

20749

34655-
9-6-57

0710

Aug
64.
9-39

doze plantas e
calculos

Ilmo Snr. Dr. Loureiro da Silva

M.D. Prefeito Municipal de Porto Alegre.

Como pagar 10/6/59
Pomestri
PUBLICADO

A Irmandade do Divino Espirito Santo, representada pelo seu Imperador, vem perante V.S. requerer lhe seja concedida a licença para terminar a construção de sua Capella.

Apresentando para isto o projeto de suas torres que é o que falta construir.

Nestes termos

P.D.

Porto Alegre, 5 de Novembro de 1938

Cel. Flaminio da Cunha Lucena
Prof. católicos de Colégio Mar

Imperador Festeiro de 1938



SECO
Ficha Nº 8
14-11-38
L. G. de Souza

D.G.O.V. PROTOCOLO
Recbi m plantas
Em 6 de 1938
Yost & S. de 1938

Seria conveniente dizer
a Procuradoria Municipal
se o terreno em que esta
construida a Capela e da
Irmã da de ou da Paróquia.

Em 14-11-38

[Signature]

Solicito por meio de
Procuradoria.

16-XI-1938

[Signature]

Não ha inconveniente
em se ceder.

9. requer

Em 29/10/39

[Signature]

De novo

29-X-1939

[Signature]

Obm

12/11/39
[Signature]

20449/938

(2)

DECLARAÇÃO

Declaramos pela presente que entregamos a construção das
Torres da Capella do Divino Espirito Santo ao Eng^o Humberto
Della Múa.

Porto Alegre, 5 de Novembro de 1938

Col. Himerio da Cunha Lima da
Prof. cat. de Arte do Colégio N. S.
Imperador Festeiro de 1939

De acordo

Humberto Della Múa
Eng. Civil



Reconheço as duas firmas supra
Himerio da Cunha Lima da
Eng. Civil Humberto Della Múa
testemunha *publicado*

Porto Alegre, *5 de Novembro de 1938*
Notario, *Humberto Della Múa*



R. 1000

②

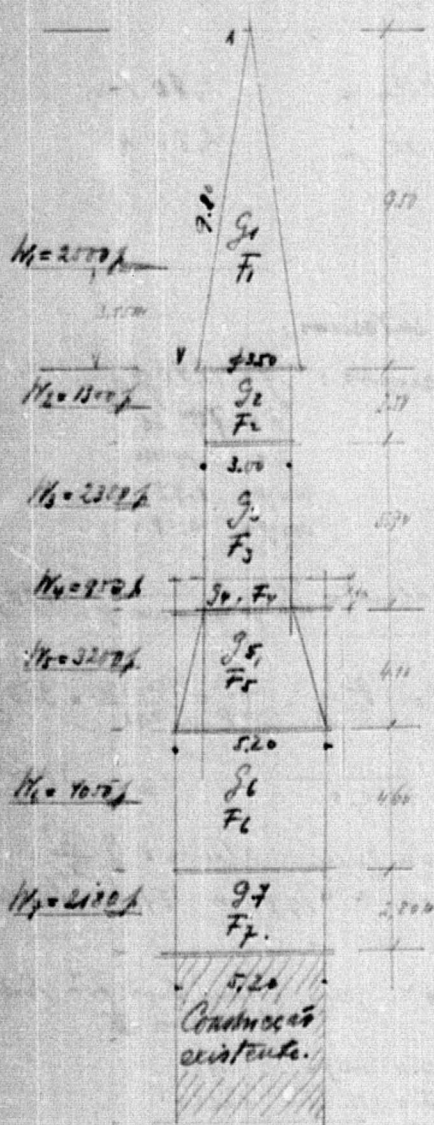
204-1932

20349/938

(3)

Acum.

A) Cálculo dos Pesos:



$$G_1 = \text{Superfície} \cdot p \cdot h \cdot s = 6.75 \cdot 8.75 \cdot 5.4 \text{ m}^2$$

$$\text{Área} = 10 \text{ cm concreto} = 2.40 \text{ flm}^2$$

$$G_1 = 5.4 \cdot 2.40 = 10.00 \text{ To.}$$

$$G_2 = \text{alven. item. 2.5. 9.20. 0.48} = 11.70$$

$$\text{cimento arm.: 0.30} = 15.00 \text{ "}$$

$$G_3 = \text{8 colunas arm. arm.} = 16.00 \text{ "}$$

$$8. 4.20. 4.17. 5.70. 2.40 =$$

$$G_4 = \text{Balaustradas: 30 cm. 2.40. 0.48} = 11.50$$

$$\text{Laje de pavimento sub. ripas} = 1.50 = 13.00 \text{ "}$$

$$G_5 = \text{alven. item. 4.5. 4.10. 0.48} = 11.50$$

$$\text{Laje + ripas} = 10.00 = 21.50 \text{ "}$$

$$G_6 = \text{alven. item. 8.5. 4.60. 0.48} = 19.00$$

$$\text{Laje + ripas} = 8.00 = 27.00 \text{ "}$$

$$G_7 = \text{alven. item. 4.5. 4.20. 0.48} = 21.00 \text{ "}$$

$$\Sigma G = 195.00 \text{ To.}$$

B) Forças de vento = $w_0 = 150 \text{ kg/m}^2$.

$$W_1 = 9.17 \cdot 3.17 \cdot 150 = 2500 \text{ p}$$

$$W_2 = 2.57 \cdot 3.17 \cdot 150 = 1200 \text{ "}$$

$$W_3 = 4.60 \cdot 3.17 \cdot 150 = 2200 \text{ "}$$

$$W_4 = 4.10 \cdot 5.20 \cdot 150 = 950 \text{ "}$$

$$W_5 = 4.10 \cdot 5.20 \cdot 150 = 3200 \text{ "}$$

$$W_6 = 4.60 \cdot 5.20 \cdot 150 = 4050 \text{ "}$$

$$W_7 = 4.10 \cdot 5.20 \cdot 150 = 2100 \text{ "}$$

$$\Sigma W = 16.500 \text{ p.}$$

Directoria de Obras,
1ª SEÇÃO
VISTO

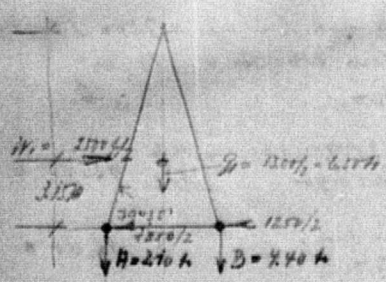
AREA _____

Data: 29/1/59

LR



1) Telhado:

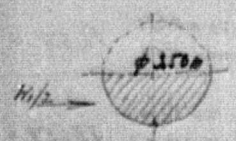


$$H_1 = 2.500/2 \cdot 3.5 = 3,25 \text{ m} \text{ (consideramos a metade do telhado)}$$

$$G = 12.00/2 = 6,00 \text{ k}$$

$$H = \frac{3.95 - 6.52 \cdot 1.75}{3.57} = 2,80 \text{ k}$$

$$V = \frac{3.95 + 6.52 \cdot 1.75}{3.57} = 4,40 \text{ k}$$



Tensões = Forças internas:

a) prov. do peso próprio: $q = 240 \text{ f/m}^2$
 $\varphi = 35^\circ$
 $r = 1.75 \text{ m}$
 $\sin \varphi = 0.57$
 $\cos \varphi = 0.82$

$$T_1 = \text{Pressão no meridiano} = H \cdot r \cdot \frac{1}{\sin \varphi \cdot \cos \varphi} = 1190 \text{ f/m}$$

$$T_2 = \text{Força de avel} = \frac{q}{2} \cdot r^2 \cdot \frac{1}{\sin \varphi} = \frac{120 \cdot 1.75^2}{0.57} = 380 \text{ f/m}$$

