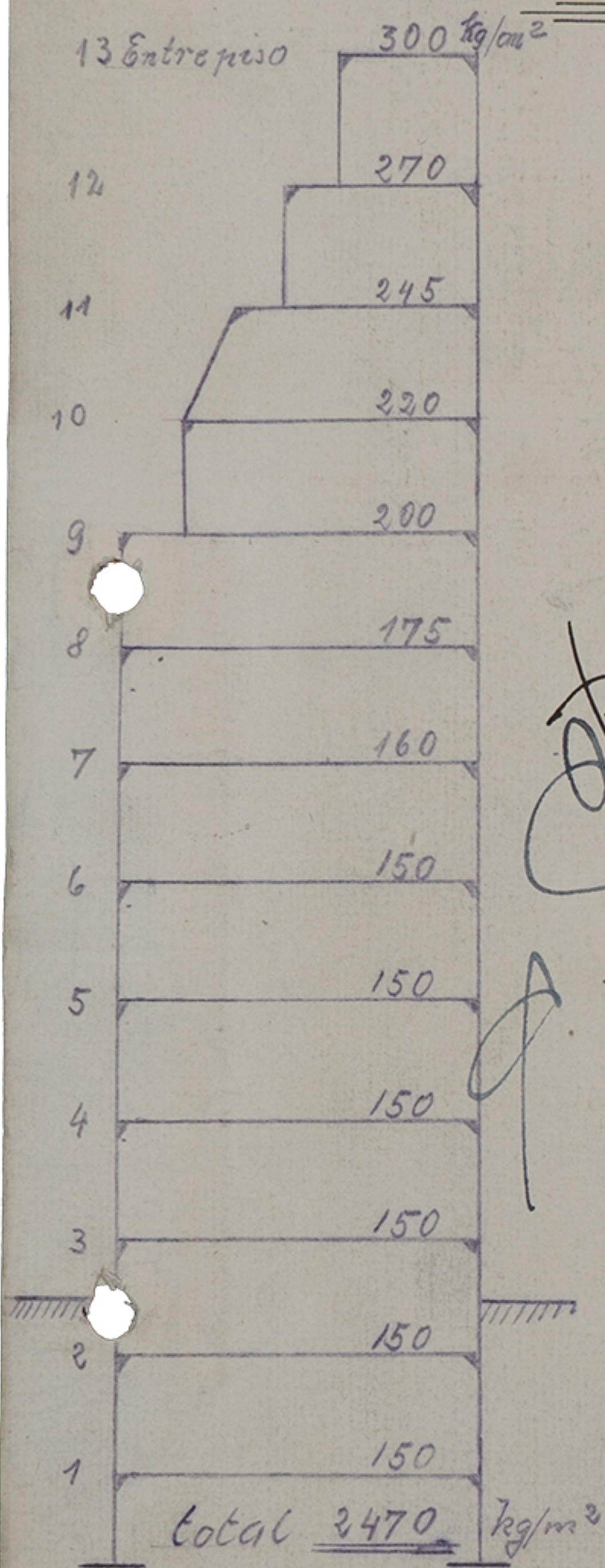


Modificación de cálculos de la memoria original por disminución de cargas.
Bunge & Born Ltda.

Cálculo suplementario de las cargas y dimensiones de columnas y cimientos.



1. Disminución de las cargas de las columnas por el 10% de la sobrecarga existente hasta un mín. de 150.- kg/m².

Carga calculada en el cálculo principal

$$P_{max.} = 11.300 + 2.400 = 4100 \text{ Kg/m}^2$$

$$\text{carga disminuida} = 2470$$

$$\text{a disminuir total } 1630 \text{ Kg/m}^2$$

$$\text{a disminuir por m}^2 = \frac{1630}{13} = 125 \text{ Kg/m}^2$$

$$\text{tabiques de } 300 \text{ Kg/ml} = 1750. - \text{ ml} =$$

$$= \frac{1750 \cdot 0,30}{7,535} = 70 \text{ Kg/m}^2$$

aberturas en la mampostería existente

$$\text{Mampostería existente} = 3265 \text{ t}$$

$$\text{aberturas y deducciones} = 450$$

$$\text{a deducir por m}^2 = \frac{450}{7,535} = 60 \text{ Kg/m}^2$$

$$\text{a deducir por m}^2 = 260 \text{ Kg/m}^2$$

sobrecarga existente por m²

$$P_{max} = \frac{2470}{13} = 190 \text{ Kg/m}^2$$

Cargas calculadas en el cálculo anterior:

$$1500 \text{ m}^3 \text{ concreto a } 2,40 = 3600. - \text{ t}$$

$$7535 \text{ m}^2 \text{ sobrecarga entrepiso a } 0,30 = 2260. - "$$

$$\text{tabiques de } 0,30 \text{ m l por metro} = 525. - "$$

$$\text{tabiques de } 0,15 \text{ m en cada viga principal} = 600. - "$$

$$\text{Mampostería existente} = 2665. - "$$

$$\text{Carga total} = 9650. - \text{ t.}$$

reducción sobre el total

$$7635.0260 = 1960. - t \approx 20\% \text{ sobre el total.}$$

adicional.

$$\text{cargas del viento: } 459 t \approx 5\% \quad " \quad " \quad " \quad (\text{véase pag. 5.})$$

$$\text{reducción total: } 20\% - 5\% = \underline{15\%}.$$

$$\Sigma \text{ Carga disminuada de columnas total} = 7730. - t$$

$$\Sigma \text{ Carga adicional viento} \quad \underline{459. - "}$$

$$P_{\max} = \underline{8189 t.}$$

Cargas de las columnas del sótano.

Cargas de las columnas existentes, menos superficie $0.26 t/m^2$
+ presión del viento sobre las columnas exteriores -

$$C_1 = 63,33 - 66,0 \cdot 0,26 = 17,00 t = 46,33 t + 13,80 t = 50,13 t.$$

$$C_2 = 205,77 - 157,0 \cdot 0,26 = 39,00 " = 166,77 " \dots$$

$$C_3 = 309,92 - 165 \cdot 0,26 = 42,60 " = 267,32 " + 13,80 " = 281,12 "$$

$$C_4 = 99,71 - 150 \cdot 0,26 = 39,00 " = 60,71 " + 14,00 " = 74,71 "$$

$$C_5 = 253,45 - 231,0 \cdot 0,26 = 60,00 " = 193,45 " + 9,75 " = 203,20 "$$

$$C_6 = 236,34 - 228,0 \cdot 0,26 = 59,00 " = 177,34 "$$

$$C_7 = 333,40 - 230,0 \cdot 0,26 = 60,00 " = 273,40 "$$

$$C_8 = 319,67 - 212 \cdot 0,26 = 55,0 " = 264,67 " + 23,75 " = 288,42 "$$

$$C_9 = 85,85 - 145 \cdot 0,26 = 37,50 " = 48,35 " + 23,25 " = 71,60 "$$

$$C_{10} = 161,84 - 209 \cdot 0,26 = 54,5 " = 107,34 "$$

$$C_{11} = 271,41 - 176 \cdot 0,26 = 45,5 " = 225,91 " + 23,25 " = 249,16 "$$

$$C_{12} = 228,55 - 257 \cdot 0,26 = 67,0 " = 161,55 "$$

$$C_{13} = 311,95 - 286 \cdot 0,26 = 74,0 " = 237,95 "$$

$$C_{14} = 46,84 - 96 \cdot 0,26 = 25,0 " = 21,84 " + 11,37 " = 33,21 t.$$

Columnas $2252,93 t$; $132,97 t$ viento

7.7

$$\begin{aligned}
C_{15} &= 175,83 - 110 \cdot 0,26 = 28,7 \text{ t} = 147,13 \text{ t} + 11,27 = 158,50 \text{ t} \\
C_{16} &= 163,47 - 119 \cdot 0,26 = 31,0 \text{ " } = 132,47 \text{ t} \\
C_{17} &= 318,08 - 224 \cdot 0,26 = 58,0 \text{ " } = 260,08 \text{ " } \\
C_{18} &= 232,43 - 182 \cdot 0,26 = 47,0 \text{ " } = 185,43 \text{ " } + 22,75 = 208,18 \text{ " } \\
C_{19} &= 83,61 - 95 \cdot 0,26 = 25,0 \text{ " } = 58,61 \text{ " } + 12,0 = 70,61 \text{ " } \\
C_{20} &= 145,45 - 123 \cdot 0,26 = 32,0 \text{ " } = 113,45 \text{ " } + 10,75 = 124,20 \text{ " } \\
C_{21} &= 216,20 - 132 \cdot 0,26 = 32,0 \text{ " } = 184,20 \text{ " } \\
C_{22} &= 350,24 - 250 \cdot 0,26 = 65,0 \text{ " } = 285,24 \text{ " } \\
C_{23} &= 200,15 - 170 \cdot 0,26 = 44,0 \text{ " } = 156,15 \text{ " } + 22,75 = 178,90 \text{ " } \\
C_{24} &= 177,07 - 162 \cdot 0,26 = 42,0 \text{ " } = 135,07 \text{ " } + 22,75 = 157,82 \text{ " } \\
C_{25} &= 274,34 - 192 \cdot 0,26 = 50,0 \text{ " } = 224,34 \text{ " } \\
C_{26} &= 336,81 - 250 \cdot 0,26 = 65,0 \text{ " } = 271,81 \text{ " } \\
C_{27} &= 202,88 - 168 \cdot 0,26 = 43,5 \text{ " } = 159,38 \text{ " } + 22,75 = 182,13 \text{ " } \\
C_{28} &= 50,66 - 31 \cdot 0,26 = 8,0 \text{ " } = 42,66 \text{ " } \\
C_{29} &= 186,60 - 100 \cdot 0,26 = 26,0 \text{ " } = 160,60 \text{ " } \\
C_{30} &= 186,20 - 112 \cdot 0,26 = 29,0 \text{ " } = 157,20 \text{ " } + 17,0 = 174,20 \text{ " } \\
C_{31} &= 305,79 - 224 \cdot 0,26 = 58,0 \text{ " } = 247,79 \text{ " } + 17,0 = 264,79 \text{ " } \\
C_{32} &= 338,96 - 246 \cdot 0,26 = 64,0 \text{ " } = 274,96 \text{ " } \\
C_{33} &= 220,98 - 186 \cdot 0,26 = 48,50 \text{ " } = 172,48 \text{ " } + 34,0 = 206,48 \text{ " } \\
C_{34} &= 71,06 - 42 \cdot 0,26 = 11,00 \text{ " } = 60,06 \text{ " } + 13,25 = 73,31 \text{ " } \\
C_{35} &= 201,70 - 152 \cdot 0,26 = 40,00 \text{ " } = 161,70 \text{ " } + 13,25 = 174,95 \text{ " } \\
C_{36} &= 276,29 - 200 \cdot 0,26 = 52,00 \text{ " } = 224,29 \text{ " } \\
C_{37} &= 303,82 - 225 \cdot 0,26 = 50,00 \text{ " } = 244,82 \text{ " } \\
C_{38} &= 227,26 - 137 \cdot 0,26 = 35,60 \text{ " } = 191,66 \text{ " } + 26,50 = 218,16 \text{ " } \\
C_{39} &= 193,14 - 144 \cdot 0,26 = 37,50 \text{ " } = 155,64 \text{ " } + 26,50 = 182,14 \text{ " } \\
C_{40} &= 233,97 - 200 \cdot 0,26 = 52,00 \text{ " } = 181,97 \text{ " }
\end{aligned}$$

Columnas 4589,19 t; 272,62 t viciato

137

$$C_{41} = 234,32 - 200 \cdot 0,26 = 52,00 t = 182,32 t$$

$$C_{42} = 223,03 - 148 \cdot 0,26 = 38,50 " = 184,53 " + 26,50 = 211,03 t$$

$$C_{43} = 139,68 - 56 \cdot 0,26 = 14,60 " = 125,08 " + 13,25 = 138,33 "$$

$$C_{44} = 185,49 - 100 \cdot 0,26 = 26,00 " = 159,49 "$$

$$C_{45} = 188,96 - 100 \cdot 0,26 = 26,00 " = 162,96 "$$

$$C_{46} = 88,21 - 54 \cdot 0,26 = 14,00 " = 74,21 " + 13,25 = 87,46 "$$

Columnas $\therefore 888,59 t$; $53,00 t$ viento.

