -123.707 | -443.469 | 94.791 | 154.640 |
| 36 | 480.783 | -86.955 | -146.885 | -284.646 | 117.788 | 178.033 |
| 37 | 407.626 | -112.927 | -170.437 | -212.000 | 141.367 | 200.084 |
| 38 | 258.147 | -142.594 | -197.614 | -101.172 | 168.199 | 224.165 |
| 39 | 121.758 | -165.608 | -222.417 | 1.840 | 201.555 | 249.425 |
| 40 | 7.014 | -201.998 | -248.662 | 229.518 | 266.053 | 276.225 |

COMBINACION 47  1.35 (G1 + G2) + 1.5 (SCTMAX-EC1) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -229.950 | 480.675 | 440.721 | -186.968 | -424.451 | -420.803 |
| 2 | 180.613 | 424.903 | 421.510 | -456.609 | -363.156 | -376.979 |
| 3 | 438.403 | 364.586 | 378.496 | -695.035 | -313.849 | -334.471 |
| 4 | 666.766 | 316.153 | 336.861 | -715.996 | -242.715 | -282.003 |
| 5 | 737.670 | 245.073 | 301.501 | -819.078 | -206.679 | -254.650 |
| 6 | 820.505 | 206.593 | 255.303 | -872.694 | -171.984 | -227.256 |
| 7 | 874.278 | 171.801 | 228.022 | -880.335 | -138.589 | -201.326 |
| 8 | 962.627 | 150.850 | 202.890 | -845.604 | -106.613 | -177.198 |
| 9 | 928.628 | 117.364 | 180.938 | -772.711 | -76.111 | -154.313 |
| 10 | 815.439 | 80.802 | 159.497 | -661.757 | -58.921 | -132.463 |
| 11 | 706.686 | 63.277 | 138.613 | -675.094 | -43.428 | -115.060 |
| 12 | 633.706 | 50.871 | 122.981 | -543.598 | -27.580 | -95.589 |
| 13 | 504.751 | 35.561 | 104.289 | -488.755 | -20.502 | -87.045 |
| 14 | 453.273 | 29.096 | 96.561 | -221.246 | -10.071 | -70.549 |
| 15 | 303.060 | 15.936 | 79.211 | -69.923 | 1.260 | -55.896 |
| 16 | 147.546 | 3.847 | 63.263 | 81.729 | 11.804 | -42.688 |
| 17 | -9.136 | -7.379 | 48.901 | 180.231 | 18.758 | -35.652 |
| 18 | -179.581 | -19.200 | 38.135 | 338.008 | 58.050 | -27.453 |
| 19 | -327.793 | -57.921 | 25.468 | 523.581 | 234.461 | -20.308 |
| 20 | -519.650 | -234.728 | 23.553 | 949.482 | 200.668 | -211.514 |
| 21 | -1782.923 | 834.591 | 403.416 | 1541.506 | -705.390 | -441.453 |
| 22 | -1545.571 | 705.597 | 442.145 | 1001.719 | -458.548 | -397.322 |
| 23 | -1013.720 | 459.202 | 399.814 | 236.227 | -394.094 | -357.212 |
| 24 | -256.930 | 395.310 | 360.116 | -78.852 | -356.753 | -317.527 |
| 25 | 50.001 | 358.511 | 321.670 | -343.960 | -320.658 | -278.893 |
| 26 | 307.325 | 322.987 | 284.143 | -558.491 | -285.056 | -241.727 |
| 27 | 514.200 | 288.117 | 248.094 | -712.192 | -250.282 | -211.551 |
| 28 | 661.384 | 254.092 | 218.967 | -811.019 | -217.089 | -178.851 |
| 29 | 754.506 | 221.805 | 187.399 | -861.856 | -185.810 | -148.663 |
| 30 | 800.820 | 191.151 | 158.384 | -1119.637 | -156.103 | -144.314 |
| 31 | 810.624 | 163.390 | 132.272 | -1103.012 | -134.178 | -124.692 |
| 32 | 1050.290 | 139.944 | 133.455 | -1062.031 | -105.937 | -105.902 |
| 33 | 1009.115 | 112.417 | 115.037 | -972.089 | -77.801 | -87.201 |
| 34 | 920.373 | 84.887 | 97.475 | -686.316 | -48.500 | -72.284 |
| 35 | 789.461 | 57.988 | 81.936 | -535.116 | -24.940 | -58.859 |
| 36 | 240.736 | 35.221 | 45.625 | -358.113 | -2.823 | -47.039 |
| 37 | 118.407 | 16.571 | 37.698 | -161.849 | 17.752 | -36.165 |
| 38 | -11.353 | 3.244 | 31.785 | 157.074 | 26.428 | -22.225 |
| 39 | -125.015 | -8.114 | 28.237 | 189.701 | 19.419 | -22.890 |
| 40 | -150.726 | -26.417 | 26.879 | 230.110 | 61.090 | -24.886 |

COMBINACION 48  1.35 (G1 + G2) + 1.5 (SCTMIN-EC1) + PRETD

ESFUERZOS EN EXTREMO DE BARRA

| Barra | Momento1 | Cortante1 | Torsor1 | Momento2 | Cortante2 | Torsor2 |
|---|---|---|---|---|---|---|
| 1 | -231.415 | 156.859 | 8.234 | 102.554 | -120.142 | -7.022 |
| 2 | -102.992 | 119.662 | 9.967 | -11.479 | -109.468 | -4.341 |
| 3 | 20.017 | 125.619 | 8.319 | -146.248 | -85.694 | 0.193 |
| 4 | 159.364 | 102.691 | 4.284 | -273.704 | -60.374 | 5.792 |
| 5 | 291.999 | 78.388 | -0.944 | -330.517 | -34.510 | -8.959 |
| 6 | 339.824 | 55.037 | 15.430 | -422.356 | -11.648 | 1.173 |
| 7 | 429.095 | 31.997 | 6.208 | -510.445 | 11.050 | 12.596 |
| 8 | 500.665 | 7.917 | -4.086 | -575.400 | 33.874 | 24.419 |
| 9 | 551.779 | -17.120 | -15.259 | -602.177 | 58.589 | 36.736 |
| 10 | 579.758 | -42.986 | -27.740 | -639.142 | 67.160 | 50.044 |
| 11 | 578.203 | -58.039 | -41.617 | -637.392 | 80.751 | 62.625 |
| 12 | 589.537 | -72.853 | -55.172 | -602.882 | 95.854 | 76.824 |
| 13 | 568.581 | -90.053 | -71.006 | -522.858 | 106.497 | 87.247 |
| 14 | 156.090 | -132.224 | -81.138 | -55.772 | 155.755 | 102.971 |
| 15 | 43.623 | -152.642 | -99.468 | 71.885 | 176.477 | 121.875 |
| 16 | -82.174 | -173.195 | -118.256 | 248.927 | 194.940 | 140.884 |
| 17 | -221.484 | -193.091 | -136.912 | -80.053 | 170.892 | 151.271 |
| 18 | 89.219 | -170.307 | -148.745 | 62.843 | 222.080 | 170.854 |
| 19 | -59.232 | -221.863 | -170.220 | 339.775 | 415.171 | 190.855 |
| 20 | -338.876 | -415.119 | -190.639 | 891.616 | 509.643 | 149.530 |
| 21 | -994.497 | 380.129 | -67.558 | 704.286 | -318.744 | -2.216 |
| 22 | -704.441 | 318.206 | 5.298 | 385.380 | -96.219 | 0.709 |
| 23 | -474.644 | 100.494 | 2.330 | 269.440 | -83.598 | 4.950 |
| 24 | -354.020 | 87.927 | -1.294 | 157.049 | -72.790 | 10.475 |
| 25 | -236.994 | 77.118 | -6.037 | 45.654 | -62.627 | 16.960 |
| 26 | -122.039 | 66.981 | -11.444 | -64.540 | -52.233 | 24.569 |
| 27 | -9.043 | 56.805 | -17.862 | -171.274 | -41.225 | 33.185 |
| 28 | 100.025 | 46.046 | -25.319 | -271.183 | -29.319 | 42.545 |
| 29 | 202.049 | 34.522 | -33.914 | -360.487 | -16.508 | 52.749 |
| 30 | 409.965 | 24.790 | -44.004 | -435.457 | -2.552 | 63.845 |
| 31 | 487.130 | 10.101 | -56.042 | -492.884 | 12.245 | 75.717 |
| 32 | 545.580 | -5.276 | -68.598 | -545.124 | 34.526 | 88.419 |
| 33 | 690.707 | -44.715 | -86.095 | -687.184 | 72.068 | 105.531 |
| 34 | 680.813 | -71.564 | -94.737 | -657.616 | 99.071 | 116.941 |
| 35 | 638.616 | -96.486 | -112.976 | -589.355 | 123.260 | 134.428 |
| 36 | 571.995 | -120.283 | -130.368 | -396.488 | 145.042 | 151.814 |
| 37 | 472.910 | -143.973 | -147.619 | -289.491 | 166.632 | 167.051 |
| 38 | 288.302 | -166.800 | -166.384 | -139.214 | 186.763 | 182.336 |
| 39 | 138.470 | -186.786 | -182.110 | -14.113 | 217.236 | 197.789 |
| 40 | 13.835 | -217.246 | -197.496 | 229.577 | 250.179 | 214.661 |

DIMENSIONAMIENTO A TORSION SEGUN NORMATIVA EHE

Angulo de la biela comprimida(sex.) = 35.00

| SECC | Td (mT) | Tu1 (mT) | T-V | Asl (cm2/m) | Ast (cm2/m) | theta | thetae |
|---|---|---|---|---|---|---|---|
| 1 | 440.72 | 1627.40 | 0.14 | 17.44 | 8.55 | 35.00 | 26.57 |
| 2 | 421.51 | 1627.40 | 0.12 | 16.68 | 8.18 | 35.00 | 26.57 |
| 3 | 378.50 | 1358.57 | 0.34 | 13.46 | 6.60 | 35.00 | 26.57 |
| 4 | 336.86 | 1358.57 | 0.28 | 11.98 | 5.87 | 35.00 | 26.57 |
| 5 | 301.50 | 1358.57 | 0.22 | 10.72 | 5.26 | 35.00 | 26.57 |
| 6 | 255.30 | 1358.57 | 0.17 | 9.08 | 4.45 | 35.00 | 26.57 |
| 7 | 228.02 | 1358.57 | 0.14 | 8.11 | 3.98 | 35.00 | 26.57 |
| 8 | 202.89 | 1358.57 | 0.11 | 7.22 | 3.54 | 35.00 | 26.57 |
| 9 | 180.94 | 1358.57 | 0.09 | 6.43 | 3.15 | 35.00 | 26.57 |
| 10 | 159.50 | 1358.57 | 0.06 | 5.67 | 2.78 | 35.00 | 26.57 |
| 11 | 138.61 | 1358.57 | 0.05 | 4.93 | 2.42 | 35.00 | 26.57 |
| 12 | 122.98 | 1358.57 | 0.04 | 4.37 | 2.14 | 35.00 | 26.57 |
| 13 | 104.29 | 1358.57 | 0.05 | 3.71 | 1.82 | 35.00 | 26.57 |
| 14 | 96.56 | 1358.57 | 0.06 | 3.43 | 1.68 | 35.00 | 26.57 |
| 15 | 110.77 | 1358.57 | 0.08 | 3.94 | 1.93 | 35.00 | 26.57 |
| 16 | 131.96 | 1358.57 | 0.09 | 4.69 | 2.30 | 35.00 | 26.57 |
| 17 | 154.79 | 1358.57 | 0.11 | 5.50 | 2.70 | 35.00 | 26.57 |
| 18 | 178.18 | 1358.57 | 0.14 | 6.34 | 3.11 | 35.00 | 26.57 |
| 19 | 203.36 | 1358.57 | 0.18 | 7.23 | 3.55 | 35.00 | 26.57 |
| 20 | 228.71 | 1358.57 | 0.34 | 8.13 | 3.99 | 35.00 | 26.57 |
| 21 | 403.42 | 1627.40 | 0.19 | 15.97 | 7.83 | 35.00 | 26.57 |
| 22 | 442.14 | 1358.57 | 0.69 | 15.72 | 7.71 | 35.00 | 26.57 |
| 23 | 399.81 | 1358.57 | 0.43 | 14.22 | 6.97 | 35.00 | 26.57 |
| 24 | 360.12 | 1358.57 | 0.36 | 12.81 | 6.28 | 35.00 | 26.57 |
| 25 | 321.67 | 1358.57 | 0.31 | 11.44 | 5.61 | 35.00 | 26.57 |
| 26 | 284.14 | 1358.57 | 0.26 | 10.10 | 4.95 | 35.00 | 26.57 |
| 27 | 248.09 | 1358.57 | 0.22 | 8.82 | 4.33 | 35.00 | 26.57 |
| 28 | 218.97 | 1358.57 | 0.18 | 7.79 | 3.82 | 35.00 | 26.57 |
| 29 | 187.40 | 1358.57 | 0.15 | 6.66 | 3.27 | 35.00 | 26.57 |
| 30 | 158.38 | 1358.57 | 0.12 | 5.63 | 2.76 | 35.00 | 26.57 |
| 31 | 132.27 | 1358.57 | 0.09 | 4.70 | 2.31 | 35.00 | 26.57 |
| 32 | 133.46 | 1358.57 | 0.08 | 4.75 | 2.33 | 35.00 | 26.57 |
| 33 | 115.04 | 1358.57 | 0.06 | 4.09 | 2.01 | 35.00 | 26.57 |
| 34 | 102.72 | 1358.57 | 0.05 | 3.65 | 1.79 | 35.00 | 26.57 |
| 35 | 123.71 | 1358.57 | 0.06 | 4.40 | 2.16 | 35.00 | 26.57 |
| 36 | 146.88 | 1358.57 | 0.08 | 5.22 | 2.56 | 35.00 | 26.57 |
| 37 | 170.44 | 1358.57 | 0.10 | 6.06 | 2.97 | 35.00 | 26.57 |
| 38 | 197.61 | 1358.57 | 0.13 | 7.03 | 3.45 | 35.00 | 26.57 |
| 39 | 222.42 | 1358.57 | 0.15 | 7.91 | 3.88 | 35.00 | 26.57 |
| 40 | 248.66 | 1627.40 | 0.05 | 9.84 | 4.83 | 35.00 | 26.57 |
| 41 | 24.52 | 1627.40 | 0.07 | 0.97 | 0.48 | 35.00 | 26.57 |

## EVALUACIÓN DEL E.L.U. DE RASANTE

En el presente apartado se obtendrá el esfuerzo rasante entre alas y alma que afecta a la estructura debido a la variación de la ley de momentos flectores.

A partir de los esfuerzos obtenidos, se verificará la resistencia a la compresión oblicua del hormigón en el plano de unión de las alas al alma, así como se calculará la armadura necesaria para resistir este esfuerzo.

Todas los cálculos realizados se han formulado a partir de lo indicado en la normativa de hormigón actual (EHE) en su artículo 44.2.3.5

DIMENSIONAMIENTO A RASANTE (Vd)
Y VERIFICACION DE AGOTAMIENTO DEL HORMIGON POR
TENSIONES TANGENCIALES SEGUN NORMATIVA EHE

| Secc | Vd (T) | Td (mT) | Thetae | Corte | T-V | Asv cm2 | Ast cm2 |
|---|---|---|---|---|---|---|---|
| 1 | 314.8 | 440.7 | 35.0 | 1 | 0.15 | 7.8 | 0.0 |
| 2 | 262.0 | 421.5 | 35.0 | 1 | 0.12 | 6.5 | 0.0 |
| 3 | 220.8 | 378.5 | 35.0 | 1 | 0.10 | 5.6 | 0.0 |
| 4 | 190.9 | 336.9 | 35.0 | 1 | 0.08 | 4.8 | 0.0 |
| 5 | 162.1 | 301.5 | 35.0 | 1 | 0.05 | 4.1 | 0.0 |
| 6 | 137.5 | 255.3 | 35.0 | 1 | 0.04 | 3.5 | 0.0 |
| 7 | 115.6 | 228.0 | 35.0 | 1 | 0.03 | 2.9 | 0.0 |
| 8 | 94.1 | 202.9 | 35.0 | 1 | 0.02 | 2.4 | 0.0 |
| 9 | 73.2 | 180.9 | 35.0 | 1 | 0.02 | 1.9 | 0.0 |
| 10 | 82.4 | 159.5 | 35.0 | 1 | 0.01 | 2.1 | 0.0 |
| 11 | 93.1 | 138.6 | 35.0 | 1 | 0.01 | 2.4 | 0.0 |
| 12 | 106.5 | 123.0 | 35.0 | 1 | 0.01 | 2.7 | 0.0 |
| 13 | 122.1 | 104.3 | 35.0 | 1 | 0.02 | 3.1 | 0.0 |
| 14 | 133.7 | 96.6 | 35.0 | 1 | 0.02 | 3.4 | 0.0 |
| 15 | 151.6 | 110.8 | 35.0 | 1 | 0.02 | 3.8 | 0.0 |
| 16 | 170.5 | 132.0 | 35.0 | 1 | 0.03 | 4.3 | 0.0 |
| 17 | 190.6 | 154.8 | 35.0 | 1 | 0.03 | 4.8 | 0.0 |
| 18 | 212.3 | 178.2 | 35.0 | 1 | 0.04 | 5.4 | 0.0 |
| 19 | 264.3 | 203.4 | 35.0 | 1 | 0.06 | 6.7 | 0.0 |
| 20 | 459.3 | 228.7 | 35.0 | 1 | 0.14 | 11.7 | 0.0 |
| 21 | 655.5 | 403.4 | 35.0 | 1 | 0.36 | 16.3 | 0.0 |
| 22 | 468.8 | 442.1 | 35.0 | 1 | 0.28 | 11.9 | 0.0 |
| 23 | 237.7 | 399.8 | 35.0 | 1 | 0.14 | 6.0 | 0.0 |
| 24 | 213.0 | 360.1 | 35.0 | 1 | 0.11 | 5.4 | 0.0 |
| 25 | 191.2 | 321.7 | 35.0 | 1 | 0.10 | 4.9 | 0.0 |
| 26 | 171.3 | 284.1 | 35.0 | 1 | 0.08 | 4.3 | 0.0 |
| 27 | 152.6 | 248.1 | 35.0 | 1 | 0.07 | 3.9 | 0.0 |
| 28 | 135.4 | 219.0 | 35.0 | 1 | 0.06 | 3.4 | 0.0 |
| 29 | 119.3 | 187.4 | 35.0 | 1 | 0.04 | 3.0 | 0.0 |
| 30 | 103.8 | 158.4 | 35.0 | 1 | 0.03 | 2.6 | 0.0 |
| 31 | 89.2 | 132.3 | 35.0 | 1 | 0.03 | 2.3 | 0.0 |
| 32 | 78.0 | 133.5 | 35.0 | 1 | 0.02 | 2.0 | 0.0 |
| 33 | 75.3 | 115.0 | 35.0 | 1 | 0.01 | 1.9 | 0.0 |
| 34 | 90.9 | 102.7 | 35.0 | 1 | 0.01 | 2.3 | 0.0 |
| 35 | 106.8 | 123.7 | 35.0 | 1 | 0.01 | 2.7 | 0.0 |
| 36 | 124.2 | 146.9 | 35.0 | 1 | 0.02 | 3.2 | 0.0 |
| 37 | 148.2 | 170.4 | 35.0 | 1 | 0.02 | 3.8 | 0.0 |
| 38 | 173.4 | 197.6 | 35.0 | 1 | 0.03 | 4.4 | 0.0 |
| 39 | 197.9 | 222.4 | 35.0 | 1 | 0.04 | 5.0 | 0.0 |
| 40 | 234.2 | 248.7 | 35.0 | 1 | 0.05 | 5.8 | 0.0 |
| 41 | 299.4 | 24.5 | 35.0 | 1 | 0.07 | 7.4 | 0.0 |

Seccion = 1

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 314.835 Td (mT) = 440.721

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 227.36 | 0.00 | 0.15 | 7.83 |

Seccion = 2

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 262.047 Td (mT) = 421.510

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 200.98 | 0.00 | 0.12 | 6.51 |

Seccion = 3

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 220.840 Td (mT) = 378.496

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 176.09 | 0.00 | 0.10 | 5.61 |

Seccion = 4

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 190.850 Td (mT) = 336.861

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 152.70 | 0.00 | 0.08 | 4.84 |

Seccion = 5

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 162.105 Td (mT) = 301.501

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 118.37 | 0.00 | 0.05 | 4.11 |

Seccion = 6

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 137.474 Td (mT) = 255.303

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 99.78 | 0.00 | 0.04 | 3.49 |

Seccion = 7

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 115.587 Td (mT) = 228.022

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 82.98 | 0.00 | 0.03 | 2.93 |

Seccion = 8

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 94.120 Td (mT) = 202.890

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 72.86 | 0.00 | 0.02 | 2.39 |

Seccion = 9

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 73.154 Td (mT) = 180.938

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 56.69 | 0.00 | 0.02 | 1.86 |

Seccion = 10

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 82.377 Td (mT) = 159.497

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 39.03 | 0.00 | 0.01 | 2.09 |

Seccion = 11

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 93.092 Td (mT) = 138.613

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 30.56 | 0.00 | 0.01 | 2.36 |

Seccion = 12

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 106.486 Td (mT) = 122.981

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 24.57 | 0.00 | 0.01 | 2.70 |

Seccion = 13

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 122.134 Td (mT) = 104.289

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 17.18 | 0.00 | 0.02 | 3.10 |

Seccion = 14

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 133.663 Td (mT) = 96.561

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 14.05 | 0.00 | 0.02 | 3.39 |

Seccion = 15

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 151.591 Td (mT) = 110.774

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 53.93 | 0.00 | 0.02 | 3.85 |

Seccion = 16

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 170.502 Td (mT) = 131.962

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 62.99 | 0.00 | 0.03 | 4.33 |

Seccion = 17

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 190.599 Td (mT) = 154.786

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 72.61 | 0.00 | 0.03 | 4.84 |

Seccion = 18

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 212.328 Td (mT) = 178.183

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 82.96 | 0.00 | 0.04 | 5.39 |

Seccion = 19

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 264.266 Td (mT) = 203.357

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 107.56 | 0.00 | 0.06 | 6.71 |

Seccion = 20

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 459.319 Td (mT) = 228.706

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 201.25 | 0.00 | 0.14 | 11.66 |

Seccion = 21

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 655.526 Td (mT) = 403.416

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 394.76 | 0.00 | 0.36 | 16.29 |

Seccion = 22

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 468.789 Td (mT) = 442.145

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 340.80 | 0.00 | 0.28 | 11.90 |

Seccion = 23

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 237.675 Td (mT) = 399.814

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 221.79 | 0.00 | 0.14 | 6.03 |

Seccion = 24

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 212.967 Td (mT) = 360.116

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 190.93 | 0.00 | 0.11 | 5.41 |

Seccion = 25

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 191.173 Td (mT) = 321.670

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 173.16 | 0.00 | 0.10 | 4.85 |

Seccion = 26

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 171.269 Td (mT) = 284.143

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 156.00 | 0.00 | 0.08 | 4.35 |

Seccion = 27

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 152.623 Td (mT) = 248.094

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 139.16 | 0.00 | 0.07 | 3.87 |

Seccion = 28

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 135.364 Td (mT) = 218.967

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 122.73 | 0.00 | 0.06 | 3.44 |

Seccion = 29

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 119.269 Td (mT) = 187.399

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 107.13 | 0.00 | 0.04 | 3.03 |

Seccion = 30

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 103.767 Td (mT) = 158.384

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 92.33 | 0.00 | 0.03 | 2.63 |

Seccion = 31

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 89.159 Td (mT) = 132.272

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 78.92 | 0.00 | 0.03 | 2.26 |

Seccion = 32

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 78.004 Td (mT) = 133.455

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 67.59 | 0.00 | 0.02 | 1.98 |

Seccion = 33

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 75.336 Td (mT) = 115.037

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 54.30 | 0.00 | 0.01 | 1.91 |

Seccion = 34

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 90.914 Td (mT) = 102.723

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 17.95 | 0.00 | 0.01 | 2.31 |

Seccion = 35

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 106.795 Td (mT) = 123.707

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 29.76 | 0.00 | 0.01 | 2.71 |

Seccion = 36

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 124.220 Td (mT) = 146.885

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 42.00 | 0.00 | 0.02 | 3.15 |

Seccion = 37

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 148.171 Td (mT) = 170.437

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 54.54 | 0.00 | 0.02 | 3.76 |

Seccion = 38

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 173.404 Td (mT) = 197.614

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 68.87 | 0.00 | 0.03 | 4.40 |

Seccion = 39

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 197.851 Td (mT) = 222.417

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 79.99 | 0.00 | 0.04 | 5.02 |

Seccion = 40

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 234.194 Td (mT) = 248.662

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 95.54 | 0.00 | 0.05 | 5.82 |

Seccion = 41

Angulo de la biela comprimida (sex) = 35.00

Valores maximos de los esfuerzos
Vd (T) = 299.418 Td (mT) = 24.518

| Corte | tau_Vu (T/m2) | tau_Tu (T/m2) | tau_Vd (T/m2) | tau_Td (T/m2) | T-V | As,ras (cm2/m) |
|---|---|---|---|---|---|---|
| 1 | 751.75 | 902.11 | 43.15 | 0.00 | 0.07 | 7.44 |

## REACCIONES VERTICALES

Las reacciones verticales en los distintos apoyos se han calculado a partir de los resultados del apartado 3. Los resultados se resumen en este apartado siguiendo los criterios de numeración de nudos y designación de cargas adoptados en el mencionado apartado 3.