$$P_H (\text{Força de avel na base}) = 380 \text{ f/m}$$

$$T_2: \text{Força de avel em qualquer altura} = q \cdot \frac{r^2}{2} = 240 \cdot 1.75^2 / 2 = 770 \text{ f/m}$$

b) prov. do vento: $q = 150 \text{ f/m}^2$: seg. Handbuch für Projektanten

$$H_2 = \frac{E}{4} \cdot \sin \varphi \cdot 2 \cdot W \cdot F = \text{com } \sin \varphi = 0.57$$

$$F = 3.57 \cdot \frac{25}{2} = 44.6 \text{ m}$$

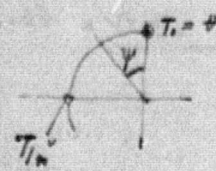
$$E = \frac{1.14}{2} = 0.57$$

$$H_2 = 0.57 \cdot 99 \cdot 2 \cdot 3.57 \cdot 44.6 = 3850 \text{ f}$$

$$\text{Forças } T_1: \frac{H}{r} = \frac{H}{r} = \frac{\pi \cdot W \cdot \cos \varphi}{\pi \cdot r^2} (3 \cos \varphi - 1) \cdot \frac{3}{2} = 1170 \text{ f/m}$$

$$T_2 = T_{1m} \sin \varphi: \text{para } \varphi = 45^\circ: T_2 = 125 \text{ f/m}$$

$$\text{para } \varphi = +: T_2 = +$$



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(4)

Lavoura

Forças T_2 .

$$T_{2n} = w_0 \cdot \text{ctg} \varphi \cdot z = 150 \cdot 0,5 \cdot 9,5 = 256 \text{ f/m.}$$

$$T_2(\varphi = 45^\circ) = w_0 \cdot \text{ctg} \varphi \cdot z \cdot \sin \varphi = 180 \text{ "}$$

$$T_2(\varphi = 0) = 0.$$

Força cortante: S : $S = S_h \cdot \cos \varphi$.

$$S_h = \frac{w_0 \cdot z}{3 \cdot \sin \varphi} = \frac{150 \cdot 9,5}{3 \cdot 0,98} = 485 \text{ f/m. porim.}$$

$$\text{para } \varphi = 90^\circ: S = 0$$

$$\varphi = 45^\circ: S = 0,707 \cdot 485 = 334 \text{ f/m.}$$

$$\varphi = 0^\circ: S = 485 \text{ f/m.}$$

Forças de a) e b)

$$T_{1n \text{ min.}} = \overset{(\text{top})}{+1190} - \overset{(\text{vento})}{1170} = +20 \text{ f/m.}$$

$$T_{1n \text{ max.}} = +1190 + 1170 = +2360 \text{ f/m. porim.}$$

$$T_{2 \text{ max.}} = +77 + 256 = +333 \text{ f/m. abs.}$$

$$S_{\text{max.}} = 485 \text{ f/m. porim.}$$

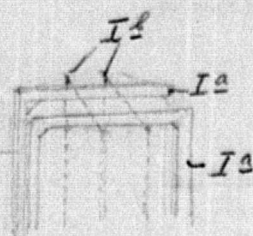
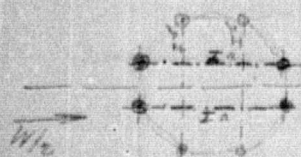
Suspensão de concreto: $S_{\text{con}} = d$:

$$T_1 \text{ max.} = 2360 \text{ f/m.} : \sigma_1 = \frac{2360}{5,100} = 4,67 \text{ f/m.}^2$$

$$T_2 \text{ " } = 333 \text{ " } : \sigma_2 = \frac{333}{5,100} = 6,67 \text{ "}$$

$$S \text{ " } = 485 \text{ " } : \sigma_s = \sigma_0 = \frac{485}{5,100} = 0,97 \text{ "}$$

Portico I:



Com Vento as juntas descoladas
trabalham os porticos Ia.
(Porticos Ib não trabalham)

Cada um dos 2 porticos Ia recebe
a Metade do Vento:

$$W_h = \frac{2360}{2} = 1180 \text{ f/m.} = 1600 \text{ f}$$

$$K_q = \frac{0,5 \cdot 1600 \cdot 2,57}{2,70} = 1,25 \text{ f}$$

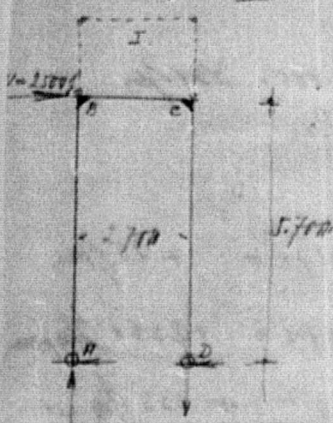
$$+ K_q \text{ de cima} + 2,10 \cdot 6$$

$$K_q = + 0,77 \text{ f}$$

$V_D = +1.28 + 4.40 = +5.53 \text{ kN}$
 $M_B = M_C = \pm 1600 \cdot 2.57/2 = \pm 2.08 \text{ mts}$
 $H = \frac{Q}{2} = 1600/2 = 800 \text{ f}$

Alcova

Portico I.



$H = 1600 + 1300/4 + 2380/4 = 2577 \text{ f}$

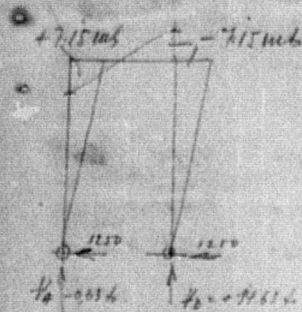
$H = \frac{Q}{2} = 1250 \text{ f}$

$V_B = 2577 \cdot 5.71/2.71 = -5.25 \text{ kN} \uparrow$
 de cima Portico I.
 alcova 2.71m $\cdot 1.10 \cdot 2.57 \cdot 0.5 = +1.64 \text{ kN} \downarrow$
 pp. columna $+2.25 \text{ kN} \downarrow$

$V_B = -5.25 + 4.62 = -0.63 \text{ kN}$

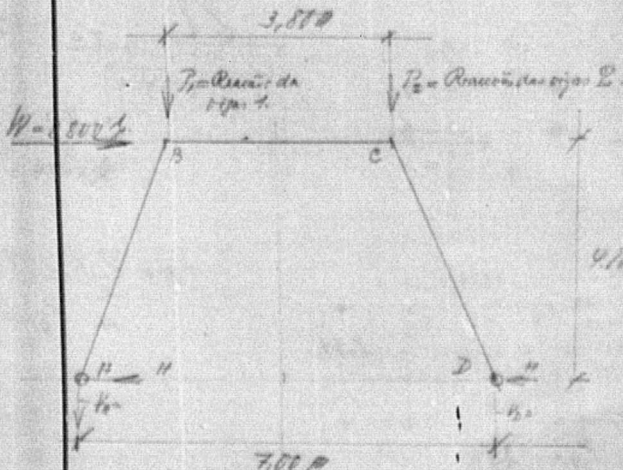
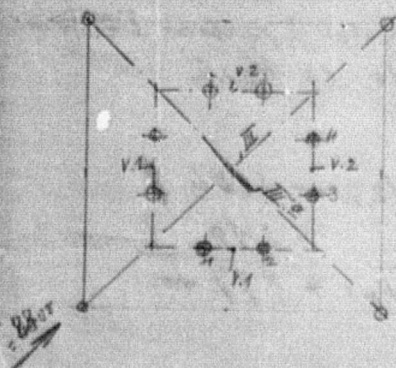
$V_D = +5.25 + 5.53 + 1.64 + 2.25 = +14.63 \text{ kN}$

$M_B = M_C = \pm 2577 \cdot 5.71/2 = \pm 7.15 \text{ mts}$



Portico III.