Aumentos de las columnas por la presión del viento.

Viento por metro según el cálculo principal:

$$P_1 = 0,15 \cdot 18,10 = 2,70 t$$

$$P_2 = 0,10 \cdot 25,25 = 2,53 "$$

$$H = 2,70 \cdot 17,30 + 2,53 \cdot 39,0 = 147,00 \text{ tm.}$$

$$\text{Col. } C_1 + C_3 = P = \frac{147,0 \cdot 30}{16,0} = \frac{27,6}{2} = 13,80 t.$$

$$\text{Col. } C_8. \quad P = \frac{147,0}{18} \cdot \frac{11,7}{2} = \frac{47,5}{2} = 23,75 t.$$

$$\text{Col. } C_4. \quad P = 23,75 - 9,75 = 14,00 t.$$

$$\text{Col. } C_5. \quad P = 23,75 \cdot \frac{7,5}{18,0} = 9,75 t.$$

$$\text{Col. } C_9 + C_{11}. \quad P = \frac{147,0}{18} \cdot \frac{5,7}{2} = 23,25 t.$$

$$\text{Col. } C_{18}. \quad P = \frac{147,0}{18} \cdot \frac{5,65}{2} = 22,75 "$$

$$" \quad C_{14} + C_{15} = \frac{22,75}{2} = 11,37 "$$

$$\text{Col. } C_{19} + C_{20} + C_{23} \text{ igual Col. } C_{14} + C_{15} + C_{18}.$$

$$\text{Col. } C_{24} + C_{27} \text{ igual Col. } C_{19} + C_{23}.$$

$$\text{Col. } C_{30} + C_{31} + C_{33}. \quad P = \frac{147,0}{13} \cdot \frac{5,95}{2} = 34,0 t$$

$$C_{31} = 34,0 \cdot \frac{3,25}{6,50} = 17,00 t$$

$$C_{30} = 34,0 - 17,0 = 17,00 "$$

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$$\text{Col. } C_{34} + C_{35} + C_{38}.$$

$$P = \frac{147,0}{16,0} \cdot \frac{5,75}{2} = \underline{26,5 t} = C_{38}.$$

$$C_{35} = \frac{26,50}{8,0} \cdot 4,0 = \underline{13,25 t}$$

$$\text{Col. } C_{39} + C_{42} = C_{38} = \underline{26,5 t}.$$

$$\text{Col. } C_{43} + C_{46} = \frac{26,5}{2} = \underline{13,25 t}.$$

Aumento de las cargas de columnas por el viento.

viento:	132,97 t ;	carga columnas	2252,93 t
	272,62 "		4589,19 "
	53. - "		888,59 "

Total viento	<u>458,59 t.</u>	carga columnas:	<u>7730,71 t.</u>
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Dimensiones de los cimientos. $\sigma_t = 2,50 \text{ Kg/cm}^2$.

Cimiento C_1 . $P_{\max} = 50,13 t = 50,13 t$

Medianera $0,50 \cdot 41,40 = \underline{20,70 "$

$$P_{\max} = \underline{70,83}.$$

$$f = \frac{70,83}{25,0} = \underline{2,80 m^2}.$$

$$a = 1,50 m ; b = 1,85 m.$$

Nervadura: $L = 1,85 - (0,38 + 0,55) = \underline{0,92 m}$

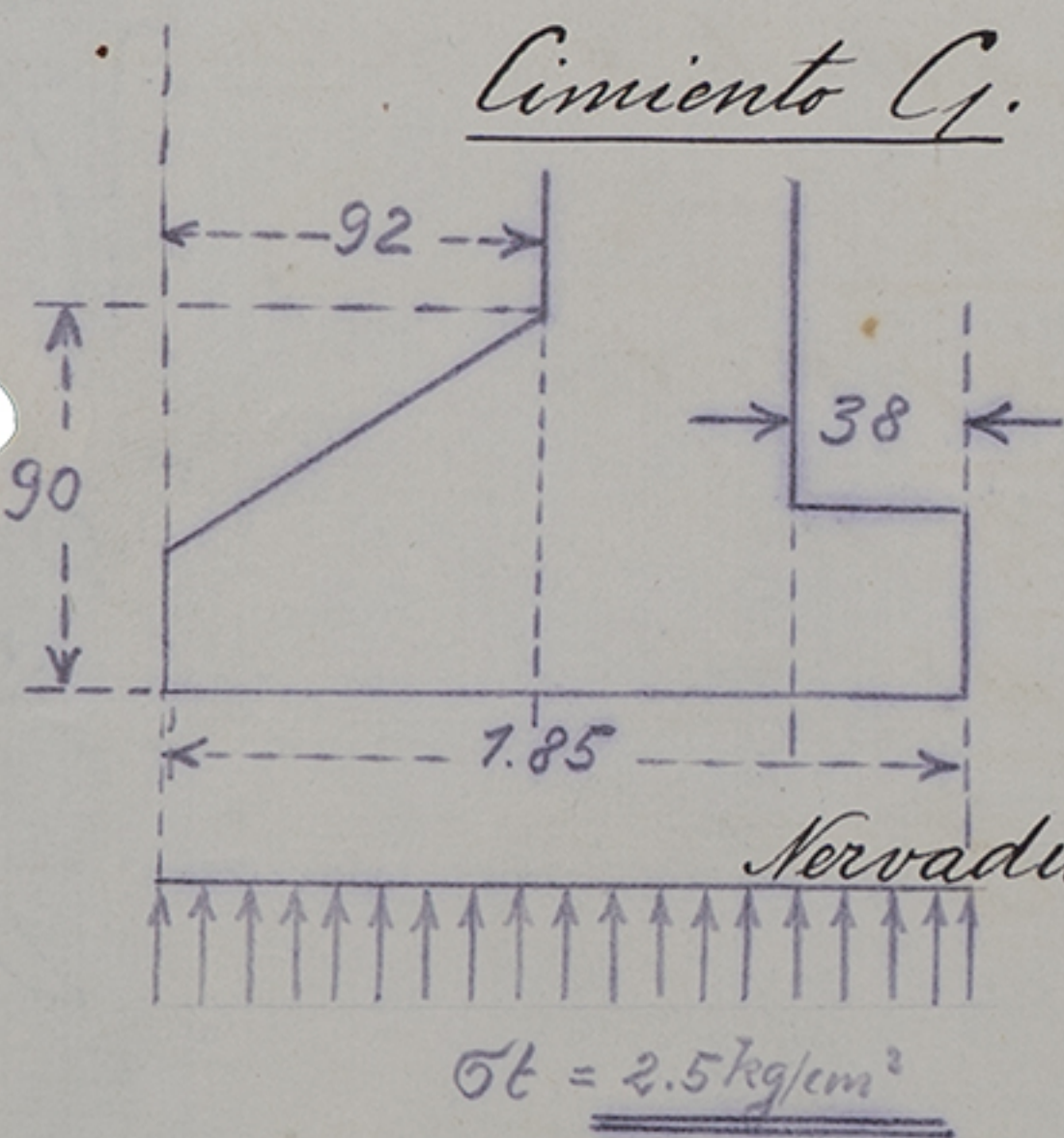
$$p_{\max} = 25,0 \cdot 1,50 = \underline{37,50 t/m}.$$

$$M_{\max} = 37,50 \cdot \frac{0,92^2}{2} = \underline{15,80 \text{ ton} \cdot m}.$$

$$h = \underline{90 \text{ cm}} ; b = \underline{55 \text{ cm}} ; f_c = \underline{23,00 \text{ cm}^2}.$$

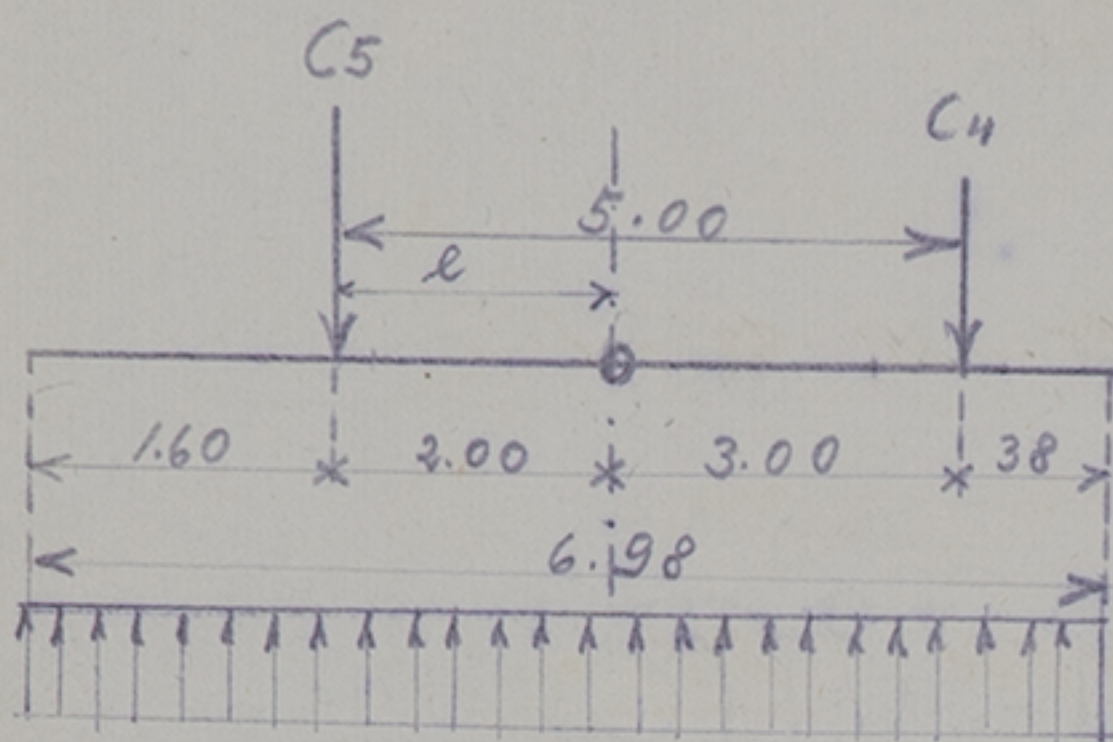
Losa. $L = \frac{1,85 - 0,55}{2} = \underline{0,65 m}$

$$M = 25,0 \cdot \frac{0,65^2}{2} = \underline{5,30 \text{ ton} \cdot m} ; h = \underline{28,0 \text{ cm}} ; f_c = \underline{23,70 \text{ cm}^2}.$$



[Signature]

6)

Cimiento $C_4 + C_5$.

$$\sigma_t = 25 \text{ kg/cm}^2$$

$$C_4 = 74,71 + 15 \cdot 4,14 = 136,71 \text{ t}$$

$$C_5 = 203,20 \text{ t}$$

$$P = 339,91 \text{ t}$$

$$e = 136,71 \cdot \frac{5,00}{339,91} = 2,00 \text{ m}$$

$$C_4 = \frac{136,71}{25,0} = 5,40 \text{ m}^2 = 3,38 \cdot 1,60 \text{ m}$$

$$C_5 = \frac{203,20}{25,0} = 8,10 \text{ m}^2 = 3,60 \cdot 2,25 \text{ m}$$

$$l = 6,98 \text{ m}$$

Nervaduras. $L = 1,60 - 0,27 = 1,33 \text{ m}$

$$p = 25,0 \cdot 2,25 = 56,00 \text{ t/m}$$

$$M = 56,00 \cdot \frac{1,33^2}{2} = 50,00 \text{ tm}$$

$$h = 90 \text{ cm}; b = 65 \text{ cm}; f_c = 70 \text{ cm}^2; f_c' = 35,00 \text{ cm}^2$$

$$L = 0,38 \text{ cm} \quad M = 56,0 \cdot \frac{0,38^2}{2} = 4,05 \text{ tm (medianera)}$$

$$h = 30 \text{ cm}; b = 65 \text{ cm}; f_c = 16,40 \text{ cm}^2$$

Losa. $L_1 = \frac{1,60 - 0,65}{2} = 0,48 \text{ m}; M = 25,0 \cdot \frac{0,48^2}{2} = 2,90 \text{ tm}; h = 22 \text{ cm}; f_c = 11,74 \text{ cm}^2$

$$L_2 = \frac{2,25 - 0,65}{2} = 0,80 \text{ m}; M = 25,0 \cdot \frac{0,80^2}{2} = 8,00 \text{ tm}; h = 35 \text{ cm}; f_c = 28,8 \text{ cm}^2$$