Referencia del Proyecto: L.A.V. Castellbisbal-Papiol. Viaducto Puerto-Marto

APOYO N = 42

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 56.59833 | 0.00000 |
| G2 | 0.00000 | 41.62255 | 0.00000 |
| Pii | 0.00000 | 16.31394 | 0.00000 |
| Pi | 0.00000 | 27.52239 | 0.00000 |
| Pd | 0.00000 | 23.56875 | 0.00000 |
| TEMP | 0.00000 | 7.35225 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 3.49258 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.54518 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -5.14264 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 70.45670 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -5.04846 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 90.94550 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -4.20038 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 90.06639 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -4.20038 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 88.05574 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -8.75469 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 95.18777 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -8.83303 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 82.69133 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -11.55888 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 6.89094 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.76969 | 0.00000 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00008 | 0.00000 | 0.00035 |
| G2 | -0.00007 | 0.00000 | 0.00027 |
| Pii | 0.00016 | 0.00000 | -0.00057 |
| Pi | 0.00027 | 0.00000 | -0.00098 |
| Pd | 0.00024 | 0.00000 | -0.00085 |
| TEMP | 0.00005 | 0.00000 | -0.00016 |
| SC peatonal(100%) Max | 0.00000 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00001 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00003 | 0.00000 | 0.00031 |
| IPF-75 TREN A via 1 (Min) | -0.00008 | 0.00000 | -0.00012 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B1 via 1 (Min) | -0.00003 | 0.00000 | -0.00001 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B2 via 1 (Min) | -0.00003 | 0.00000 | -0.00001 |
| EC-1 TREN LM71 via 1 (Max) | 0.00002 | 0.00000 | 0.00017 |
| EC-1 TREN LM71 via 1 (Min) | -0.00004 | 0.00000 | -0.00006 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00005 | 0.00000 | 0.00054 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00013 | 0.00000 | -0.00020 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00007 | 0.00000 | 0.00062 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00015 | 0.00000 | -0.00026 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 0.00000 | 0.00005 |
| EC-1 TREN 12.5 via 1 (Min) | -0.00001 | 0.00000 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

| | | | |
|---|---|---|---|
| Reaccion permanente | (ELS) = | 121.790 |
| Reaccion maxima | (ELS) = | 224.654 |
| Reaccion minima | (ELS) = | 109.785 |
| Reaccion minima | (ELU) = | 99.775 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | -0.000225 |
| Giro maximo | (ELS) = | 0.000396 |
| Giro minimo | (ELS) = | -0.000654 |

APOYO N = 43

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 55.85826 | 0.00000 |
| G2 | 0.00000 | 34.23617 | 0.00000 |
| Pii | 0.00000 | 20.33158 | 0.00000 |
| Pi | 0.00000 | 34.37971 | 0.00000 |
| Pd | 0.00000 | 29.50485 | 0.00000 |
| TEMP | 0.00000 | 6.79312 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 2.44101 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.58905 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 7.77136 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -0.21207 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 10.48512 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -4.96711 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 8.60371 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -8.82347 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 8.60371 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -8.54824 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 17.33712 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -8.67215 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 17.73680 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -8.65481 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 46.81587 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -11.03111 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 3.90132 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.48006 | 0.00000 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00011 | 0.00000 | 0.00036 |
| G2 | -0.00008 | 0.00000 | 0.00027 |
| Pii | 0.00016 | 0.00000 | -0.00059 |
| Pi | 0.00027 | 0.00000 | -0.00101 |
| Pd | 0.00023 | 0.00000 | -0.00088 |
| TEMP | 0.00004 | 0.00000 | -0.00017 |
| SC peatonal(100%) Max | 0.00000 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00001 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00003 | 0.00000 | 0.00032 |
| IPF-75 TREN A via 1 (Min) | -0.00009 | 0.00000 | -0.00012 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 0.00000 | 0.00013 |
| IPF-75 TREN B1 via 1 (Min) | -0.00004 | 0.00000 | -0.00001 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 0.00000 | 0.00012 |
| IPF-75 TREN B2 via 1 (Min) | -0.00003 | 0.00000 | -0.00001 |
| EC-1 TREN LM71 via 1 (Max) | 0.00002 | 0.00000 | 0.00017 |
| EC-1 TREN LM71 via 1 (Min) | -0.00005 | 0.00000 | -0.00006 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00006 | 0.00000 | 0.00055 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00016 | 0.00000 | -0.00021 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00008 | 0.00000 | 0.00063 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00018 | 0.00000 | -0.00027 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 0.00000 | 0.00005 |
| EC-1 TREN 12.5 via 1 (Min) | -0.00002 | 0.00000 | 0.00000 |

COMBINACION DE REACCIONES VERTICALES

| | | | |
|---|---|---|---|
| Reaccion permanente | (ELS) = | 119.599 |
| Reaccion maxima | (ELS) = | 173.978 |
| Reaccion minima | (ELS) = | 108.526 |
| Reaccion minima | (ELU) = | 98.722 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | -0.000245 |
| Giro maximo | (ELS) = | 0.000384 |
| Giro minimo | (ELS) = | -0.000685 |

APOYO N = 44

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 188.79039 | 0.00000 |
| G2 | 0.00000 | 150.31602 | 0.00000 |
| Pii | 0.00000 | -38.63897 | 0.00000 |
| Pi | 0.00000 | -65.27045 | 0.00000 |
| Pd | 0.00000 | -55.94998 | 0.00000 |
| TEMP | 0.00000 | -12.12901 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 15.31869 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -14.57645 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 89.11552 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | 0.00000 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 265.07645 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | 0.01770 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 246.53477 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | 0.01770 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 208.47252 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | 0.00000 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 208.41263 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | 0.00000 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 203.24538 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | 0.02947 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 19.37444 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00246 | 0.00000 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00001 | 0.00000 | 0.00010 |
| G2 | -0.00001 | 0.00000 | 0.00008 |
| Pii | 0.00004 | 0.00000 | -0.00019 |
| Pi | 0.00007 | 0.00000 | -0.00032 |
| Pd | 0.00006 | 0.00000 | -0.00026 |
| TEMP | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(100%) Max | 0.00001 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00002 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00006 | 0.00000 | 0.00024 |
| IPF-75 TREN A via 1 (Min) | -0.00005 | 0.00000 | -0.00021 |
| IPF-75 TREN B1 via 1 (Max) | 0.00002 | 0.00000 | 0.00008 |
| IPF-75 TREN B1 via 1 (Min) | -0.00002 | 0.00000 | -0.00009 |
| IPF-75 TREN B2 via 1 (Max) | 0.00002 | 0.00000 | 0.00007 |
| IPF-75 TREN B2 via 1 (Min) | -0.00001 | 0.00000 | -0.00008 |
| EC-1 TREN LM71 via 1 (Max) | 0.00003 | 0.00000 | 0.00013 |
| EC-1 TREN LM71 via 1 (Min) | -0.00003 | 0.00000 | -0.00011 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00010 | 0.00000 | 0.00041 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00009 | 0.00000 | -0.00037 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00012 | 0.00000 | 0.00053 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00012 | 0.00000 | -0.00043 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00001 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00004 |

COMBINACION DE REACCIONES VERTICALES

Reaccion permanente (ELS) = 283.156
Reaccion maxima (ELS) = 548.992
Reaccion minima (ELS) = 270.238
Reaccion minima (ELU) = 258.819

COMBINACION DE GIROS DE FLEXION

Acciones permanentes (ELS) = -0.000081
Giro maximo (ELS) = 0.000452
Giro minimo (ELS) = -0.000510

APOYO N = 45

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 188.19046 | 0.00000 |
| G2 | 0.00000 | 129.47974 | 0.00000 |
| Pii | 0.00000 | -30.98318 | 0.00000 |
| Pi | 0.00000 | -52.33148 | 0.00000 |
| Pd | 0.00000 | -44.85689 | 0.00000 |
| TEMP | 0.00000 | -14.74430 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 2.42740 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.03034 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 23.41840 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 8.51759 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -0.16136 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 24.63017 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -0.14786 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 23.24824 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -0.14786 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 37.57571 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -0.05417 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 43.33251 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -0.05912 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 115.45592 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -0.02474 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 11.14949 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | -0.00206 | 0.00000 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | -0.00004 | 0.00000 | 0.00010 |
| G2 | -0.00003 | 0.00000 | 0.00008 |
| Pii | 0.00005 | 0.00000 | -0.00020 |
| Pi | 0.00009 | 0.00000 | -0.00033 |
| Pd | 0.00007 | 0.00000 | -0.00028 |
| TEMP | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 0.00000 | 0.00003 |
| SC peatonal(100%) Min | -0.00001 | 0.00000 | -0.00002 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00001 |
| IPF-75 TREN A via 1 (Max) | 0.00005 | 0.00000 | 0.00024 |
| IPF-75 TREN A via 1 (Min) | -0.00006 | 0.00000 | -0.00022 |
| IPF-75 TREN B1 via 1 (Max) | 0.00002 | 0.00000 | 0.00008 |
| IPF-75 TREN B1 via 1 (Min) | -0.00002 | 0.00000 | -0.00009 |
| IPF-75 TREN B2 via 1 (Max) | 0.00002 | 0.00000 | 0.00007 |
| IPF-75 TREN B2 via 1 (Min) | -0.00002 | 0.00000 | -0.00008 |
| EC-1 TREN LM71 via 1 (Max) | 0.00003 | 0.00000 | 0.00013 |
| EC-1 TREN LM71 via 1 (Min) | -0.00003 | 0.00000 | -0.00011 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00009 | 0.00000 | 0.00042 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00011 | 0.00000 | -0.00038 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00010 | 0.00000 | 0.00054 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00014 | 0.00000 | -0.00044 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00001 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00004 |

COMBINACION DE REACCIONES VERTICALES

| | | |
|---|---|---|
| Reaccion permanente | (ELS) = | 272.813 |
| Reaccion maxima | (ELS) = | 389.431 |
| Reaccion minima | (ELS) = | 257.893 |
| Reaccion minima | (ELU) = | 247.627 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | -0.000100 |
| Giro maximo | (ELS) = | 0.000441 |
| Giro minimo | (ELS) = | -0.000541 |

APOYO N = 46

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 67.08292 | 0.00000 |
| G2 | 0.00000 | 49.78502 | 0.00000 |
| Pii | 0.00000 | 12.91614 | 0.00000 |
| Pi | 0.00000 | 21.78006 | 0.00000 |
| Pd | 0.00000 | 18.70592 | 0.00000 |
| TEMP | 0.00000 | 6.63301 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 6.05500 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.35874 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -5.58792 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 67.30278 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -3.63929 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 97.41261 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -5.87105 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 96.57502 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -5.82705 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 92.85748 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -5.87940 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 94.67149 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -6.43003 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 81.82366 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -7.54940 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 6.18952 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | -0.62912 | 0.00000 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | 0.00015 | 0.00000 | -0.00061 |
| G2 | 0.00012 | 0.00000 | -0.00047 |
| Pii | -0.00025 | 0.00000 | 0.00110 |
| Pi | -0.00043 | 0.00000 | 0.00187 |
| Pd | -0.00036 | 0.00000 | 0.00159 |
| TEMP | -0.00004 | 0.00000 | 0.00019 |
| SC peatonal(100%) Max | 0.00001 | 0.00000 | 0.00001 |
| SC peatonal(100%) Min | 0.00000 | 0.00000 | -0.00004 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00002 |
| IPF-75 TREN A via 1 (Max) | 0.00010 | 0.00000 | 0.00011 |
| IPF-75 TREN A via 1 (Min) | -0.00003 | 0.00000 | -0.00038 |
| IPF-75 TREN B1 via 1 (Max) | 0.00004 | 0.00000 | 0.00004 |
| IPF-75 TREN B1 via 1 (Min) | -0.00001 | 0.00000 | -0.00015 |
| IPF-75 TREN B2 via 1 (Max) | 0.00004 | 0.00000 | 0.00004 |
| IPF-75 TREN B2 via 1 (Min) | -0.00001 | 0.00000 | -0.00014 |
| EC-1 TREN LM71 via 1 (Max) | 0.00005 | 0.00000 | 0.00006 |
| EC-1 TREN LM71 via 1 (Min) | -0.00001 | 0.00000 | -0.00020 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00016 | 0.00000 | 0.00019 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00005 | 0.00000 | -0.00065 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00021 | 0.00000 | 0.00022 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00005 | 0.00000 | -0.00083 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00002 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00005 |

COMBINACION DE REACCIONES VERTICALES

| | | | |
|---|---|---|---|
| Reaccion permanente | (ELS) = | 135.574 |
| Reaccion maxima | (ELS) = | 240.248 |
| Reaccion minima | (ELS) = | 127.529 |
| Reaccion minima | (ELU) = | 119.217 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | 0.000511 |
| Giro maximo | (ELS) = | 0.000916 |
| Giro minimo | (ELS) = | -0.000321 |

APOYO N = 47

| REACCIONES | Flector | Reac_vert | Torsor |
|---|---|---|---|
| G1 | 0.00000 | 65.17480 | 0.00000 |
| G2 | 0.00000 | 40.77182 | 0.00000 |
| Pii | 0.00000 | 20.03031 | 0.00000 |
| Pi | 0.00000 | 33.86968 | 0.00000 |
| Pd | 0.00000 | 28.98670 | 0.00000 |
| TEMP | 0.00000 | 6.09443 | 0.00000 |
| SC peatonal(100%) Max | 0.00000 | 0.45991 | 0.00000 |
| SC peatonal(100%) Min | 0.00000 | -0.42762 | 0.00000 |
| SC peatonal(50%) Max | 0.00000 | 8.60201 | 0.00000 |
| SC peatonal(50%) Min | 0.00000 | -0.13133 | 0.00000 |
| IPF-75 TREN A via 1 (Max) | 0.00000 | 9.12347 | 0.00000 |
| IPF-75 TREN A via 1 (Min) | 0.00000 | -3.65707 | 0.00000 |
| IPF-75 TREN B1 via 1 (Max) | 0.00000 | 7.78930 | 0.00000 |
| IPF-75 TREN B1 via 1 (Min) | 0.00000 | -6.95081 | 0.00000 |
| IPF-75 TREN B2 via 1 (Max) | 0.00000 | 7.78930 | 0.00000 |
| IPF-75 TREN B2 via 1 (Min) | 0.00000 | -6.66444 | 0.00000 |
| EC-1 TREN LM71 via 1 (Max) | 0.00000 | 17.18323 | 0.00000 |
| EC-1 TREN LM71 via 1 (Min) | 0.00000 | -6.01914 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00000 | 17.55798 | 0.00000 |
| EC-1 TREN SW/0 via 1 (Min) | 0.00000 | -6.46353 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00000 | 44.83294 | 0.00000 |
| EC-1 TREN SW/2 via 1 (Min) | 0.00000 | -7.29837 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00000 | 3.12788 | 0.00000 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | -0.60820 | 0.00000 |

| DESPLAZAMIENTOS | GX | FZ | GY |
|---|---|---|---|
| G1 | 0.00013 | 0.00000 | -0.00061 |
| G2 | 0.00010 | 0.00000 | -0.00046 |
| Pii | -0.00025 | 0.00000 | 0.00108 |
| Pi | -0.00043 | 0.00000 | 0.00184 |
| Pd | -0.00037 | 0.00000 | 0.00156 |
| TEMP | -0.00004 | 0.00000 | 0.00018 |
| SC peatonal(100%) Max | 0.00001 | 0.00000 | 0.00001 |
| SC peatonal(100%) Min | 0.00000 | 0.00000 | -0.00004 |
| SC peatonal(50%) Max | 0.00000 | 0.00000 | 0.00001 |
| SC peatonal(50%) Min | 0.00000 | 0.00000 | -0.00002 |
| IPF-75 TREN A via 1 (Max) | 0.00008 | 0.00000 | 0.00011 |
| IPF-75 TREN A via 1 (Min) | -0.00002 | 0.00000 | -0.00038 |
| IPF-75 TREN B1 via 1 (Max) | 0.00003 | 0.00000 | 0.00004 |
| IPF-75 TREN B1 via 1 (Min) | -0.00001 | 0.00000 | -0.00015 |
| IPF-75 TREN B2 via 1 (Max) | 0.00003 | 0.00000 | 0.00004 |
| IPF-75 TREN B2 via 1 (Min) | -0.00001 | 0.00000 | -0.00014 |
| EC-1 TREN LM71 via 1 (Max) | 0.00004 | 0.00000 | 0.00006 |
| EC-1 TREN LM71 via 1 (Min) | -0.00001 | 0.00000 | -0.00020 |
| EC-1 TREN SW/0 via 1 (Max) | 0.00014 | 0.00000 | 0.00019 |
| EC-1 TREN SW/0 via 1 (Min) | -0.00004 | 0.00000 | -0.00065 |
| EC-1 TREN SW/2 via 1 (Max) | 0.00018 | 0.00000 | 0.00022 |
| EC-1 TREN SW/2 via 1 (Min) | -0.00005 | 0.00000 | -0.00082 |
| EC-1 TREN 12.5 via 1 (Max) | 0.00001 | 0.00000 | 0.00002 |
| EC-1 TREN 12.5 via 1 (Min) | 0.00000 | 0.00000 | -0.00005 |

COMBINACION DE REACCIONES VERTICALES

| | | | |
|---|---|---|---|
| Reaccion permanente | (ELS) = | 134.933 |
| Reaccion maxima | (ELS) = | 186.717 |
| Reaccion minima | (ELS) = | 127.607 |
| Reaccion minima | (ELU) = | 119.236 |

COMBINACION DE GIROS DE FLEXION

| | | |
|---|---|---|
| Acciones permanentes | (ELS) = | 0.000490 |
| Giro maximo | (ELS) = | 0.000890 |
| Giro minimo | (ELS) = | -0.000335 |

## REACCIONES HORIZONTALES

En este apartado se resume el cálculo del reparto de fuerzas horizontales actuantes sobre el tablero en las pilas y estribos.

Las acciones horizontales se han determinado de acuerdo con los criterios de la normativa vigente y su cálculo se detalla en el apartado 2 del presente anejo de cálculo. Se han incluido las acciones reológicas, ambientales, frenado y sismo (éstas últimas se incorporan en el análisis de fuerzas horizontales en el caso de puentes ubicados en regiones sísmicas tal y como especifica la normativa IAP).

El reparto de acciones horizontales en las pilas y estribos se realiza con un programa desarrollado que calcula las rigideces horizontales de cada elemento de apoyo (pilas y estribos) incluyéndose la rigidez del neopreno (rigidez equivalente de pila/estribo + neoprenos). Una vez determinada la rigidez de cada eje de apoyo se reparten las fuerzas horizontales que actúan sobre el tablero suponiendo que éste se comporta como un sólido indeformable, distribuyéndose las fuerzas actuantes de forma proporcional a la rigidez horizontal del elemento de apoyo (pila o estribo). En el caso de movimientos impuestos, previamente se calcula el punto fijo del tablero y los movimientos sobre cada línea de apoyo.

En los cálculos de las rigideces de los apoyos se han adoptado los siguientes parámetros:

**Módulos de deformación transversal del neopreno**

- Acciones a corto plazo Gi= 160 $T/m^2$
- Acciones lentas Gl= 80 $T/m^2$

**Módulo de deformación del hormigón**

- Ec= 8500 $(fcm)^{1/3}$ MPa

**Acciones horizontales consideradas**

- Deformaciones diferidas (mm/m) = 0,80
- Incremento térmico (C) = 21,0 ºC
- Frenado $F_x$= 57,5 T
- Fuerzas de rozamiento en POTs $F_x$ = 39,4 T
- Fuerza centrífuga $F_y$ = 132 T
- Viento $F_{yw}$= 30,9 T
- Viento concomitante con sobrecarga $F_{yw,conc}$ = 39,0 T

CALCULO DE REACCIONES HORIZONTALES EN SENTIDO LONGITUDINAL

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08036 BARCELONA

REFERENCIA DEL PROYECTO : VIADUCTO PUERTO-MARTORELL. REPARTO LONGITUDINAL

Numero de apoyos longitudinales = 3

Mod. de Rigidez transversal del neopreno (mov. inst.) T/m2 = 160.0
Mod. de Rigidez transversal del neopreno (mov. lentos) T/m2 = 80.0

ESTRIBO 1

Altura = 8.60
Canto medio del muro frontal del estribo = 2.00
Ancho del estribo (m) = 6.80
Modulo de deformacion (T/m2) = 2860000.00
Numero de aparatos de apoyo = 2
Apoyo deslizante
Rigidez de la cimentacion TIPO= 2

APOYO = 2

Numero de fustes = 1
Pila de fuste rectangular
Altura de la pila = 7.5
Canto longitudinal y transv. (m) = 1 3.2
Modulo de deformacion (T/m2) = 2860000.00
Numero de aparatos de apoyo = 2
Apoyo deslizante
Tipo 1=Dato (T/m) 2=Superficial TIPO= 2
Rigidez de la cimentacion TIPO= 0

ESTRIBO 2

Altura = 7.80
Canto medio del muro frontal del estribo = 1.20
Ancho del estribo = 8.20
Modulo de deformacion (T/m2) = 2860000.00
Numero de aparatos de apoyo = 2
Apoyo fijo
Rigidez de la cimentacion TIPO= 2

LUCES DESDE EL ESTRIBO 1

Luz del vano (m) 1 L = 18.50
Luz del vano (m) 2 L = 20.50

CALCULO DE RESPUESTA LONGITUDINAL FRENTE A ACCIONES HORIZONTALES

REFERENCIA DEL PROYECTO : VIADUCTO PUERTO-MARTORELL. REPARTO LONGITUDINAL

RIGIDEZ EQUIVALENTE DEL APOYO = 1
Rigidez frente a esfuerzos longitudinales
Rigidez para movimientos instant. (T/m) = 0.0
Rigidez para movimientos lentos (T/m) = 0.0

Rigidez frente a esfuerzos transversales
Rigidez para movimientos instant. (T/m) = 0.0

RIGIDEZ EQUIVALENTE DEL APOYO = 2
Rigidez frente a esfuerzos longitudinales
Rigidez para movimientos instant. (T/m) = 0.0
Rigidez para movimientos lentos (T/m) = 0.0

Rigidez frente a esfuerzos transversales
Rigidez para movimientos instant. (T/m) = 0.0

RIGIDEZ EQUIVALENTE DEL APOYO = 3
Rigidez frente a esfuerzos longitudinales
Rigidez para movimientos instant. (T/m) = 21349.1
Rigidez para movimientos lentos (T/m) = 21349.1

Rigidez frente a esfuerzos transversales
Rigidez para movimientos instant. (T/m) = 0.0

DISTANCIA DEL PUNTO FIJO AL ESTRIBO 1 X (m) = 39

MOVIMIENTOS DIFERIDOS Y POR TEMPERATURA

Deformaciones diferidas (mm/m) = 0.8
Incremento termico (C) = 21.0

APOYO = 1
Maximo movimiento por efectos diferidos (mm) = 31.2000
Maximo movimiento del neopreno por efectos diferidos (mm) = 31.2000
Maximo movimiento por efectos termicos (mm) = 8.1900
Maximo movimiento del neopreno por temperatura (mm) = 8.1900

APOYO = 2
Maximo movimiento por efectos diferidos (mm) = 16.4000
Maximo movimiento del neopreno por efectos diferidos (mm) = 16.4000
Maximo movimiento por efectos termicos (mm) = 4.3050
Maximo movimiento del neopreno por temperatura (mm) = 4.3050

APOYO = 3
Maximo movimiento por efectos diferidos (mm) = 0.0000
Maximo movimiento del neopreno por efectos diferidos (mm) = 0.0000
Reaccion del aparato de apoyo (T) = 0.00
Maximo movimiento por efectos termicos (mm) = 0.0000
Maximo movimiento del neopreno por temperatura (mm) = 0.0000
Reaccion del aparato de apoyo (T) = 0.00

REPARTO DE CARGAS LONGITUDINALES BAJO UNA FUERZA HORIZONTAL F (T) = 97.00

Eje de APOYO = 1
Solicitacion por Eje de Apoyo (T) = 0.00
Solicitacion por Aparato de Apoyo (T) = 0.00
Movimiento del aparato de apoyo (mm) = 4.544
Movimiento total del apoyo (mm) = 4.544

Eje de APOYO = 2
Solicitacion por Eje de Apoyo (T) = 0.00
Solicitacion por Aparato de Apoyo (T) = 0.00
Movimiento del aparato de apoyo (mm) = 4.544
Movimiento total del apoyo (mm) = 4.544

Eje de APOYO = 3
Solicitacion por Eje de Apoyo (T) = 97.00
Solicitacion por Aparato de Apoyo (T) = 48.50
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 4.544

CALCULO DE REACCIONES HORIZONTALES EN SENTIDO TRANSVERSAL

PEDELTA, S.L.
C. Urgell, 288
08036 BARCELONA

REFERENCIA DEL PROYECTO : VIADUCTO PUERTO-MARTORELL. REPARTO TRANSVERSAL

Numero de apoyos longitudinales = 3

Mod. de Rigidez transversal del neopreno (mov. inst.) T/m2 = 160.0
Mod. de Rigidez transversal del neopreno (mov. lentos) T/m2 = 80.0

ESTRIBO 1

Altura = 8.60
Canto medio del muro frontal del estribo = 2.00
Ancho del estribo (m) = 6.80
Modulo de deformacion (T/m2) = 2860000.00
Numero de aparatos de apoyo = 2
Apoyo fijo
Rigidez de la cimentacion TIPO= 2

APOYO = 2

Numero de fustes = 1
Pila de fuste rectangular
Altura de la pila = 7.5
Canto longitudinal y transv. (m) = 1 3.2
Modulo de deformacion (T/m2) = 2860000.00
Numero de aparatos de apoyo = 2
Apoyo fijo
Tipo 1=Dato (T/m) 2=Superficial TIPO= 2
Rigidez de la cimentacion TIPO= 0

ESTRIBO 2

Altura = 7.80
Canto medio del muro frontal del estribo = 1.20
Ancho del estribo = 8.20
Modulo de deformacion (T/m2) = 2860000.00
Numero de aparatos de apoyo = 2
Apoyo fijo
Rigidez de la cimentacion TIPO= 2

LUCES DESDE EL ESTRIBO 1

Luz del vano (m) 1 L = 18.50
Luz del vano (m) 2 L = 20.50

CALCULO DE RESPUESTA LONGITUDINAL FRENTE A ACCIONES HORIZONTALES

REFERENCIA DEL PROYECTO : VIADUCTO PUERTO-MARTORELL. REPARTO TRANSVERSAL

RIGIDEZ EQUIVALENTE DEL APOYO = 1
Rigidez frente a esfuerzos longitudinales
Rigidez para movimientos instant. (T/m) = 0.0
Rigidez para movimientos lentos (T/m) = 61151.8

Rigidez frente a esfuerzos transversales
Rigidez para movimientos instant. (T/m) = 706915.3

RIGIDEZ EQUIVALENTE DEL APOYO = 2
Rigidez frente a esfuerzos longitudinales
Rigidez para movimientos instant. (T/m) = 0.0
Rigidez para movimientos lentos (T/m) = 5423.4

Rigidez frente a esfuerzos transversales
Rigidez para movimientos instant. (T/m) = 55535.7

RIGIDEZ EQUIVALENTE DEL APOYO = 3
Rigidez frente a esfuerzos longitudinales
Rigidez para movimientos instant. (T/m) = 0.0
Rigidez para movimientos lentos (T/m) = 21349.1

Rigidez frente a esfuerzos transversales
Rigidez para movimientos instant. (T/m) = 996884.8

REPARTO DE CARGAS TRANSVERSALES BAJO UNA FUERZA HORIZONTAL F (T) = 132.00

APOYO = 1
Solicitacion por Eje de Apoyo (T) = 53.04
Solicitacion por Aparato de Apoyo (T) = 26.52
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.075
APOYO = 2
Solicitacion por Eje de Apoyo (T) = 4.17
Solicitacion por Aparato de Apoyo (T) = 2.08
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.075
APOYO = 3
Solicitacion por Eje de Apoyo (T) = 74.79
Solicitacion por Aparato de Apoyo (T) = 37.40
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.075

REPARTO DE CARGAS TRANSVERSALES BAJO UNA FUERZA HORIZONTAL F (T) = 30.90

APOYO = 1
Solicitacion por Eje de Apoyo (T) = 12.42
Solicitacion por Aparato de Apoyo (T) = 6.21
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.018
APOYO = 2
Solicitacion por Eje de Apoyo (T) = 0.98
Solicitacion por Aparato de Apoyo (T) = 0.49
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.018
APOYO = 3
Solicitacion por Eje de Apoyo (T) = 17.51
Solicitacion por Aparato de Apoyo (T) = 8.75
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.018

REPARTO DE CARGAS TRANSVERSALES BAJO UNA FUERZA HORIZONTAL F (T) = 39.00

APOYO = 1
Solicitacion por Eje de Apoyo (T) = 15.67
Solicitacion por Aparato de Apoyo (T) = 7.84
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.022
APOYO = 2
Solicitacion por Eje de Apoyo (T) = 1.23
Solicitacion por Aparato de Apoyo (T) = 0.62
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.022
APOYO = 3
Solicitacion por Eje de Apoyo (T) = 22.10
Solicitacion por Aparato de Apoyo (T) = 11.05
Movimiento del aparato de apoyo (mm) = 0.000
Movimiento total del apoyo (mm) = 0.022

## VERIFICACIÓN DE APARATOS DE APOYO Y MOVIMIENTOS EN JUNTAS

### Aparatos de apoyo tipo POT

Los aparatos de apoyo dispuestos son los que se muestran en la tabla adjunta. Todos ellos admiten una reacción vertical en Estado Límite de Servicio superior a la reacción vertical máxima expuesta en el apartado 10.1. En dicho cuadro también se detalla el movimiento y las fuerzas que deben admitir cada uno de los aparatos de apoyo.

| ELEMENTO | APOYO | TIPO DE POT | Reacción Vertical (T) | Fuerza Transversal (T) | Fuerza Longitudinal(T) | Máx. alargamiento (mm) | Máx. acortamiento (mm) |
|---|---|---|---|---|---|---|---|
| **PILA 1** | 42 | PL-300 | 225 | 0.0 | 0.0 | 12.7 | 43.9 |
| **PILA 1** | 43 | PU-300 | 225 | 69 | 0.0 | 12.7 | 43.9 |
| **PILA 2** | 44 | PL-600 | 550 | 0.0 | 0.0 | 8.8 | 25.2 |
| **PILA 2** | 45 | PU-600 | 550 | 6 | 0.0 | 8.8 | 25.2 |
| **ESTRIBO 2** | 46 | PT-300 | 240 | 0.0 | 49 | 0.0 | 0.0 |
| **ESTRIBO 2** | 47 | PF-300 | 240 | 97 | 49 | 0.0 | 0.0 |

### Juntas de calzada

Los movimientos en juntas coinciden con los previstos en los POTs de estribos. Durante la ejecución del tablero se deberán prever las holguras necesarias entre la junta y el muro de resguardo del estribo teniendo en cuenta que durante los primeros años se van a producir los acortamientos del puente debidos a las acciones reológicas (retracción y fluencia). Éstas holguras dependen de la temperatura media ambiental en el momento de ejecutar las juntas de calzada.

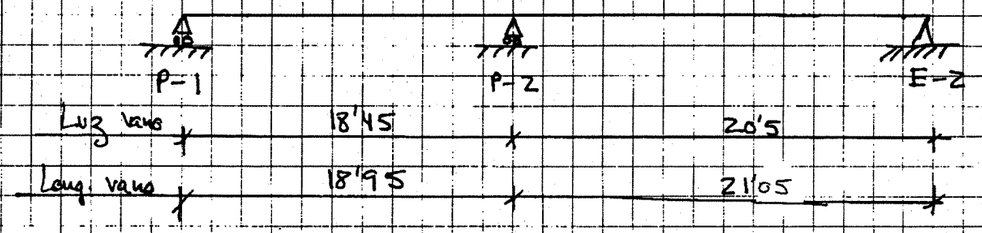
## CÁLCULO DEL ESTRIBO 2

**GEOMETRÍA**

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

# DISTRIBUCIÓN DE FUERZAS LONGITUDINALES EN PILAS Y ESTRIBOS.




Long. tablero = 40 m.