Esquema:



Cargas das Colunas: 20749/938 (5) *Alencar*

col 1. - 0,63 to 1

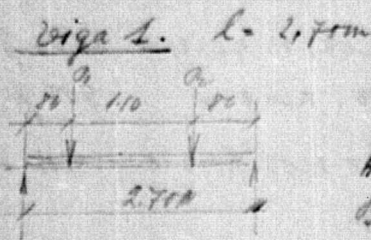
col 2: almanac 1.10. 2.17. 570 = + 1.64 to + 2.25 ~ 4.00 to.

col 3 = col 2 = ~ 4.00 to

col 4. + 14.63 + 4. = + 14.63 to.

$$\Sigma \text{Cargas} = 4.00 + 4.00 + 14.63 - 0.63 = 22.0 \text{ to.}$$

$$= \frac{q_1 + q_2 + q_3}{2} = \frac{44.00}{2} = 22.00 \text{ (Ocorr.)}$$



$C = 1000 \text{ Pa.}$

$q_1 = \text{col 1} = -0.63 \text{ to}$

$q_2 = \text{col 2} = +4.00 \text{ to}$

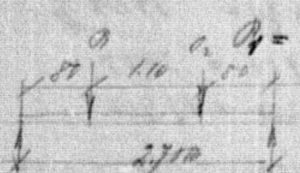
$$H = 1.35 \cdot 1000 = 1.35 \cdot 1.97 \cdot 2.70 + 4.00 \cdot \frac{2.70}{2} = 2100 \text{ p.}$$

$$B = 1350 + 120 + 2800 = 3970 \text{ p.}$$

$\gamma = 0.80m.$

$$M_0 = 0.80 \cdot 3970 = 0.80 \cdot 1000 = 2850 \text{ emp.}$$

Viga 2 $L = 2.70m$ $C = 1000 \text{ Pa.}$: *Cargas com v.t.*



$q_1 = \text{Col 3} = 4.00 \text{ to}$ $q_2 = \text{col 4} = 14.63 \text{ to.}$

$$H = 1.35 \cdot 1000 + 4.00 \cdot \frac{1.97}{2.70} + 14.63 \cdot \frac{0.1}{2.70} = 8570 \text{ p.}$$

$$B = 1350 + 1200 + 10.300 = 12.850 \text{ p.}$$

$\gamma = 0.80m.$

$$M_0 = 12.850 \cdot 0.80 = 0.80 \cdot 1000 = 9900 \text{ emp.}$$

Portico III: *detalh. das cargas, separadamente:*



1) carga 2 = q_1 + pequena parte da q_2 = 577 Pa.

Normais de inercia: $M_2 = 31 \cdot 30/55.$

$$F = 31.05 \cdot \frac{3}{12} = 410.000 \text{ em 4.}$$

Colunas: $F_1 = \frac{2}{40} (mudis) = 20.40 \cdot \frac{3}{12} \cdot 10000 \text{ to.}$

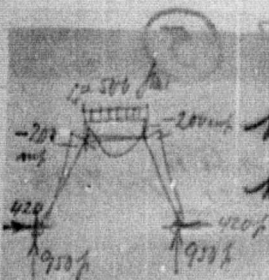
$$X_1 = \frac{F}{F_1} \cdot \frac{3}{16} = \frac{410.000}{160} \cdot \frac{45}{120} = 3.04.$$

$$N_0 = N = X \cdot 2 + 3 = 6.08 + 3 = 9.08; Q = 311.000 = 1900 \text{ p.}$$

$$H = \frac{1900 \cdot 1.60 \cdot 9.14 + 2620}{2.400 \cdot 9.54} = 420 \text{ p.}$$

$$T = 2 \cdot \frac{3}{2} = 500 \cdot 3.04 \cdot \frac{3}{2} = 2320.$$

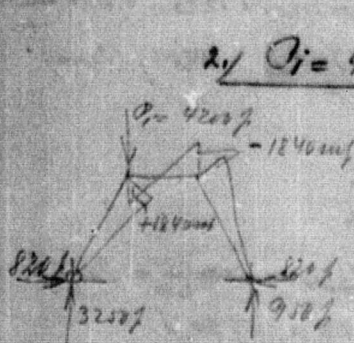
-5-



$$V_H = V_D = 950 \text{ k}$$

$$H_D = H_C = - \frac{1900 \cdot 4.6}{2} - 420 \cdot 4.10 = -200 \text{ mp}$$

$$H^0 = 3.50 / 3.50 = +900 \text{ mp}$$



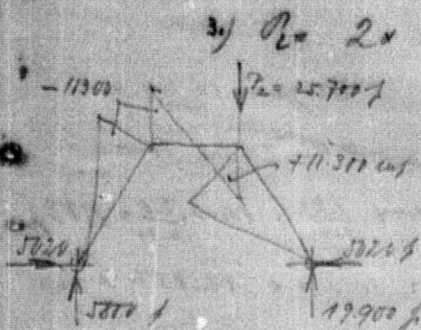
$$2) \quad Q_i = 420 \text{ k} \quad H = \frac{Q_i \cdot a}{2 \cdot h} = \frac{420 \cdot 4.6}{2 \cdot 4.10} = 120 \text{ k}$$

$$V_H = Q_i (1 - \alpha) = 420 (1 - 0.228) = 325 \text{ k}$$

$$V_D = Q_i \cdot \alpha = 420 \cdot 0.228 = 95 \text{ k}$$

$$H_H = V_D \cdot a = H \cdot h = 325 \cdot 4.6 = 820 \cdot 4.10 = +1840 \text{ kmp}$$

$$H_C = -1840 \text{ mp}$$



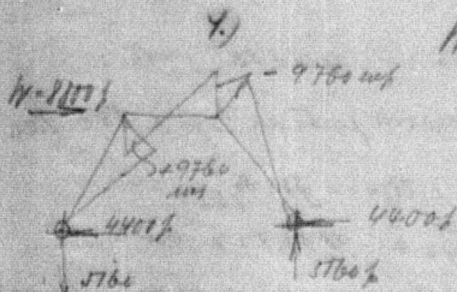
$$3) \quad Q_i = 2 \times 12.5 \text{ k} = 25.7 \text{ k}$$

$$H = 25.7 / 420 \cdot 820 = 50 \text{ k}$$

$$V_H = H \cdot 9.10 = 50 \text{ k}$$

$$V_D = H \cdot 325 = 17.90 \text{ k}$$

$$H_D = -H_C = H \cdot 1840 = \pm 1180 \text{ kmp}$$



$$H = 8800 \text{ k} = 2500 + 1200 + 2300 + 900 + 1600 = 8700 = \sim 8800 \text{ k}$$

$$H = 4400 \text{ k}$$

$$H = \pm \frac{Q \cdot h}{2} = \frac{8700 \cdot 4.6}{2} = 5100 \text{ k}$$

$$H_D = -H_C = \frac{Q \cdot h \cdot \beta}{2} = \frac{8700 \cdot 4.10 \cdot 0.542}{2} = 9760 \text{ kmp}$$

$$\left(\beta = \frac{h}{\rho} = \frac{3.80}{7.00} = 0.542 \right)$$

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⑥

Secção

$$1+2+3+4: H_H = +420 + 820 + 5020 - 4400 = 1860 \text{ f} \rightarrow$$

$$H_D = 420 + 820 + 5020 + 4400 = 10660 \text{ f} \leftarrow$$

$$\text{Força de distensão de tensor} := 420 + 820 + 5020 - 6260 \text{ f}$$

$$V_H = 950 + 3250 + 5800 - 5700 = 4840 \text{ f} \downarrow$$

$$V_D = 950 + 950 + 19200 + 5600 = 26960 \text{ f} \downarrow$$

$$M_B = -200 - 11300 + 1840 + 9760 = +100 \text{ mpf}$$

$$M_C = -200 - 1840 + 11300 - 9760 = -500 \text{ mpf}$$

Portão III^a

$$P_1 = P_2 = \frac{v.1}{v.2} = \frac{3970 \text{ f}}{8550 \text{ f}}, \gamma = 12.470 = \sim 12.570 \text{ f}$$