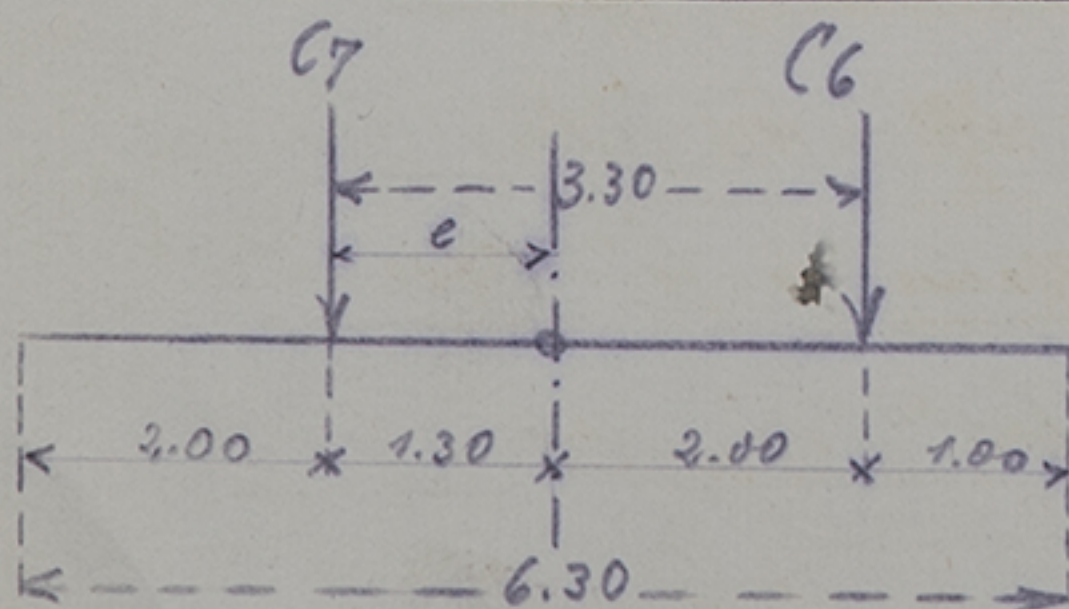
Nervadura entre las columnas.

$$p = (2,00 \cdot 2,25 + 3,00 \cdot 1,60) \cdot 25,00 = \frac{233,0}{5,00} = 47,0 \text{ t/m}$$

$$M_{\max} = 47,00 \cdot \frac{5,00^2}{8} - \frac{50,0 + 4,05}{2} = +120,00 \text{ tm}$$

$$h = 90,0 \text{ cm}; b = 175,0 \text{ cm}; f_c = 168,00 \text{ cm}^2$$

$$f_c' = 84,00 \text{ cm}^2$$

Cimiento $C_6 + C_7$.

$$C_6 = 177,34 \text{ t}$$

$$C_7 = 273,60 \text{ t} \quad P_{\max} = 450,94 \text{ t}$$

$$f = \frac{450,94}{25,00} = 18,00 \text{ m}^2$$

$$e = \frac{177,34 \cdot 3,30}{450,94} = 1,30 \text{ m}$$

$$C_6 = \frac{177,34}{25,0} = 7,00 \text{ m}^2 = 3,00 \cdot 2,50 \text{ m}$$

$$C_7 = \frac{273,60}{25,0} = 11,00 \text{ m}^2 = 3,30 \cdot 3,35 "$$

$$l = 6,30 \text{ m}$$

Nervaduras. $L = 2,00 - 0,27 = 1,73 \text{ m}$ $p = 25,0 \cdot 3,35 = 84,00 \text{ t/m}$

$$M = 84,00 \cdot \frac{1,73^2}{2} = 126 \text{ tm}$$

$$h = 100 \text{ cm}; b = 90,0 \text{ cm}; f_c = f_c' = 141,0 \text{ cm}^2$$

$$L = 1,00 - 0,27 = 0,73 \text{ m}$$

$$p = 25,0 \cdot 2,50 = 62,50 \text{ t/m}$$

$$M = 62,50 \cdot \frac{0,73^2}{2} = 16,60 \text{ tm}$$

$$h = 100 \text{ m}; b = 90,0 \text{ cm}; f_c = 22,40 \text{ cm}^2$$

Momento entre las columnas.

$$p = \frac{(1,30 \cdot 3,35 + 2,00 \cdot 2,50) 25,0}{3,30} = 71,0 \text{ t/m}$$

$$M_{\text{max}} = 71,00 \cdot \frac{3,30^2}{8} - \frac{126,0 + 16,60}{2} = +25,70 \text{ tm}$$

$$h = 70 \text{ cm}; b = 50,0 \text{ cm}; b' = 80,0 \text{ cm}; f_c = 46,5 \text{ cm}^2$$

Losas. $L_1 = \frac{2,50 - 0,65}{2} = 0,93 \text{ m}$ $M = 25,0 \cdot \frac{0,93^2}{2} = 10,8 \text{ tm}$ $h = 40 \text{ cm}; f_c = 33,70 \text{ cm}^2$

$$L_2 = \frac{3,35 - 0,90}{2} = 1,23 \text{ m}$$

$$M = 25,0 \cdot \frac{1,23^2}{2} = 19,00 \text{ tm}$$

$$h = 54 \text{ cm}; f_c = 43,70 \text{ cm}^2$$

Cimiento $C_3 + C_8$. $P_{\text{max}} = C_8 = 288,42 \text{ t}$

Mampostería del frente $2,5 \cdot 11,50 = 28,70 "$

$$P_{\text{max}} = 317,12 \text{ t}$$

$$f = \frac{317,12}{25,0} = 12,70 \text{ m}^2; a = 3,80 \text{ m}; b = 3,35 \text{ m}$$

Nervaduras. $L = 0,90 \text{ m}$ $p = 25,0 \cdot 3,80 = 95,0 \text{ t/m}$

$$M = 95 \cdot \frac{0,90^2}{2} = 38,20 \text{ tm}$$

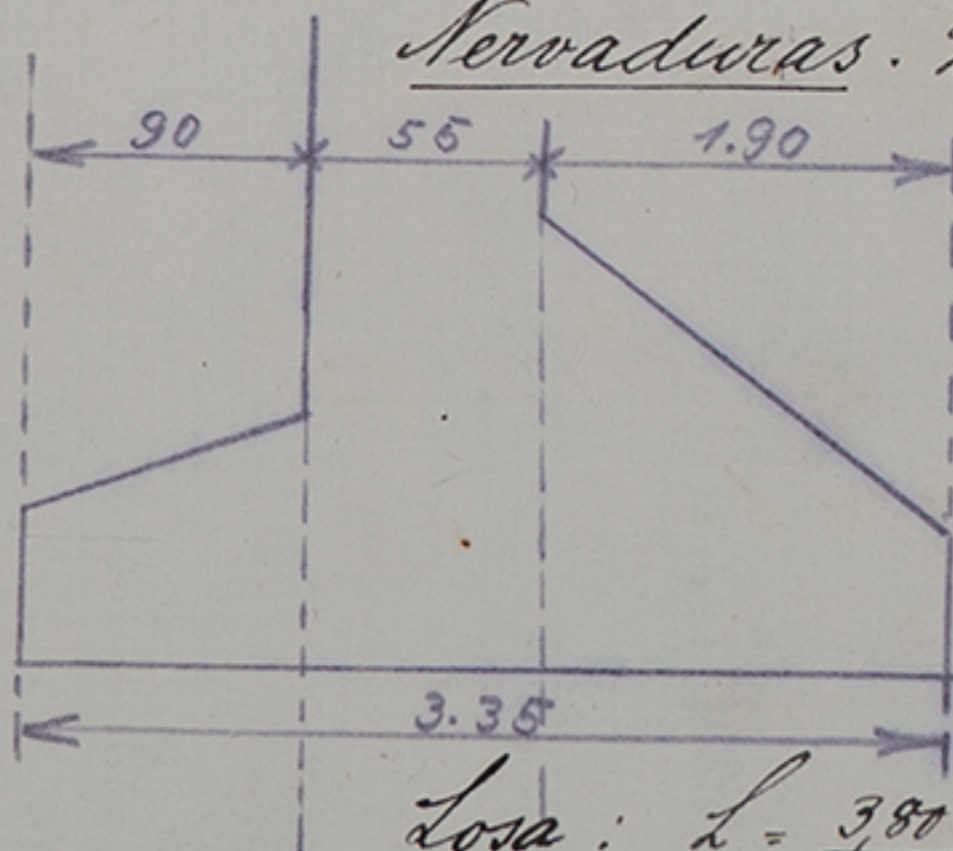
$$h = 80 \text{ cm}; b = 90 \text{ cm}; f_c = 59,6 \text{ cm}^2$$

$$L = 1,90 \text{ m}; M = 95 \cdot \frac{1,90^2}{2} = 172 \text{ tm}$$

$$h = 120 \text{ cm}; b = 90,0 \text{ cm}; f_c = f_c' = 174,00 \text{ cm}^2$$

Losa: $L = \frac{3,80 - 0,90}{2} = 1,45 \text{ m}$ $M = 25,0 \cdot \frac{1,45^2}{2} = 26,50 \text{ tm}$

$$h = 64 \text{ cm}; f_c = 52,50 \text{ cm}^2$$



B.T.

Cimiento C₂ $P_{max} = 166,77 \text{ t.}$

Mampostería frente $1,50 \cdot 11,50 = 17,25 "$

$P_{max} = 183,97 \text{ t.}$

$f = \frac{184,00}{25,0} = 7,35 \text{ m}^2; a = b = 2,70 \text{ m.}$

Nervaduras. $L = 0,90 \text{ m}$ $p = 25,0 \cdot 2,70 = 67,50 \text{ t/m.}$

$M = 67,50 \cdot \frac{0,90^2}{2} = 27,30 \text{ ton}$

$h = 66 \text{ cm}; b = 70 \text{ cm}; f_c = 50,50 \text{ cm}^2; f_c' = 25,25 \text{ cm}^2.$

$L = 1,25 \text{ m. } M = 67,50 \cdot \frac{1,25^2}{2} = 52,50 \text{ ton.}$

$h = 90 \text{ cm}; b = 70 \text{ cm}; f_c = 71,50 \text{ cm}^2; f_c' = 35,75 \text{ cm}^2.$

Losa. $L = \frac{2,70 - 0,70}{2} = 1,00 \text{ m}$

$M_{max} = 25,00 \cdot \frac{1,00^2}{2} = 12,50 \text{ ton.}$

$h = 44 \text{ cm}; f_c = 36,40 \text{ cm}^2.$

Cimiento C₁₁ $P_{max} = 249,16 \text{ t}$

Mampostería frente $11,50 \cdot 2,0 = 23,00 "$

$P_{max} = 272,16 "$

$f = \frac{272,16}{25,0} = 10,88 \text{ m}^2; a = b = 3,25 \text{ m.}$

Nervaduras. $L = 0,90 \text{ m}; p = 25,0 \cdot 3,25 = 81,0 \text{ t/m}$

$M = 81,0 \cdot \frac{0,90^2}{2} = 32,50 \text{ ton}$

$h = 90 \text{ cm}; b = 70 \text{ cm}; f_c = 44,30 \text{ cm}^2$

$L = 3,25 - (0,90 + 0,55) = 1,80 \text{ m}$

$M_{max} = 81,00 \cdot \frac{1,80^2}{2} = 131,00 \text{ ton.}$

$h = 100 \text{ cm}; b = 80 \text{ cm}; f_c = 14,50 \text{ cm}^2; f_c' = 14,50 \text{ cm}^2.$