Fuerza de frenado IPF-75

$$F_{FR,IPF} = \frac{12\cdot 30 + 10\cdot 10}{8} = 57'5 \text{ T} \quad \text{(valor máximo)}$$

$$F_{A,IPF} = \frac{12\,30}{8} = 45 \text{ T} \leftarrow \text{fuerza de arranque}$$

Fuerza de frenado EC-1:

$$F_{FR,EC-1} = 2\cdot 40 = 80 \text{ T}$$

$$F_{A,EC-1} = 3'3\cdot 40 = 132 \not< 100 \text{ T}$$

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

Fuerza de rozamiento en POT's:

$$R_{perm,P-1} = 128'8 + 123'2 = 252 \text{ T}$$

$$R_{perm,P-2} = 278'3 + 257'6 = 536 \text{ T}$$

$$F_{R,P-1} = \mu \cdot R_{perm,P-1} = 12'6 \text{ T} \quad \text{(valor máximo)}$$

$$F_{R,P-2} = 26'8 \text{ T} \quad \text{(valor máximo)}$$

Fuerza total que ejerce el tablero en el punto fijo del estribo 2:

$$F = F_{R,P-1} + F_{R,P-2} + \max\left\{F_{FR} \text{ ó } F_A\right\}$$

Según IPF-75: F = 97 T

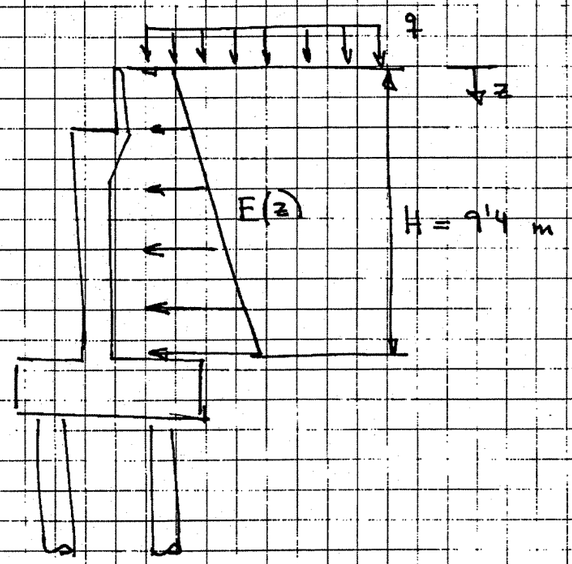
Según EC-1: F = 139 T

Momento repartido en base de estribo:

$$m = \frac{97\cdot(9'4+1'6)}{8'2} = 92'3 \text{ mT/m}$$

$$m = \frac{139\,(9'4-1'6)}{8'2} = 132'2 \text{ mT/m}$$

Empuje de tierras en trasdós estribo:




$E(z) = K \cdot (q + \gamma \cdot z)$

$q = 3\ T/m^2$

$\gamma = 2\ T/m^3$

Hipótesis 1: $K = K_0 = 0'5$ $(\phi = 30°\quad c = 0)$

$E(z) = 1'5 + \cdot z \Rightarrow E(z=9'4) = 10'9\ T/m^2$

$E_{resultante} = \underbrace{1'5 \cdot 9'4}_{14'1} + \underbrace{\frac{9'4^2}{2}}_{44'18} = 58'28\ T/m$

$M_{result,\ base\ muro} = 14'1 \cdot \frac{9'4}{2} + 44'18 \cdot \frac{9'4}{3} = 204'7\ mT/m$



Hipótesis 2: $K = K_a = 0'33$ $(\phi = 30°\quad c = 0)$

$E(z) = 1 + \frac{2 \cdot z}{3} \Rightarrow E(z=9'4) = 7'3\ T/m^2$

$E_{result} = 1 \cdot 9'4 + \frac{9'4 \cdot 6'3}{2} = 9'4 + 29'61 = 39'0\ T/m$

$M_{result,\ base\ muro} = 9'4 \cdot \frac{9'4}{2} + 29'61 \cdot \frac{9'4}{3} = 137'0\ mT/m$

Peso de tierras sobre encapado.

$P(z) = \gamma \cdot z$

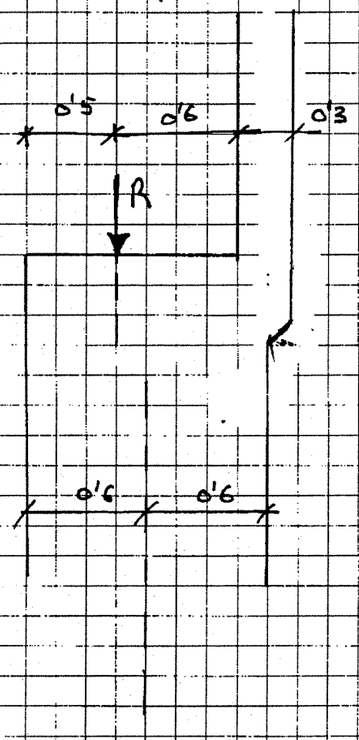
$P_T(z = 9'4) = 18'8\ T/m^2$ (en trasdós estribo)

$P_I(z = 1'0) = 2\ T/m^2$ (en intradós estribo)

$P_I$ sólo se tendrá en cuenta si es desfavorable para la comprobación en cuestión.

Cargas verticales sobre el estribo:

a) Transmitidas por el tablero




$R_{perm} = 143'6 + 136'5 = 280'1$ T  $H_{TRANSV} = 0$ mT

$R_{IPF} = 96'9 + 7'9 = 104'8$ T  $H_{TRANSV} = 142'4$ mT

$R_{EC-1} = 94'4 + 17'7 = 112'1$ T  $H_{TRANSV} = 122'7$ mT



b) Debidas al peso propio del estribo.

$$P_{muro} = 2'5 \cdot 8'2 \cdot (9'4 - 1'8) \cdot 1'2 = 186'96 \text{ T}$$

Por metro de ancho:

$$p_{muro} = \frac{186'96}{8'2} = 22'8 \text{ T/m}$$

Resumen de esfuerzos en base de estribo debidos a cargas verticales:

IPF:

$$p_v = \frac{280'1 + 104'8}{8'2} + 22'8 = 69'7 \text{ T/m}$$

$$m = \frac{(280'1 + 104'8) \cdot 0'10}{8'2} = 4'7 \text{ mT/m}$$

EC-1:

$$p = \frac{280'1 + 112'1}{8'2} + 22'8 = 70'6 \text{ T/m}$$

$$m = \frac{(280'1 + 112'1) \cdot 0'10}{8'2} = 4'8 \text{ mT/m}$$

## CÁLCULO DE ESFUERZOS Y DIMENSIONAMIENTO

El cálculo y dimensionamiento de los estribos se detalla en las páginas siguientes. Las hipótesis de cálculo se exponen a continuación:

1. El cálculo se realiza en la hipótesis clásica como muro con acciones en coronación debidas a las reacciones horizontales y verticales transmitidas por el tablero. Los empujes del terreno se han calculado para un coeficiente de empuje K= 0,33 y una densidad del terreno de 2,0 $T/m^3$. No se han considerado eventuales empujes hidrostáticos al colocar un adecuado drenaje en el trasdós del estribo.

2. Se ha comprobado que no se supera la carga admisible por pilote. Esta es de 600 Ton.

3. El dimensionamiento de las armaduras de flexión y cortante del muro y zapata se realiza con los criterios de la Normativa vigente para estructuras de hormigón (EHE). Los coeficientes de seguridad de las acciones corresponden con un **nivel de control intenso $\gamma_{fg}$ =1,35 y $\gamma_{fq}$ =1,50.**

4. Las armaduras horizontales de flexión transversal se colocan de acuerdo con los valores mínimos exigidos por la Normativa EHE.

**********
**********
***  ****
***  Programa de calculo para estribos generales  ****
***  ****
***  PEDELTA  ****
***  ****
**********
**********

Nombre del proyecto: VIADUCTO PUERTO-MARTORELL
Referencia del proyecto: Cálculo del estribo 2

DATOS DE ENTRADA
---

Tipologia de estribo:
Estribo cerrado con cimentación profunda

Características de los materiales

| | | |
|---|---|---|
| fck_alzado: | 30.00 | MPa |
| fck_cimentación: | 25.00 | MPa |
| fck_pilotes: | 25.00 | MPa |
| fyk: | 500.00 | MPa |
| Coef.fluencia: | 2.00 | MPa |
| Ec_alzado: | 28576.79 | MPa |
| Es: | 200000.00 | MPa |

Coeficientes de mayoración de acciones

| | |
|---|---|
| G_g: | 1.35 |
| G_q: | 1.50 |

Coeficientes de combinación de acciones

| | |
|---|---|
| psi0: | 0.80 |
| psi1: | 0.60 |
| psi2: | 0.20 |

Características del terreno

| | | |
|---|---|---|
| Altura tierras: | 0.00 | m |
| Peso tierras: | 20.00 | kN/m3 |
| Carga de trabajo: | 4.52 | MPa |

Características de los pilotes
Diámetro pilotes: 1.25

Sentido longitudinal
N°pilotes_x: 3

Excentricidades con respecto al eje

| | |
|---|---|
| Exc_ 1 | 0.82 m |
| Exc_ 2 | 4.57 m |
| Exc_ 3 | 8.32 m |
| Dist. al eje: | 2.12 m |

Sentido transversal

| | |
|---|---|
| N°pilotes_y: | 3 |
| Separación: | 3.12 m |

Características geotécnicas
N° estratos: 1

| Estrato | Espesor | ni _Tn/m3 |
|---|---|---|
| 1 | 30.00 | 5000.00 |

Suelo granular
Pilote biempotrado

Características de los apoyos

| | |
|---|---|
| N° apoyos: | 2 |
| Separación ap.: | 3.20 m |
| Excent. lgtd: | 0.50 m |
| Altura apoyo: | 0.15 m |
| Dimensión apoyo_x | 0.50 m |
| Dimensión apoyo_y | 0.50 m |

CARGAS:
SC terraplén: 30.00 kN/m2

| Estado carga | Fz(kN) | Mx(mkN) | __Ap 1 |
|---|---|---|---|
| Peso_prop: | 669.00 | 0.00 | |
| CP2: | 496.00 | 0.00 | |
| Pretensado: | 270.00 | 0.00 | |
| SC 100%: | 500.00 | 0.00 | |
| SC 50%: | 0.00 | 0.00 | |
| V60 CENTR: | 0.00 | 0.00 | |
| V60 EXCENT: | 969.00 | 0.00 | |
| Gradiente: | 67.00 | 0.00 | |
| Deformación: | 0.00 | 0.00 | |

| Estado carga | Fz(kN) | Mx(mkN) | __Ap 2 |
|---|---|---|---|
| Peso_prop: | 650.00 | 0.00 | |
| CP2: | 407.00 | 0.00 | |
| Pretensado: | 307.00 | 0.00 | |
| SC 100%: | 500.00 | 0.00 | |
| SC 50%: | 0.00 | 0.00 | |
| V60 CENTR: | 0.00 | 0.00 | |
| V60 EXCENT: | 0.00 | 0.00 | |
| Gradiente: | 62.00 | 0.00 | |
| Deformación: | 0.00 | 0.00 | |

| Acciones hztales | Fx(kN) | Fy(kN) | __Ap |
|---|---|---|---|
| Reológicas: | 394.00 | 0.00 | |
| Temperatura: | 0.00 | 0.00 | |
| Frenado: | 575.00 | 0.00 | |
| Centrífuga: | 0.00 | 748.00 | |
| Viento_lgtd: | 0.00 | 0.00 | |
| Viento_lg_concom: | 0.00 | 0.00 | |
| Viento_transv: | 0.00 | 0.00 | |
| Viento_tv_concom: | 0.00 | 221.00 | |
| Sismo longitud.: | 0.00 | 0.00 | |
| Sismo trvsal: | 0.00 | 0.00 | |

GEOMETRÍA
---

Características muro frontal:

| | | |
|---|---|---|
| Altura murete | (H1): | 1.80 |
| Altura recrecido | (H2): | 0.00 |
| Altura trasdós | (H3): | 0.50 |
| Altura trasdós | (H4): | 0.20 |
| Canto zapata | (H5): | 1.90 |
| Canto viga | (H6): | 1.65 |
| Altura apoyo | (H7): | 0.15 |
| H derecha | (HMD): | 7.60 |
| H izquierda | (HMI): | 7.60 |
| Ancho cargadero | (B1): | 1.10 |
| Ancho murete | (B2): | 0.30 |
| Ancho recrecido | (B3): | 0.01 |
| Ancho muro sup. | (B4): | 1.20 |
| Ancho trasdós | (B5): | 0.21 |
| Excentr. lgtd. | (B6): | 0.50 |
| Lgtd puntera | (B7): | 1.62 |
| Ancho muro inf. | (B8): | 1.20 |
| Lgtd talón | (B9): | 6.32 |
| Ancho zapata | (BX): | 0.00 |
| Largo zapata | (BY): | 8.20 |
| Ángulo cimentac. | (A_C): | 0.00 |

ANÁLISIS DEL ESTRIBO Y PRESENTACIÓN DE RESULTADOS
---

DESGLOSE DEL PESO PROPIO DEL ESTRIBO
---

| Parte del estribo | Volumen(m3) | ug(m) |
|---|---|---|
| Aleta derecha | | |
| Aletas,voladizo_d | 0.93 | 3.47 |
| Aletas,voladizo_d | 8.23 | 2.85 |
| Aletas,apoyadas_d | 0.00 | 1.62 |
| Contrafuertes_d | 0.00 | 1.62 |
| Contraf. chaflán_d | 0.00 | 1.62 |
| Aleta izquierda | | |
| Aletas,voladizo_i | 0.93 | 3.47 |
| Aletas,voladizo_i | 8.23 | 2.85 |
| Aletas,apoyadas_i | 0.00 | 1.62 |
| Contrafuertes_i | 0.00 | 1.62 |
| Contraf. chaflán_i | 0.00 | 1.62 |
| Fuste del estribo | | |
| Muro frontal | 65.66 | 2.22 |
| Muro frontal | 0.86 | 2.22 |
| Muro frontal | 0.08 | 2.89 |
| Muro frontal | 2.54 | 1.73 |
| Murete de guarda | 3.89 | 2.87 |
| Murete de guarda | 0.00 | 2.72 |
| Murete de guarda | 0.00 | 2.72 |
| Cajeado | | |
| Macizos cajeado | 0.00 | 2.72 |
| Macizos cajeado | 0.00 | 2.17 |
| Macizos cajeado | 0.00 | 2.17 |
| Encepado | | |
| Encepado | 142.40 | 4.57 |

RESUMEN DE ACCIONES

| | | |
|---|---|---|
| Peso propio estribo: | 5843.64 | kN |
| Momento Myb: | -21690.51 | mkN |
| Peso tierras estr. : | 7582.18 | kN |
| Momento Myt: | -45465.54 | mkN |
| Empuje tierras : | 4416.79 | kN |
| Momento Mye: | 18381.69 | mkN |
| Roz vert tierras : | 883.36 | kN |
| Momento Myv: | -8073.90 | mkN |
| Sobrecarga estr. : | 1321.92 | kN |
| Momento Myq: | -8037.27 | mkN |
| Fuerza transversal: | 176.80 | kN |
| Momento Mx: | 3660.72 | mkN |

Esfuerzos totales en servicio

| | | |
|---|---|---|
| Fz_s: | 20534.20 | kN |
| Fx_s: | 5385.79 | kN |
| Fy_s: | 176.80 | kN |
| Mx_s: | 3660.72 | mkN |
| My_s: | -63968.01 | mkN |

Esfuerzos totales en servicio

| | | |
|---|---|---|
| Fz_s: | 20534.20 | kN |
| Fx_s: | 5385.79 | kN |
| Fy_s: | 176.80 | kN |
| Mx_s: | 29873.27 | mkN |
| My_s: | 3660.72 | mkN |

Definición de los cdg de los pilotes

| Pilote | x(i) | y(i) |
|---|---|---|
| 1 | -3.75 | 3.12 |
| 2 | -3.75 | 0.00 |
| 3 | -3.75 | -3.12 |
| 4 | 0.00 | 3.12 |
| 5 | 0.00 | 0.00 |
| 6 | 0.00 | -3.12 |
| 7 | 3.75 | 3.12 |
| 8 | 3.75 | 0.00 |
| 9 | 3.75 | -3.12 |

Carga de hundimiento

| Pilote | Ph(i) | Vx(i) | Vy(i) |
|---|---|---|---|
| 1 | 1149.43 | 598.42 | 19.64 |
| 2 | 953.88 | 598.42 | 19.64 |
| 3 | 758.33 | 598.42 | 19.64 |
| 4 | 2477.13 | 598.42 | 19.64 |
| 5 | 2281.58 | 598.42 | 19.64 |
| 6 | 2086.03 | 598.42 | 19.64 |
| 7 | 3804.83 | 598.42 | 19.64 |
| 8 | 3609.28 | 598.42 | 19.64 |
| 9 | 3413.73 | 598.42 | 19.64 |

Verificación del diámetro del pilote

| | | |
|---|---|---|
| Carga hundimiento admisible: | 5546.87 | kN |
| Pilote más cargado: | 3804.83 | kN |

Q_adm > F_max => Correcto

Características del terreno

| Estrato | h(i) | ni(i) |
|---|---|---|
| 1 | 30.00 | 5000.00 |

Cohesivo/granular 1

Nota: Estrato cohesivo = 0. / No cohesivo = 1.

Esfuerzos totales de cálculo

| | | |
|---|---|---|
| Fz_d: | 28136.78 | kN |
| Fx_d: | 7933.34 | kN |
| Fy_d: | 265.20 | kN |
| Mx_d: | 4498.80 | mkN |
| My_d: | 42422.93 | mkN |

| | | |
|---|---|---|
| Lgtd equivalente: | 3.66 | m |
| Lgtd momentos: | 7.31 | m |
| Lgtd desplaz: | 9.14 | m |

Armado del encepado

| | | | | |
|---|---|---|---|---|
| Arm.principal de bandas lgtd: | 288.07 | cm2 | distribuida en: | 1.35 m |
| Arm.principal de bandas trvs: | 72.02 | cm2 | distribuida en: | 1.35 m |
| Arm.transv. vertical lgtd: | 12.41 | cm2 | distribuida en: | 5.00 m |
| Arm.transv. vertical trvs: | 13.84 | cm2 | distribuida en: | 3.74 m |
| Arm. superior/lateral lgtd: | 17.10 | cm2 | distribuida en: | 1.00 ml |
| Arm. superior/lateral trvs: | 17.10 | cm2 | distribuida en: | 1.00 ml |
| Arm. entre bandas lgtd: | 28.81 | cm2 | distribuida en: | 1.00 ml |
| Arm. entre bandas trvs: | 38.51 | cm2 | distribuida en: | 1.00 ml |

ANÁLISIS DEL MURO FRONTAL DEL ESTRIBO

ANÁLISIS CON HIPÓTESIS DE DEFORMACIÓN PLANA__ELS

Momento Mz(-): 0.0 mkN/ml (Hip:Ménsula)
Momento Mz(+): 0.0 mkN/ml (Hip:Ménsula)
Momento My: 2466.2 mkN/ml (Hip:Ménsula)

ANÁLISIS CON HIPÓTESIS DE DEFORMACIÓN PLANA__ELU

Momento Mz(-): 0.0 mkN/ml (Hip:Ménsula)
Momento Mz(+): 0.0 mkN/ml (Hip:Ménsula)
Momento My: 3369.7 mkN/ml (Hip:Ménsula)

1. Dimensionamiento de la armadura horizontal

| Resultados de armado | As1_cm2/ml | As2_cm2/ml |
|---|---|---|
| Armadura cálculo (-): | 0.00 | 0.00 |
| Armadura cálculo (+): | 0.00 | 0.00 |
| Armadura geom. mínima: | 12.80 | 25.60 |

2. Dimensionamiento de la armadura vertical

| Resultados de armado | As1_cm2/ml | As2_cm2/ml |
|---|---|---|
| Armadura cálculo: | 62.39 | 18.72 |
| Armadura geom. mínima: | 10.80 | 3.60 |
| Armadura mec. mínima: | 22.08 | 6.62 |

CUANTÍAS ARMADO A LO LARGO DE LA ALTURA DEL FUSTE

| z(i) | Fz(kN) | My(mkN/ml) | As1_cm2/ml | As2_cm2/ml |
|---|---|---|---|---|
| 0.00 | 3.75 | -5.37 | 22.08 | 6.62 |
| 0.50 | 7.50 | -15.75 | 22.08 | 6.62 |
| 1.00 | 11.25 | -32.37 | 22.08 | 6.62 |
| 1.50 | 618.49 | -176.55 | 22.08 | 6.62 |
| 2.00 | 635.59 | -298.79 | 22.08 | 6.62 |
| 2.50 | 650.59 | -418.14 | 22.08 | 6.62 |
| 3.00 | 665.59 | -548.74 | 22.08 | 6.62 |
| 3.50 | 680.59 | -691.83 | 22.08 | 6.62 |
| 4.00 | 695.59 | -848.68 | 22.08 | 6.62 |
| 4.50 | 710.59 | -1020.53 | 22.08 | 6.62 |
| 5.00 | 725.59 | -1208.63 | 22.08 | 6.62 |
| 5.50 | 740.59 | -1414.23 | 22.08 | 6.62 |
| 6.00 | 755.59 | -1638.58 | 25.16 | 7.55 |
| 6.50 | 770.59 | -1882.93 | 30.20 | 9.06 |
| 7.00 | 785.59 | -2148.52 | 35.75 | 10.73 |
| 7.50 | 800.59 | -2436.62 | 41.88 | 12.56 |
| 8.00 | 815.59 | -2748.47 | 48.63 | 14.59 |
| 8.50 | 830.59 | -3085.32 | 56.07 | 16.82 |
| 9.00 | 845.59 | -3448.42 | 64.26 | 19.28 |
| 9.50 | 848.29 | -3448.42 | 64.22 | 19.27 |
| 9.59 | 848.29 | -3448.42 | 64.22 | 19.27 |

COMPROBACIÓN DE LA SECCIÓN A CORTANTE

1.Esfuerzo cortante de agotamiento por compresión oblicua en el alma
Vu1 > Vrd: Correcto

2.Esfuerzo cortante de agotamiento por tracción en el alma

| z(i) | Vrd (kN) |
|---|---|
| 0.00 | 0.00 |
| 0.50 | 8.75 |
| 1.00 | 20.00 |
| 1.50 | 33.75 |
| 2.00 | 209.53 |
| 2.50 | 228.28 |
| 3.00 | 249.53 |
| 3.50 | 273.28 |
| 4.00 | 299.53 |
| 4.50 | 328.28 |
| 5.00 | 359.53 |
| 5.50 | 393.28 |
| 6.00 | 429.53 |
| 6.50 | 468.28 |
| 7.00 | 509.53 |
| 7.50 | 553.28 |
| 8.00 | 599.53 |
| 8.44 | 648.28 |

Eps: 1.42
ro: 0.0054
fck: 30.00
Vu2: 751.39 kN
Vrd: 648.28 kN
Vu2 > Vrd: Correcto

ARMADURA DEL MURETE DE GUARDA

Análisis a flexión:
Momento murete (mkN): 36.00

| | As1_cm2 | As2_cm2 |
|---|---|---|
| Armadura de cálculo: | 3.37 | 0.00 |
| Armadura geométrica: | 2.70 | 0.90 |
| Armadura mecánica: | 5.52 | 0.00 |

Comprobación de la sección a cortante:
1.Esfuerzo cortante de agotamiento por compresión oblicua en el alma
Vu1: 1500.00 kN
Vrd: 44.70 kN
Vu1 > Vrd : Correcto

2.Esfuerzo cortante de agotamiento por tracción en el alma
Eps: 1.89
ro: 0.0018
fck: 30.00 MPa
Vu2: 100.44 kN
Vrd: 44.70 kN
Vu2 > Vrd : Correcto

DIMENSIONAMIENTO DE LA CORONACION

A. Nudos de compresión en coronación

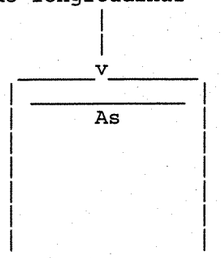
1.Carga puntual

| | |
|---|---|
| bx: | 0.50 m |
| by: | 0.50 m |
| fcd: | 20.00 MPa |
| Nu: | 11000.00 kN |
| Nd: | 4133.55 kN |

Nd < Nu: Correcto

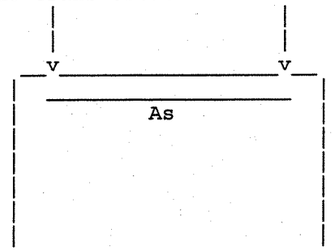
Configuración de los modelos de bielas y tirantes

1.Sentido longitudinal




Modelo de bielas y tirantes

2.Sentido transversal




Modelo de bielas y tirantes del análisis global

B. Armadura en coronación

| | | |
|---|---|---|
| Armadura global y: | 2422.0 mm2 | 24.22 cm2 |
| Direccion x: | 1409.2 mm2 | 14.09 cm2 |
| Direccion y: | 1409.2 mm2 | 14.09 cm2 |

CLASIFICACIÓN DEL ARMADO

| | | phi | Sep_cm/ml | As_cm2/ml |
|---|---|---|---|---|
| Lgtd.superior encepado | 1: | 25. | 20.0 | 24.54 |
| Lgtd.entre bandas inferior | 2: | 32. | 20.0 | 40.21 |

| Lgtd.bandas inferior encepado 2a: | phi | n° barras | As_cm2 |
|---|---|---|---|
| | 20. | 92 | 289.03 |
| | 25. | 59 | 289.62 |
| | 32. | 36 | 289.53 |

| | | phi | Sep_cm/ml | As_cm2/ml |
|---|---|---|---|---|
| Trvs.superior encepado | 3: | 25. | 20.0 | 24.54 |
| Trvs.entre bandas inferior | 4: | 32. | 20.0 | 40.21 |

| Trvs.bandas inferior encepado 4a: | phi | n° barras | As_cm2 |
|---|---|---|---|
| | 20. | 23 | 72.26 |
| | 25. | 15 | 73.63 |
| | 32. | 9 | 72.38 |
| Laterales 5,6: | 25. | 20.0 | 24.54 |

| Cercos lgtudinales 5a: | phi | Sep_cm/ml | n°cercos |
|---|---|---|---|
| | 10. | 20.0 | 25 |
| | 12. | 20.0 | 25 |
| | 16. | 20.0 | 25 |

| Cercos transversales 6a: | phi | Sep_cm/ml | n°cercos |
|---|---|---|---|
| | 10. | 20.0 | 19 |
| | 12. | 20.0 | 19 |
| | 16. | 20.0 | 19 |

| | | phi | Sep_cm/ml | As_cm2/ml |
|---|---|---|---|---|
| Espera vertical intradós | 7: | 25. | 20.0 | 24.54 |
| Vertical muro, intradós | 8: | 25. | 20.0 | 24.54 |
| Espera vertical trasdós | 9: | 32. | 12.5 | 64.34 |
| Vertical muro, trasdós | 10: | 32. | 12.5 | 64.34 |
| Armadura hztal trasdós | 11: | 20. | 20.0 | 15.71 |
| Armadura hztal intradós | 12: | 32. | 20.0 | 40.21 |
| Posición 13,hztal cargadero | 13: | 20. | 20.0 | 15.71 |
| Posición 14 | 14: | 20. | 20.0 | 15.71 |
| Posición 15 | 15: | 12. | 20.0 | 5.65 |
| Posición 16 | 16: | 32. | 12.5 | 64.34 |
| Posición 17 | 17: | 25. | 20.0 | 24.54 |
| Posición 18, vert.murete | 18: | 12. | 20.0 | 5.65 |

VERIFICACIÓN DE LA FISURACIÓN EN EL FUSTE DEL MURO
---

Acciones
Nk (kN): 571.03
Mk (mkN): -2059.83
Mfis(mkN): -809.36

Mk > Mfis: Hay fisuración

Apertura de fisura (wk_mm)

| phi\sep | 10. | 12.5 | 15. | 20. |
|---|---|---|---|---|
| 12. | | | | |
| 16. | | | | |
| 20. | | | | |
| 25. | | | | |
| 32. | 0.1788 | 0.2315 | | |

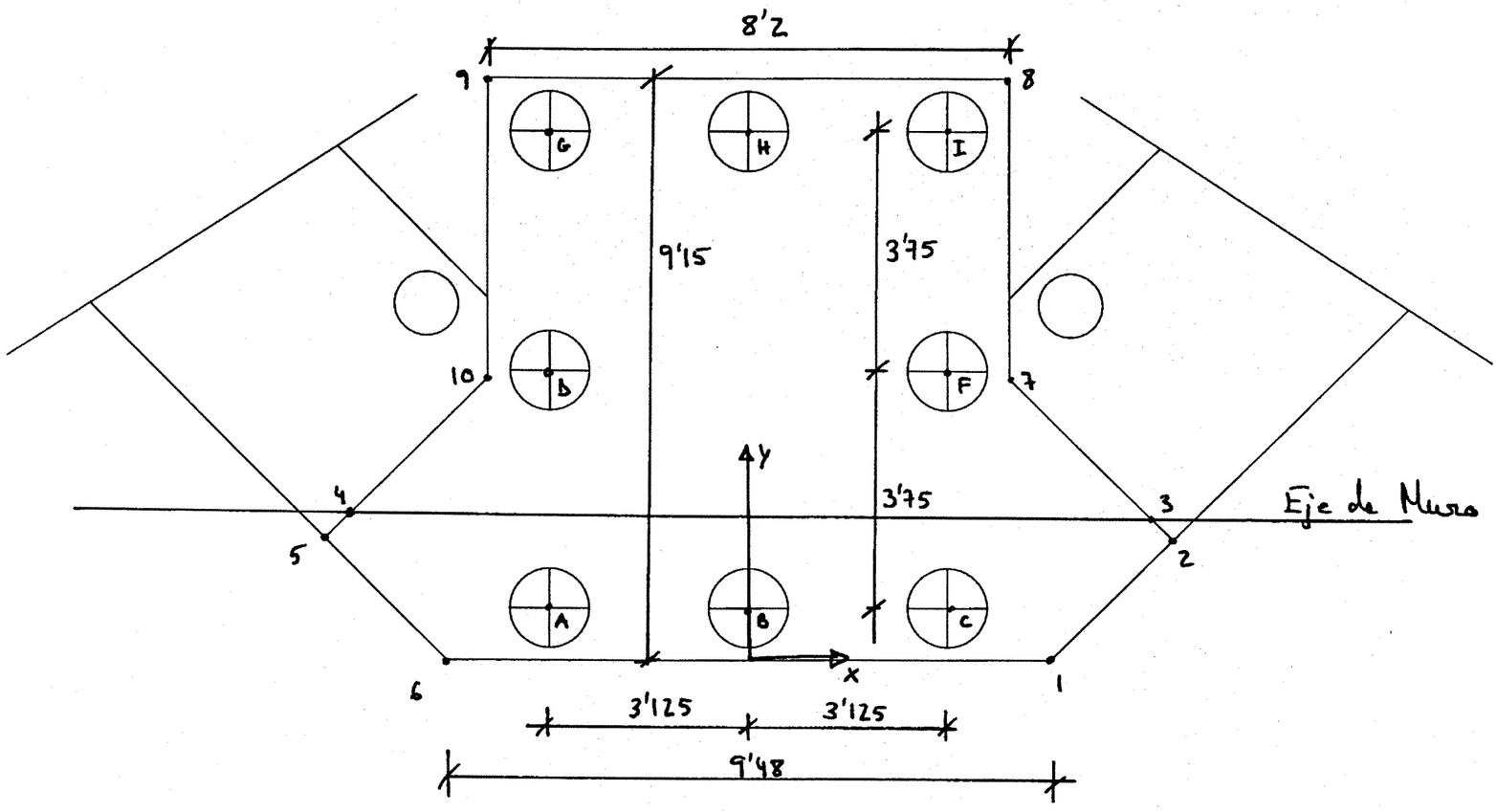
SOLAPOS Y ANCLAJES
---

| | Lgt_cm |
|---|---|
| a.Espera intradós: | |
| Longt.anclaje: | 81.2 cm |
| Longt.solapo: | 81.2 cm |
| Longt.espera: | 300.0 cm |
| b.Vertical intradós: | |
| Longt.anclaje: | 81.2 cm |
| Longt.solapo: | 81.2 cm |
| c.Espera trasdós: | |
| Longt.anclaje: | 133.1 cm |
| Longt.solapo: | 239.6 cm |
| Longt.espera: | 450.0 cm |
| d.Vertical trasdós: | |
| Longt.anclaje: | 186.4 cm |
| Longt.solapo: | 335.5 cm |
| f.Vertical cargadero: | |
| Longt.anclaje: | 133.1 cm |
| g.Vertical murete: | |
| Longt.anclaje: | 30.0 cm |

## CÁLCULO DE LA CIMENTACIÓN

ENCEPADO DE 8 PILOTES $\phi = 1'25$ m.