$$V_H = V_D = +12570 \text{ f}$$

$$H = \frac{2 \cdot P_1}{2 \cdot h} = \frac{2 \cdot 12570 \cdot 1.6}{2 \cdot 4.0} = 4875 \text{ f}$$

$$M_B = M_C = -200 \text{ mpf. como portão III}$$

Outro sensor de vento = $H = 8800 \text{ f}$

$$\text{col 1: } -0.626 \text{ t, col 2: } +4.000 \text{ t, col 3: } +4.000 \text{ t}$$

$$\text{col 4: } +14.63 \text{ t}$$

$$\text{figa 1. } L = 2.70 \text{ m, } \zeta = 1000 \text{ f/m, } P_1 = \text{col 2} = 4000 \text{ f} = P_2$$

$$H = B = 1.35 \cdot 1000 + 4000 = 5350 \text{ f}$$

$$M = 1.35 \cdot 5350 - 1.35 \cdot \frac{1}{2} \cdot 1000 = 4000 \cdot 0.55 = 4000 \text{ mpf}$$

$$\text{figa 2. } L = 2.70 \text{ m, } \zeta = 1000 \text{ f/m, } P_1 = P_2 = \text{col 4} = 14.63 \text{ t}$$

$$H = B = 1350 + 14.630 = 15980 \text{ f}$$

$$M = 15980 \cdot 1.35 - 1.35 \cdot \frac{1}{2} \cdot 1000 = 12790 \text{ mpf}$$

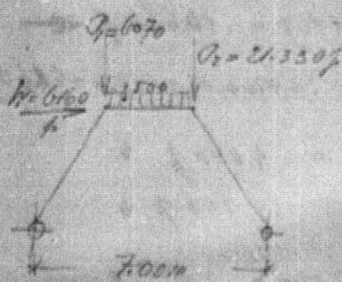
$$\text{figa 3. } L = 2.70 \text{ m, } \zeta = 1000 \text{ f/m, } P_1 = P_2 = -630 \text{ f (col 1)}$$

$$H = B = 1350 - 630 = 720 \text{ f}$$

2

88P1P4508

Casa um das prátias III^a trabalha com a metare: $\frac{1}{2}$ long



$$Q_1 = v.1 + v.3 = 5350 + 3200 = 6070 f$$

$$Q_2 = v.1 + v.2 = 5350 + 15980 = 21.330 f$$

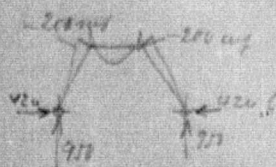
$$H = 8800 \cdot 0.707 = 6160 f$$

1) $Q_1 = 6070 f$

$\frac{1}{2} = 500 f/m. Q = 1900 f. H = 420 f$

$$H_H = 950 f = H_D$$

$$H_B = H_C = -200 mps$$



2) $Q_2 = 6070 f$

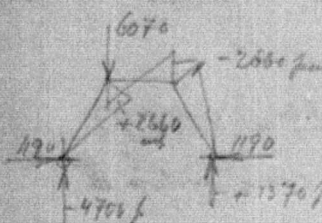
$$H = 6070 / 420 \cdot 820 = 1190 f$$

$$H_H = 6070 / 420 \cdot 3200 = 4700 f$$

$$H_D = H_H \cdot 950 = 1370 f$$

$$H_B = H_H \cdot 1840 = +2660 f$$

$$H_C = -2660 mps$$



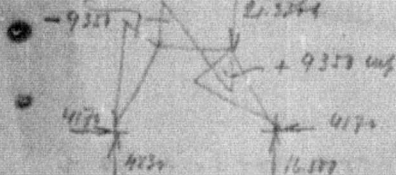
3) $Q_3 = 21.330 f$

$$H = 21330 / 420 \cdot 820 = 4170 f$$

$$H_H = H_H \cdot 950 = 4830 f$$

$$H_D = H_H \cdot 3200 = 16.500 f$$

$$H_B = H_C = H_H \cdot 1840 = \pm 9350 mps$$

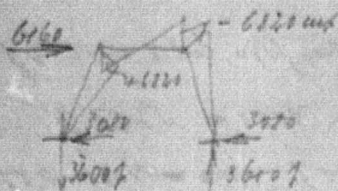


4) $H = 6160 f$

$$H = 6160 / 8800 \cdot 4800 = 3080 f$$

$$H_D = H_H \cdot 5160 = 2600 f$$

$$H_B = H_C = H_H \cdot 9760 = 6820 mps$$



1+2+3+4)

$$H_H = 420 + 1190 + 4170 - 3080 = 2700 f \rightarrow$$

$$H_D = 420 + 1190 + 4170 + 3080 = 8860 f \leftarrow$$

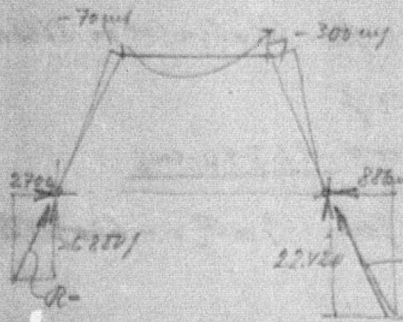
$$H_H = 950 + 4700 + 4830 - 2600 = +6880 f$$

$$H_D = 950 + 1370 + 16.500 + 2600 = +22.420 f$$

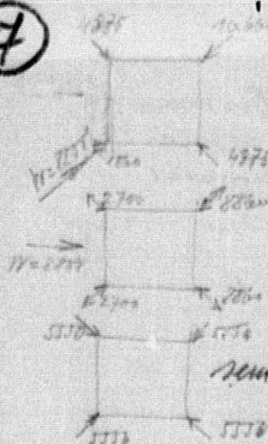
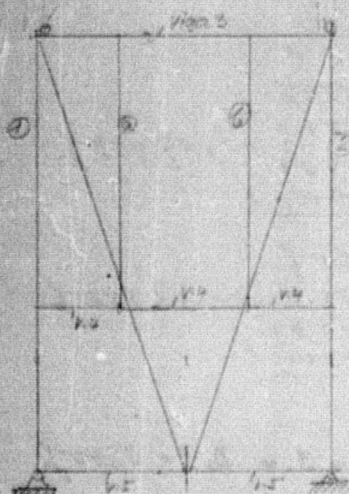
$$H_B = -200 + 2660 - 9350 + 6820 = -70 mps$$

$$H_C = -200 - 2660 + 9350 - 6820 = -330 mps$$

$$Tension: 420 + 1190 + 4170 = 5780 f$$

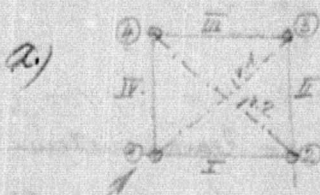


Partes 6 e 7. 20749/938 (7)
Caso a.)



Conso C.

Case c.)



bijsl: nerve cramp. Heuron: l = 7.000

$\theta = 0 \rightarrow 360^\circ$

N_c bis fengas = 6200 f. (0 vultu nati protra N)

072.2 = v. 1.

biga 3

$L = 1.35 \text{ e } 2.20 \text{ m} : \begin{cases} \text{parapente 30} \\ \text{parade 30} \end{cases} > 2500 \text{ fms}$

lage 107. 500. 250 4
74 250.

$$\theta = \phi = \frac{1.35}{2} \text{ rad} = 20.25^\circ$$

$$B = C = \frac{3.14}{2} \cdot 2112 = 5317$$

$$A_{\text{rms}} = 1.35 \times 3070 = 5000 \text{ amp}$$

M_2 var. = 2.24715. 2 var. = 970.