Losa. $L = \frac{3,25 - 0,70}{2} = 1,275 \text{ m.}$

$M = 25,0 \cdot \frac{1,28^2}{2} = 20,50 \text{ ton.}$

$h = 54 \text{ cm}; f_c = 46,50 \text{ cm}^2.$

Cimiento C₉

P_{max}

$$= 71,60 t$$

$$\text{medianera } 1,50 \cdot 41,40 = 62,00 "$$

$$P_{max} = 133,60 t$$

$$f = \frac{133,60}{25,0} = 5,30 m^2; a = 2,10 m; b = 2,55 m.$$

Nervadura. $L = 2,55 - (0,38 + 0,55) = 1,62 m$

$$p = 25,0 \cdot 2,10 = 52,0 t.$$

$$M_{max} = 52,00 \cdot \frac{1,62^2}{2} = 68,00 \text{ ton}$$

$$h = 90 \text{ cm}; b = 70 \text{ cm}; f_c = f_c' = 91 \text{ cm}^2.$$

$$L = 0,38 m (\text{medianera})$$

$$M = 52,0 \cdot \frac{0,38^2}{2} = 3,75 \text{ ton}.$$

$$h = 30 \text{ cm}; b = 70 \text{ cm}; f_c = 15,60 \text{ cm}^2.$$

Losas.

$$L = \frac{2,10 - 0,70}{2} = 0,70 m. M = 25,0 \cdot \frac{0,70^2}{2} = 6,10 \text{ ton}.$$

$$h = 30 \text{ cm}; f_c = 25,20 \text{ cm}^2.$$

Cimiento C₁₃

$$P_{max} = 238,0 t$$

$$f = \frac{238,0}{25,0} = 9,60 m^2 \quad a = b = 3,10 m.$$

$$L = \frac{3,10 - 0,85}{2} = 1,13 m.$$

$$M_{max} = 25,0 \cdot \frac{1,13^2}{2} = 16,00 \text{ ton}.$$

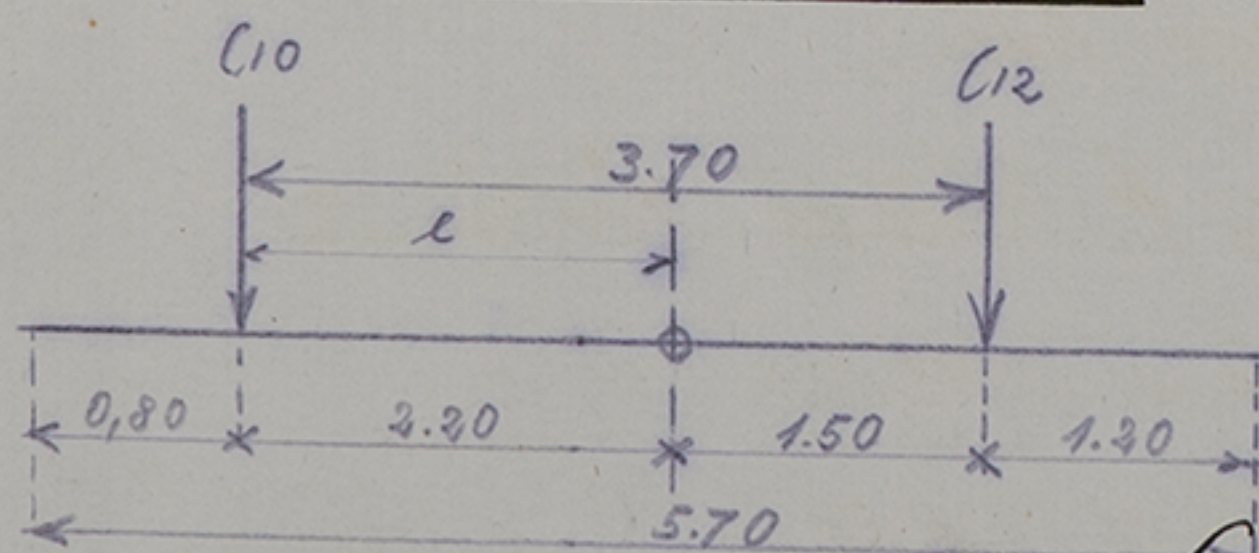
$$h = 48 \text{ cm}; f_c = 41,00 \text{ cm}^2.$$

Cimiento C₁₀ + C₁₂

$$C_{10} = 107,34 t.$$

$$C_{12} = 161,55 " \quad P_{max} = 268,89 t$$

$$e = \frac{161,55 \cdot 3,70}{268,89} = 2,20 m.$$



$$C_{10} = \frac{107,34}{25,0} = 4,30 m^2 = 3,00 \cdot 1,40 m$$

$$C_{12} = \frac{161,55}{25,0} = 6,40 " = 2,70 \cdot 2,35 "$$

$$L = 5,70 m.$$

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Nervaduras. $L = \frac{0,80 - 0,27}{2} = 0,53 \text{ m}$ $p = 25,0 \cdot 1,40 = 35,0 \text{ t/m}$

$$M = 35,0 \cdot \frac{0,53^2}{2} = 5,00 \text{ ton.}$$

$$h = 50 \text{ cm}; b = 65 \text{ cm}; f_c = 12,0 \text{ cm}^2.$$

$$L = 1,20 - 0,20 = 1,00 \text{ m} \quad p = 25,0 \cdot 2,35 = 58,50 \text{ t/m}$$

$$M = 58,50 \cdot \frac{1,00^2}{2} = 29,25 \text{ ton.}$$

$$h = 90 \text{ cm}; b = 65 \text{ cm}; f_c = 40,50 \text{ cm}^2.$$

Momento entre las columnas.

$$p = \frac{(2,20 \cdot 1,40 + 1,50 \cdot 2,35) \cdot 25,0}{3,70} = 44,50 \text{ t/m.}$$

$$M_{\max} = 44,5 \cdot \frac{3,70^2}{8} - \frac{29,25 + 5,00}{2} = +58,87 \text{ ton.}$$

$$h = 90 \text{ cm}; b = 65,0 \text{ cm}; b' = 130 \text{ cm}; f_c = 90 \text{ cm}^2.$$

Losa.

$$L_1 = \frac{1,40 - 0,65}{2} = 0,38 \text{ m}$$

$$M = 25,0 \cdot \frac{0,38^2}{2} = 1,80 \text{ ton.}$$

$$h = 18 \text{ cm}; f_c = 13,60 \text{ cm}^2.$$

$$L_2 = \frac{2,55 - 0,65}{2} = 0,95 \text{ m}$$

$$M = 25,0 \cdot \frac{0,95^2}{2} = 11,20 \text{ ton.}$$

$$h = 40 \text{ cm}; f_c = 34,30 \text{ cm}^2.$$

Cimiento C₁₄ + C₁₅.

$$C_{14} = 33,21 + 1,0 \cdot 41,40 = 74,61 \text{ t}$$

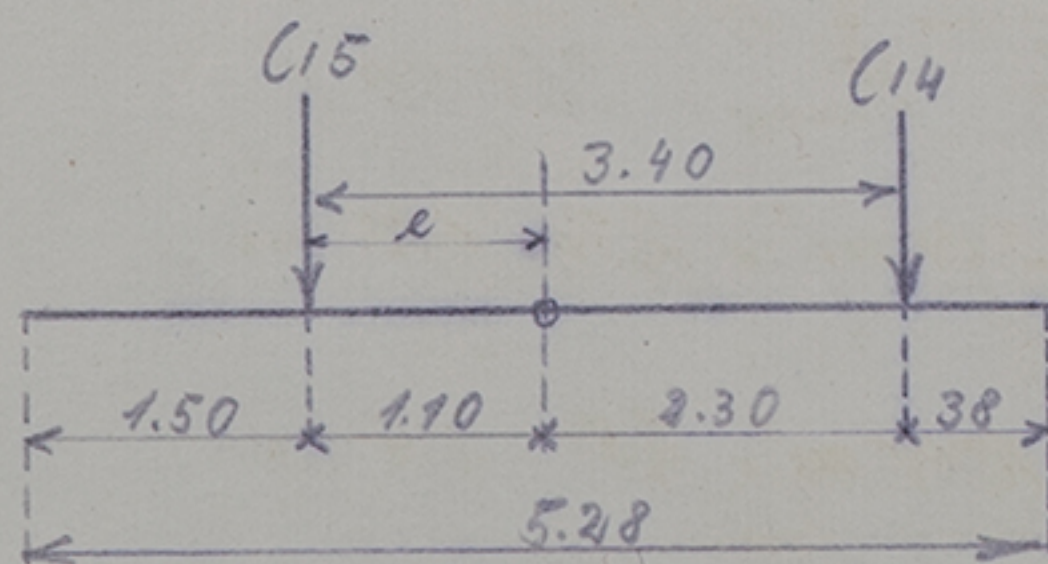
$$C_{15} = \frac{158,50}{2} = 79,25 \text{ t}$$

$$e = \frac{74,61 \cdot 3,40}{233,11} = 1,10 \text{ m}$$

$$C_{14} = \frac{74,61}{25,0} = 3,00 \text{ m}^2 = 2,68 \cdot 1,00 \text{ m}$$

$$C_{15} = \frac{158,5}{25,0} = 6,30 \text{ m}^2 = 2,60 \cdot 2,40 \text{ m}$$

$$l = 5,28 \text{ m.}$$



Nervaduras. $L = 1,50 - 0,27 = 1,23 \text{ m}$

$$\mu = 25,0 \cdot 2,40 = 60,0 \text{ t/m}$$

$$M_{\text{max}} = 60 \cdot \frac{1,23^2}{2} = 45,50 \text{ tm}$$

$$h = 90 \text{ cm}; b = 65 \text{ cm}; f_c = 59,50 \text{ cm}^2; f_c' = 29,75 \text{ cm}^2$$

$$L = 0,38 \text{ m (medianera)}$$

$$M = 25,0 \cdot 1,10 \cdot \frac{0,38^2}{2} = 2,00 \text{ tm}$$

$$h = 50 \text{ cm}, b = 65,0 \text{ cm} f_c = 5,00 \text{ cm}^2$$

Momento entre las columnas.

$$L = 3,40 \text{ m} \cdot \mu = \frac{(1,10 \cdot 2,40 + 2,30 \cdot 1,10) \cdot 25,0}{3,40} = 38,50 \text{ t/m}$$

$$M = 38,50 \cdot \frac{3,40^2}{8} - \frac{45,50 + 2,00}{2} = +32,25 \text{ tm}$$

$$h = 90 \text{ cm}; b = 50 \text{ cm}; b' = 65 \text{ cm}; f_c = 45,50 \text{ cm}^2$$

Losas.