PLANTA




PEDELTA
INGENIERIA CIVIL

FECHA

HOJA

Encepado de 8 pilotes $\phi = 1'25$ m

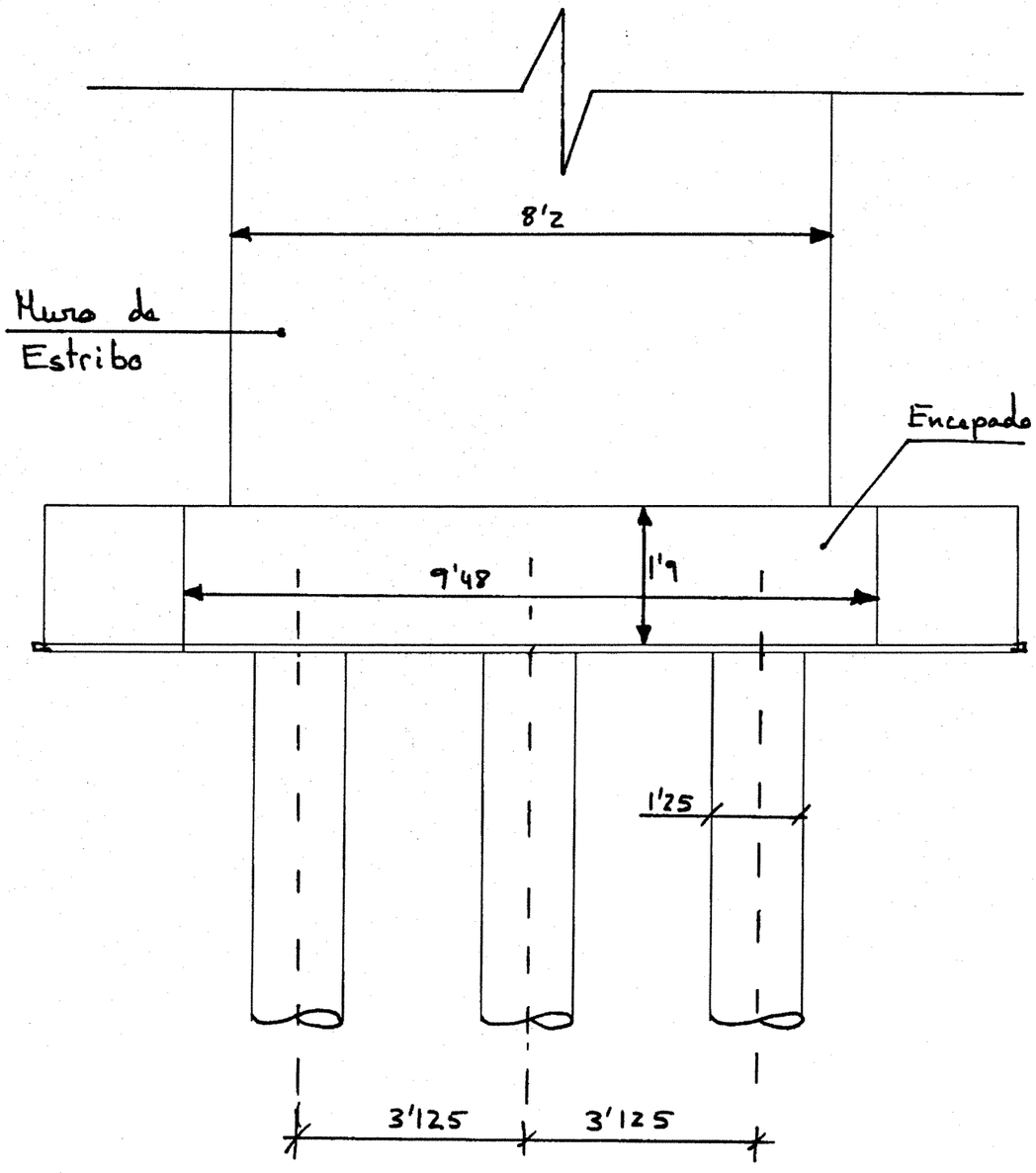
Coordenadas del centro

1 → (4'74; 0)
2 → (6'64; 1'9)
3 → (6'32; 2'225)
4 → (-6'32; 2'225)
5 → (-6'64; 1'9)
6 → (-4'74; 0)
7 → (4'10; 4'45)
8 → (4'10; 9'15)
9 → (-4'10; 9'15)
10 → (-4'10; 4'45)

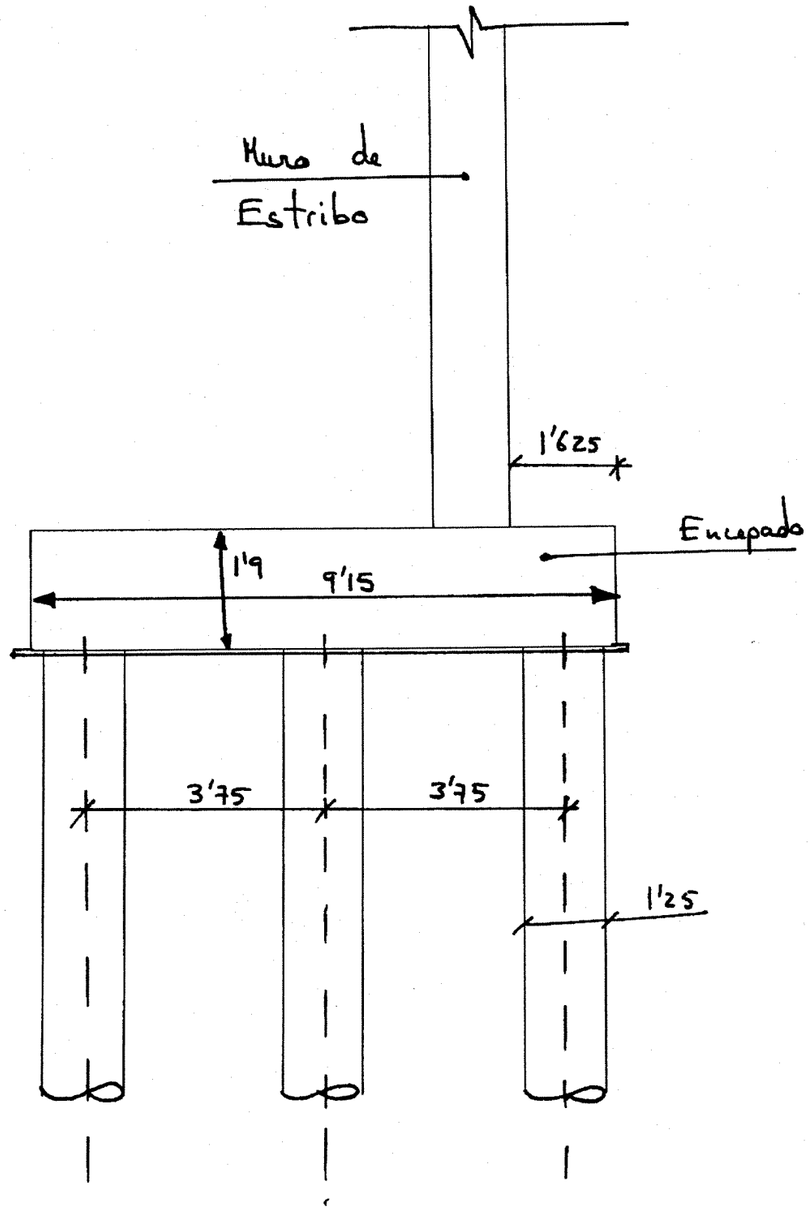
Coordenadas del centro de los pilotes

A → (-3'125; 0'825)
B → (0'0; 0'825)
C → (3'125; 0'825)
D → (-3'125; 4'575)
F → (3'125; 4'575)
G → (-3'125; 8'325)
H → (0'0; 8'325)
I → (3'125; 8'325)

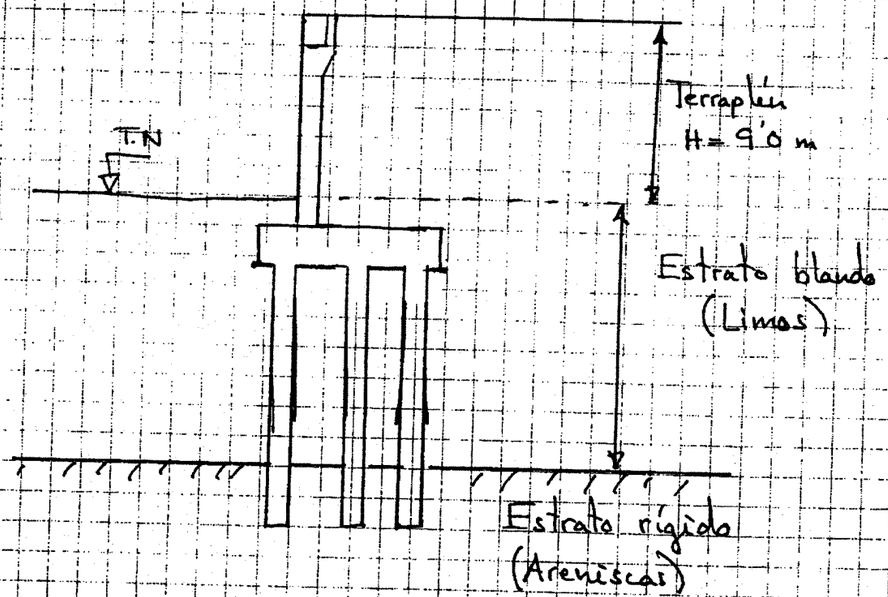
ALZADO FRONTAL




SECCIÓN TRANSVERSAL



# Cálculo de la carga horizontal sobre los pilotes




Datos terreno:

$H = 9'0\ m \Rightarrow p_v = \gamma \cdot H = 18\ T/m^2$

$\gamma = 2\ T/m^3$

$C_u \simeq 0'5\ kp/cm^2 = 5\ T/m^2$ en limos

Datos pilotes:

$\phi = 1'25\ m$

$s = 3 \cdot \phi = 3'75\ m.$ (separación pilotes)



Según Jiménez-Salas:

$p_h = p_v - 2 \cdot C_u = 8\ T/m^2$

Sobre la 1ª fila de pilotes actúa la siguiente carga:

$$p_1 = p_h \cdot 2\phi = 20\ T/m$$

Sobre la 2ª fila de pilotes:

$$p_{h,2} = p_h - \frac{p_1}{s} = 2'7\ T/m^2$$

$$p_2 = p_{h,2} \cdot 2\phi = 6'7\ T/m$$

Sobre la 3ª fila de pilotes:

$$p_{h,3} = p_{h,2} - \frac{p_2}{s} = 0'92\ T/m^2$$

$$p_3 = p_{h,3} \cdot 2\phi = 2'3\ T/m$$

En el pilote central de la 3ª fila:

$$p'_{h,3} = p_h - \frac{p_1}{2'5} = 5'33\ T/m^2$$

$$p'_3 = p'_{h,3} \cdot 2\phi = 13'3\ T/m^2$$

La carga total sobre los pilotes será:

$P_H = P_4 \cdot B = 8 \cdot 8'2 = 65'6$ T/m

↑
Ancho trapecio

Sin embargo, la carga sobre los pilotes es:

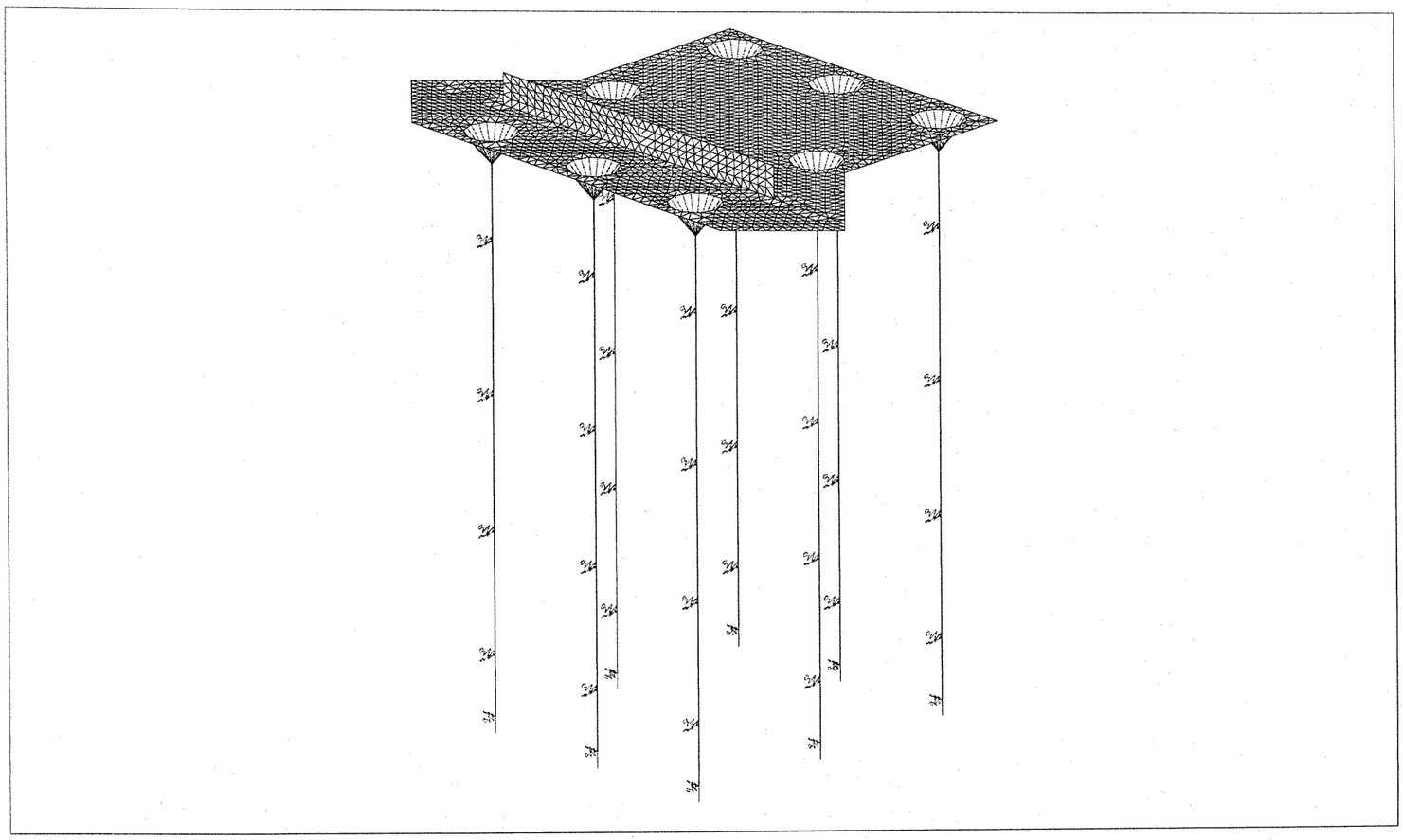
$\sum P_i = 3 \cdot P_1 + 2 \cdot P_2 + 2 \cdot P_3 + P_3' = 91'3$ T/m

Como $\sum P_i$ debe ser menor que $P_H$, se aplica el siguiente coef. reductor:

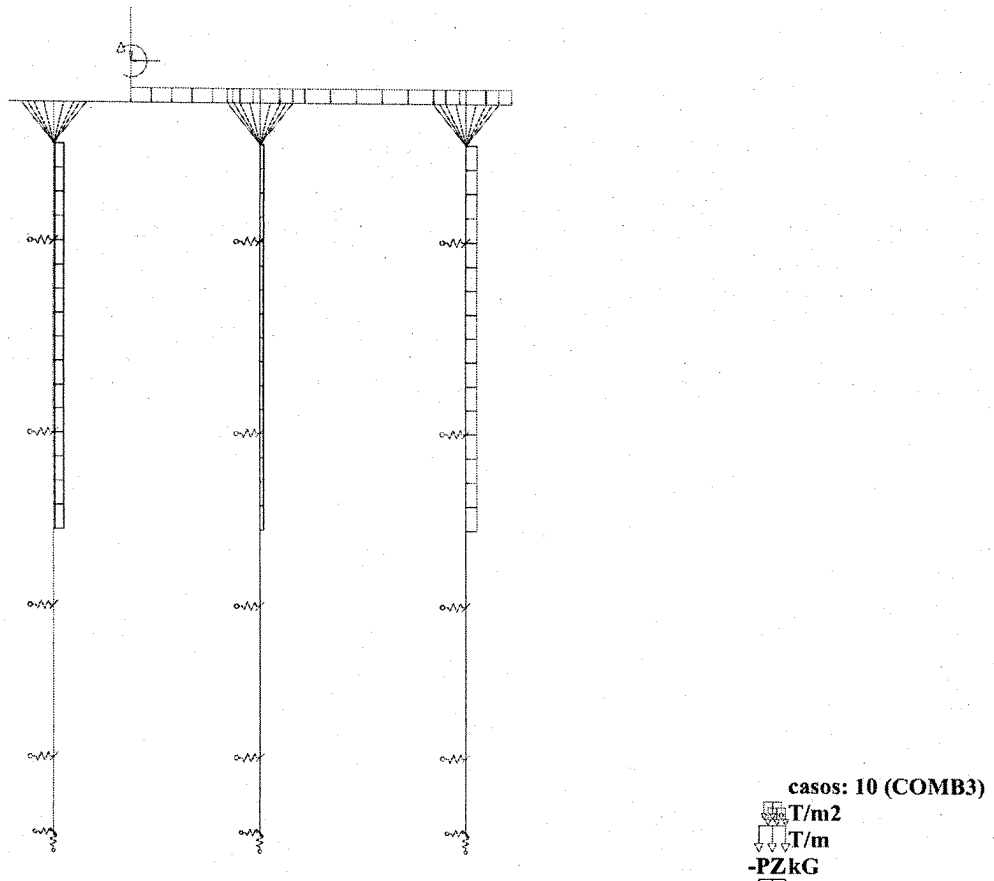
$$\alpha = \frac{P_H}{\sum P_i} = \frac{65'6}{91'3} = 0'72$$



## Vista - casos: 1 (PESO PROPIO)



## Vista - casos: 10 (COMB3)








**Reacciones sistema de coordenadas global - Caso: 10 (COMB3)**

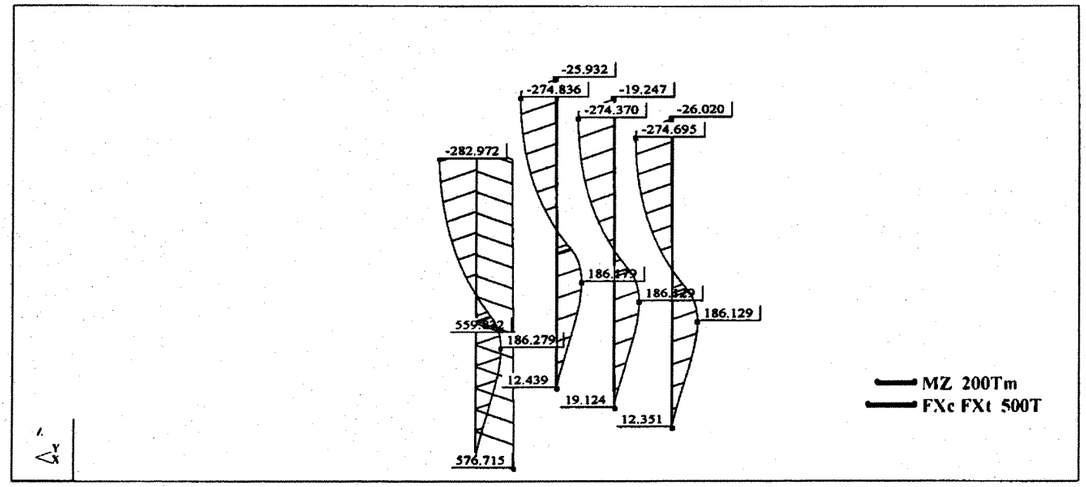
**sistema de coordenadas global - Caso: 10 (COMB3)**

| Filtrar | Nudo | Caso |
|---|---|---|
| Lista completa | 1A671 716A2012 2023 2024 2027A2034 | 1A10 |
| Selección | 1843 1845 1847 2024 2028A2034CA2 | 10 |
| | | |
| Número total | 1978 | 10 |
| Número seleccion | 8 | 1 |

**sistema de coordenadas global - Caso: 10 (COMB3)**

| Caso/Nudo | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| | | | | | | |
| Nombre del caso | COMB3 | | | | | |
| 10 (C)/ 1843 | -0.031 | -34.447 | 575.998 | 0.000 | -0.000 | 0.0 |
| 10 (C)/ 1845 | 0.005 | -37.249 | 576.715 | 0.000 | 0.000 | 0.0 |
| 10 (C)/ 1847 | 0.041 | -34.438 | 575.832 | 0.000 | 0.0 | 0.0 |
| 10 (C)/ 2024 | -0.135 | -35.533 | 280.972 | 0.000 | 0.000 | 0.0 |
| 10 (C)/ 2028 | 0.134 | -35.525 | 280.866 | 0.000 | 0.000 | 0.0 |
| 10 (C)/ 2030 | -0.119 | -37.758 | 12.439 | 0.000 | -0.000 | 0.0 |
| 10 (C)/ 2032 | -0.006 | -37.746 | 19.124 | 0.000 | -0.000 | 0.0 |
| 10 (C)/ 2034 | 0.107 | -37.750 | 12.351 | 0.000 | 0.000 | 0.0 |
| | | | | | | |
| Caso 10 (C) | COMB3 | | | | | |
| Suma final | -0.003 | -290.446 | 2334.296 | 0.000 | -0.000 | 0.0 |
| Suma de reacciones < | -0.000 | 1394.634 | 2334.296 | 11777.064 | 1.205 | -0.844 |
| Suma de esfuerzos | 0.0 | -1394.634 | -2334.296 | -11777.064 | -1.205 | 0.844 |
| Verificación | -0.000 | 0.000 | 0.000 | -0.000 | -0.000 | -0.000 |
| Precisión: | 5.97296e-008 | 2.26993e-017 | | | | |

## Diagramas - FX;MZ; casos: 10 (COMB3)




| | FX (T) | MZ (Tm) |
|---|---|---|
| Tipo (color) de línea | | |
| Escala : (cm) = | 509.9 | 254.929 |
| | | |
| MAX | 576.715 | 186.279 |
| Barra | 3 | 3 |
| Punto | x = 1.0000 | x = 0.2700 |
| Caso | 10 | 10 |
| | | |
| MIN | -26.020 | -282.972 |
| Barra | 12 | 4 |
| Punto | x = 0.0000 | x = 0.0000 |
| Caso | 10 | 10 |
| | | |





Obra: General
Fecha: 22/04/2004
Hora: 17:40:39

## Cálculo de secciones a flexión compuesta recta

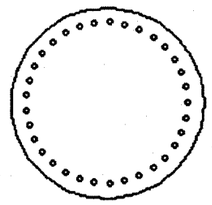
### 1 Datos

- Materiales

```
Tipo de hormigón : HA-25
Tipo de acero    : B-500-S
fck [MPa]        = 25.00
fyk [MPa]        = 500.00
γc               = 1.50
γs               = 1.15
```

- Sección

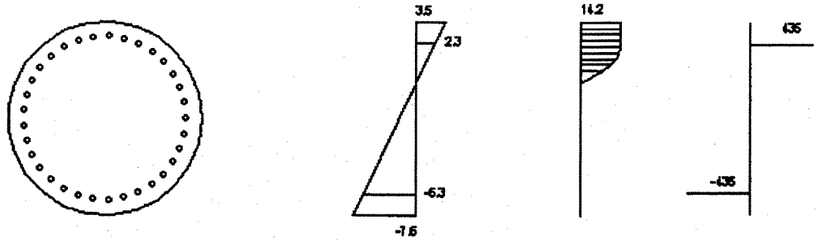
```
Sección : PIL125
ϕ [m] = 1.25
r [m] = 0.100
nº barras = 33
```



### 2 Comprobación

```
ϕ [mm] = 32
Nd [kN]    = 0
Md [kN·m] = 4245

Nu [kN]    = -0.0
Mu [kN·m] = 4751.4
γ          = 1.12
```




Plano de deformación de agotamiento

x [m] = 0.396

1/r [1/m]·1.E-3 = 8.8

εs ·1.E-3 = 3.5

εi ·1.E-3 = -7.6

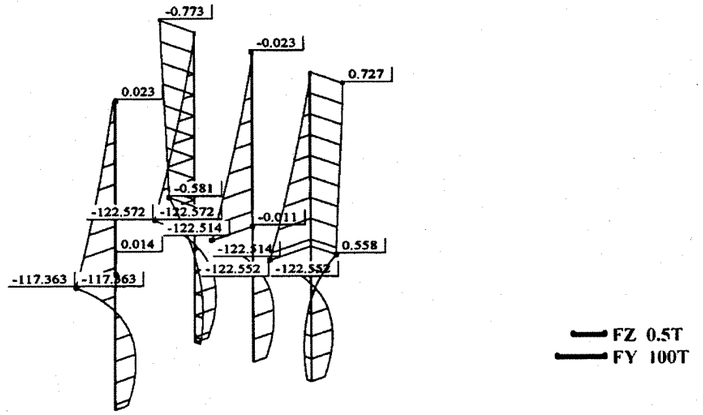
Deformación y tensión de armaduras superior e inferior

| Profundidad [m] | Deformación ·1.E-3 | Tensión [MPa] |
|---|---|---|
| 0.139 | 2.3 | -434.8 |
| 1.111 | -6.3 | 434.8 |

ROBOT v 16.1.0
Autor : **PEDELTA**
Dirección :

© RoboBAT 1996-2003
Archivo : **Encepado 08.rtd**
Proyecto : Encepado 08

## Diagramas - FY;FZ; casos: 10 (COMB3)




| | FY (T) | FZ (T) |
|---|---|---|
| **Tipo (color) de línea** | | |
| **Escala : (cm) =** | 102.0 | 0.8 |
| | | |
| **MAX** | 62.279 | 0.727 |
| **Barra** | 15 | 12 |
| **Punto** | x = 0.7100 | x = 0.0000 |
| **Caso** | 10 | 10 |
| | | |
| **MIN** | -122.572 | -0.773 |
| **Barra** | 16 | 16 |
| **Punto** | x = 1.0000 | x = 0.0000 |
| **Caso** | 10 | 10 |
| | | |

Fecha : 22/04/04

Página : 1

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Pilote trasero en estribo 2.**

**PILOTE EN PILA 2**

| | |
|---|---|
| D(mm) | 1150 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 680 |
| As(cm2) | 88 |
| Vrd(Tn) | 184.00 |
| N(Tn) | 0 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.417 |
| Roele | 0.0113 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 404425.6 |

[redacted]

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 337021.35 |
| Vsu,p | 414000.00 |

[redacted]

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 12272 |
| Sigmacd (N/mm2) | 0 |
| K | 1 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 3910000 |

**Verificada la resistencia del alma a la compresión**

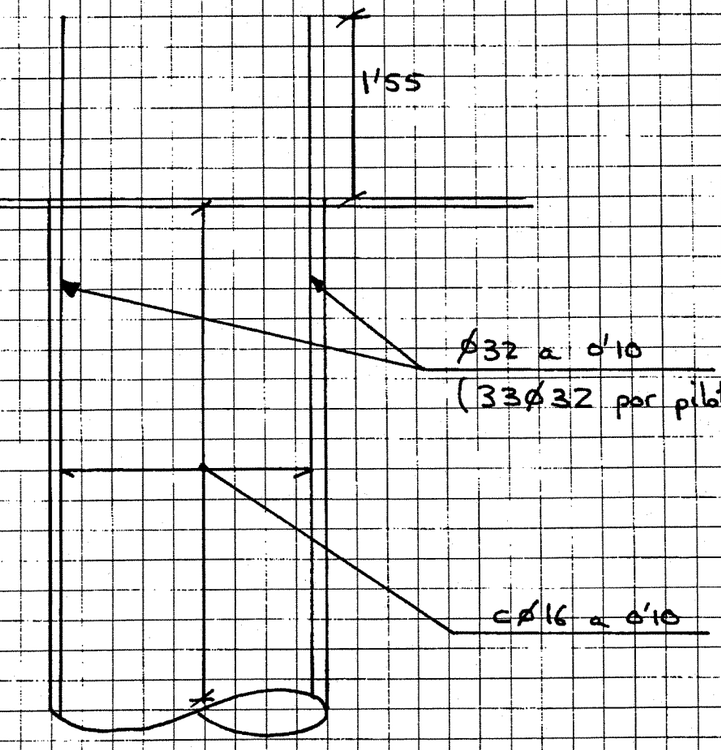
**CÁLCULO DE LA ARMADURA MÍNIMA DE CORTANTE**

| | | | |
|---|---|---|---|
| α (en grados) = | 90 | As, c mín. (cm2/m) = | [redacted] |

PEDELTA
INGENIERIA CIVIL

FECHA HOJA

ESQUEMA DE ARMADO DE UN PILOTE




Recubrimiento nominal = 70 mm.