Map - 1.75795. Inv = -9650.

$N = 4100 \text{ f. compressed}$
(veja relaxação por ser)

Grda 4.

$$L_1 = 1.35 \text{ m}, = L_3$$

lay interna. ~ 625 μ

Alcorno 34. 85. 400. 2170 "
by. 205"

$E = 3000 \text{ ft.}$

$H = 2 = 2020\%$

$$\{ \begin{aligned} \Theta = \mathbb{C} &= 1314'4 \end{aligned}$$

$$H_1 \cap H_2 = H_1 \cap H_2$$

Monte 270

distance. (1)

$A = 05-00$ g. distilato. (baja calidad pesa)

Count 1.2:

2769 5.

$\ell = 2,457$; $\mu =$

loc. 3400 260.480 - 1250 ft

$$\frac{2500}{2} = 1250 \text{ A}$$

$$R = B = 2.40\%, \quad 1.75 = 194\%$$

$$K = 2.457 \times 10^{11} = +101$$

0 ms, $K_{\text{eff}} = \frac{2.45^2}{2} \cdot 1000 = -1152 \text{ ms}$

Columna 1.
Cargas na cabeça
das colunas:

K_H portão I.	4840 f	} 11.700 f
1 x v.1 = (touro)	2100 f	
2 x v.3 = 2.2020 =	4040 f	
H_p col.	760 f	

2. K_H portão II.	12570 f	} 19.400 f
v.1.	2100 f	
2 x v.3.	4040 f	
H_p col.	760 f	

3. K_H portão I.	26960 f	} 33.800 f
v.1. touro	2100 f	
2 x 3 =	4040 f	
H_p col.	760 f	

4. = col. 2. = 19400 f.

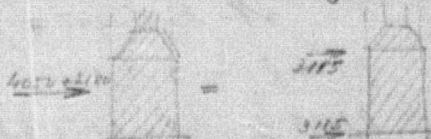
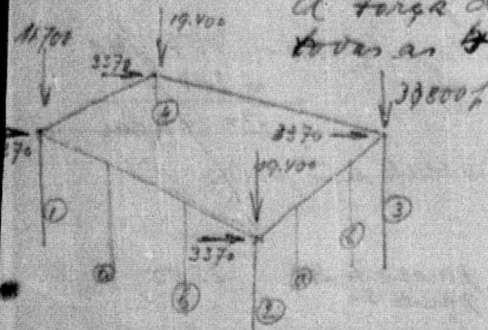
5 = 6 = Reação interna da viga 3. = D, E = 5300 f

Na cabeça das colunas tem mais as Forças do vento:

A Força de vento se distribui igualmente sobre
todas as 4 colunas:

$$W = 8700 + 1600 + \left(\frac{4050 + 2100}{2} \right) = 13.575 \text{ f.}$$

$$W/4 = 13.575/4 = 3.394 \text{ f. por coluna}$$



Caso b.)



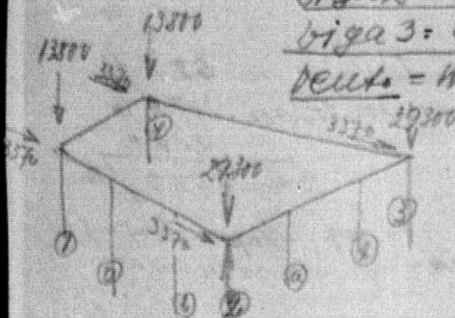
liga 1. (Touro) $N = 3680 \text{ imp. como v.1. ad a)$

$N = 5780 \text{ f. (v.1. ad a) (v.1. ad a)}$

liga 2 = v.1.

liga 3 = como v.3 ad a)

Vento = $W = 3370 \text{ f. como a)}$



col 1. = col 2.	K_H Portão I.	6850 f	} 13.700 f
	1 x v.1 (touro)	2100 f	
	2 x v.3.	4040 f	
	H_p col.	760 f	
col 2. = col 3.	K_H =	22.420 f	} 29300 f
	v.1	2.100 f	
	2 x v.3	4.040 f	
	H_p col.	760 f	

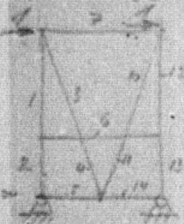
5 = 6 = D = E da viga 3 = 5300 f.

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⑧

Foram desenhadas plantas de Cremona para Forças de vento: "W = 1.00 to. (desenho)

$P_1 = 16$ $P_2 = 100$



$$\begin{aligned} 1=2 &= -3,00 \text{ to} \\ 3=4 &= +3,20 \text{ to} \\ 5 &= -1,00 \text{ to} \\ 6,7,8,9 &= 0 \\ 10 &= -3,20 \text{ to} \\ 11=12 &= +3,20 \text{ to} \\ 13=14 &= +3,20 \text{ to} \\ 14=5 &= -1,00 \text{ to} \end{aligned}$$

Mais:



$$\begin{aligned} 1=2 &= +1,00 \text{ to} \\ 3 &= -1,05 \text{ to} \\ 4,5 &= 0 \\ 6 &= -0,32 \text{ to} \\ 7 &= +0,32 \text{ to} \\ 8=9 &= 0 \\ 10 &= -1,05 \text{ to} \\ 11 &= 0 \\ 12=13 &= +1,05 \text{ to} \\ 14 &= 0 \end{aligned}$$

C mais:



$$\begin{aligned} 1=2 &= +0,5 \text{ to} \\ 3=4 &= -0,5 \text{ to} \\ 5=6 &= 0 \\ 7 &= +0,20 \text{ to} \\ 8=9 &= 0 \\ 10=11 &= -0,5 \text{ to} \\ 12=13 &= +0,5 \text{ to} \\ 14 &= 0 \end{aligned}$$

O caso a)



A componente de $W/4 = 3370 \text{ to}$

$$W = 3370 \cdot 0,707 = 2350 \text{ to}$$

$P_1 = P_2 = 2350 \text{ to}$ (Componente de 3370 to)

$$P_3 = P_4 = \text{cal } (a) = \text{cal } (b) = \frac{3370}{0,707} = 4760 \text{ to}$$

$$P_5 = 1,5 + 1,5 = 1840 + 1840 =$$

$$3680 \text{ to}$$

$$P_6 = 1840 \text{ to}$$

$$9200 \text{ to}$$

$$P_7 = 3370 \text{ to}$$

$$16900 \text{ to}$$

$$P_8 = 1,5 =$$

$$2020 \text{ to}$$

$$P_9 = P_8 =$$

$$2020 \text{ to}$$

$$P_{10} = 1,5 =$$

$$1840 \text{ to}$$

$$P_{11} = P_{10} =$$

$$1840 \text{ to}$$

$$\Sigma = 48600 \text{ to}$$

Método I: Forças na placa:

$$\begin{aligned} ①: P_1 + P_2 &= 2350 \cdot 2,00 = 4700 \text{ to} \\ P_3 + P_4 &= 4760 \cdot 4,00 = 19040 \text{ to} \\ P_5 &= 2 \cdot 1840 \cdot 0,5 = 1840 \text{ to} \end{aligned}$$

$$= 7,550 \text{ to}$$

$$+ 10,600 \text{ to}$$

$$+ 1,840 \text{ to}$$

$$> 15,990 \text{ to}$$

$$\begin{aligned} ②: P_6 &= 1840 \text{ to} \\ P_{10} &= 1840 \text{ to} \end{aligned}$$

$$> + 18,950 \text{ to}$$

$$\begin{aligned} ③: P_1 + P_2 &= 2350 \cdot 2,00 = 4700 \text{ to} \\ P_3 + P_4 &= 4760 \cdot 2,00 = 9520 \text{ to} \\ P_5 &= 3680 \cdot 0,5 = 1840 \text{ to} \end{aligned}$$

$$+ 7,550 \text{ to}$$

$$- 10,600 \text{ to}$$

$$- 2,000 \text{ to}$$

$$> -5,050 \text{ to}$$

REPIK X AC

④: $q_1 + q_2$: course 3 : +7.50 k
 $q_3 + q_4$: $\frac{8}{2} > +5.50 k$
 q_5 : 3.68 - 0.17 = -2.00 k