$$L_1 = \frac{1,10 - 0,50}{2} = 0,30 \text{ m}$$

$$M = 25,0 \cdot \frac{0,30^2}{2} = 1,12 \text{ tm}$$

$$h = 15 \text{ cm}; f_c = 11,00 \text{ cm}^2$$

$$L_2 = \frac{2,40 - 0,50}{2} = 0,95 \text{ m}$$

$$M = 25,0 \cdot \frac{0,95^2}{2} = 11,20 \text{ tm}$$

$$h = 40 \text{ cm}, f_c = 34,00 \text{ cm}^2$$

Cimiento C₁₆ + C₁₇. $C_{16} = 132,47 \text{ t}$

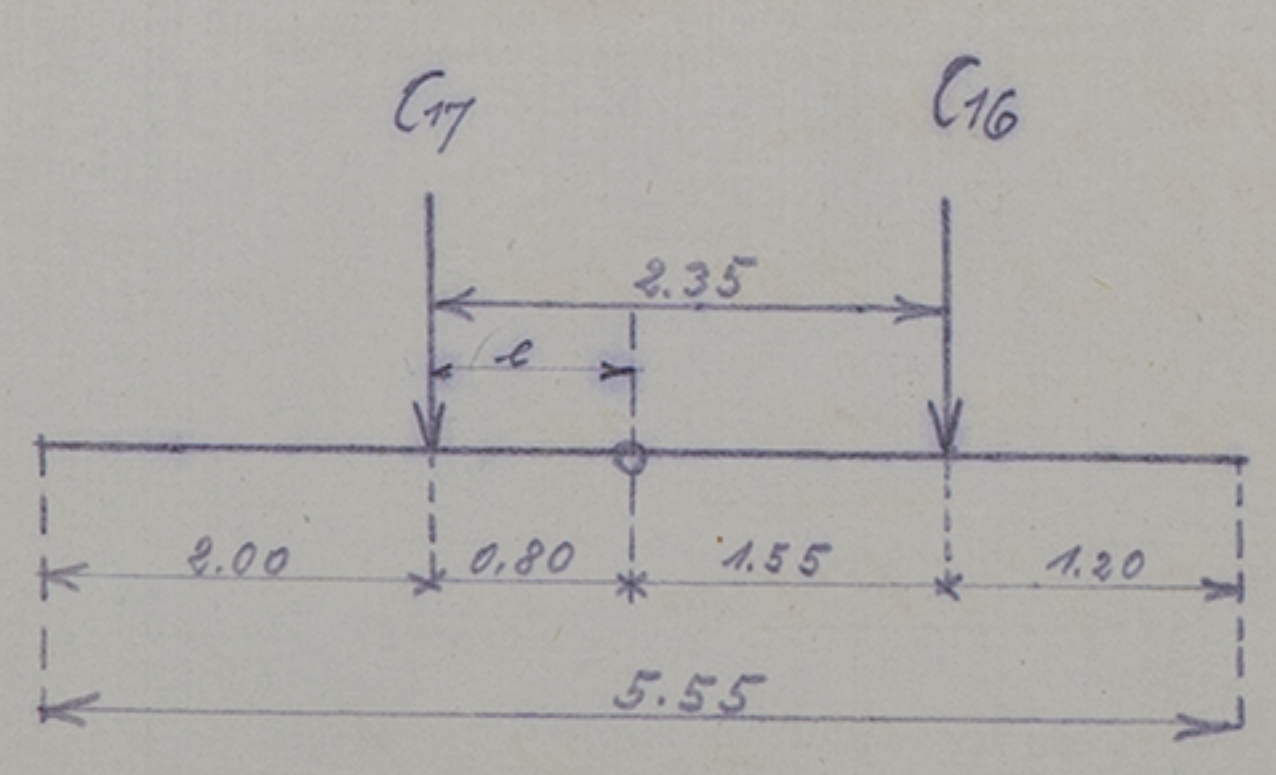
$$C_{17} = 260,08 \text{ t} \quad P_{\text{max}} = 392,55 \text{ t}$$

$$e = \frac{132,47 \cdot 2,35}{392,55} \approx 0,80 \text{ m}$$

$$C_{16} = \frac{132,47}{25,0} = 5,30 \text{ m}^2 = 2,75 \cdot 1,95 \text{ m}$$

$$C_{17} = \frac{260,08}{25,0} = 10,40 \text{ m}^2 = 2,80 \cdot 3,70 \text{ m}$$

$$l = 5,55 \text{ m}$$



12.4

Nervaduras. $L = 2,00 - 0,27 = 1,73 \text{ m}$; $p = 25,0 \cdot 3,70 = 93,0 \text{ t/m}$

$$M = 93,0 \cdot \frac{1,73^2}{2} = 138,0 \text{ ton}$$

$$h = 100 \text{ cm}; b = 90 \text{ cm}; f_e = f_e' = 160 \text{ cm}^2$$

$$L = 1,20 - 0,27 = 0,93 \text{ m}; p = 25,0 \cdot 1,95 = 49,00 \text{ t/m}$$

$$M = 49,0 \cdot \frac{0,93^2}{2} = 20,60 \text{ ton}$$

$$h = 70 \text{ cm}; b = 65 \text{ cm}; f_e = 37,50 \text{ cm}^2$$

Momento entre las columnas.

$$p = \frac{25,0(0,80 \cdot 3,70 + 1,55 \cdot 1,95)}{2,35} = 63,50 \text{ t/m}$$

$$M_{\max} = 63,50 \cdot \frac{2,35^2}{8} - \frac{138,0 + 20,60}{2} = -36,0 \text{ ton}$$

$$h = 90 \text{ cm}; b = 65 \text{ cm}; f_e = 49,50 \text{ cm}^2$$

Losa.

$$L_1 = \frac{1,95 - 0,65}{2} = 0,65 \text{ m}$$

$$M = 25,0 \cdot \frac{0,65^2}{2} = 5,30 \text{ ton}$$

$$h = 28 \text{ cm}; f_e = 23,50 \text{ cm}^2$$

$$L_2 = \frac{3,70 - 0,90}{2} = 1,40 \text{ m}$$

$$M = 25,0 \cdot \frac{1,40^2}{2} = 24,50 \text{ ton}$$

$$h = 48 \text{ cm}; f_e = 50,50 \text{ cm}^2$$

Cimientos $C_{18} + C_{33} + C_{38} + C_{42} + C_{23} + C_{27}$.

$$C_{18} = 208,18 + 2 \cdot 11,50 = 231,18 \text{ t}$$

$$C_{33} = 206,48 + 2 \cdot 11,50 = 229,48 \text{ "}$$

$$C_{38} = 218,16 + 2 \cdot 11,50 = 241,16 \text{ "}$$

$$C_{42} = 211,03 + 2 \cdot 11,50 = 234,03 \text{ "}$$

$$C_{23} = 178,90 + 2 \cdot 11,50 = 201,90 \text{ "}$$

$$C_{27} = 182,13 + 2 \cdot 11,50 = 205,13 \text{ "}$$

$$P_{\max} = \frac{1342,88 \text{ t}}{6} \approx 224 \text{ t}$$

$$f = \frac{224,00}{25,0} = 9,00 \text{ m}^2 \quad a = b = 3,00 \text{ m}$$

Nervaduras. $L = 0,90 \text{ m}$ $p = 25,0 \cdot 3,00 = 75,0 \text{ t/m}$

$$M = 75,0 \cdot \frac{0,90^2}{2} = 30,20 \text{ ton.}$$

$$h = 75 \text{ cm}; b = 80 \text{ cm}; f_c = 50,0 \text{ cm}^2.$$

$$L_1 = 3,00 - (0,55 + 0,90) = 1,65 \text{ m}$$

$$M_{\max} = 75,0 \cdot \frac{1,65^2}{2} = 102,0 \text{ ton.}$$

$$h = 100 \text{ cm}; b = 80 \text{ cm}; f_c = f_c' = 126,0 \text{ cm}^2.$$

Losas.

$$L = \frac{3,00 - 0,80}{2} = 1,10 \text{ m}$$

$$M = 25,0 \cdot \frac{1,10^2}{2} = 15,00 \text{ ton.}$$

$$h = 46 \text{ cm}; f_c = 39,60 \text{ cm}^2.$$

Cimiento $C_{40} + C_{41}$.

$$C_{40} = 181,97 \text{ t}$$

$$C_{41} = 182,32 \text{ " } P_{\max} = 364,29 \text{ t.}$$

$$f = \frac{364,29}{25,0} = 14,50 \text{ m}^2 \quad a = 2,50 \text{ m}; b = 5,75 \text{ m}$$

Nervaduras. $L = \frac{5,75 - 2,35}{2} = 1,70 \text{ m}$

$$L = 1,70 - 0,27 = 1,43 \text{ m.}$$

$$p = 25,0 \cdot 2,50 = 62,50 \text{ t/m.}$$

$$M_{\max} = 62,50 \cdot \frac{1,43^2}{2} = 64,50 \text{ ton}$$

$$h = 90 \text{ cm}, b = 70 \text{ cm}, f_c = f_c' = 88,0 \text{ cm}^2.$$

Momentos entre las columnas.

$$M = 62,50 \cdot \frac{2,35^2}{8} - 64,50 = -21,0 \text{ ton.}$$

$$h = 70 \text{ cm}; b = 70 \text{ cm}; f_c = 39,00 \text{ cm}^2.$$

Losas.

$$L = \frac{2,50 - 0,70}{2} = 0,90 \text{ m}$$

$$M = 25,0 \cdot \frac{0,90^2}{2} = 10,20 \text{ ton}$$

$$h = 42 \text{ cm}, f_c = 32,60 \text{ cm}^2.$$

B.F.

Cimiento $C_{21} + C_{22}$.

$$C_{21} = 184,20 \text{ t}$$

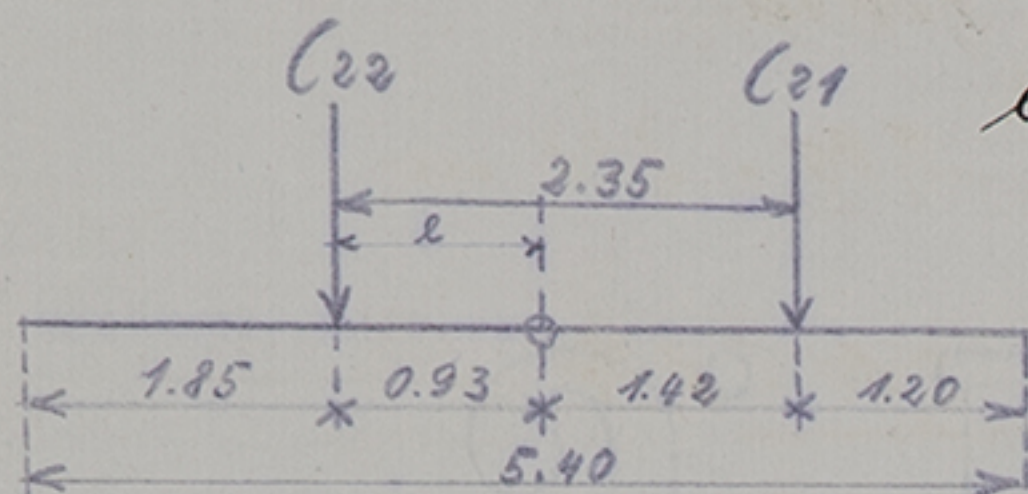
$$C_{22} = 285,24 \text{ " } P_{\max} = 469,44 \text{ t.}$$

$$e = \frac{184,20 \cdot 2,35}{469,44} = 0,93 \text{ m.}$$

$$C_{21} = \frac{184,20}{25,0} = 7,30 \text{ m}^2 = 2,62 \cdot 2,80 \text{ m.}$$

$$C_{22} = \frac{285,24}{25,00} = 11,40 \text{ m}^2 = 2,78 \cdot 4,15 \text{ m.}$$

$$l = \dots \dots \dots = 5,40 \text{ m.}$$

Nervaduras.

$$L = 1,85 - 0,27 = 1,58 \text{ m. } p = 25,0 \cdot 4,15 = 104 \text{ t/m.}$$

$$M_{\max} = 104 \cdot \frac{1,58^2}{2} = 130, - \text{ ton.}$$

$$h = 100 \text{ cm; } b = 90 \text{ cm; } f_c = f_c' = 160, - \text{ cm}^2.$$

$$L_1 = 1,20 - 0,27 = 0,93 \text{ m.}$$

$$p = 25,0 \cdot 2,80 = 70,50 \text{ t/m; } M = 70,50 \cdot \frac{0,93^2}{2} = 30,20 \text{ ton.}$$

$$h = 70 \text{ cm; } b = 90 \text{ cm; } f_c = 53,50 \text{ cm}^2.$$

Momento entre las columnas.