ARMADURA EN ENCEPADO DE ESTRIBO 2.

1.] Dimensionamiento a flexión

Arm. longitudinal

$M_{d,max} = 1'5 \cdot 215'4 = 323'1$ mT
$M_{d,min} = 1'5 \cdot 140 = -210$ mT
$\Rightarrow \begin{cases} A_{s,sup} = 43 \text{ cm}^2/\text{m} \\ A_{s,inf} = 28 \text{ cm}^2/\text{m} \end{cases}$

Arm. transversal

$M_{d,max} = 1'5 \cdot 84'5 = 126'8$ mT/m
$M_{d,min} = 1'5 \cdot 61'4 = -92'1$ mT/m
$\Rightarrow \begin{cases} A_{s,sup} = 16 \text{ cm}^2/\text{m} \\ A_{s,inf} = 12 \text{ cm}^2/\text{m} \end{cases}$

Arm. mínima geométrica

$A_{min} = \frac{0'9}{1000} \cdot 190 \cdot 100 = 17'1 \text{ cm}^2/\text{m} \Leftrightarrow \phi 20$ a $0'15$

Arm. mínima mecánica.

$A_{min} = 0'04 \cdot A_c \frac{f_{cd}}{f_{yd}} = 30 \text{ cm}^2/\text{m} \Leftrightarrow \phi 25$ a $0'15$
$\phi 20$ a $0'10$



ARMADURA EN ENCEPADO DE ESTRIBO 2

2.] ELS fisuración.

Arm. longitudinal

$M_{k,max} = 215'4$ mT/m $\Leftrightarrow$ $w_k = 0'28$ mm $< 0'3$ O.K.
$M_{k,min} = 140$ mT/m $\Leftrightarrow$ $w_k = 0$ mm.

3.] ELU Cortante

Según gráfico adjunto, entre pilotes:

$V_d = \frac{325'6}{2'5} \cdot 1'5 \simeq 200$ T/m $\Rightarrow$

$\Rightarrow A_{sc} > 24 \text{ cm}^2/\text{m} \Rightarrow c\phi 16$ cada $0'15$

En sentido transversal los cortantes son menores $\Rightarrow$
$\Rightarrow$ Dispondremos la misma armadura.

**Proyecto: Viaducto Puerto-Martorell.**
**Elemento: Encepado E-2**

**CALCULO DE ARMADURA LONGITUDINAL SUPERIOR**

| | |
|---|---|
| M(Kpxcm) | 3.23E+07 |
| N(Kp)(COMPRESION POSITIVA) | 0 |
| B(cm) | 100 |
| D(cm) | 180 |
| Fcd(kp/cm2) | 200.0 |
| H(cm) | 190 |
| Fyd(kp/cm2) | 4347.83 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **10.89** |
| **ARMADURA NECESARIA(cm2)** | **42.57** |

**Proyecto: Viaducto Puerto-Martorell.**
**Elemento: Encepado E-2**

**CALCULO DE ARMADURA LONGITUDINAL INFERIOR**

| | |
|---|---|
| M(Kpxcm) | 2.10E+07 |
| N(Kp)(COMPRESION POSITIVA) | 0 |
| B(cm) | 100 |
| D(cm) | 180 |
| Fcd(kp/cm2) | 200.0 |
| H(cm) | 190 |
| Fyd(kp/cm2) | 4347.83 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **7.00** |
| **ARMADURA NECESARIA(cm2)** | **27.37** |

**Proyecto: Viaducto Puerto-Martorell.**
**Elemento: Encepado E-2**

**CALCULO DE ARMADURA TRANSVERSAL SUPERIOR**

| | |
|---|---|
| M(Kpxcm) | 1.27E+07 |
| N(Kp)(COMPRESION POSITIVA) | 0 |
| B(cm) | 100 |
| D(cm) | 180 |
| Fcd(kp/cm2) | 200.0 |
| H(cm) | 190 |
| Fyd(kp/cm2) | 4347.83 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **4.19** |
| **ARMADURA NECESARIA(cm2)** | **16.39** |

**Proyecto: Viaducto Puerto-Martorell.**
**Elemento: Encepado E-2**

**CALCULO DE ARMADURA TRANSVERSAL INFERIOR**

| | |
|---|---|
| M(Kpxcm) | 9.21E+06 |
| N(Kp)(COMPRESION POSITIVA) | 0 |
| B(cm) | 100 |
| D(cm) | 180 |
| Fcd(kp/cm2) | 200.0 |
| H(cm) | 190 |
| Fyd(kp/cm2) | 4347.83 |

| | |
|---|---|
| **POSICION FIBRA NEUTRA(cm)** | **3.04** |
| **ARMADURA NECESARIA(cm2)** | **11.87** |

## CÁLCULO DE FISURACIÓN

**Proyecto:** Viaducto Puerto-Martorell
**Elemento:** Encepado E-2

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 190.00 |
| Arm. Tracción | As1 | cm2 | 53.40 |
| Canto útil | d | cm | 180.00 |
| Arm. Compresión | As2 | cm2 | 53.40 |
| Dist. d' | d' | cm | 6.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,000,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 6.00 |
| Area hormigón | Ac | cm2 | 19000 |
| Area sec. Homog. | Ah | cm2 | 19783.45 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 94.92 |
| Inercia sec. Homog. | Ih | cm4 | 63091281.41 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.34 |
| Cuantía mecánica 1 | ρ1 | 0.0030 |
| Cuantía mecánica 2 | ρ2 | 0.0030 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 170.202 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 7.37 |
| Inercia fisurada | If | cm4 | 12,004,305 |

| DATOS PARA EL CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 215.40 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 15 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,796 |
| Tensión de servicio | Ts | kp/cm2 | 2,272 |
| Area eficaz | Ac,ef | cm2 | 3000 |
| Alargamiento medio armaduras | εsm | | 0.0008 |
| Separación media de fisuras | Sm | mm | 207.89 |
| **Abertura característica** | **Wk** | **mm** | **0.28** |

| DATOS INICIALES | | | |
|---|---|---|---|
| Ancho | b | cm | 100.00 |
| Canto | h | cm | 190.00 |
| Arm. Tracción | As1 | cm2 | 53.40 |
| Canto útil | d | cm | 180.00 |
| Arm. Compresión | As2 | cm2 | 53.40 |
| Dist. d' | d' | cm | 6.00 |
| Módulo hormigón | Ec | kp/cm2 | 272,640 |
| Módulo acero | Es | kp/cm2 | 2,000,000 |

| DATOS PARA EL CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Resistencia caract. Horm. | fck | kp/cm2 | 250 |
| Resistencia media a tracción | fctm | kp/cm2 | -25.65 |
| Resistencia caract. Acero | fyk | kp/cm2 | 5100 |
| Dist. De As2 a la fib. Sup. | d2 | cm | 6.00 |
| Area hormigón | Ac | cm2 | 19000 |
| Area sec. Homog. | Ah | cm2 | 19783.45 |
| C.d.g. De la sec. Homog. | Xg | cm2 | 94.92 |
| Inercia sec. Homog. | Ih | cm4 | 63091281.41 |

| CÁLCULO DE PARÁMETROS ADIMENSIONALES | | |
|---|---|---|
| Coef. homog. | n | 7.34 |
| Cuantía mecánica 1 | ρ1 | 0.0030 |
| Cuantía mecánica 2 | ρ2 | 0.0030 |

| CÁLCULO DEL MOMENTO DE FISURACIÓN | | | |
|---|---|---|---|
| Momento de fisuración | Mfis | mT | 170.202 |

| CARACTERÍSTICAS DE LA SECCIÓN FISURADA | | | |
|---|---|---|---|
| Prof. fibra neutra | x | cm | 7.37 |
| Inercia fisurada | If | cm4 | 12,004,305 |

| DATOS PARA EL CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Momento solicitante | Mk | mT | 140.00 |
| Diámetro | ϕ | mm | 32 |
| Separación | s | cm | 15 |
| Parámetro k2 | k2 | | 0.5 |
| Parámetro β | β | | 1.7 |
| Coeficiente k1 | k1 | | 0.125 |

| CÁLCULO DE LA ABERTURA DE FISURA | | | |
|---|---|---|---|
| Tensión de fisuración | Tsr | kp/cm2 | 1,796 |
| Tensión de servicio | Ts | kp/cm2 | 1,477 |
| Area eficaz | Ac,ef | cm2 | 3000 |
| Alargamiento medio armaduras | εsm | | 0.0003 |
| Separación media de fisuras | Sm | mm | 207.89 |
| **Abertura característica** | **Wk** | **mm** | **0.00** |

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto:** VIADUCTO PUERTO-MARTORELL
**Elemento:** ENCEPADO ESTRIBO 2

| | |
|---|---|
| D(mm) | 1800 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 1000 |
| As(cm2) | 53.4 |
| Vrd(Tn) | 200.00 |
| N(Tn) | 0 |

Limitación de tensión en armadura de cortante (art. 40.2 EHE)

*N<0 para compresión.

### VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE

| | |
|---|---|
| PSI | 1.333 |
| Roele | 0.0030 |
| Sigmaprima (N/mm2) | 0.00 |
| Vu2 (N) | 561645.2 |

**Necesita armadura de cortante**

### OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA

| | |
|---|---|
| Theta | |
| Vu2 | 468037.69 |
| Vsu,p | 648000.00 |

***As,c =*** ***23.6*** **cm2/m**

### VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA

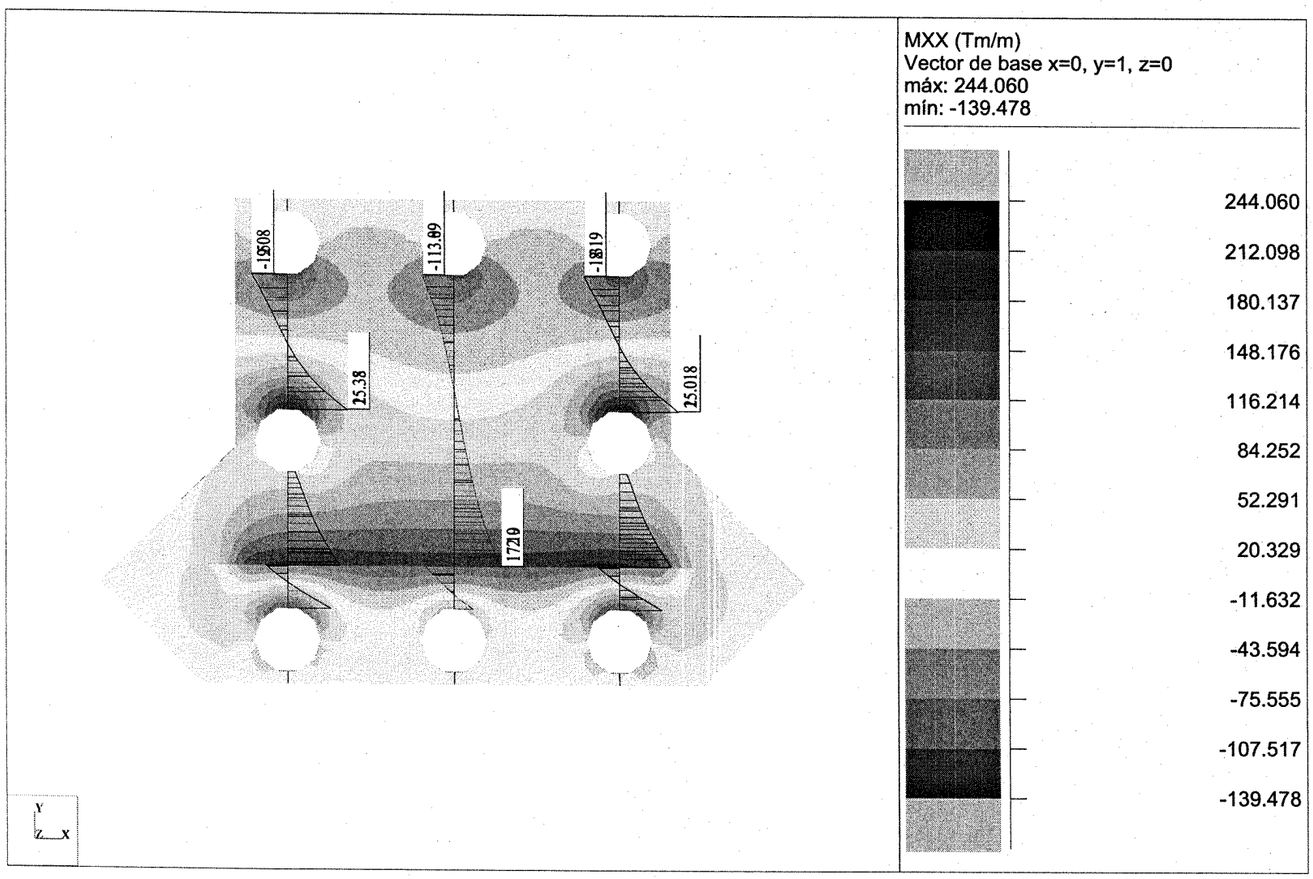
| | |
|---|---|
| Ac (cm2) | 19000 |
| Sigmacd (N/mm2) | 0 |
| K | 1 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 9000000 |

**Verificada la resistencia del alma a la compresión**

### CÁLCULO DE LA ARMADURA MÍNIMA DE CORTANTE

| | | | |
|---|---|---|---|
| α (en grados) = | 90 | As, c mín. (cm2/m) = | 8.33 |

## Mapas para paneles:1 - MXX (Tm/m) Vector de base x=0, y=1, z=0 A - A1 A - A2 A - A3 casos: 10 (COMB3)

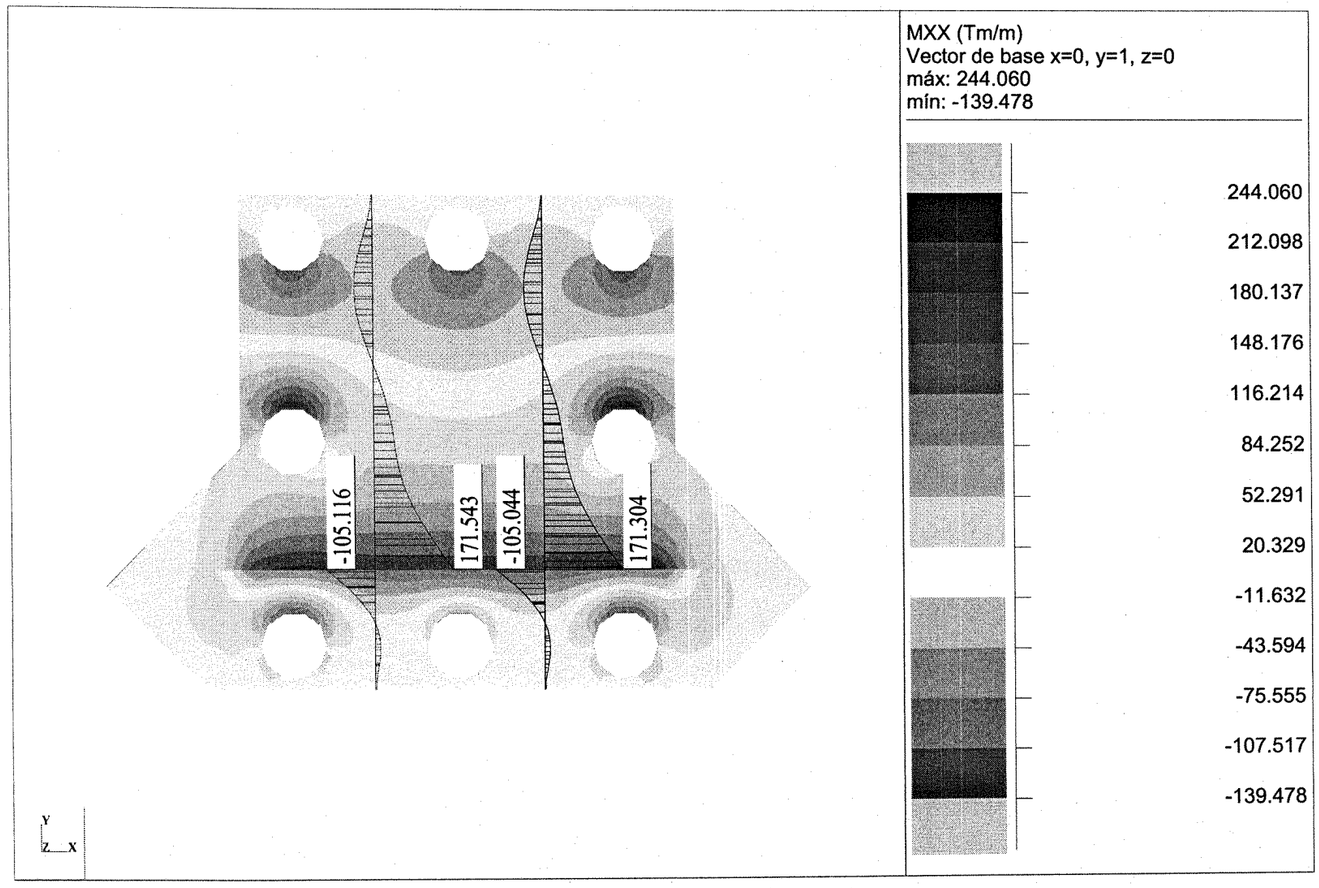




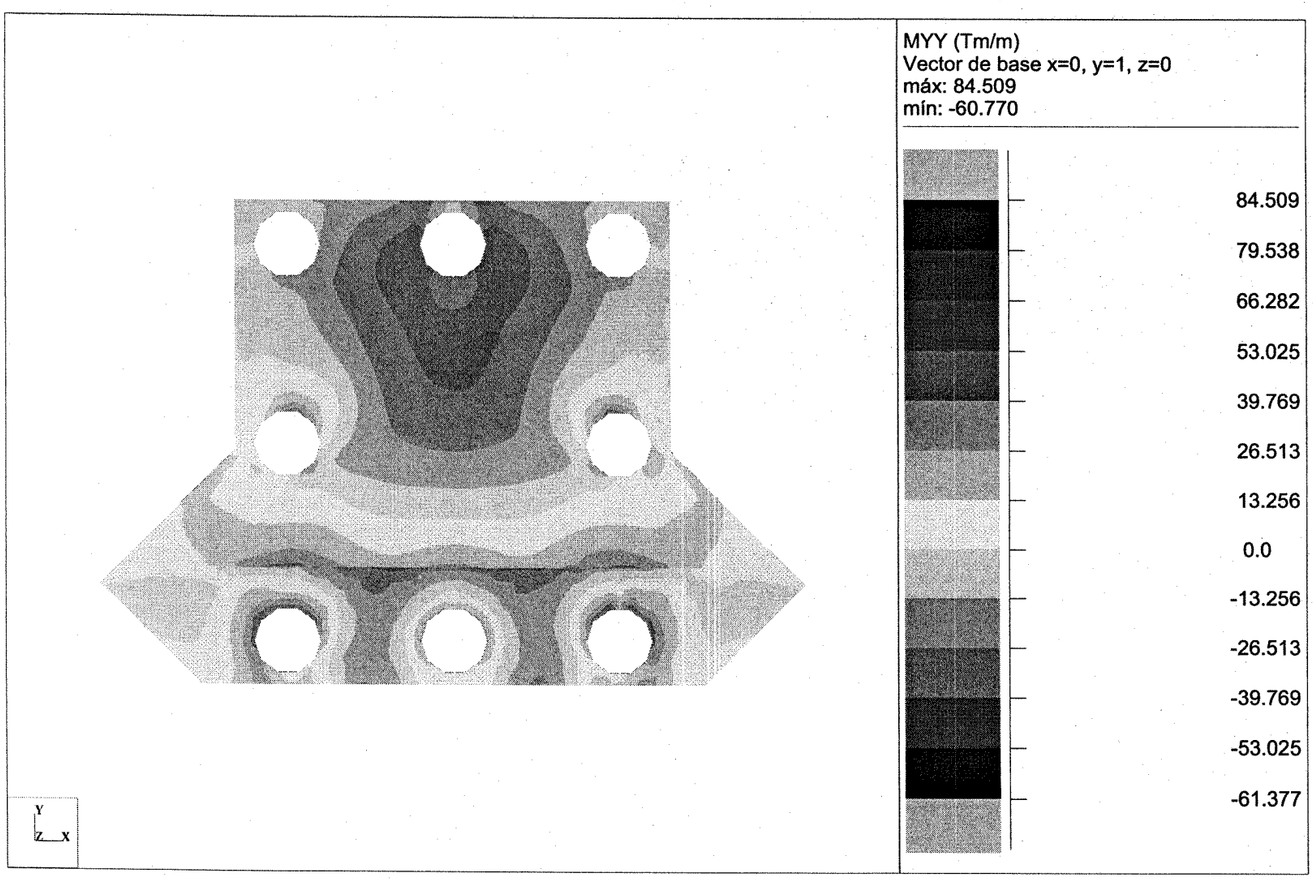

ROBOT v 16.1.0
Autor :
Dirección :

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Archivo : **Encepado 08.rtd**
Proyecto : Encepado 08

## Mapas para paneles:1 - MXX (Tm/m) Vector de base x=0, y=1, z=0 A - A4 A - A5 casos: 10 (COMB3)



## Mapas para paneles - MYY (Tm/m) Vector de base x=0, y=1, z=0 casos: 10 (COMB3)

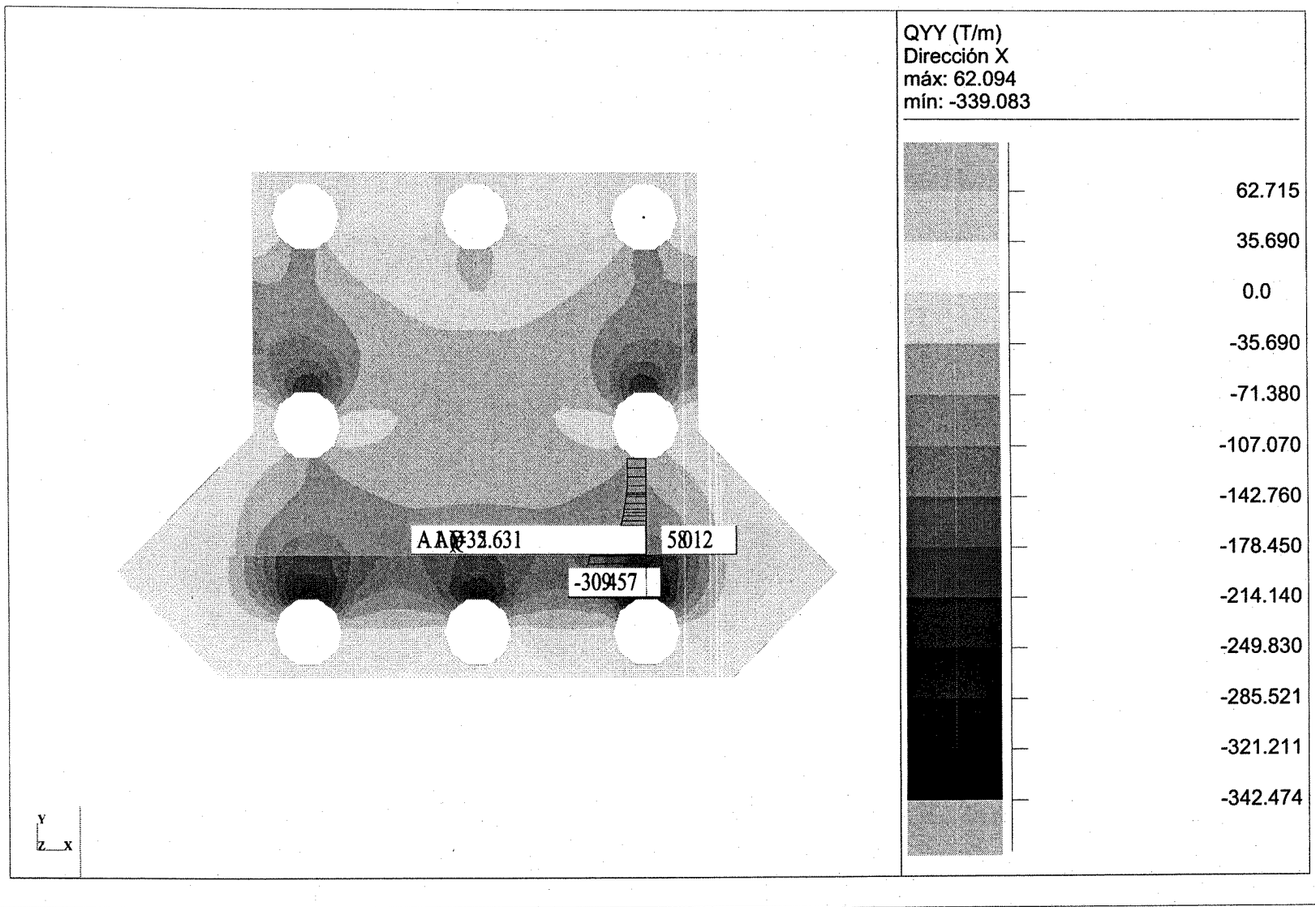




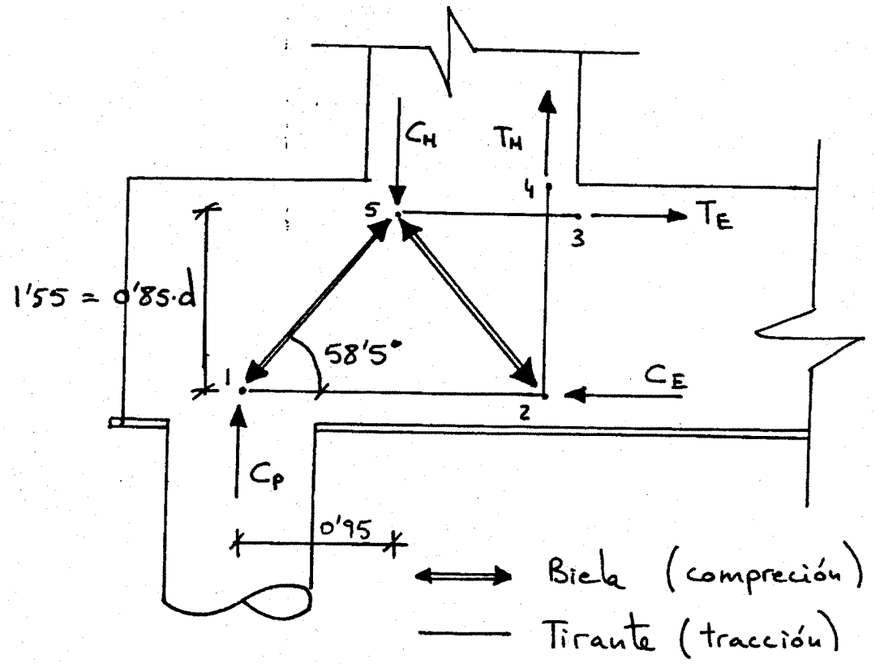

ROBOT v 16.1.0
Autor :
Dirección :