⑤: $q_1 + q_2$: -1.05 · 2.35 = -2.35 k
 $q_3 + q_4$: $\frac{1}{2} > -2.35 k$
 q_5 = $\frac{1}{2}$

⑥: $q_1 + q_2$ = $\frac{1}{2}$
 $q_3 + q_4$: 10.60 - 0.32 = -3.40 k
 q_5 = $\frac{1}{2} > -3.40 k$

⑦: $q_3 + q_4$: +0.32 · 10.60 = +3.40 k
 q_5 : 3.68 + 0.20 = +0.70 k
 $\frac{1}{2} > +4.90 k$

⑧ = ⑦ = $q_3 = q_4$ = +5.50 k

⑩: $q_1 + q_2$ = 2.35 - 3.20 = -7.50 k
 $q_3 + q_4$ = -1.05 · 10.60 = -11.10 k
 q_5 = -0.55 · 16.80 = -2.00 k
 $\frac{1}{2} > -20.60 k$

⑪: $q_1 + q_2$ = -7.50 k
 $q_3 + q_4$ = $\frac{1}{2}$
 q_5 = -0.55 · 3.68 = -2.00 k
 $\frac{1}{2} > -9.50 k$

⑫: $q_1 + q_2$ = +3.07 · 2.35 = +7.05 k
 $q_3 + q_4$ = +1.05 · 10.60 = +10.60 k
 q_5 = 0.5 · 3.68 = +1.84 k
 $q_6 = q_7$; $q_7 = 33.80 \cdot \frac{1}{2} = +16.90 k$
 $\frac{1}{2} > +36.39 k$

⑬: para ⑫
 q_9 = 26.39 k
 q_{10} = 2.02 k
 $\frac{1}{2} > +40.25 k$
 $\frac{1}{2} = 1.84$

Tralice II = I.

Tralice III = IV =

②: $q_1 + q_2$: 2.35 · 3.07 = -7.05 k
 $q_3 + q_4$ = +10.60 k
 q_5 = 0.5 · 3.68 = +1.84 k
 $q_{4/2}$ = 11.700 k + 5.85 k
 $\frac{1}{2} > +19.24 k$

②: q_1 = +19.24 k
 q_8 = +2.02 k
 q_9 = +1.84 k
 $\frac{1}{2} > +15.90 k$

③, ④, ⑤, ⑥, ⑦, ⑧, ⑨, ⑩, ⑪ course Tralice I.

⑫: $q_1 + q_2$ = +7.05 k
 $q_3 + q_4$ = 10.60 k
 q_5 = 1.84 k
 q_7 : 19.400 k + 9.70 k
 $\frac{1}{2} > 29.190 k$

⑬: q_2 = 29.190 k
 q_9 = 2.02 k
 q_{11} = 1.84 k
 $\frac{1}{2} > 33.050 k$

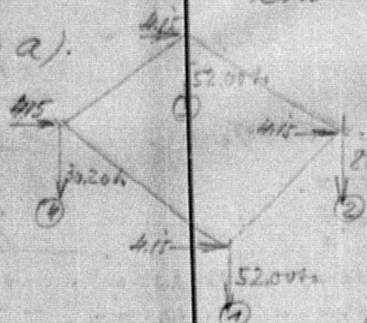
ΣJ = Tralice I: ② + ⑬ = 18.950 + 40.250 = 59.200 k
 II = I = 59.200 k
 III: ② + ⑬ = 15.700 + 33.050 = 48.750 k
 IV = III = 48.750 k

$\Sigma = 214.700 k$

① 8EPI/PHKAS

Forças na Base : para serem transmitidas sobre a continuidade existente. Luz

o caso a).



$$\text{Cálculo: } I = 18,95 + 52,00 = 70,95$$

$$II = 33,05$$

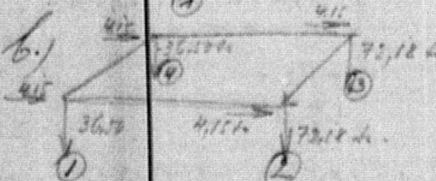
$$\text{Cálculo: } 2 \times 40,25 = 80,50$$

$$\text{Cálculo: } 1 = 52,00$$

$$\text{Cálculo: } 2 \times 15,70 = 31,40$$

$$\Sigma = 214,70$$

o caso b.)



$$\text{Cálculo: } 2 + 12 = 36,50$$

$$\text{Cálculo: } 1 + 2 = 72,18$$

$$\text{Cálculo: } 2 = 72,18$$

$$\text{Cálculo: } 1 = 36,50$$

A Força maior vertical = 80,50

" " horizontal = $\frac{214,70}{4} = 53,67$

Relações das Forças de peças:

caso a)

caso b.)