$$p = \frac{25,0(0,93 \cdot 4,15 + 1,42 \cdot 2,80)}{2,35} = 84,0 \text{ t/m.}$$

$$M_{\max} = 84,0 \cdot \frac{2,35^2}{8} - \frac{130,0 + 30,20}{2} = - 22,10 \text{ ton.}$$

$$h = 80 \text{ cm; } b = 50 \text{ cm; } f_c = 34,40 \text{ cm}^2.$$

$$\text{Losa. } L_1 = \frac{2,80 - 0,70}{2} = 1,05 \text{ m.}$$

$$M = 25,0 \cdot \frac{1,05^2}{2} = 14,00 \text{ ton.}$$

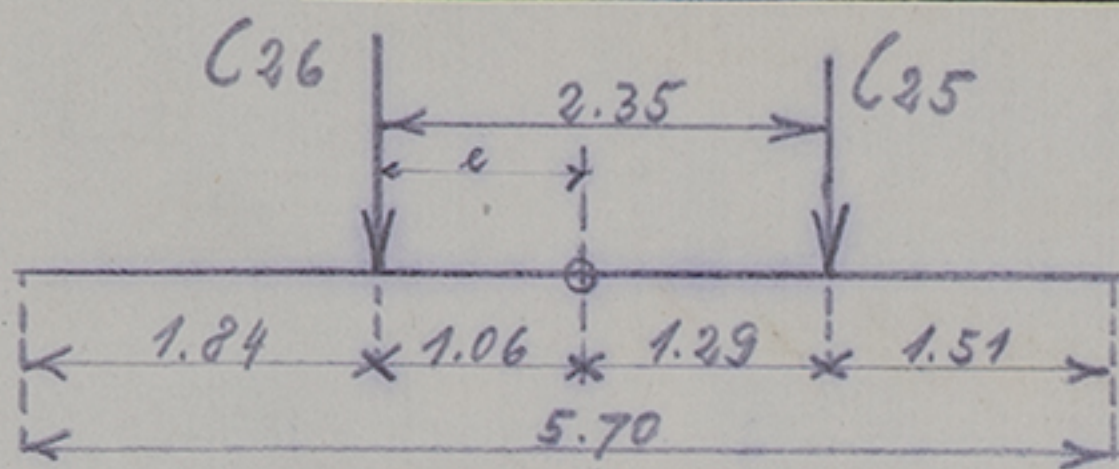
$$h = 46 \text{ cm; } f_c = 38,20 \text{ cm}^2.$$

$$L_2 = \frac{4,15 - 0,90}{2} = 1,62 \text{ m.}$$

$$M = 25,00 \cdot \frac{1,62^2}{2} = 33,0 \text{ ton}$$

$$h = 60 \text{ cm; } f_c = 59,0 \text{ cm}^2.$$

Cimiento C₂₅ + C₂₆.



$$C_{25} = 224,34 \text{ t}$$

$$C_{26} = 271,81 \text{ " } P_{max} = 496,15 \text{ t.}$$

$$e = \frac{224,34 \cdot 2,35}{496,15} = 1,06 \text{ m.}$$

$$C_{25} = \frac{224,34}{25,0} = 9,00 \text{ m}^2 = 2,80 \cdot 3,20 \text{ m.}$$

$$C_{26} = \frac{271,81}{25,0} = 10,80 \text{ m}^2 = 2,90 \cdot 3,70 \text{ "}$$

$$l = 5,70 \text{ m.}$$

Nervaduras. $L = 1,84 - 0,27 = 1,57 \text{ m.}$

$$p = 25,0 \cdot 3,70 = 93,00 \text{ t/m.}$$

$$M_{max} = 93,00 \cdot \frac{1,57^2}{2} = 110,00 \text{ ton.}$$

$$h = 90,0 \text{ cm ; } b = 90,0 \text{ cm ; } f_c = f_c' = 142,0 \text{ cm}^2.$$

$$L = 1,57 - 0,27 = 1,24 \text{ m.}$$

$$p = 25,0 \cdot 3,20 = 81,00 \text{ t/m.}$$

$$M = 81,00 \cdot \frac{1,24^2}{2} = 61,00 \text{ ton.}$$

$$h = 90 \text{ cm ; } b = 90 \text{ cm ; } f_c = 80,00 \text{ cm}^2$$

$$f_c' = 43,00 \text{ cm}^2.$$

Momento entre las columnas.

$$p = \frac{25,0 \cdot (1,06 \cdot 3,70 + 1,29 \cdot 3,20)}{2,35} = 87,00 \text{ t/m.}$$

$$M = 87,00 \cdot \frac{2,35^2}{8} - \frac{110 + 61}{2} = -25,50 \text{ ton.}$$

$$h = 90 \text{ cm ; } b = 50 \text{ cm ; } f_c = 36,50 \text{ cm}^2.$$

Losas. $L_1 = \frac{3,20 - 0,90}{2} = 1,15 \text{ m. } M = 25,0 \cdot \frac{1,15^2}{2} = 15,60 \text{ ton.}$

$$h = 48 \text{ cm ; } f_c = 40,50 \text{ cm}^2.$$

$$L_2 = \frac{3,70 - 0,90}{2} = 1,40 \text{ m. } M = 25,0 \cdot \frac{1,40^2}{2} = 24,50 \text{ ton.}$$

$$h = 60 \text{ cm ; } f_c = 50,60 \text{ cm}^2.$$

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Cimiento C₃₁ + C₃₂.

$$C_{31} = 264,79 \text{ t}$$

$$C_{32} = 274,96 \text{ " } P_{\max} = 539,75 \text{ t.}$$

$$f = \frac{539,75}{25,0} = 21,60 \text{ m}^2; a = 3,50 \text{ m}; b = 6,15 \text{ m.}$$

$$\text{Nervaduras. } L = \frac{6,15 - 2,35}{2} = 1,90 - 0,27 = 1,63 \text{ m.}$$

$$p = 25,0 \cdot 3,50 = 87,50 \text{ t/m.}$$

$$M_{\max} = 87,50 \cdot \frac{1,63^2}{2} = 116,50 \text{ ton.}$$

$$h = 95 \text{ cm}; b = 90 \text{ cm}; f_e = f_e' = 154,00 \text{ cm}^2.$$

Momento entre las columnas.

$$M_{\max} = 87,50 \cdot \frac{2,35^2}{8} - 116,50 = -56,50 \text{ ton.}$$

$$h = 95 \text{ cm}; b = 70 \text{ cm}; f_e = 86,50 \text{ cm}^2$$

$$f_e' = 43,25 \text{ cm}^2.$$

$$\text{Losas. } L = \frac{3,50 - 0,80}{2} = 1,35 \text{ m.}$$

$$M_{\max} = 25,0 \cdot \frac{1,35^2}{2} = 22,90 \text{ ton.}$$

$$h = 60 \text{ cm}; f_e = 49,00 \text{ cm}^2.$$

Cimiento C₃₆ + C₃₇.

$$C_{36} = 224,29 \text{ t}$$

$$C_{37} = 244,83 \text{ " } P_{\max} = 469,11 \text{ t.}$$

$$f_e = \frac{469,11}{25,0} = 18,80 \text{ m}^2.$$

$$a = 3,05 \text{ m}; b = 6,15 \text{ m.}$$

$$\text{Nervaduras. } L = \frac{6,15 - 2,35}{2} = 1,90 - 0,27 = 1,63 \text{ m.}$$

$$p = 25,0 \cdot 3,05 = 76,0 \text{ t/m.}$$

$$M_{\max} = 76,0 \cdot \frac{1,63^2}{2} = 101, - \text{ ton.}$$

$$h = 90 \text{ cm}; b = 90 \text{ cm}; f_e = f_e' = 132,00 \text{ cm}^2.$$

Momento entre las columnas.

$$M_{\max} = 76,0 \cdot \frac{2,35^2}{8} - 101 = -48,50 \text{ ton.}$$

$$h = 90 \text{ cm}; b = 70 \text{ cm}; f_c = 64,50 \text{ cm}^2; f_c' = 32,25 \text{ cm}^2.$$

Losas. $L = \frac{3,05 - 0,80}{2} = 1,13 \text{ m}$

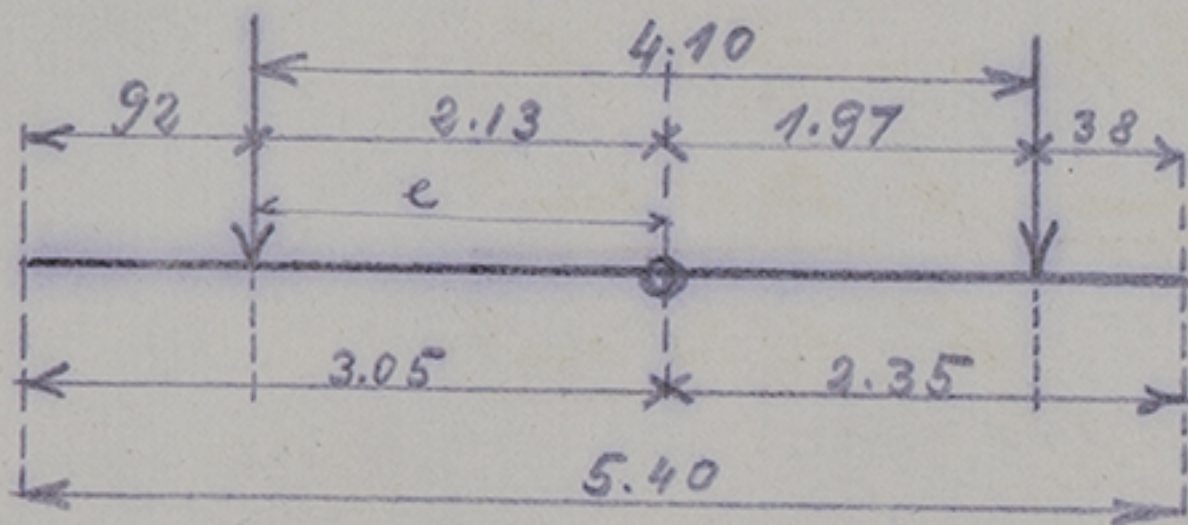
$$M = 25,0 \cdot \frac{1,13^2}{2} = 16,00 \text{ ton.}$$

$$h = 50 \text{ cm}; f_c = 41,00 \text{ cm}^2.$$

Cimiento C₁₉ + C₂₀.

$$C_{19} = 70,61 + 1,5 \cdot 41,40 = 133,61 \text{ t}$$

$$C_{20} = \frac{124,20}{2} \text{ " } P_{\max} = 257,81 \text{ t}$$



$$e = \frac{133,61 \cdot 4,10}{257,81} = 2,13 \text{ m.}$$

$$C_{19} = \frac{133,61}{25,0} = 5,35 \text{ m} = 2,35 \cdot 2,25 \text{ m.}$$

$$C_{20} = \frac{124,20}{25,0} = 4,95 \text{ m} = \frac{3,05 \cdot 1,65}{2}$$

$$l = 5,40 \text{ m.}$$

Nervaduras.

$$L = 0,92 - 0,27 = 0,65 \text{ m}$$

$$p = 25,0 \cdot 1,65 = 41,00 \text{ t/m.}$$

$$M = 41,00 \cdot \frac{0,65^2}{2} = 8,65 \text{ ton.}$$

$$h = 70 \text{ cm}; b = 55 \text{ cm}; f_c = 15,70 \text{ cm}^2.$$

$$L = 0,38 \text{ m}; p = 25,0 \cdot 2,25 = 56,0 \text{ t/m. (medianera)}$$

$$M = 56,0 \cdot \frac{0,38^2}{2} = 4,05 \text{ ton.}$$

$$h = 35,0 \text{ cm}; b = 55 \text{ cm}; f_c = 15,20 \text{ cm}^2.$$

Momento entre las columnas.

$$p = \frac{25,0(2,13 \cdot 1,65 + 1,97 \cdot 2,25)}{4,10} = 48,0 \text{ t/m.}$$

$$M = 48,0 \cdot \frac{4,10^2}{8} - \frac{8,65 + 4,05}{2} = +89,30 \text{ ton.}$$

$$h = 90 \text{ cm}; b = 120 \text{ cm}; b' = 70 \text{ cm}; f_c = 124,00 \text{ cm}^2; f_c' = 62,00 \text{ cm}^2.$$

25.1

Losas. $L_1 = \frac{2,25 - 0,70}{2} = 0,78 \text{ m}$

$M = 25,0 \cdot \frac{0,78^2}{2} = 7,60 \text{ ton} \cdot h = 34 \text{ cm}; fe = 2800 \text{ cm}^2$

$L_2 = \frac{1,65 - 0,55}{2} = 0,55 \text{ m}$

$M = 25,0 \cdot \frac{0,55^2}{2} = 3,80 \text{ ton} \cdot h = 25,0 \text{ cm}; fe = 1980 \text{ cm}^2$

Cimiento C24.