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Archivo : **Encepado 08.rtd**
Proyecto : Encepado 08

## Mapas para paneles:1 - QYY (T/m) Dirección X A - A1 casos: 10 (COMB3)



## MODELO DE BIELAS Y TIRANTES PARA PUNTERA E-2




$C_{p,max}$ = 810 T/pilote en ELU

Por lo tanto;

$$C_{15} = \frac{C_p}{\text{sen } 58'5} = 950 \text{ T}$$

$$T_{12} = C_{15} \cdot \cos 58'5 = 496 \text{ T} \Rightarrow$$

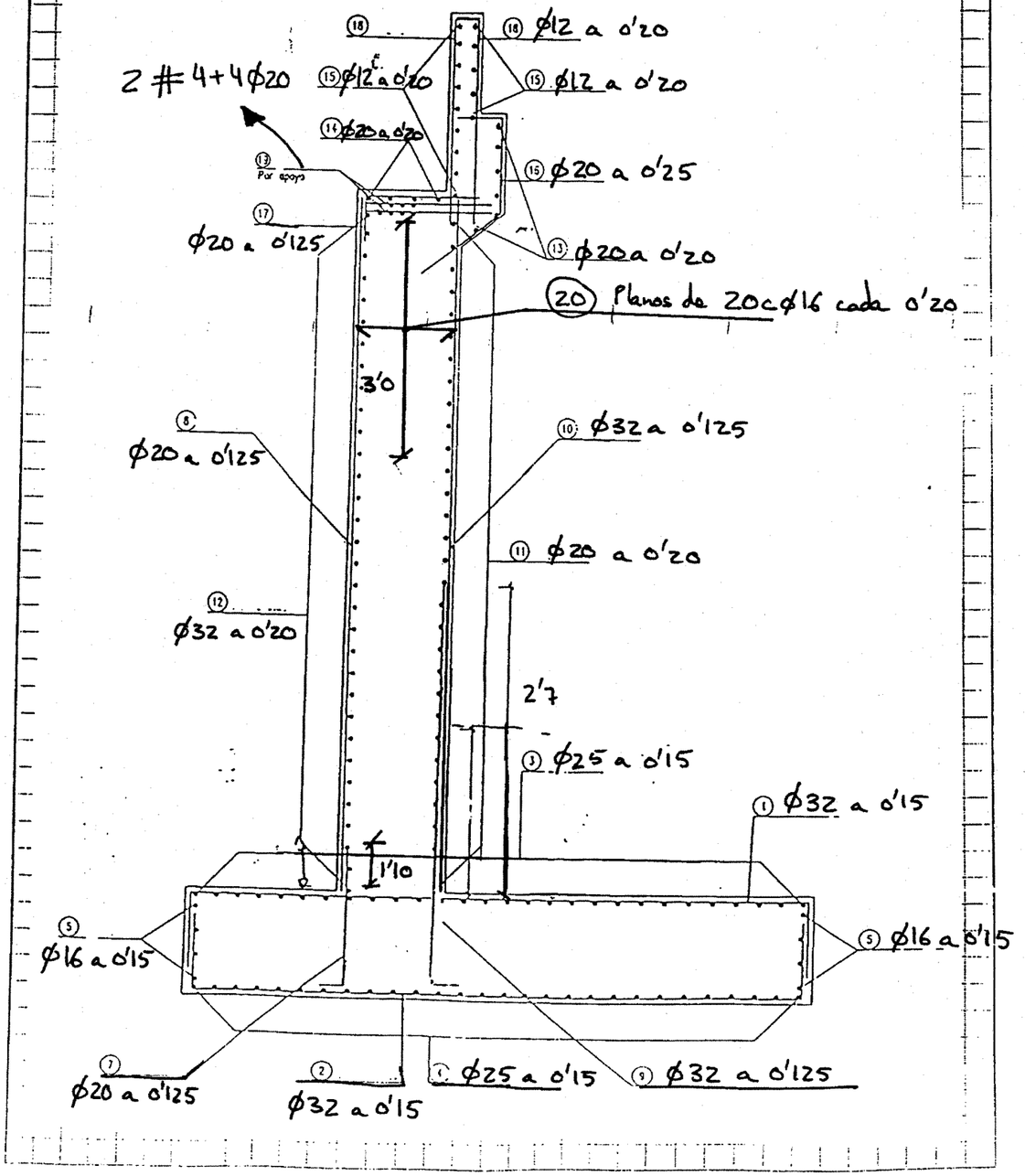
$$\Rightarrow A_s \geq \frac{T_{12}}{f_{yd}} = 125 \text{ cm}^2 \Longleftrightarrow \text{2 capas de } \phi 32 \text{ a } 0'15$$

PEDELTA, S.L.
INGENIERÍA DE ESTRUCTURAS

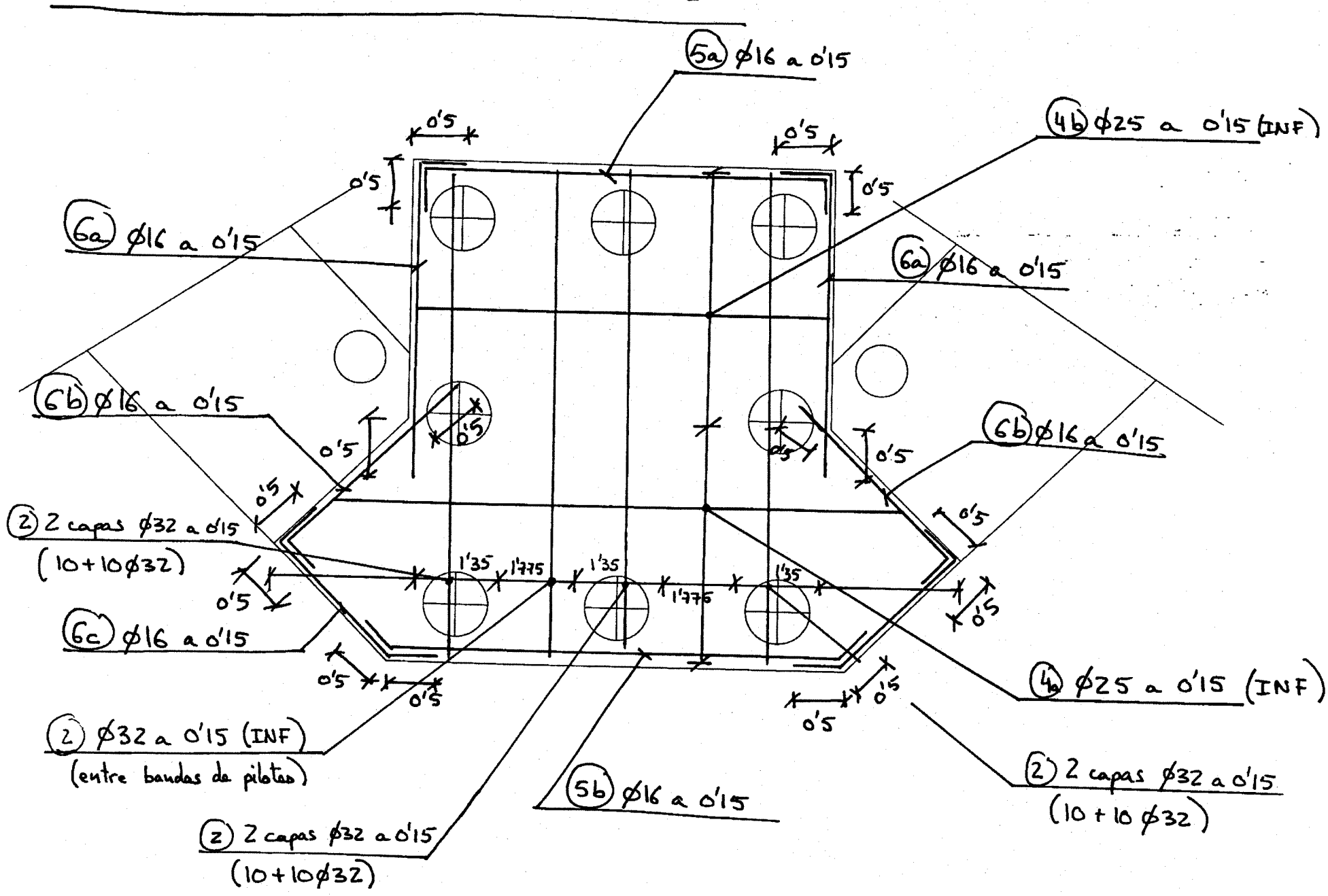
Fecha:

Hoja:

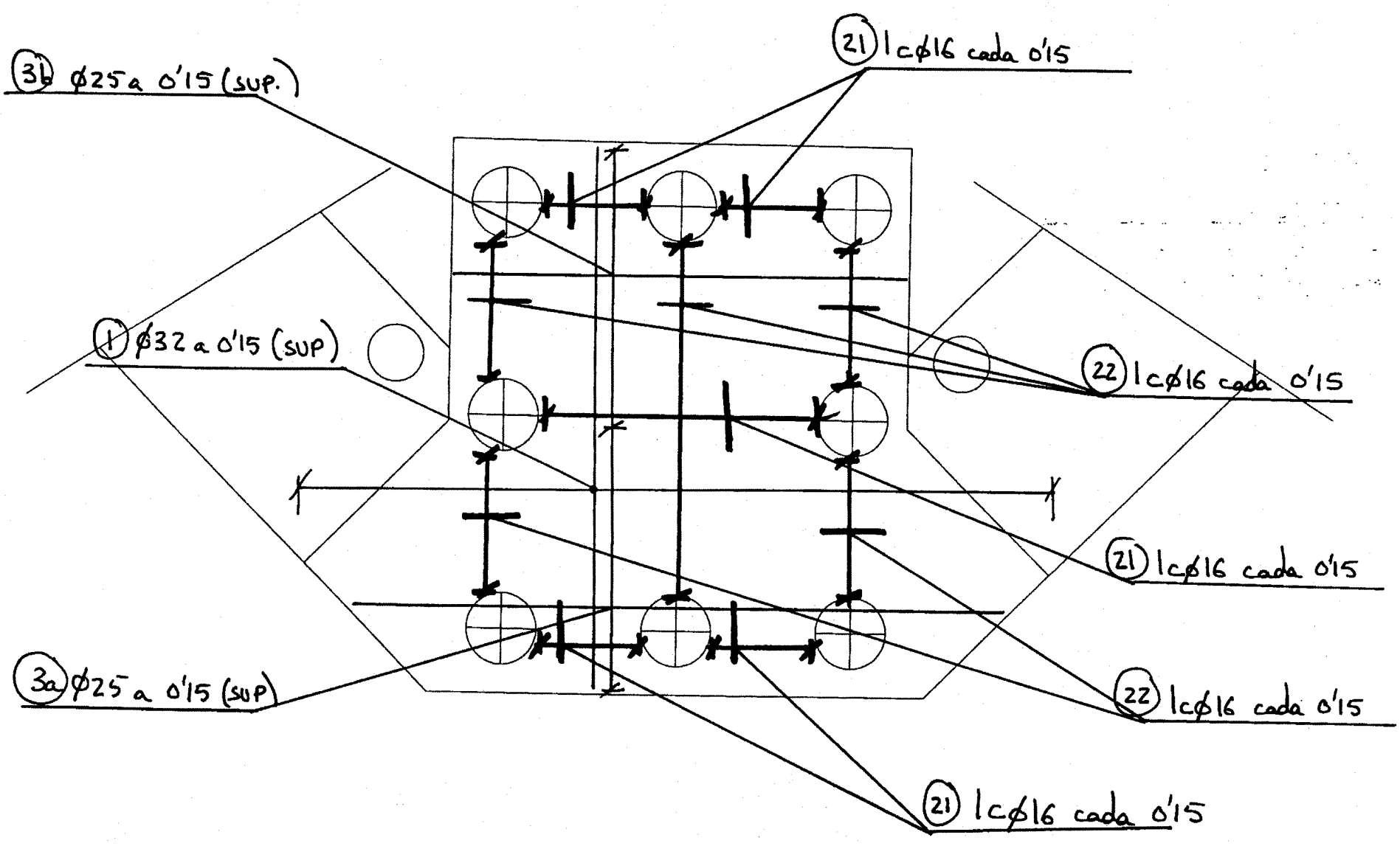
SECCIÓN TIPO ARMADO ESTRIBOS



## ARMADURA INFERIOR Y PERIMETRAL




## CERCOS Y ARMADURA SUPERIOR

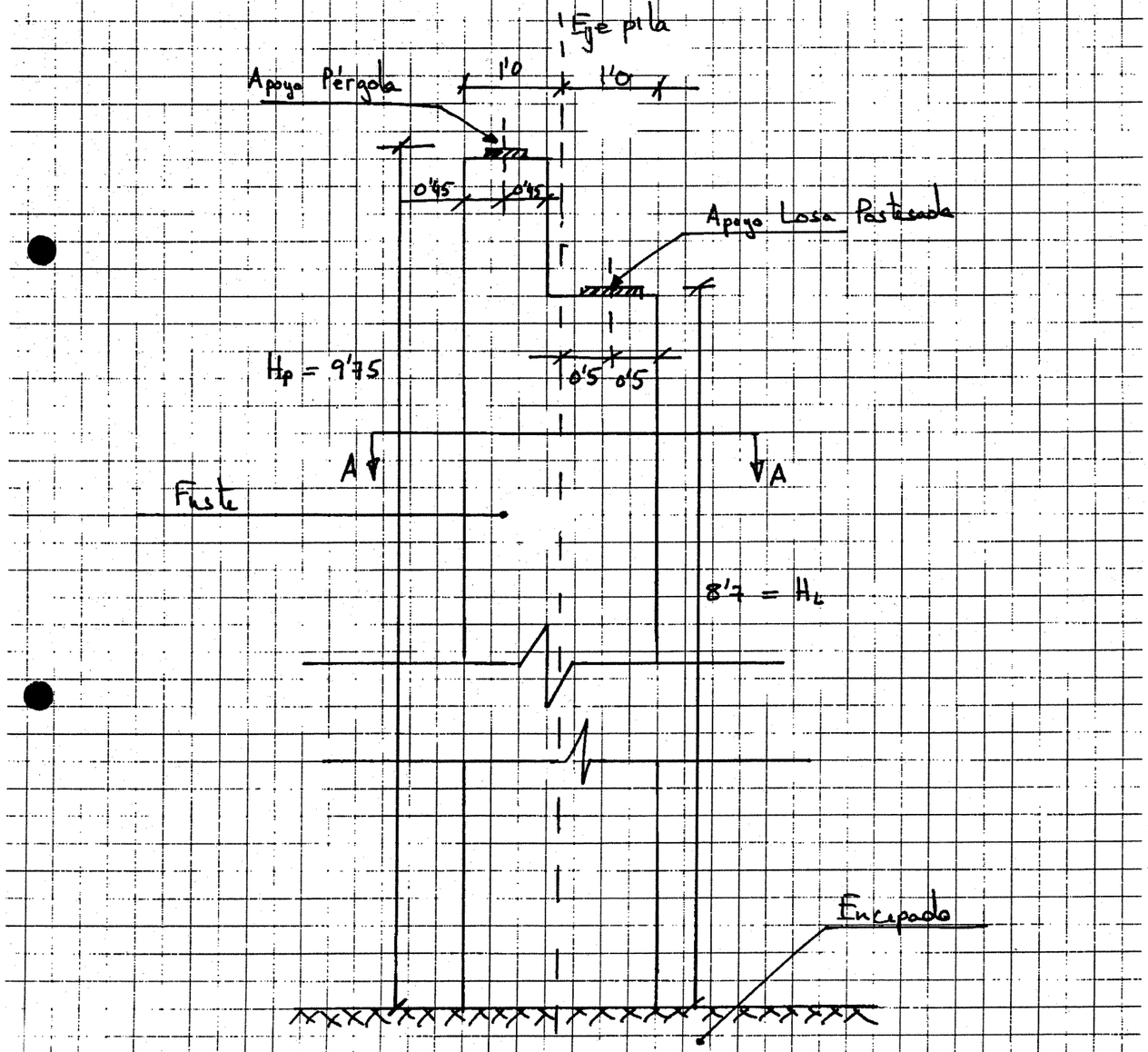


## CÁLCULO DE LA PILA 1

**GEOMETRÍA**

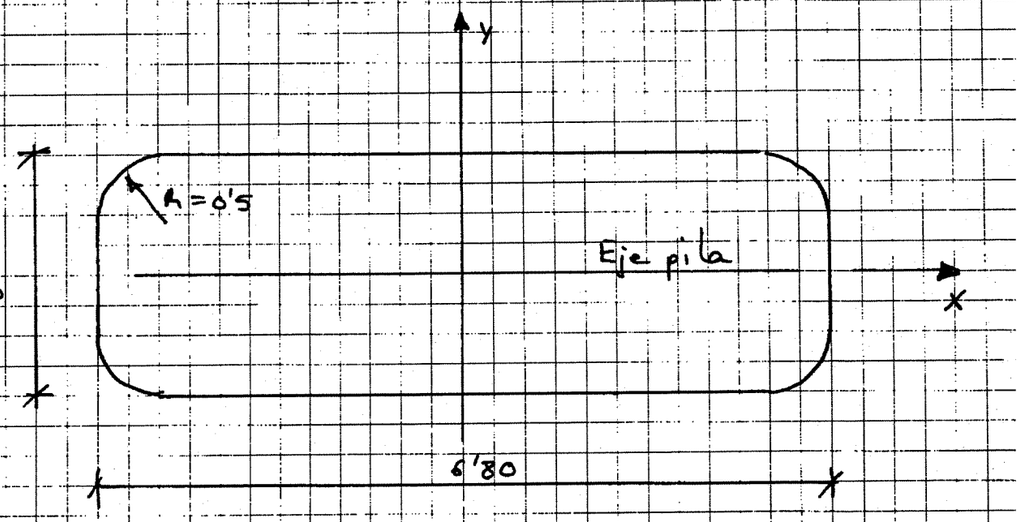
# CÁLCULO DE LA PILA 1. GEOMETRÍA

## SECCIÓN TIPO EN FUSTE






## SECCIÓN A-A




$A = 13'385\ m^2$

$I_x = 4'362\ m^4 \Longrightarrow i_x = \sqrt{\frac{I_x}{A}} = 0'571\ m$

$I_y = 50'083\ m^4 \Longrightarrow i_y = \sqrt{\frac{I_y}{A}} = 1'934\ m$

$l_p = \beta \cdot \max\{H_p ; H_L\} = 2 \cdot 9'75 = 19'5\ m$

$\lambda_x = \frac{l_p}{i_x} = 34'2 < 35$

$\lambda_y = \frac{l_p}{i_y} = 10'1 < 35$

Según art. 43.5 de EHE pueden despreciarse los efectos de 2º orden.

**ACCIONES EN CORONACIÓN**

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## CÁLCULO DE LA PILA 1. ACCIONES EN CORONACIÓN

### ACCIONES TRANSMITIDAS POR EL TABLERO TIPO LOSA.

1/ Reacciones Verticales.

Apoyos 42 y 43 del modelo de emparrillado

| | Apoyo 42 | Apoyo 43 |
|---|---|---|
| Permanente | 128'8 | 123'2 |
| Máxima Sobrec. | 102'6 | 54'6 |
| Mínima Sobrec. | −12'1 | −11'1 |

Hipótesis 1. Máxima reacción vertical

$N = N_{perm} + N_{max} = 409'2$ T

$N_{perm} = 128'8 + 123'2 = 252$ T

$N_{max} = 102'6 + 54'6 = 157'2$ T

$M_T = 85'7$ mT

Hipótesis 2. Máxima momento transversal

$N = N_{perm} + 102'6 - 11'1 = 343'5$ T

$M_T = 190'9$ mT

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2/ Reacciones Horizontales Transversales.

Lazo → $F_T = 5$ T

Centrífuga → $F_T = 53'0$ T

Viento → $F_T = 12'4$ T

Viento Conc. → $F_T = 15'7$ T

3/ Reacciones Horizontales Longitudinales.

Por rozamiento de los apoyos tipo POT:

$\mu = 0'05 \div 0'01$

$F_{L,max} = 12'6$ T

$F_{L,min} = 2'5$ T

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## CÁLCULO DE LA PILA 1. ACCIONES EN CORONACIÓN

### ACCIONES TRANSMITIDAS POR LA PÉRGOLA

1) Reacciones Verticales

Cargas Permanentes ⟶ 48'1 T

Sobrecarga ⟶ 13'5 T

Hipótesis 1. Máxima reacción vertical

$N = 48'1 + 13'5 = 61'6$ T

$M_T = N \cdot 3'0 = 184'8$ mT

Hipótesis 2. Máximo momento transversal

$N = 61'6$ T

$M_T = 184'8$ mT

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## CÁLCULO DE LA PILA 1. ACCIONES EN CORONACIÓN

### ACCIONES TRANSMITIDAS POR LA LOSA

1) Reacciones Verticales

Permanentes (total) = 29'1 T

Máximas:

Apoyo 334 ⟶ 22'9 T

" 597 ⟶ 62'8 T

85'7 T (56'6 T)

2) Reacciones Horizontales Longitudinales

Fuerza total de frenado sobre la pérgola:

$$F_{fr} = \left(12 \cdot 30 + 10 \cdot 33'9\right) \frac{1}{8} = 87'4 \text{ T}$$

$L_{pérgola} = 30 + 33'9 = 63'9$ m

Por simetría del tablero lo repartimos entre el E-1 y la P-1 a partes iguales:

$F_{fr,P-1} = 43'7$ T

Como hay 3 apoyos en P-1:

$F_{fr,apoyo} = 14'6$ T/apoyo

Por otra parte supondremos que bajo cargas permanentes (por retracción y fluencia) el acortamiento de la pérgola produce una fuerza longitudinal de 4 T por apoyo:

$F_{i,perm} = 4\ T/apoyo = 12\ T$ en P-1

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RESUMEN DE ACCIONES EN CORONACIÓN DE PILA 1

CASO 2. PERMANENTES LOSA

$F_y = -12'6\ T$
$F_z = -128'8\ T$
$M_x = 64'4\ mT$
$M_y = 9'0\ mT$

CASO 3. PERMANENTES PÉRGOLA

$F_y = 12\ T$
$F_z = -77'2\ T$
$M_x = -77'2 \cdot 0'55 = -42'5\ mT$
$M_y = 48'13 - 7'8 \cdot 2'6 = 124'0\ mT$

CASO 4. SOBRECARGAS LOSA HIP. 1.

$F_z = -153'2\ T$
$M_x = 78'6\ mT$
$M_y = 76'7\ mT$

CASO 5. SOBRECARGAS PÉRGOLA HIP. 1.

$F_z = -70'1$ T

$M_x = -38'6$ mT

$M_y = -153'2'6 + 135'3 \simeq 0$ mT

CASO 6. SOBRECARGAS LOSA HIP. 2.

$F_z = -91'5$ T

$M_x = 45'8$ mT

$M_y = 181'9$ mT

CASO 7. SOBRECARGAS PÉRGOLA HIP. 2.