peça 1

I 1

+15,00

I 1

+9,24

II 12

+29,19

II 12

+19,54

2

I 2

+18,95

I 2

+13,10

II 13

+33,05

II 13

+23,10

3

max -2,40

min -5,60

4

+8,70

+5,50

5

-2,34

-3,37

6

-3,40

-3,40

7

+4,10

+4,10

8 = 9

+5,31

+5,31

10

-20,60

-23,80

11

-9,50

-12,70

12

I 12 +26,39

I 12 37,19

13

II 13 +36,39

II 13 21,29

14

I 14 +40,25

I 14 44,03

15

II 15 +40,25

II 15 31,15

16

I 16 +40,25

I 16 44,03

17

II 17 +40,25

II 17 31,15

18

I 18 +40,25

I 18 44,03

19

II 19 +40,25

II 19 31,15

20

I 20 +40,25

I 20 44,03

21

II 21 +40,25

II 21 31,15

22

I 22 +40,25

I 22 44,03

23

II 23 +40,25

II 23 31,15

24

I 24 +40,25

I 24 44,03

25

II 25 +40,25

II 25 31,15

26

I 26 +40,25

I 26 44,03

27

II 27 +40,25

II 27 31,15

28

I 28 +40,25

I 28 44,03

29

II 29 +40,25

II 29 31,15

30

I 30 +40,25

I 30 44,03

31

II 31 +40,25

II 31 31,15

32

I 32 +40,25

I 32 44,03

33

II 33 +40,25

II 33 31,15

34

I 34 +40,25

I 34 44,03

35

II 35 +40,25

II 35 31,15

36

I 36 +40,25

I 36 44,03

37

II 37 +40,25

II 37 31,15

38

I 38 +40,25

I 38 44,03

39

II 39 +40,25

II 39 31,15

40

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I 40 44,03

41

II 41 +40,25

II 41 31,15

42

I 42 +40,25

I 42 44,03

43

II 43 +40,25

II 43 31,15

44

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I 44 44,03

45

II 45 +40,25

II 45 31,15

46

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I 46 44,03

47

II 47 +40,25

II 47 31,15

48

I 48 +40,25

I 48 44,03

49

II 49 +40,25

II 49 31,15

50

I 50 +40,25

I 50 44,03

51

II 51 +40,25

II 51 31,15

52

I 52 +40,25

I 52 44,03

53

II 53 +40,25

II 53 31,15

54

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I 54 44,03

55

II 55 +40,25

II 55 31,15

56

I 56 +40,25

I 56 44,03

57

II 57 +40,25

II 57 31,15

58

I 58 +40,25

I 58 44,03

59

II 59 +40,25

II 59 31,15

60

I 60 +40,25

I 60 44,03

61

II 61 +40,25

II 61 31,15

62

I 62 +40,25

I 62 44,03

63

II 63 +40,25

II 63 31,15

64

I 64 +40,25

I 64 44,03

65

II 65 +40,25

II 65 31,15

66

I 66 +40,25

I 66 44,03

67

II 67 +40,25

II 67 31,15

68

I 68 +40,25

I 68 44,03

69

II 69 +40,25

II 69 31,15

70

I 70 +40,25

I 70 44,03

71

II 71 +40,25

II 71 31,15

72

I 72 +40,25

I 72 44,03

73

II 73 +40,25

II 73 31,15

74

I 74 +40,25

I 74 44,03

75

II 75 +40,25

II 75 31,15

76

I 76 +40,25

I 76 44,03

77

II 77 +40,25

II 77 31,15

78

I 78 +40,25

I 78 44,03

79

II 79 +40,25

II 79 31,15

80

I 80 +40,25

I 80 44,03

Dimensões:

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(10)

King

Telhado: $d = 5\text{cm}$; as forças internas foram calculadas na página 3; as tensões no concreto receberam (pág. 3):
para T_{max} (força meridional) = $4.75 \text{ kg/cm}^2 = 66 \text{ kg/cm}^2$ compres.
" T_e " (força de anel) = $1.67 \text{ kg/cm}^2 = 66 \text{ kg/cm}^2$ compres.
" S " (força cortante) = $0.97 \text{ kg/cm}^2 = T_e$.

a armadas: μ muito pequeno precisava armadura de ouro: $7\phi 1/4$ por anéis
corte, nos totais: $1\phi 1/4$ cada 15cm no sentido da meridional

Arma Anel de base nos totais $2\phi 1/2$ (2,54cm)
 $\sigma_c = 388/2.54 = 152 \text{ kg/cm}^2$.

Portico I.

Corte a-a: $M = +1.90 \text{ mt}$
 $N = +0.77 \text{ t. compres.}$ $\gamma_0 = \frac{M}{N} = \frac{1.9}{0.77} = 2.47 \text{ m}$

$$\begin{aligned} A_e &= 0.17 \cdot (2.47 + 0.10) = 1.94 \text{ mt}^2 \\ d &= 26 \text{ cm} = 3 + 0.284 \cdot \sqrt{1987.50}; \quad 50/1200 \frac{\text{cm}}{\text{cm}} \\ f_c &= 1.21 \cdot 23.30 = 2.80 \text{ cm} \\ f_c' &= 0.17 \cdot 2.80 = 0.48 \text{ cm} \\ X &= 0.385 \cdot 23 = 8.91 \text{ cm} \\ f_c' &= \frac{1}{2} \cdot 8.91 \cdot 2.80 = 12.47 \text{ cm} = 4\phi 7/8 \\ k &= 8.91 - \frac{12.47}{2} = 7.66 \text{ cm} = 4\phi 7/8 (7.99) \end{aligned}$$

$$\begin{aligned} M &= -1.90 \text{ mt} \\ N &= +5.13 \text{ t.} \end{aligned} \quad \gamma_0 = \frac{1.9}{5.13} = 0.37 \text{ m}$$

$$\begin{aligned} A_e &= 5.13 \cdot (0.37 + 0.10) = 2.43 \text{ mt}^2 \\ d &= 26 \text{ cm} = 3 + 0.284 \cdot \sqrt{1987.50}; \quad 50/1200 \frac{\text{cm}}{\text{cm}} \\ f_c &= 1.43 \cdot 23.30 = 3.33 \text{ cm} \\ f_c' &= 0.17 \cdot 3.33 = 0.57 \text{ cm} \\ X &= 8.90 \text{ cm} \cdot 8.90 \cdot 2.80 = 21.50 \text{ cm} = 4\phi 7/8 (7.99) \\ f_c' &= \frac{1}{2} \cdot 10.51 \cdot 2.80 = 14.71 \text{ cm} = 4\phi 7/8 (7.99) \\ k &= 7.90 - \frac{14.71}{2} = 5.54 \text{ cm} = 4\phi 7/8 (7.99) \end{aligned}$$

Fig. 1: Corte b-b: $M = 1.80 \text{ mt}$, $N = 7$

$$\begin{aligned} 30/30. \quad d &= 30 \text{ cm} = 3 + 0.349 \cdot \sqrt{1987.50}; \quad 49 \pm 11 \text{ cm} \\ f_c &= 0.788 \cdot 23.27 = 18.35 \text{ cm} = 4\phi 7/8 (7.99 \text{ cm}) \end{aligned}$$

Forças cortantes: $Q = \frac{3.00}{2.54} = 1.18 \text{ t}$;
 $T_0 = 888/30 \cdot 0.27 \cdot 25 = 1.31 \text{ kg/cm}^2$

$$\text{viga: } Q = \frac{4.00}{2.70} = 1.48 \text{ t}; \quad T_0 = \frac{1480}{24 \cdot 0.27 \cdot 25} = 2.10 \text{ kg/cm}^2$$

Portico II

Arco a-a: $M = +7.00 \text{ ms}$ $> e = 10.15 \text{ m}$
 $N = -0.63 \text{ ts}$

sem consideração de N :

$d = 55 \text{ cm} = 3 + 1.341 \sqrt{7000 \cdot 30} / 571200$

$f_c = 9.827 \cdot 30.52 = 12.90 \text{ cm}^2 = 5\phi^{3/4} (14.20)$
 $f_c' = 0$

$M = +7.00 \text{ ms}$ $> e = 0.41 \text{ m}$
 $N = +14.63 \text{ ts}$

$M_e = 14.63 \cdot (0.41 + 0.22) = 10.39 \text{ ms}$

$d = 55 \text{ cm} = 3 + 0.282 \sqrt{10355 / 1.30} / 571200$

$f_c = 1/20 \cdot 30.52 = 18.80 \text{ cm}^2$

$f_c' = 1.87e = 15 \text{ cm}^2$

$x = 0.385 \cdot 52 = 20.00 \text{ cm}$

$f_c' = 2/3 \cdot 15 \cdot \frac{52}{18} = 11.11 \text{ cm}^2 = 5\phi^{3/4} (14.20)$

$f_c = 12.80 - 14.63071200 = 6.60 \text{ cm}^2 = 3\phi^{3/4}$
 $(= 8.15 \text{ cm}^2)$

$Q = 7000 / 571200 = 1.23 \text{ f}$

$T_c = 1230730 / 0.89 \cdot 52 = 1.7 \text{ f/cm}^2$

Viga: arco b-b: $M = 5500 \text{ ms}$ (desenho)

$f_c = 4\phi^{3/4} (11.41 \text{ cm}^2)$; $f_c' = \frac{170}{11.41 \cdot 489.52} = 1040 \text{ f/cm}^2$

$T_c = \frac{52000}{120 \cdot 489.52} = 10.10 \text{ f/cm}^2$

$Q = 2 \cdot 7000 / 2.70 = 5200 \text{ f}$

$T = \frac{1.1}{2} \cdot 14000 / 1.09 \cdot 52 = 31.200 \text{ f}$

Arco $5\phi^{7/16} \text{ mm}$: $2.70 \cdot 5.1200 = 16.300 \text{ f}$

Arco $4\phi^{3/4}$: $= 19.300 \text{ f}$

$T_{\text{tot}} = 35.600 \text{ f}$

$G_b < 50 \text{ f/cm}^2$ (veja balanço arco a-a)