Mediana $1,50 \cdot 41,50 = 62,25 \text{ t}$

$P_{\max} = 157,82$

$P_{\max} = 220,07 \text{ t}$

$fe = \frac{220,07}{25,0} = 8,80 \text{ m}^2; a = 3,50 \text{ m}, b = 2,50 \text{ m}$

Nervadura. $L = 2,50 - (0,38 + 0,55) = 1,57 \text{ m}$

$p = 25,0 \cdot 3,50 = 87,50 \text{ t/m}$

$M = 87,50 \cdot \frac{1,57^2}{2} = 108,00 \text{ ton}$

$h = 90 \text{ cm}; b = 90 \text{ cm}; fe = fe' = 140,00 \text{ cm}^2$

Losa. $L = \frac{3,50 - 0,90}{2} = 1,30 \text{ m}$

$M = 25,0 \cdot \frac{1,30^2}{2} = 21,00 \text{ ton} \cdot h = 38 \text{ cm}; fe = 470 \text{ cm}^2$

Cimiento C28 + C29.

$C_{28} = 42,66 + 10 \cdot 41,40 = 84,06 \text{ t}$

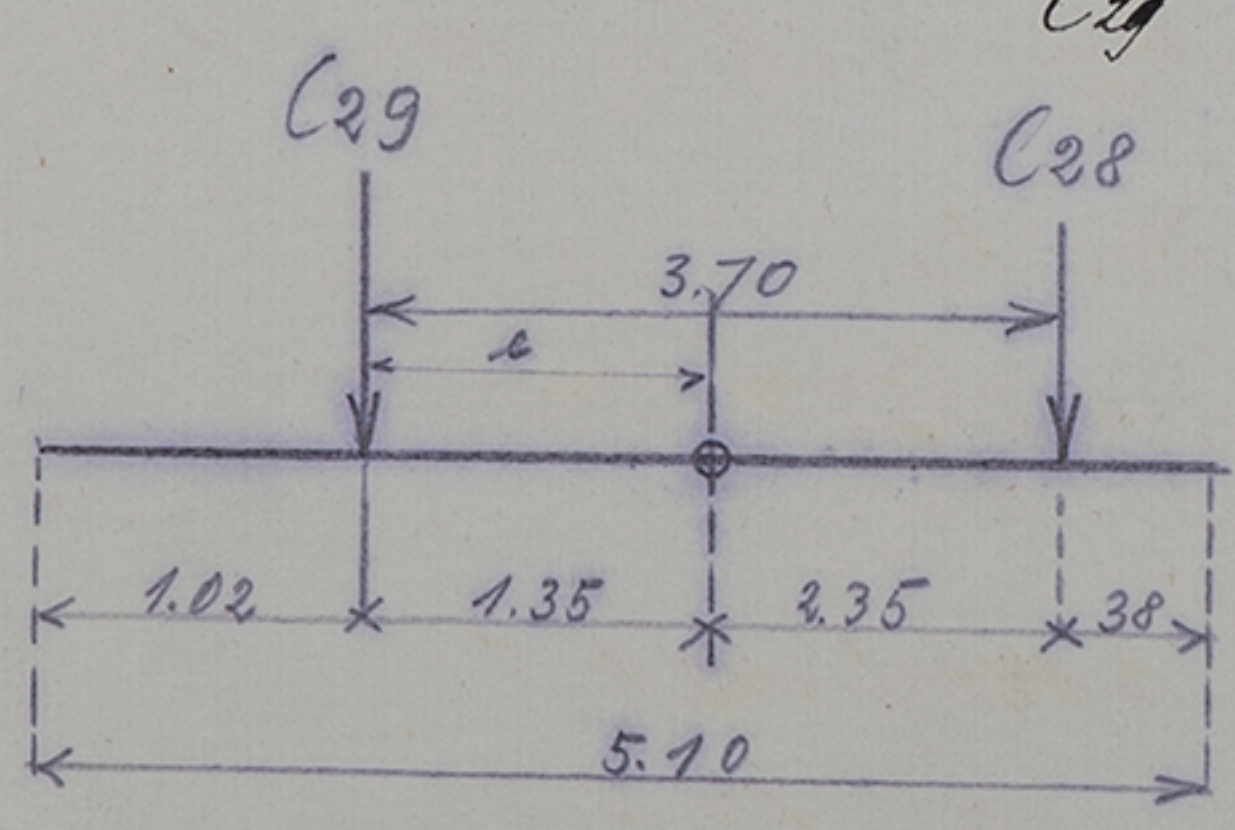
$C_{29} = 160,60 \text{ t} \cdot P_{\max} = 244,66 \text{ t}$

$e = \frac{84,06 \cdot 3,70}{244,66} = 1,35 \text{ m}$

$C_{28} = \frac{84,06}{25,0} = 3,37 \text{ m}^2 = 2,73 \cdot 1,25 \text{ m}$

$C_{29} = \frac{160,60}{25,0} = 6,40 \text{ m}^2 = 2,37 \cdot 2,65 \text{ m}$

$l = 5,10 \text{ m}$



Veredas. $L = 1,02 - 0,27 = 0,75 \text{ m}$; $p = 25,0 \cdot 2,65 = 66,50 \text{ t/m}$

$$M = 66,50 \cdot \frac{0,75^2}{2} = 18,80 \text{ ton.}$$

$$h = \underline{70 \text{ cm}}; b = \underline{55 \text{ cm}}; f_c = \underline{33,00 \text{ cm}^2}.$$

$$L_1 = 0,38 \text{ m}; p = 25,0 \cdot 1,25 = 31,50 \text{ t/m.}$$

$$M = 31,50 \cdot \frac{0,38^2}{2} = 2,28 \text{ ton.}$$

$$h = \underline{30 \text{ cm}}; b = \underline{55 \text{ cm}}; f_c = \underline{10,60 \text{ cm}^2}.$$

Momento entre las columnas.

$$p = \frac{(1,35 \cdot 2,65 + 2,35 \cdot 1,25) \cdot 25,0}{3,70} = 43,50 \text{ t/m.}$$

$$M_{\text{max}} = 43,50 \cdot \frac{3,70^2}{8} - \frac{18,80 + 2,28}{2} = 74,00 \text{ ton.}$$

$$h = \underline{90 \text{ cm}}; b = \underline{120 \text{ cm}}; f_c = \underline{98,00 \text{ cm}^2}; f_c = \underline{49,00 \text{ cm}^2}$$

$$b = \underline{70,0 \text{ cm}}.$$

Losas. $L_1 = \frac{2,65 - 0,70}{2} = 0,98 \text{ m.}$

$$M = 25,0 \cdot \frac{0,98^2}{2} = 12,0 \text{ ton. } h = \underline{42 \text{ cm}}; f_c = \underline{35,40 \text{ cm}^2}.$$

$$L_2 = \frac{1,25 - 0,70}{2} = 0,28 \text{ m}$$

$$M = 25,0 \cdot \frac{0,28^2}{2} = 1,00 \text{ ton. } h = \underline{15 \text{ cm}}; f_c = \underline{10,50 \text{ cm}^2}.$$

Cimiento C30. $P_{\text{max}} = 174,20 \text{ t}$

$$f_c = \frac{174,20}{25,0} = 6,75 \text{ m}^2 = 2,60 \cdot 2,60 \text{ m.}$$

$$L = \frac{2,60 - 0,80}{2} = 0,90 \text{ m}$$

$$M_{\text{max}} = 25,0 \cdot \frac{0,90^2}{2} = 10,20 \text{ ton.}$$

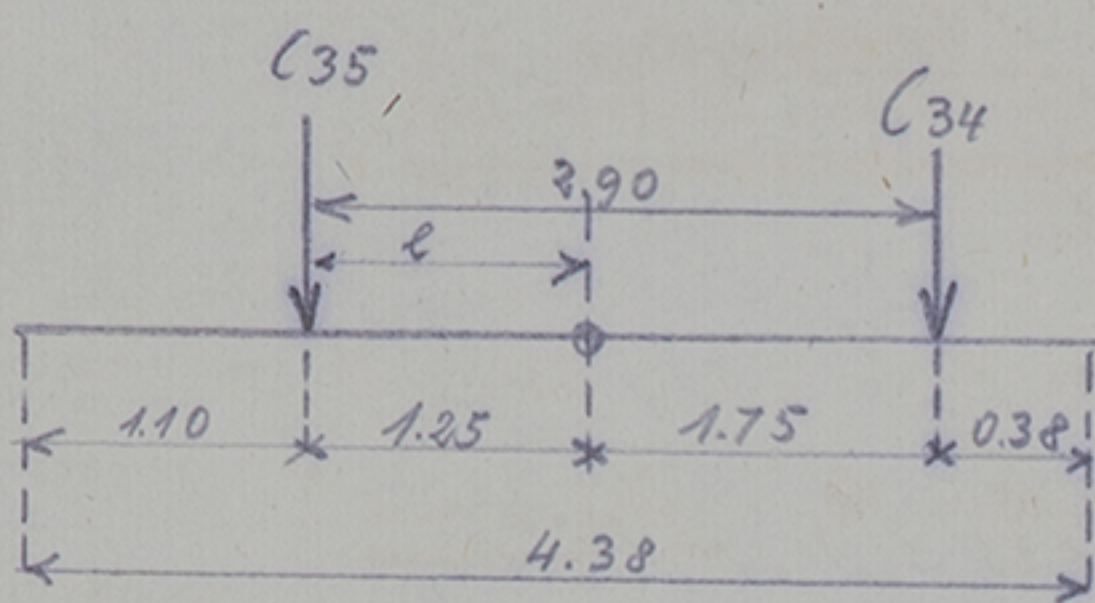
$$h = \underline{40 \text{ cm}}; f_c = \underline{32,60 \text{ cm}^2}.$$

Cimiento C34 + C35. $C_{34} = 73,31 + 1,0 \cdot 41,40 = 114,71 \text{ t.}$

$$C_{35} = 175,95 \text{ t.}$$

$$P_{\text{max}} = 290,66 \text{ t.}$$

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$$e = \frac{114.71 \cdot 2.90}{290.66} = 1.15 \text{ m}$$

$$C_{34} = \frac{114.71}{25.0} = 4.55 \text{ m}^2 = 2.13 \cdot 2.10 \text{ m}$$

$$C_{35} = \frac{175.95}{25.0} = 7.00 \text{ m}^2 = 2.25 \cdot 3.10 \text{ m}$$

$$l = 4.38 \text{ m}$$

Nervaduras. $l = 1.10 - 0.27 = 0.83 \text{ m}$

$$p = 25.0 \cdot 3.10 = 77.50 \text{ t/m}$$

$$M = 77.50 \cdot \frac{0.83^2}{2} = 26.50 \text{ ton}$$

$$h = 90 \text{ cm}; b = 55 \text{ cm}; f_e = 37.00 \text{ cm}^2$$

$$l = 0.38 \text{ m} \quad p = 25.0 \cdot 2.10 = 52.50 \text{ t/m}$$

$$M = 52.50 \cdot \frac{0.38^2}{2} = 3.80 \text{ ton}$$

$$h = 30 \text{ cm}; b = 55 \text{ cm}; f_e = 14.70 \text{ cm}^2$$

Momento entre las columnas.

$$p = \frac{25.0 \cdot (1.15 \cdot 3.10 + 1.75 \cdot 2.10)}{2.90} = 62.00 \text{ t/m}$$

$$M_{\text{max}} = 62.00 \cdot \frac{2.90^2}{8} - \frac{26.50 + 3.80}{2} = +50.70 \text{ ton}$$

$$h = 90 \text{ cm}; b = 115 \text{ cm}; b' = 70 \text{ cm}; f_e = 71.00 \text{ cm}^2$$

Losas. $l_1 = \frac{2.10 - 0.65}{2} = 0.73 \text{ m}$

$$M = 25.0 \cdot \frac{0.73^2}{2} = 6.75 \text{ ton}; h = 32 \text{ cm}; f_e = 27.0 \text{ cm}^2$$

$$l_2 = \frac{3.10 - 0.65}{2} = 1.23 \text{ m}$$

$$M = 25.0 \cdot \frac{1.23^2}{2} = 19.00 \text{ ton}; h = 53 \text{ cm}; f_e = 44.50 \text{ cm}^2$$

Cimiento C39.

$$C_{39} = 182.14 + 10 \cdot 4.140 = 220.50 \text{ t}$$

$$f = \frac{220.50}{25.0} = 8.90 \text{ m}^2$$

$$a = 3.30 \text{ m}; b = 2.70 \text{ m}$$

Nervadura. $L = 2,70 - (0,38 + 0,55) = 1,77 \text{ m.}$

$p = 25,0 \cdot 3,30 = 82,50 \text{ t}$

$M = 82,50 \cdot \frac{1,77^2}{2} = 128,00 \text{ ton.}$

$h = 110 \text{ cm}; b = 80 \text{ cm}; f_e = f_e' = 142,00 \text{ cm}^2.$

Losa. $L = \frac{3,30 - 0,80}{2} = 1,25 \text{ m}$

$M = 25,0 \cdot \frac{1,25^2}{2} = 19,50 \text{ ton.}$

$h = 55 \text{ cm}; f_e = 45,00 \text{ cm}^2.$

Cimiento C43.