$F_z = -13'5$ T

$M_x = -7'4$ mT

$M_y = 40'5$ mT

CASO 8. LAZO + CENTRIF + 0'6 · VIENTO CONC

$F_x = 67'4$ T

CASO 9. 0'8 (LAZO + CENTRIF.) + VIENTO

$F_x = 58'8$ T

CASO 10. FRENADO EN PÉRGOLA

$F_y = 43'7$ T

## CÁLCULO DE ESFUERZOS Y DIMENSIONAMIENTO

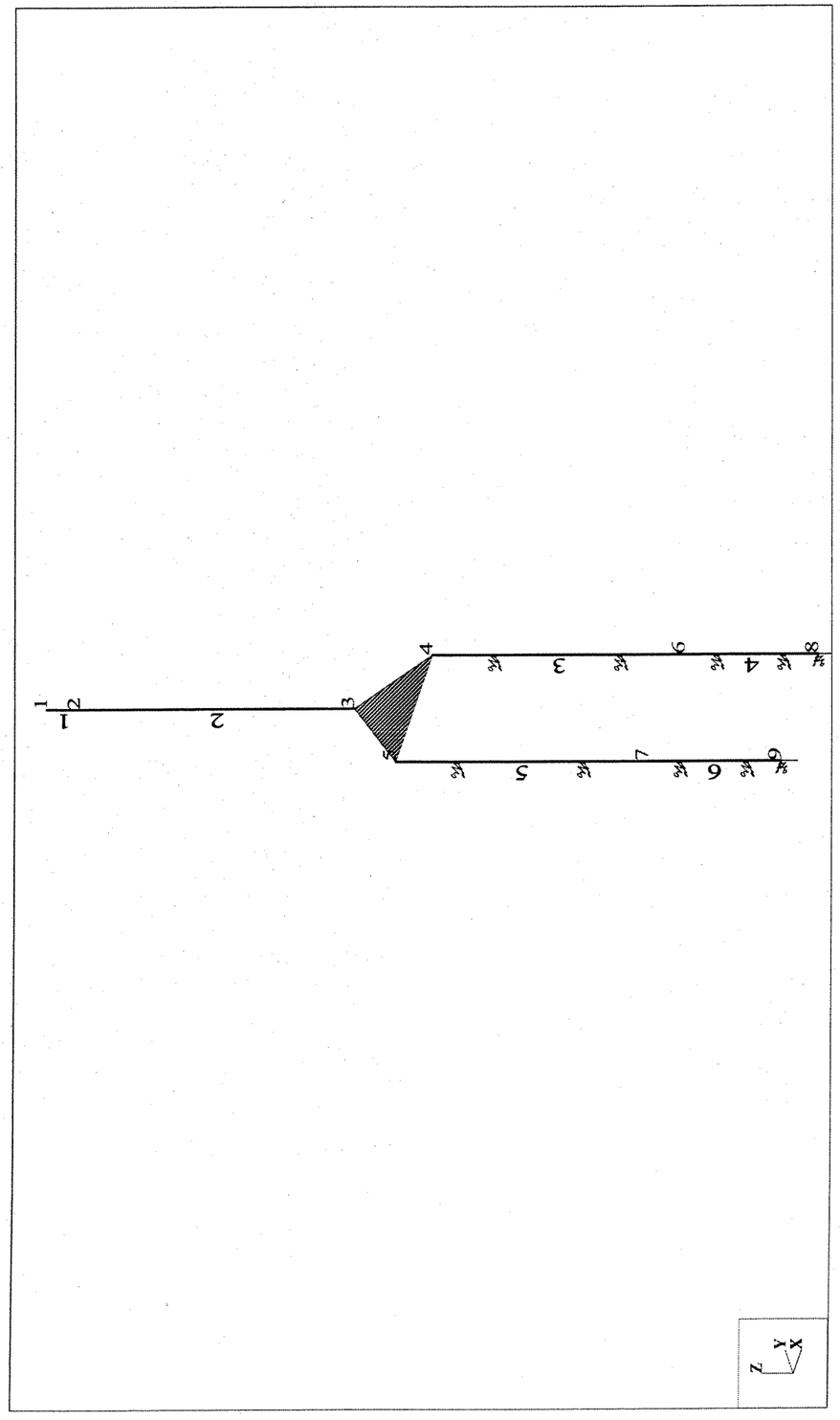
El cálculo y dimensionamiento de las pilas se detalla en las páginas siguientes. Las hipótesis de cálculo se exponen a continuación:

1. El cálculo se ha realizado según especificaciones de la EHE a partir de las reacciones en coronación que se detallan.

2. Se ha comprobado que no se supera la carga admisible por pilote.

3. El dimensionamiento de las armaduras de flexión y cortante del muro y encepado se realiza con los criterios de la Normativa vigente para estructuras de hormigón (EHE). Los coeficientes de seguridad de las acciones corresponden con un **nivel de control intenso** $\gamma_{fg}$ **=1,35 y** $\gamma_{fq}$ **=1,50.**

## Vista - casos: 1 (Peso Propio)






ROBOT v 16.1.0
Autor : **PEDELTA**
Dirección :

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Archivo : **Pila 1. Modelo 04.rtd**
Proyecto : Pila 1. Modelo 04

### Coordenadas de Nudos

| Filtrar | Nudo |
|---|---|
| Lista compl | 1A9 |
| Selección | 1A9 |
| | |
| Número tot | 9 |
| Número sel | 9 |

| Nudo | X (m) | Y (m) | Z (m) | Apoyo - código | Apoyo |
|---|---|---|---|---|---|
| 1 | 0.0 | 0.0 | 0.0 | | |
| 2 | 0.0 | 0.0 | -1.050 | | |
| 3 | 0.0 | 0.0 | -9.750 | | |
| 4 | 2.250 | 0.0 | -11.650 | | |
| 5 | -2.250 | 0.0 | -11.650 | | |
| 6 | 2.250 | 0.0 | -19.650 | | |
| 7 | -2.250 | 0.0 | -19.650 | | |
| 8 | 2.250 | 0.0 | -23.850 | eeelll | Apoyo |
| 9 | -2.250 | 0.0 | -23.850 | eeelll | Apoyo |

**Definición de Barras**

| Filtrar | Barra | Elemento |
|---|---|---|
| Lista compl | 1A6 | 1A3 5A7 |
| Selección | 1A6 | 1A3 5A7 |
| | | |
| Número tot | 6 | 6 |
| Número sel | 6 | 6 |

| Barra | Nudos | Nudo 2 | Sección | Material | Longitud (m) | Gama (Deg) | Tipo |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | Fuste1 | HORMIGON | 1.050 | 90.0 | Columna de hormigón armado |
| 2 | 2 | 3 | Fuste2 | HORMIGON | 8.700 | 90.0 | Columna de hormigón armado |
| 3 | 4 | 6 | Pilote150 | HORMIGON | 8.000 | 0.0 | Columna de hormigón armado |
| 4 | 6 | 8 | Pilote150 | HORMIGON | 4.200 | 0.0 | Columna de hormigón armado |
| 5 | 5 | 7 | Pilote150 | HORMIGON | 8.000 | 0.0 | Columna de hormigón armado |
| 6 | 7 | 9 | Pilote150 | HORMIGON | 4.200 | 0.0 | Columna de hormigón armado |





**Características de las Barras**

| Nombre de la sección | Lista de barras | SX (m^2) | SY (m^2) | SZ (m^2) | IX (m^4) | IY (m^4) | IZ (m^4) |
|---|---|---|---|---|---|---|---|
| Fuste1 | 1 | 6.120 | 5.100 | 5.100 | 1.515 | 0.413 | 23.582 |
| Fuste2 | 2 | 13.600 | 11.333 | 11.333 | 14.772 | 4.533 | 52.405 |
| Pilote150 | 3A6 | 1.767 | 1.491 | 1.491 | 0.497 | 0.249 | 0.249 |

**Definición Cargas - Casos: 1A10**

| Caso | Nombre del caso | Naturaleza | tipo de análisis |
|---|---|---|---|
| 1 | Peso Propio | permanente | Estático lineal |
| 2 | Permanentes Losa | permanente | Estático lineal |
| 3 | Permanentes Pérgola | permanente | Estático lineal |
| 4 | Sobrecargas Losa HIP.1 | explotación | Estático lineal |
| 5 | Sobrecargas Pérgola HIP. 1 | explotación | Estático lineal |
| 6 | Sobrecargas Losa HIP. 2 | explotación | Estático lineal |
| 7 | Sobrecargas Pérgola HIP. 2 | explotación | Estático lineal |
| 8 | Lazo+Centrif.+0.6*Viento | explotación | Estático lineal |
| 9 | 0.8*(Lazo+Centrif.)+Viento | explotación | Estático lineal |
| 10 | Frenado Pérgola | explotación | Estático lineal |

| | Caso | Nombre del caso | Tipo de carga | Lista | Valores de carga |
|---|---|---|---|---|---|
| | 1 | Peso Propio | peso propio | 1A6 | PZ Menos |
| | 2 | Permanentes Losa | fuerza nodal | 2 | FY=-12.600(T) FZ=-128.800(T) CX=64.400(Tm) CY=9.000(Tm) |
| | 3 | Permanentes Pérgola | fuerza nodal | 1 | FY=12.000(T) FZ=-77.200(T) CX=-42.500(Tm) CY=124.000(Tm) |
| | 4 | Sobrecargas Losa HIP.1 | fuerza nodal | 2 | FZ=-157.200(T) CX=78.600(Tm) CY=76.700(Tm) |
| | 5 | Sobrecargas Pérgola HIP. 1 | fuerza nodal | 1 | FZ=-70.100(T) CX=-38.600(Tm) |
| | 6 | Sobrecargas Losa HIP. 2 | fuerza nodal | 2 | FZ=-91.500(T) CX=45.800(Tm) CY=181.900(Tm) |
| | 7 | Sobrecargas Pérgola HIP. 2 | fuerza nodal | 1 | FZ=-13.500(T) CX=-7.400(Tm) CY=40.500(Tm) |
| | 8 | Lazo+Centrif.+0.6*Viento | fuerza nodal | 1 | FX=67.400(T) |
| | 9 | 0.8*(Lazo+Centrif.)+Viento | fuerza nodal | 1 | FX=58.800(T) |
| | 10 | Frenado Pérgola | fuerza nodal | 1 | FY=43.700(T) |





**Combinaciones de casos - Casos: 11A26**

**- Casos: 11A26**

| Filtrar | Combinación |
|---|---|
| Lista completa | 11A26 |
| Selección | 11A26 |
| | |
| Número total | 16 |
| Número seleccionado | 16 |

**- Casos: 11A26**

| Combinación | Nombre | Tipo de análisis | Naturaleza de combinación | Naturaleza de caso | Definición |
|---|---|---|---|---|---|
| 11 (C) | AXIL MÁXIMO 1 | Combinación lineal | ELS | permanente | (1+2+3+4+5)*1.00 |
| 12 (C) | AXIL MÁXIMO 2 | Combinación lineal | ELS | permanente | (1+2+3+4+5+8)*1.00 |
| 13 (C) | AXIL MÁXIMO 3 | Combinación lineal | ELS | permanente | (1+2+3+4+5+9)*1.00 |
| 14 (C) | AXIL MÁXIMO 4 | Combinación lineal | ELS | permanente | (1+2+3+4+5+10)*1.00 |
| 15 (C) | MOM TRANSV MÁX 1 | Combinación lineal | ELS | permanente | (1+2+3+6+7+8)*1.00 |
| 16 (C) | MOM TRANSV MÁX 2 | Combinación lineal | ELS | permanente | (1+2+3+6+7+9)*1.00 |
| 17 (C) | MOM TRANSV MÁX 3 | Combinación lineal | ELS | permanente | (1+2+3+6+7+10)*1.00 |
| 18 (C) | MOM LONG MÁX 1 | Combinación lineal | ELS | permanente | (1+2+3+5+10)*1.00 |
| 19 (C) | AXIL MÁXIMO 1 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5)*1.50 |
| 20 (C) | AXIL MÁXIMO 2 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5+8)*1.50 |
| 21 (C) | AXIL MÁXIMO 3 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5+9)*1.50 |
| 22 (C) | AXIL MÁXIMO 4 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(4+5+10)*1.50 |
| 23 (C) | MOM TRANSV MÁX 1 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(6+7+8)*1.50 |
| 24 (C) | MOM TRANSV MÁX 2 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(6+7+9)*1.50 |
| 25 (C) | MOM TRANSV MÁX 3 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(6+7+10)*1.50 |
| 26 (C) | MOM LONG MÁX 1 | Combinación lineal | ELU | permanente | (1+2+3)*1.35+(5+10)*1.50 |

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DIMENSIONAMIENTO FUSTE EN PILA 1

1. A flexión

Esfuerzos en hipótesis de axil máximo

$N_d$ = 1040'3 T

$M_{d,long}$ = 79'6 Tm

$M_{d,trans}$ = -294'6 Tm

Esfuerzos en hipótesis de axil mínimo

$N_d$ = 405'0 T

$M_{d,long}$ = -114'2 Tm

$M_{d,trans}$ = -179'6 Tm

Esfuerzos en hipótesis de momento long. máximo

$N_d$ = 804'5 T

$M_{d,long}$ = -677'4 Tm

$M_{d,trans}$ = -179'6 Tm

Esfuerzos en hipótesis de mom. transversal máximo

$N_d$ = 856'8 T

$M_{d,long}$ = 77'2 Tm

$M_{d,trans}$ = -1498'9 Tm



**Esfuerzos - Casos: 19A26**
**Envolvente**
**1**

**- Casos: 19A26**

| Filtrar | Barra | Caso |
|---|---|---|
| Lista completa | 1A6 | 1A26 |
| Selección | 2 | 19A26 |
| | | |
| Número total | 6 | 26 |
| Número seleccionado | 1 | 8 |

**- Casos: 19A26**

| Barra/Punto/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 2/ 3/ 19 (C) | **1040.297>>** | 0.000 | 0.810 | 0.0 | 79.602 | -294.600 |
| 2/ 2/ 26 (C) | **404.950<<** | 0.000 | -64.740 | 0.0 | -114.172 | -179.550 |
| 2/ 2/ 23 (C) | 457.300 | **101.100>>** | 0.810 | 0.0 | 70.155 | -619.305 |
| 2/ 2/ 26 (C) | 404.950 | **0.000<<** | -64.740 | 0.0 | -114.172 | -179.550 |
| 2/ 2/ 23 (C) | 457.300 | 101.100 | **0.810>>** | 0.0 | 70.155 | -619.305 |
| 2/ 2/ 22 (C) | 640.750 | 0.000 | **-64.740<<** | 0.0 | 3.728 | -294.600 |
| 2/ 2/ 19 (C) | 640.750 | 0.000 | 0.810 | **0.0>>** | 72.555 | -294.600 |
| 2/ 2/ 19 (C) | 640.750 | 0.000 | 0.810 | **0.0<<** | 72.555 | -294.600 |
| 2/ 3/ 20 (C) | 1040.297 | 101.100 | 0.810 | 0.0 | **79.602>>** | -1280.325 |
| 2/ 3/ 26 (C) | 804.497 | 0.000 | -64.740 | 0.0 | **-677.410<<** | -179.550 |
| 2/ 2/ 26 (C) | 404.950 | 0.000 | -64.740 | 0.0 | -114.172 | **-179.550>>** |
| 2/ 3/ 23 (C) | 856.847 | 101.100 | 0.810 | 0.0 | 77.202 | **-1498.875<<** |

**PRONTUARIO INFORMÁTICO DEL HORMIGÓN ESTRUCTURAL 3.0**
**Cátedra de Hormigón Estructural ETSICCPM - IECA**

Obra: General
Fecha: 07/05/2004
Hora: 14:55:42

## Cálculo de secciones a flexión compuesta esviada

## 1 Datos

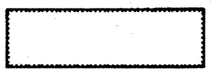
- Materiales

Tipo de hormigón : HA-30
Tipo de acero : B-500-S
fck [MPa] = 30.00
fyk [MPa] = 500.00
γc = 1.50
γs = 1.15

- Sección

Sección : FUSTE1
b [m] = 6.80
h [m] = 2.00
r [m] = 0.050

nº barras horizontales = 46
nº barras verticales = 13

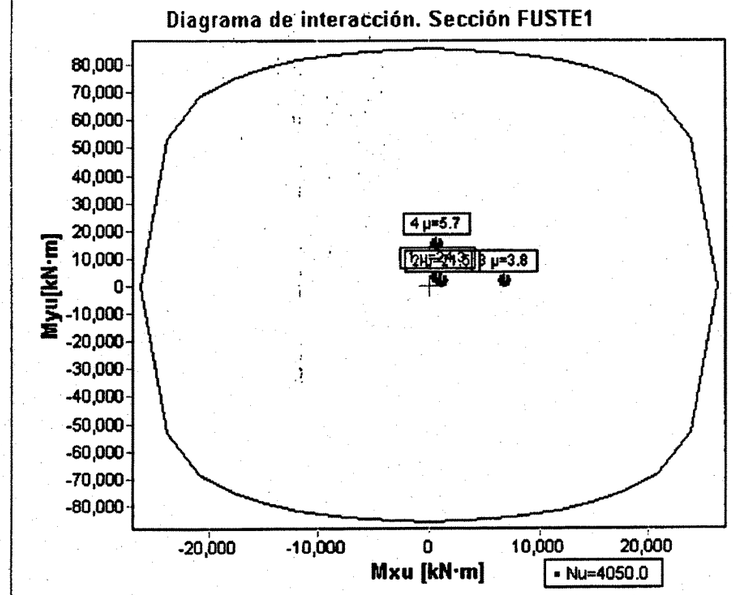


## 2 Diagrama

ϕ [mm] = 25

Resultados numéricos del diagrama de interacción

| Nu [kN] | Mxu [kN·m] | Myu [kN·m] | x [cm] | 1/r [1/m] ·1.E-3 | β [º] |
|---|---|---|---|---|---|
| -4050.0 | 26370.9 | -0.4 | 0.22 | 5.8 | 0.0 |
| -4050.0 | 23860.6 | 53297.8 | 0.71 | 4.2 | 10.0 |
| -4050.0 | 20880.2 | 68288.8 | 1.01 | 3.2 | 20.0 |
| -4050.0 | 17892.4 | 74904.7 | 1.20 | 2.6 | 30.0 |
| -4050.0 | 14820.5 | 78905.8 | 1.31 | 2.2 | 40.0 |
| -4050.0 | 11733.7 | 81616.8 | 1.34 | 2.0 | 50.0 |
| -4050.0 | 8593.0 | 83532.6 | 1.31 | 1.8 | 60.0 |
| -4050.0 | 5611.9 | 84768.1 | 1.23 | 1.7 | 70.0 |
| -4050.0 | 2774.5 | 85510.4 | 1.10 | 1.7 | 80.0 |
| -4050.0 | 0.6 | 85850.8 | 0.93 | 1.7 | 90.0 |
| -4050.0 | -2773.8 | 85510.5 | 1.10 | 1.7 | 100.0 |
| -4050.0 | -5611.6 | 84768.2 | 1.23 | 1.7 | 110.0 |
| -4050.0 | -8592.6 | 83532.8 | 1.31 | 1.8 | 120.0 |
| -4050.0 | -11733.3 | 81617.2 | 1.34 | 2.0 | 130.0 |
| -4050.0 | -14820.5 | 78905.8 | 1.31 | 2.2 | 140.0 |
| -4050.0 | -17892.4 | 74904.7 | 1.20 | 2.6 | 150.0 |
| -4050.0 | -20880.2 | 68288.8 | 1.01 | 3.2 | 160.0 |
| -4050.0 | -23860.6 | 53297.8 | 0.71 | 4.2 | 170.0 |
| -4050.0 | -26370.9 | -0.4 | 0.22 | 5.8 | 180.0 |
| -4050.0 | -23860.4 | -53298.7 | 0.71 | 4.2 | 190.0 |
| -4050.0 | -20880.1 | -68289.0 | 1.01 | 3.2 | 200.0 |
| -4050.0 | -17891.6 | -74906.0 | 1.20 | 2.6 | 210.0 |
| -4050.0 | -14818.4 | -78908.3 | 1.31 | 2.2 | 220.0 |
| -4050.0 | -11733.3 | -81617.2 | 1.34 | 2.0 | 230.0 |
| -4050.0 | -8592.6 | -83532.8 | 1.31 | 1.8 | 240.0 |
| -4050.0 | -5611.6 | -84768.2 | 1.23 | 1.7 | 250.0 |
| -4050.0 | -2773.8 | -85510.5 | 1.10 | 1.7 | 260.0 |
| -4050.0 | 0.6 | -85850.8 | 0.94 | 1.7 | 270.0 |
| -4050.0 | 2774.5 | -85510.4 | 1.10 | 1.7 | 280.0 |
| -4050.0 | 5611.9 | -84768.1 | 1.23 | 1.7 | 290.0 |
| -4050.0 | 8593.0 | -83532.6 | 1.31 | 1.8 | 300.0 |
| -4050.0 | 11733.7 | -81616.8 | 1.34 | 2.0 | 310.0 |
| -4050.0 | 14818.4 | -78908.3 | 1.31 | 2.2 | 320.0 |
| -4050.0 | 17891.6 | -74906.0 | 1.20 | 2.6 | 330.0 |
| -4050.0 | 20880.1 | -68289.0 | 1.01 | 3.2 | 340.0 |
| -4050.0 | 23860.4 | -53298.7 | 0.71 | 4.2 | 350.0 |




Coeficientes de seguridad de los pares de esfuerzos de cálculo

| Punto | Mxd [kN·m] | Myd [kN·m] | γ |
|---|---|---|---|
| 1 | 796 | 2946 | 24.32 |
| 2 | 1142 | 1796 | 21.50 |
| 3 | 6774 | 1796 | 3.84 |
| 4 | 772 | 14989 | 5.68 |

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DIMENSIONAMIENTO FUSTE EN PILA 1

2. A cortante

- Esfuerzos en hipótesis de Cortante transv. máximo

Nd = 457'3 T

Vd = 101'1 T

- Esfuerzos en hipótesis de cortante long. máximo

Nd = 640'8 T

Vd = 64'7 T

Se dispone la armadura mínima de cortante

$A_{sc,min}$ = 6'8 cm²/m ⟺ 11 cφ10 cada 0'25 m

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Fuste en pila 1.**

**FUSTE EN PILA 1. Hipótesis de Máximo Cortante Transversal**

| | |
|---|---|
| D(mm) | 6400 |
| fck(N/mm2) | 30 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 2000 |
| As(cm2) | 63.7 |
| Vrd(Tn) | 101.10 |
| N(Tn) | -457.3 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.177 |
| Roele | 0.0005 |
| Sigmaprima (N/mm2) | -0.35 |
| Vu2 (N) | 2738783.1 |

[redacted]

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 1721555.13 |
| Vsu,p | 2304000.00 |

[redacted]

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 133850 |
| Sigmacd (N/mm2) | 0.3416511 |
| K | 1 |
| f1cd (N/mm2) | 12 |
| Vu1 (N) | 76800000 |

**Verificada la resistencia del alma a la compresión**

**CÁLCULO DE LA ARMADURA MÍNIMA DE CORTANTE**

α (en grados) = 90 As, c mín. (cm2/m) = [redacted]

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Fuste en pila 1.**

**FUSTE EN PILA 1. Hipótesis de Máximo Cortante Longitudinal**

| | |
|---|---|
| D(mm) | 1900 |
| fck(N/mm2) | 30 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 6800 |
| As(cm2) | 225.4 |
| Vrd(Tn) | 64.70 |
| N(Tn) | -640.8 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

**VERIFICACIÓN DE LA NECESIDAD DE ARMADURA DE CORTANTE**

| | |
|---|---|
| PSI | 1.324 |
| Roele | 0.0017 |
| Sigmaprima (N/mm2) | -0.49 |
| Vu2 (N) | 4508115.0 |

[redacted]

**OBTENCIÓN DE LA ARMADURA DE CORTANTE NECESARIA**

| | |
|---|---|
| Theta | |
| Vu2 | 2970981.53 |
| Vsu,p | 684000.00 |

[redacted]

**VERIFICACIÓN DE LA COMPRESIÓN OBLICUA DEL ALMA**

| | |
|---|---|
| Ac (cm2) | 133850 |
| Sigmacd (N/mm2) | 0.47874486 |
| K | 1 |
| f1cd (N/mm2) | 12 |
| Vu1 (N) | 77520000 |

**Verificada la resistencia del alma a la compresión**

**CÁLCULO DE LA ARMADURA MÍNIMA DE CORTANTE**

α (en grados) = 90 As, c mín. (cm2/m) = [redacted]

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ARMADURA EN APOYOS DE LOSA POSTESADA

$R_{d,max} = 1'5 \cdot 231'4 = 347\ T \Rightarrow$

$\Rightarrow A_{s,ap} \geq 22\ cm^2$

$2\ \#\ 4+4\phi 20$

ó

$1\ \#\ 5\phi 25$

ARMADURA BAJO APOYOS DE LOSA ARMADA EN PÉRGOLA

$R_{d,max} = 1'5 \cdot 62'8 = 94'2\ T$

$A_{s,ap} \geq 6\ cm^2 \Leftrightarrow \#\ 3\phi 16$

ARMADURA BAJO APOYO DE PÉRGOLA

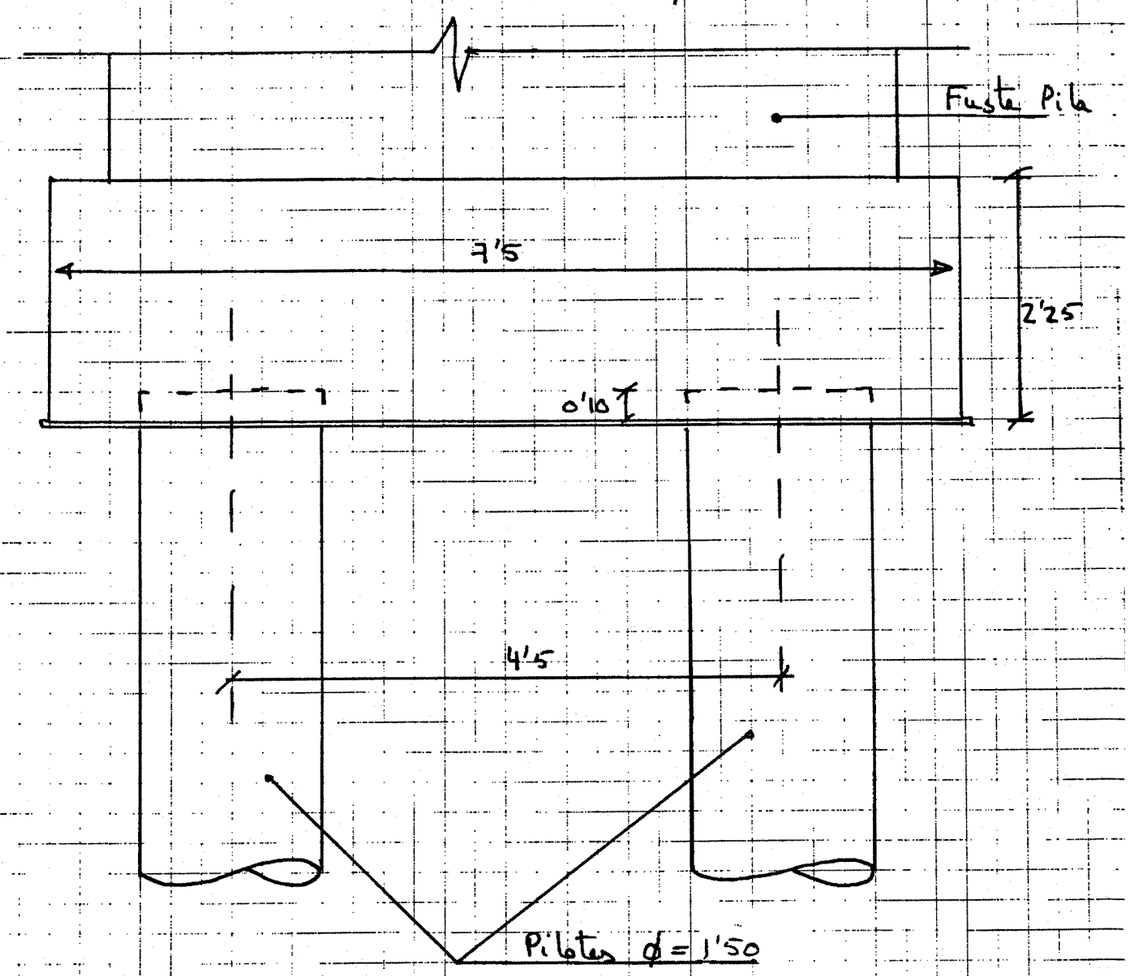
$R_{d,max} = 1'5 \cdot 61'6 = 92'4\ T$

$A_{s,ap} \geq 6\ cm^2 \Leftrightarrow \#\ 3\phi 16$

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GEOMETRÍA ENCEPADO 2 PILOTES $\phi = 1'5$ m



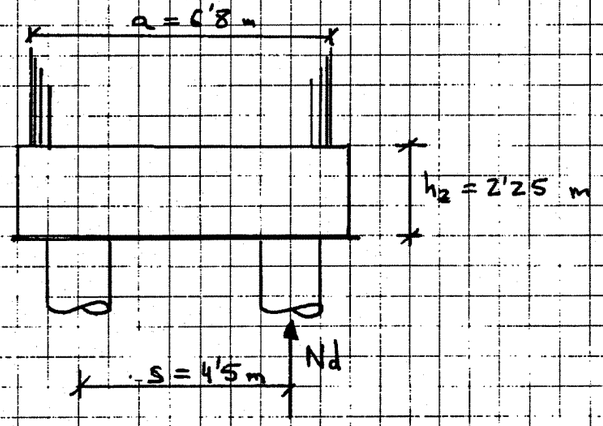
PEDELTA
INGENIERIA CIVIL

FECHA HOJA

# DIMENSIONAMIENTO DEL ENCEPADO EN P-1

## A flexión

$N_d = 1'5 \cdot 688'6 = 1033$ T/pilote




$b_2$ = ancho encepado = 2'4 m

Se aplica método de bielas y tirantes según formulación del art. 59.4.1.2.1 de la EHE.

$$T_d = \frac{N_d\,(v + 0'25 \cdot a)}{0'85 \cdot d} = A_s \cdot f_{yd}$$

$v = 0$, $d = 2'15$ m $\Rightarrow$ $T_d = 310'9$ T $\Rightarrow A_s \geq 78$ cm² $\Rightarrow$

$\Rightarrow$ $\phi 25$ a 0'15 ($16\phi 25$)

Arm. principal

Armadura secundaria

Horizontal $\begin{cases} A_{s,sup} = 16\phi 16 \ (\phi 16 \text{ a } 0'15) \\ A_{s,sup} \geq \frac{1}{3} A_{s,inf} \end{cases}$

Vertical $\rightarrow$ Por torsión

## A torsión

$T_d = \frac{750}{2}$ T (Torsor solicitante)

Según hoja adjunta:

$\frac{A_s}{s_t} = 10$ cm²/m $\Longleftrightarrow$ c $\phi 16$ a 0'20

$A_l = 91'5$ cm²

$\left.\begin{matrix} A_{s,sup} = 17\phi 16 \\ A_{s,lat} = 2 \times 15\phi 16 \end{matrix}\right\} = 94'5$ cm²

## DIMENSIONAMIENTO DE LA ARMADURA DEBIDA A TORSIÓN PURA.

Según el artículo 45.2 de la EHE.

| | | | |
|---|---|---|---|
| **Proyecto:** | VIADUCTO PUERTO-MARTORELL | | |
| **Elemento:** | PILA 1 | **Fecha:** | 07/05/2004 |
| **Sección:** | ENCEPADO | | |

**DATOS:**

| | | | |
|---|---|---|---|
| Ae (cm2) = | 45100.00 | Td (kpcm) = | 37,500,000 |
| he (cm) = | 20.00 | | |
| Ue (cm) = | 850.00 | | |
| | | fcd (kp/cm2) = | 167 |
| α = | 1.2 | fytd (kp/cm2) = | 4000 |
| Θ = | 44.00 | fyld (kp/cm2) = | 4000 |

**CÁLCULOS:**

f1cd (kp/cm2) = 100 CotgΘ= 1.04

$$Tu1 = \alpha \cdot f_{1cd} \cdot A_e \cdot h_e \cdot \frac{\cot g\theta}{1+(\cot g\theta)^2}$$

Tu1 (kpcm) = 54,195,206

$$\frac{A_t}{S_t} \geq \frac{T_d}{f_{yt,d} \cdot \cot g\theta \cdot 2 \cdot A_e}$$

At/St (cm2/ml) = 10.04

$$A_l = \frac{T_d \cdot U_e}{2 \cdot A_e \cdot f_{yl,d}}$$

Al (cm2) = 91.48

**DIMENSIONAMIENTO:**

Arm. Transversal o estribos:

| | | | |
|---|---|---|---|
| ϕ (mm) = | 16 | At (cm2) = | 2.01 |
| St (cm) = | 20 | At/St = | 10.05 |

Armadura Longitudinal:

| | | | |
|---|---|---|---|
| ϕ (mm) = | 16 | Al (cm2) = | 92.44 |
| N. Barras = | 46 | | |

**Observaciones:**

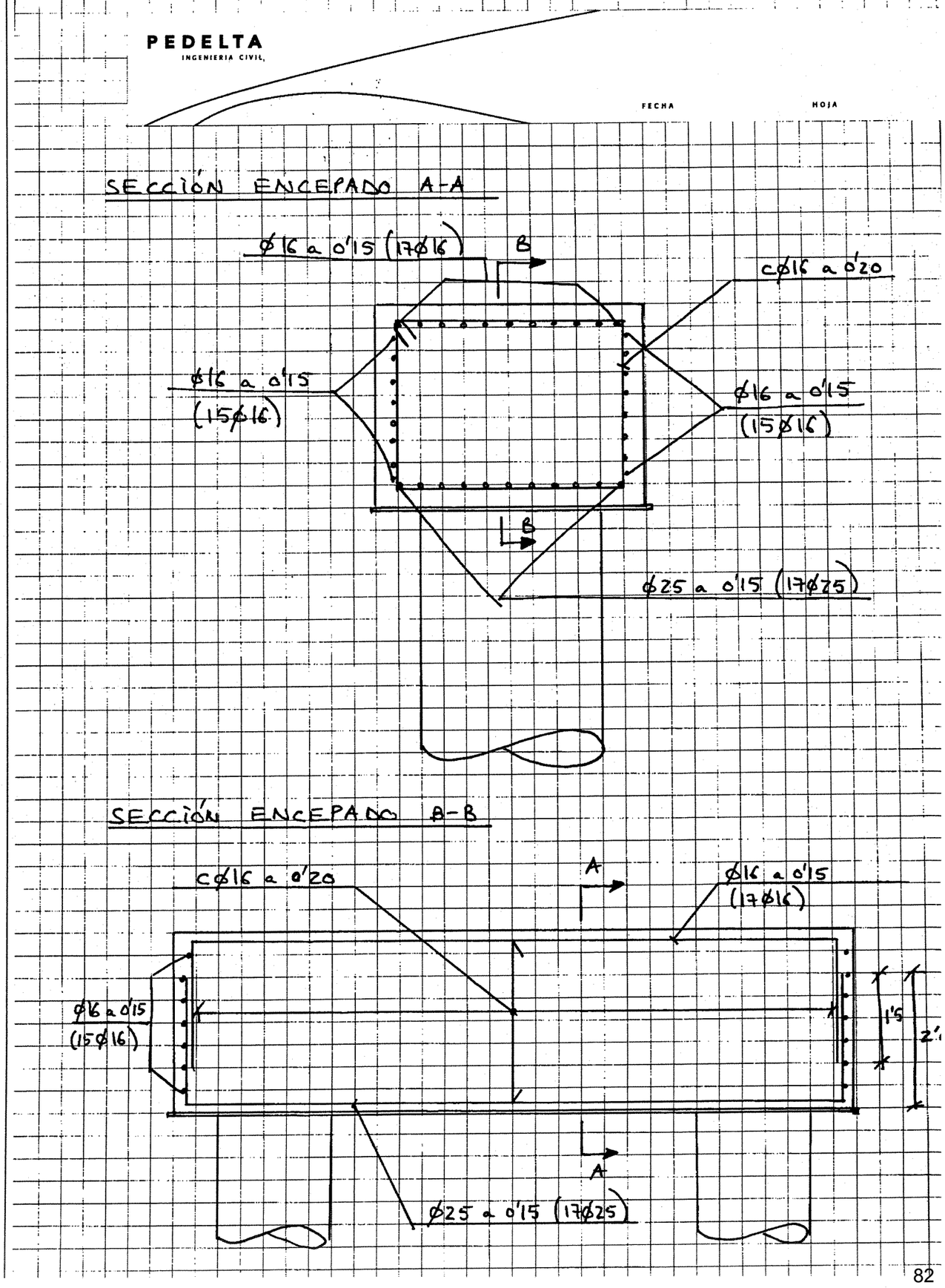
α es igual a 1,2 si hay estribos únicamente a lo largo del perímetro exterior de la pieza. Si se colocan estribos cerrados la cara interior y la exterior de la sección hueca equivalente, entonces a es igual a 1,5.

CotgΘ debe estar comprendida entre 0,4 y 2,5.

Al es la armadura longitudinal necesaria por torsión y debe estar repartida a lo largo del perímetro de la sección.

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**Reacciones sistema de coordenadas global - Casos: 11A18**
**Valores**
**1**

**sistema de coordenadas global - Casos: 11A18**

| Filtrar | Nudo | Caso |
|---|---|---|
| Lista completa | 1A9 | 1A26 |
| Selección | 8 9 | 11A18 |
| | | |
| Número total | 9 | 26 |
| Número seleccion | 2 | 8 |

**sistema de coordenadas global - Casos: 11A18**

| Nudo/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 8/ 11 (C) | 1.159 | -2.180 | 466.027 | -0.000 | -0.000 | 0.000 |
| 8/ 12 (C) | 13.741 | -2.180 | 688.606 | -0.000 | -0.000 | 0.000 |
| 8/ 13 (C) | 12.135 | -2.180 | 660.206 | -0.000 | 0.000 | 0.000 |
| 8/ 14 (C) | 1.159 | 29.303 | 466.027 | -0.000 | -0.000 | -0.000 |
| 8/ 15 (C) | 14.546 | -2.123 | 654.854 | -0.000 | -0.000 | 0.000 |
| 8/ 16 (C) | 12.940 | -2.123 | 626.453 | -0.000 | 0.000 | 0.000 |
| 8/ 17 (C) | 1.964 | 29.361 | 432.275 | -0.000 | -0.000 | -0.000 |
| 8/ 18 (C) | 0.735 | 32.127 | 373.004 | -0.000 | -0.000 | -0.000 |
| 9/ 11 (C) | 1.159 | -2.180 | 387.163 | 0.000 | -0.000 | 0.000 |
| 9/ 12 (C) | 13.741 | -2.180 | 164.584 | 0.000 | -0.000 | 0.000 |
| 9/ 13 (C) | 12.135 | -2.180 | 192.984 | 0.000 | -0.000 | 0.000 |
| 9/ 14 (C) | 1.159 | 29.303 | 387.163 | 0.000 | -0.000 | -0.000 |
| 9/ 15 (C) | 14.546 | -2.123 | 76.036 | 0.000 | -0.000 | 0.000 |
| 9/ 16 (C) | 12.940 | -2.123 | 104.437 | 0.000 | -0.000 | 0.000 |
| 9/ 17 (C) | 1.964 | 29.361 | 298.615 | 0.000 | -0.000 | -0.000 |
| 9/ 18 (C) | 0.735 | 32.127 | 322.985 | 0.000 | -0.000 | -0.000 |
| | | | | | | |
| Caso 11 (C) | AXIL MÁXIMO 1 | | | | | |
| Suma final | 2.317 | -4.361 | 853.190 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -0.000 | 0.600 | 853.190 | -48.670 | -209.700 | 0.000 |
| Suma de esfuerzo | 0.0 | -0.600 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 4.70217e+000 | 5.11606e-017 | | | | |
| | | | | | | |
| Caso 12 (C) | AXIL MÁXIMO 2 | | | | | |
| Suma final | 27.482 | -4.361 | 853.190 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -67.400 | 0.600 | 853.190 | -48.670 | -209.700 | 0.000 |
| Suma de esfuerzo | 67.400 | -0.600 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 5.00499e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 13 (C) | AXIL MÁXIMO 3 | | | | | |
| Suma final | 24.271 | -4.361 | 853.190 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -58.800 | 0.600 | 853.190 | -48.670 | -209.700 | 0.000 |
| Suma de esfuerzo | 58.800 | -0.600 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 5.70217e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 14 (C) | AXIL MÁXIMO 4 | | | | | |
| Suma final | 2.317 | 58.607 | 853.190 | -0.000 | -0.000 | -0.000 |
| Suma de reaccion | -0.000 | -43.100 | 853.190 | -48.670 | -209.700 | 0.000 |





| Nudo/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| Suma de esfuerzo | 0.0 | 43.100 | -853.190 | 48.670 | 209.700 | 0.0 |
| Verificación | -0.000 | 0.000 | -0.000 | 0.000 | -0.000 | 0.000 |
| Precisión: | 1.44522e+001 | 4.26274e-013 | | | | |
| | | | | | | |
| Caso 15 (C) | MOM TRANSV MÁX 1 | | | | | |
| Suma final | 29.092 | -4.246 | 730.890 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -67.400 | 0.600 | 730.890 | -47.070 | -355.400 | 0.000 |
| Suma de esfuerzo | 67.400 | -0.600 | -730.890 | 47.070 | 355.400 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 6.00499e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 16 (C) | MOM TRANSV MÁX 2 | | | | | |
| Suma final | 25.881 | -4.246 | 730.890 | -0.000 | -0.000 | 0.000 |
| Suma de reaccion | -58.800 | 0.600 | 730.890 | -47.070 | -355.400 | 0.000 |
| Suma de esfuerzo | 58.800 | -0.600 | -730.890 | 47.070 | 355.400 | 0.0 |
| Verificación | -0.000 | -0.000 | -0.000 | -0.000 | -0.000 | 0.000 |
| Precisión: | 6.70217e+000 | 1.00000e+000 | | | | |
| | | | | | | |
| Caso 17 (C) | MOM TRANSV MÁX 3 | | | | | |
| Suma final | 3.927 | 58.722 | 730.890 | -0.000 | -0.000 | -0.000 |
| Suma de reaccion | -0.000 | -43.100 | 730.890 | -47.070 | -355.400 | 0.000 |
| Suma de esfuerzo | 0.0 | 43.100 | -730.890 | 47.070 | 355.400 | 0.0 |
| Verificación | -0.000 | 0.000 | -0.000 | 0.000 | -0.000 | 0.000 |
| Precisión: | 1.54522e+001 | 4.26274e-013 | | | | |
| | | | | | | |
| Caso 18 (C) | MOM LONG MÁX 1 | | | | | |
| Suma final | 1.470 | 64.253 | 695.990 | -0.000 | -0.000 | -0.000 |
| Suma de reaccion | -0.000 | -43.100 | 695.990 | 29.930 | -133.000 | 0.000 |
| Suma de esfuerzo | 0.0 | 43.100 | -695.990 | -29.930 | 133.000 | 0.0 |
| Verificación | -0.000 | 0.000 | -0.000 | 0.000 | -0.000 | 0.000 |
| Precisión: | 1.34522e+001 | 4.26274e-013 | | | | |

**Esfuerzos - Casos: 19A26**
**Envolvente**
**1**

**- Casos: 19A26**

| Filtrar | Barra | Caso |
|---|---|---|
| Lista completa | 1A6 | 1A26 |
| Selección | 3A6 | 19A26 |
| | | |
| Número total | 6 | 26 |
| Número seleccionado | 4 | 8 |

**- Casos: 19A26**

| Barra/Punto/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 3/ 6/ 20 (C) | | 3.815 | 14.017 | 0.000 | 87.586 | 21.894 |
| 3/ 4/ 26 (C) | | 32.370 | 0.000 | 0.000 | 13.809 | -400.208 |
| 3/ 4/ 22 (C) | 575.546 | | 0.000 | 0.000 | 22.657 | -341.258 |
| 3/ 6/ 26 (C) | 483.750 | | -1.301 | 0.000 | 7.020 | -304.982 |
| 3/ 4/ 23 (C) | 858.785 | -0.405 | | 0.000 | -122.831 | 39.370 |
| 3/ 6/ 25 (C) | 572.656 | -31.711 | | 0.000 | 20.062 | -275.625 |
| 3/ 4/ 22 (C) | 575.546 | 32.370 | 0.000 | | 22.657 | -341.258 |
| 3/ 4/ 23 (C) | 858.785 | -0.405 | 50.550 | | -122.831 | 39.370 |
| 3/ 6/ 23 (C) | 906.524 | 3.702 | 12.433 | 0.000 | | 21.284 |
| 3/ 4/ 20 (C) | 909.414 | -0.405 | 50.550 | 0.000 | | 40.570 |
| 3/ 4/ 19 (C) | 575.546 | -0.405 | 0.000 | 0.000 | 22.657 | |
| 3/ 3/9/ 26 (C) | 447.946 | 3.643 | -0.566 | 0.000 | 13.208 | |
| 4/ 8/ 20 (C) | | 3.159 | -20.501 | 0.000 | -0.000 | 0.000 |
| 4/ 6/ 26 (C) | | -37.151 | -1.301 | -0.000 | 7.020 | -304.982 |
| 4/ 5/9/ 19 (C) | 635.816 | | -3.169 | 0.000 | 5.458 | 10.536 |
| 4/ 5/9/ 26 (C) | 496.282 | | -1.931 | -0.000 | 3.326 | -157.355 |
| 4/ 6/ 20 (C) | 957.153 | 3.815 | | 0.000 | 87.586 | 21.894 |
| 4/ 6/9/ 23 (C) | 922.189 | 5.638 | | 0.000 | 48.028 | 7.204 |
| 4/ 6/ 23 (C) | 906.524 | 3.702 | 12.433 | | 96.130 | 21.284 |
| 4/ 6/ 26 (C) | 483.750 | -37.151 | -1.301 | | 7.020 | -304.982 |
| 4/ 2/9/ 23 (C) | 909.657 | 4.772 | -4.088 | 0.000 | | 19.043 |
| 4/ 8/ 24 (C) | 888.987 | 3.073 | -19.300 | 0.000 | | 0.000 |
| 4/ 6/ 19 (C) | 623.285 | 3.815 | -2.134 | 0.000 | 11.517 | |
| 4/ 6/ 26 (C) | 483.750 | -37.151 | -1.301 | -0.000 | 7.020 | |
| 5/ 7/ 19 (C) | | 3.815 | -2.134 | 0.000 | 11.517 | 21.894 |
| 5/ 5/ 23 (C) | | -0.405 | 50.550 | 0.000 | -122.831 | 39.370 |
| 5/ 5/ 22 (C) | 464.752 | | 0.000 | 0.000 | 22.657 | -341.258 |
| 5/ 7/ 26 (C) | 416.225 | | -1.301 | 0.000 | 7.020 | -304.982 |
| 5/ 5/ 23 (C) | -1.938 | -0.405 | | 0.000 | -122.831 | 39.370 |
| 5/ 7/ 25 (C) | 379.670 | -31.711 | | 0.000 | 20.062 | -275.625 |
| 5/ 5/ 22 (C) | 464.752 | 32.370 | 0.000 | | 22.657 | -341.258 |
| 5/ 5/ 23 (C) | -1.938 | -0.405 | 50.550 | | -122.831 | 39.370 |
| 5/ 7/ 23 (C) | 45.801 | 3.702 | 12.433 | 0.000 | | 21.284 |
| 5/ 5/ 20 (C) | 130.884 | -0.405 | 50.550 | 0.000 | | 40.570 |
| 5/ 5/ 19 (C) | 464.752 | -0.405 | 0.000 | 0.000 | 22.657 | |
| 5/ 3/9/ 26 (C) | 380.421 | 3.643 | -0.566 | 0.000 | 13.208 | |
| 6/ 9/ 19 (C) | | 3.159 | -1.628 | 0.000 | 0.000 | -0.000 |
| 6/ 7/ 23 (C) | | 3.702 | 12.433 | 0.000 | 96.130 | 21.284 |
| 6/ 5/9/ 19 (C) | 525.022 | | -3.169 | 0.000 | 5.458 | 10.536 |
| 6/ 5/9/ 26 (C) | 428.756 | | -1.931 | -0.000 | 3.326 | -157.355 |





| Barra/Punto/Caso | FX (T) | FY (T) | FZ (T) | MX (Tm) | MY (Tm) | MZ (Tm) |
|---|---|---|---|---|---|---|
| 6/ 7/ 20 (C) | 178.622 | 3.815 | | 0.000 | 87.586 | 21.894 |
| 6/ 6/9/ 23 (C) | 61.466 | 5.638 | | 0.000 | 48.028 | 7.204 |
| 6/ 7/ 19 (C) | 512.491 | 3.815 | -2.134 | | 11.517 | 21.894 |
| 6/ 7/ 25 (C) | 379.670 | -31.711 | -3.718 | | 20.062 | -275.625 |
| 6/ 2/9/ 23 (C) | 48.934 | 4.772 | -4.088 | 0.000 | | 19.043 |
| 6/ 9/ 26 (C) | 441.288 | -48.302 | -0.992 | -0.000 | | -0.000 |
| 6/ 7/ 19 (C) | 512.491 | 3.815 | -2.134 | 0.000 | 11.517 | |
| 6/ 7/ 26 (C) | 416.225 | -37.151 | -1.301 | -0.000 | 7.020 | |

# PRONTUARIO INFORMÁTICO DEL HORMIGÓN ESTRUCTURAL 3.0

**Cátedra de Hormigón Estructural ETSICCPM - IECA**

Obra: General
Fecha: 27/04/2004
Hora: 11:25:13

## Cálculo de secciones a flexión compuesta recta

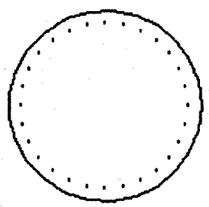
## 1 Datos

- Materiales

Tipo de hormigón : HA-25
Tipo de acero : B-500-S
fck [MPa] = 25.00
fyk [MPa] = 500.00
γc = 1.50
γs = 1.15

- Sección

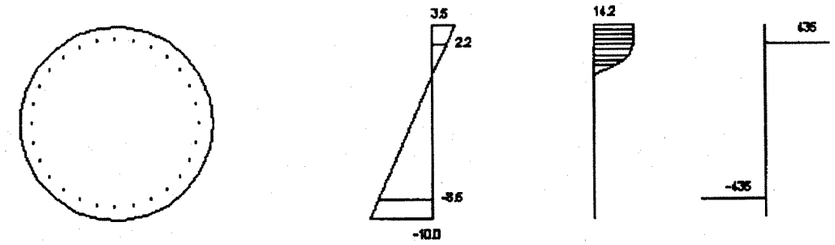
Sección : PIL150
ϕ [m] = 1.50
r [m] = 0.100
nº barras = 28



## 2 Comprobación

ϕ [mm] = 32
Nd [kN] = 0
Md [kN·m] = 4350

Nu [kN] = -0.0
Mu [kN·m] = 5303.7
γ = 1.22




Plano de deformación de agotamiento

x [m] = 0.390
1/r [1/m]·1.E-3 = 9.0
εs ·1.E-3 = 3.5
εi ·1.E-3 = -10.0

Deformación y tensión de armaduras superior e inferior

| Profundidad [m] | Deformación ·1.E-3 | Tensión [MPa] |
|---|---|---|
| 0.147 | 2.2 | -434.8 |
| 1.353 | -8.6 | 434.8 |

## CÁLCULO DE LA ARMADURA DE CORTANTE

**Proyecto: LAV CASTELLBISBAL-PAPIOL.**
**Elemento: Viaducto Puerto Martorell. Pilote en pila 1.**

**PILOTE EN PILA 1**

| | |
|---|---|
| D(mm) | 1400 |
| fck(N/mm2) | 25 |
| Sigma_s(N/mm2) | 400 |
| Bo(mm) | 750 |
| As(cm2) | 74.7 |
| Vrd(Tn) | 87.50 |
| N(Tn) | -429 |

| Limitación de tensión en armadura de cortante (art. 40.2 EHE) |
|---|
| |
| *N<0 para compresión. |

| | |
|---|---|
| PSI | 1.378 |
| Roele | 0.0071 |
| Sigmaprima (N/mm2) | -4.01 |
| Vu2 (N) | 1084483.0 |

| | |
|---|---|
| Theta | |
| Vu2 | 377674.58 |
| Vsu,p | 504000.00 |

| | |
|---|---|
| Ac (cm2) | 17672 |
| Sigmacd (N/mm2) | 2.42756904 |
| K | 1 |
| f1cd (N/mm2) | 10 |
| Vu1 (N) | 5250000 |

**Verificada la resistencia del alma a la compresión**

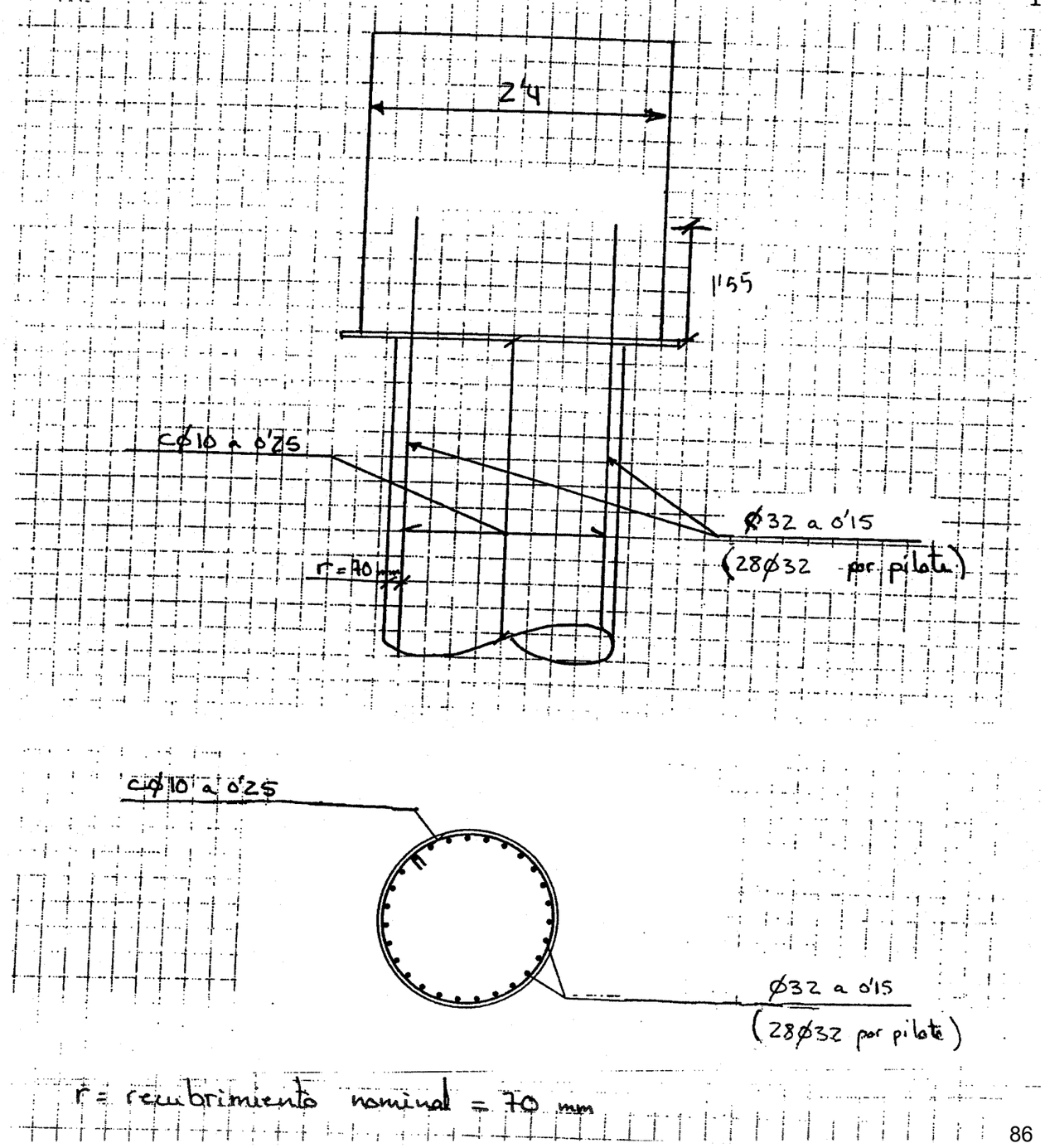
| | | | |
|---|---|---|---|
| α (en grados) = | 90 | As, c mín. (cm2/m) = | |

PEDELTA
INGENIERIA CIVIL

FECHA

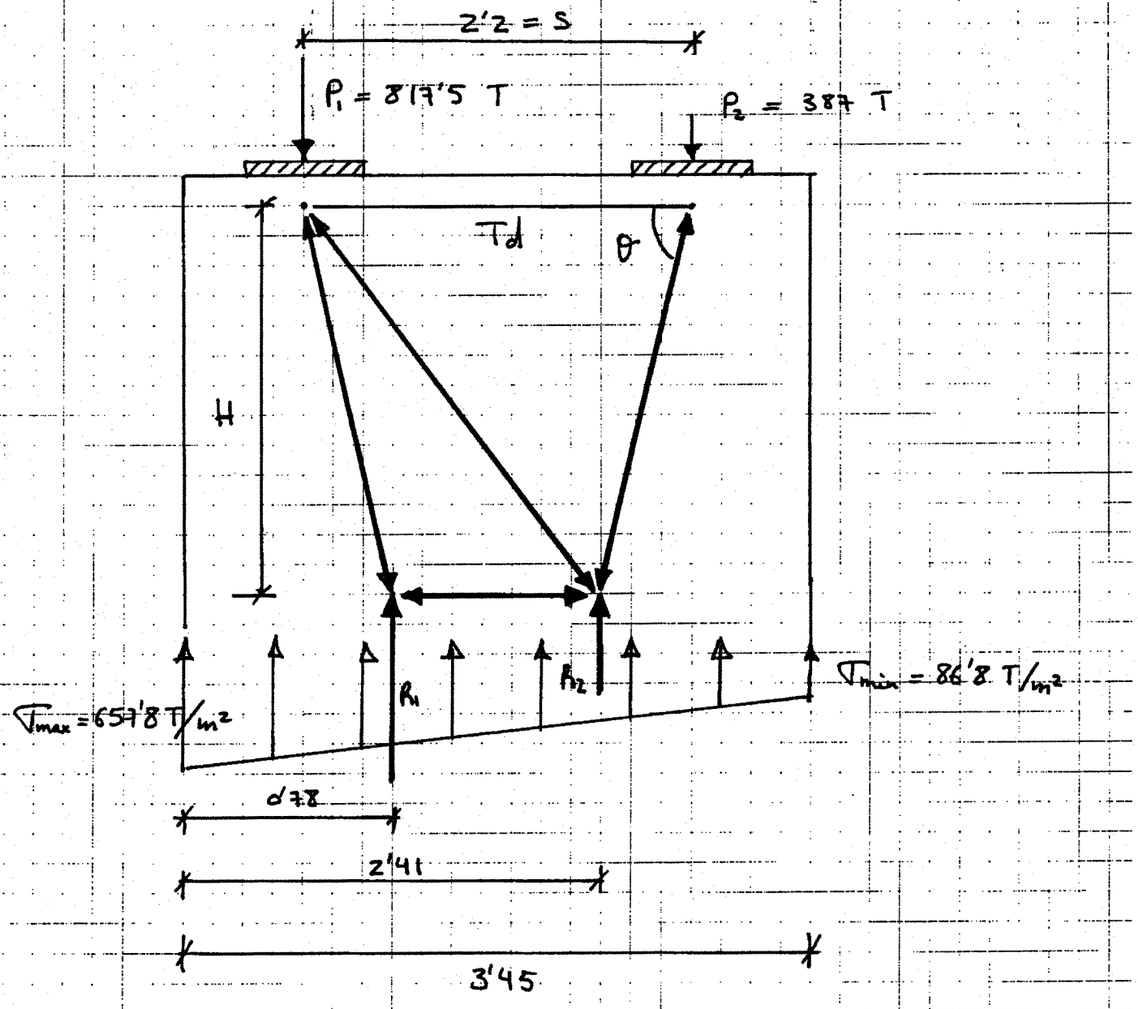
HOJA

ESQUEMA DE ARMADO




r = recubrimiento nominal = 70 mm

## CÁLCULO DE LA ARMADURA EN CORONACIÓN




$R_1 = 833'2$ T

$R_2 = 371'3$ T

Según art. 62.3 de la EHE $H = 0'6 \cdot S = 1'32$ m $\Rightarrow$

$\Rightarrow \theta = 72'55°$

Por lo tanto, la arm. necesaria en coronación es:

$$T_d = \cos\theta \cdot \frac{P_2}{\operatorname{sen}\theta} = 121'6 \text{ T} \Rightarrow$$

$$\Rightarrow A_s \geq \frac{T_d}{f_{yd}} = 30'4 \text{ cm}^2$$