$P_{\max} = 138,33 \text{ t.}$

$f = \frac{138,33}{25,0} = 5,50 \text{ m}^2$

$a = 2,20 \text{ m}; b = 2,50 \text{ m}; p = 25,0 \cdot 2,20 = 55,0 \text{ t/m.}$

Nervadura

$L = 2,50 - (0,38 + 0,55) = 1,57 \text{ m}$

$M = 55,0 \cdot \frac{1,57^2}{2} = 68,00 \text{ ton.}$

$h = 90 \text{ cm}, b = 70 \text{ cm}, f_e = f_e' = 98,0 \text{ cm}^2.$

Losa. $L = \frac{2,20 - 0,70}{2} = 0,75 \text{ m.}$

$M_{\max} = 25,0 \cdot \frac{0,75^2}{2} = 7,00 \text{ ton.}$

$h = 33 \text{ cm}; f_e = 27,00 \text{ cm}^2.$

Cimiento C44 + C45.

$C_{44} = 159,50 \text{ t}$

$C_{45} = 162,96 \text{ t. } P_{\max} = 162,96 \text{ t.}$

$f_e = \frac{162,96}{25,0} = 6,25 \text{ m}^2 = 2,50 \cdot 2,50 \text{ m}$

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Nervaduras. $L = 2,50 - (0,50 + 0,55) = 1,45 \text{ m}$

$p = 25,0 \cdot 2,50 = 62,50 \text{ t/m}$

$M = 62,50 \cdot \frac{1,45^2}{2} = 65,00 \text{ ton}$

$h = 90 \text{ cm}; b = 70 \text{ cm}; f_c = f_c' = 88, - \text{ cm}^2$

$L = 0,50 \text{ m}; M = 62,50 \cdot \frac{0,50^2}{2} = 7,85 \text{ ton}$

$h = 45 \text{ cm}; b = 70 \text{ cm}; f_c = 21,30 \text{ cm}^2$

Losa. $L = \frac{2,50 - 0,70}{2} = 0,90 \text{ m}$

$M = 25,0 \cdot \frac{0,90^2}{2} = 10,00 \text{ ton}$

$h = 38 \text{ cm}; f_c = 32,40 \text{ cm}^2$

Cimiento C46.

$P_{\max} = 87,46 \text{ t}$

$f = \frac{87,46}{25,0} = 3,50 \text{ m}^2$

existente = $1,90^2 + 1,00 = 4,25 \text{ m}^2$

$\sigma_t = \frac{87,46}{4,25} = 2,05 \text{ Kg/cm}^2$

Nervadura. $L = 1,30 \text{ m}$

$p = 1,90 \cdot 20,50 = 39, - \text{ t/m}$

$M = 39,0 \cdot \frac{1,30^2}{2} = 33, - \text{ ton}$

$h = 90 \text{ cm}; b = 70 \text{ cm}; f_c = 45, - \text{ cm}^2$

Losa. $L = 60 \text{ cm}$

$M = 20,50 \cdot \frac{0,60^2}{2} = 3,65 \text{ ton}$

$h = 24 \text{ cm}; f_c = 19,70 \text{ cm}^2$

Dimensiones de las columnas del Totano.

Col. C₃ + C₇ + C₈ + C₂₂ + C₂₆ + C₃₂. $P_{\max} = C_8 = 288,42 \text{ t}$

Sección 55/55 cm; $D_e = 50 \text{ cm}$; $F' = 1964 \text{ cm}^2$

$f_c = 10 \phi 28 \text{ mm} = 61,58 \text{ cm}^2$

$f_{es} = 20 \phi 18 \text{ mm} = 20 \cdot 3,14 \cdot 0,50 \cdot 2,54 = 79,00 \text{ cm}^2$

$P_K = 1,5 \cdot 300 \cdot 1964 + 2400 (61,58 + 2,4 \cdot 79,0) = 1490000 \text{ Kg.}$

$n = \frac{1490000}{288,42} = 5,15$

Col. C₁₇ + C₃₁. $P_{\max} = C_{31} = 264,79 \text{ t}$

Sección 55/55 cm; $D_e = 50 \text{ cm}$; $F' = 1964 \text{ cm}^2$

$f_c = 8 \phi 22 \text{ mm} = 30,41 \text{ cm}^2$

$f_{es} = 20 \phi 16 \text{ mm} = 20 \cdot 3,14 \cdot 0,50 \cdot 2,01 = 63,0 \text{ cm}^2$

$P_K = 1315 \text{ t}$

$n = \frac{1315}{264,79} = 5,00$

Col. C₁₁ + C₁₃ + C₃₇. $P_{\max} = C_{11} = 249,16 \text{ t}$

Sección 55/55 cm; $D_e = 50 \text{ cm}$; $F' = 1964 \text{ cm}^2$

$f_c = 8 \phi 18 \text{ mm} = 20,36 \text{ cm}^2$

$f_{es} = 20 \phi 14 \text{ mm} = 20 \cdot 3,14 \cdot 0,50 \cdot 2,01 = 48,0 \text{ cm}^2$

$P_K = 1210 \text{ t}$

$n = \frac{1210}{249,16} \approx 5,00$

25.1

Col. C₂₅ + C₃₆ + C₃₈. $P_{\max} = C_{25} = 224,34 \text{ t.}$

Sección 55/55 cm, $D_e = 50 \text{ cm}$, $F' = 1964 \text{ cm}^2$.

$f_e = 8 \phi 16 \text{ mm} = 16,08 \text{ cm}^2$

$f_{es} = 18 \phi 12 \text{ mm} = 18 \cdot 3,14 \cdot 0,50 \cdot 1,13 = 32,0 \text{ cm}^2$

$P_K = 1,5 \cdot 300 \cdot 1964 + 2400(16,08 + 2,4 \cdot 32,0) = 1103000 \text{ Kg}$

$n = \frac{1103}{224,34} = 5,00$

Col. C₅ + C₁₈ + C₃₃ + C₄₂. $P_{\max} = C_{42} = 211,03 \text{ t.}$

Sección 55/55 cm; $D_e = 50 \text{ cm}$; $F' = 1964 \text{ cm}^2$.

$f_e = 8 \phi 14 \text{ mm} = 12,32 \text{ cm}^2$

$f_{es} = 18 \phi 12 \text{ mm} = 18 \cdot 3,14 \cdot 0,50 \cdot 1,13 = 32,00 \text{ cm}^2$

$P_K = 1,5 \cdot 300 \cdot 1964 + 2400(12,32 + 2,4 \cdot 32,0) = 1093000 \text{ Kg}$

$n = \frac{1093}{211} = 5,10$

Col. C₂₁ + C₂₃ + C₂₇ + C₃₀ + C₃₅ + C₃₉ + C₄₀ + C₄₁ + C₂ + C₆ + C₁₅ +
+ C₄₅ + C₂₉. $P_{\max} = C_{21} = 184,20 \text{ t.}$

Sección 55/55 cm; $D_e = 50, - \text{ cm}$; $F' = 1964 \text{ cm}^2$.

$f_e = 8 \phi 12 \text{ mm} = 9,05 \text{ cm}^2$

$f_{es} = 15 \phi 8 \text{ mm} = 15 \cdot 3,14 \cdot 0,50 \cdot 0,50 = 11,70 \text{ cm}^2$

$P_K = 1,5 \cdot 300 \cdot 1964 + 2400(9,05 + 2,4 \cdot 11,70) = 973000 \text{ Kg}$

$n = \frac{973,00}{184,20} = 5,3$

Col. C₁₂. $P_{\max} = 161,55 \text{ t.}$

Sección 40/80 cm; $D = 35 \text{ cm}$; $F' = 962 \text{ cm}^2$

ó 2 columnas 40/40.

$f_e = 8 \phi 10 \text{ mm}$; $f_{es} = 20 \phi 8 \text{ mm}$.

$$P_K = 2.508.000 \text{ Kg.}$$

$$n = \frac{2.508}{161,55} = \underline{6,20.}$$

$$\underline{\text{Col. } C_{24} + C_{44}.} \quad P_{\max} = C_{44} = \underline{159,49 \text{ t.}}$$

$$\text{Sección } 55/55 \text{ cm; } D_c = 50 \text{ cm; } F_c' = 1964 \text{ cm}^2$$

$$f_c = 8 \phi 10 \text{ mm} = \underline{6,28 \text{ cm}^2}$$

$$f_{cs} = 12 \phi 8 \text{ " } = 12 \cdot 0,50 \cdot 3,14 \cdot 0,50 = \underline{9,42 \text{ cm}^2}.$$

$$P_K = 1,5 \cdot 300 \cdot 1964 + 2400(6,28 + 2,4 \cdot 9,42) = 953.500 \text{ Kg.}$$

$$n = \frac{953,50}{159,49} = \underline{6,0.}$$

$$\underline{\text{Col. } C_{16} + C_{20} + C_{43}.} \quad P_{\max} = C_{43} = \underline{138,33 \text{ t.}}$$

$$\text{Sección y armadura igual } C_{24}.$$

$$n = \frac{953,50}{138,33} = \underline{6,9.}$$

$$\underline{\text{Col. } C_{10} + C_{46}.} \quad P_{\max} = \underline{107,34 \text{ t.}}$$

$$\text{Sección } 55/55 = 3025 \text{ cm}^2$$

$$f_c = 8 \phi 14 \text{ mm} = \underline{12,32 \text{ cm}^2}.$$

$$\sigma_b = \frac{107.340}{3025 + 15 \cdot 12,32} = \underline{33,50 \text{ Kg/cm}^2}.$$

$$\underline{\text{Col. } C_4 + C_9 + C_{19} + C_{34}.} \quad P_{\max} = C_4 = \underline{74,71 \text{ t.}}$$

$$\text{Sección } 27/50 \text{ cm} = 1350 \text{ cm}^2$$

$$f_c = 10 \phi 14 \text{ mm} = \underline{15,39 \text{ cm}^2}.$$

$$f_{cs} = 15 \phi 8 \text{ mm} = 15 \cdot 2(0,24 + 0,47) \cdot 0,50 = \underline{10,6 \text{ cm}^2}.$$

$$F_b = 1350 + 15 \cdot 15,39 + 30 \cdot 10,60 = 1898 \text{ cm}^2.$$

$$\sigma_b = \frac{74.710}{1898} = \underline{39,50 \text{ Kg/cm}^2}.$$

R.F.

Col. C_1 $P = 50,13 \text{ t.}$

Sección $55/55 = 3025 \text{ cm}^2$

$f_c = 8 \phi 14^{\text{mm}} = 12,32 \text{ cm}^2$

$\sigma_c = \frac{50130}{3025 + 15 \cdot 12,32} = 15,60 \text{ Kg/cm}^2$

Col. $C_{14} + C_{28}$ $P_{\text{max}} = C_{28} = 42,66 \text{ t.}$

Sección $27/27 \text{ cm} = 729 \text{ cm}^2$

$f_c = 8 \phi 16^{\text{mm}} = 16,08 \text{ cm}^2$

$f_{cs} = 15 \phi 8^{\text{mm}} = 15 \cdot 4 \cdot 0,24 \cdot 0,50 = 7,20 \text{ cm}^2$

$F_i = 729,00 + 15 \cdot 16,08 + 30 \cdot 7,20 = 1185 \text{ cm}^2$

$\sigma_c = \frac{42660}{1185} = 36,50 \text{ Kg/cm}^2$

Buenos Aires 16 de Mayo de 1923.

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Ing. Civil