Porticos inclinados: $M_{\text{max}} = \pm 500 \text{ ms}$

$N = +29000 \text{ f}$

$30/50$: $f_c = 8\phi^{3/4} = 22.87 \text{ cm}^2$

$f_c' = 29000 / 1500 \cdot 15 \cdot 22.87 = 16.50 \text{ f/cm}^2$

Calculo para um momento suportado de

$M = 9671/2$ (prov. $W_{\text{el}} 800 \text{ f}$) = 4880 ms

$e = 4880 / 29000 = 0.17 \text{ m}$; $= 0.34 d$

seg. "Lövén": $f_c = 0.0076d = 10.10 \text{ cm}^2 = 4\phi^{3/4}$
 $(= 11.40)$

armadura simétrica =:

$\sigma_b = \frac{-29000}{1.571} (0.22 \pm \frac{17.397}{58}) = -42.02 \text{ f/cm}^2$
 $\sigma_u = +10.10 \text{ n. 2nd}$

σ_u (admissível) $< \frac{1}{4} \sigma_b = < \frac{1}{4} 42.00 \text{ f/cm}^2$

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Hany

as vigas: no 1, 2, 3, 4 $M_{max} = 12.740 \text{ kgm. (caso a) r. 2}$
 $l = 2,70 \text{ m}$ $A = B = 15.988 \text{ p}$
 $35/50: \sigma_0 = 15.988 / 35.42 = 10.90 \text{ kgm}^2.$

$$f_c = 501' (25,36 \text{ mm})$$

$$\sigma_c = 12.740 / 25.36.42 = 1195 \text{ kgm}^2.$$

$$T = 12.740 / 0.42 = 30.270 \text{ p.}$$

$$\text{Interos } 5 \phi 7/8 \text{ mm} = 5.135.1200 = 5100 \text{ p}$$

$$= 25.000 \text{ p}$$

$$\text{Total} = 33.100 \text{ p.}$$

as layer a: $L_{max} = 1.35 \text{ m}$ $2 = 570 \text{ kgm}^2.$

$$A = B = 1.35 \text{ m} \cdot 570 = 340 \text{ kgm}^2; M = 1.35 \text{ m} \cdot 570 = 830 \text{ kgm}$$

$$d = 8 \text{ cm}; f_c = 7 \phi 1/4 \text{ mm.}$$

Treliças:

Layer a: $L_{max} = 2.00 \text{ m}$ $5 = 400 \text{ kgm}^2.$

$$M = \frac{2^2}{11} \cdot 400 = 145 \text{ kgm}^2.$$

$$d = 8 \text{ cm} = 1.57 + 1.55.1145; 282/1100 \text{ kgm}^2.$$

$$f_c = 0.169.1145 = 2.04 \text{ cm}^2 = 7 \phi 1/4 \text{ mm (2.22)}$$

oja 1: Tenore: $l = 7.00 \text{ m}$ $M = 3680 \text{ kgm}$
 $N = 6260 \text{ p (dist.)}$

$$e = \frac{M}{N} = \frac{3680}{6260} = 0.59 \text{ m}$$

$$M_e = 6260 \cdot (0.59 - 0.20) = 2430 \text{ kgm}^2.$$

$$d = 12.8 + 15 = 27.8 \text{ cm}; M_6 = \frac{2430}{11} = 2180$$

$$h_{min} = 19 \text{ cm}; \sigma_c < 40 \text{ kgm}^2; \sigma_0 = 1000 \text{ kgm}^2$$

$$f_c = 243000 / 40.1000 = 6.07 \text{ cm}^2.$$

$$f_c = 6.07 + 1267/1000 = 12.33 \text{ cm}^2 = 6 \phi 7/8''$$

(11.30)

$$\sigma_0 = 2100 / 15.40 = 3.57 \text{ kgm}^2.$$

oja 2 = v. 1.

vigas 3: $20/50: M_{max} = 970 \text{ kgm}$
 $M_{max} = 4100 \text{ p.}$ $e = \frac{0.97}{4.1} = 0.24 \text{ m}.$

$$M_e = 4100 (0.24 + 0.20) = 1810 \text{ kgm}^2.$$

$$d = 58 \text{ cm} = 5 + 0.475.1150/10.15; 336/1100;$$

$$f_c = 0.445.45.21 = 4.45 \text{ cm}^2.$$

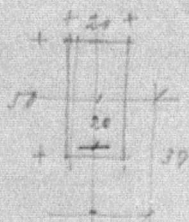
$$f_c = 4.45 = 4100/1200 = 1.03 \text{ cm}^2 = 4 \phi 1/2'' (5.00)$$

$$\sigma_0 = 3300 / 20.40 = 4.12 \text{ kgm}^2.$$

01004
(= para ⑥)

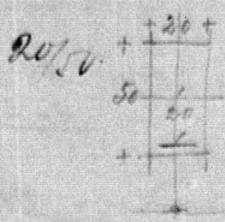
20/50: não lesado: $M = 500 \text{ mp}$
 $N = 4$: $f_c = 4 \phi \frac{1}{2}$ com v.3.

cão esatral em oprio: $M = 970 \text{ mp}$
 $N = -3,4 \text{ t}$: $f_c = \frac{0,97}{3,4} = 0,29 \text{ m}$



$M_c = 3400 (0,29 - 0,20) = 0,645 \text{ mp}$
 $f_{c, \text{m}} = 6400 / 40,12 \text{ m} = 1,55 \text{ m}$
 $f_c = 1,55 + 3400 / 11 \text{ m} = 4,18 \text{ m} = 4 \phi \frac{1}{2} (v.3)$
 $\sigma_c < 33 \frac{1}{2} \text{ flim} (v.3; k = 970 \text{ flm})$

01005 : $H = B = 10,40 \text{ f}$: $M_{\text{m}} = 2,45 \text{ f} \cdot 1500 = 1070 \text{ mp}$
(= para ⑤) : $L = 1570 \text{ flm}$: $M_{\text{ap}} = -1380 \text{ mp}$ (pag. 9)



$N = -2370 \text{ f}$: $k = 1500$
 $e = 1350 / 2370 = 0,57 \text{ m}$
 $M_c = 2370 (0,57 - 0,20) = 940 \text{ mp}$
 $\sigma_c < 33 \frac{1}{2} \text{ flim} (v.3)$
 $f_{c, \text{m}} = 9400 / 40,12 \text{ m} = 1,96 \text{ m}$
 $f_c = 1,96 + 2370 / 11 \text{ m} = 3,93 \text{ m} = 4 \phi \frac{1}{2} (v.3)$
 $\sigma_c = 1840 \text{ t} \cdot 40 = 2,30 \text{ flim}$

Pecas da tralic:

① = Column : $P_{\text{m}} = 73,78 \text{ t}$; $35/35$; $f_c = 8 \phi \frac{1}{2}$ (v.3)

② = ⑬ : $P_{\text{m}} = 80,50 \text{ f}$; $35/35$; $f_c = 8 \phi \frac{3}{4}$ (20,07); $\sigma_c = \frac{80,50}{12,3 \cdot 35} = 52,70 \text{ flm}$

③ = ⑩ : $P_c = 23,500 \text{ f}$; $20/25$; $f_c = 4 \phi \frac{1}{2}$ (20,35); $\sigma_c = \frac{23,50}{20,35} = 11,70 \text{ flm}$

④ = ⑪ : $P_c = +8,70 \text{ f}$; $20/25$; $f_c = 4 \phi \frac{3}{4}$ (11,40); $\sigma_c = 8,70 / 11,40 = 13,07 \text{ flm}$

⑤ = ⑫ : $P_c = -12,700 \text{ f}$; $20/25$; $f_c = 4 \phi \frac{3}{4}$; $\sigma_c = 12,70 / 11,40 = 11,10 \text{ flm}$

⑥ = ⑭ : v.4.

⑦ = v.3.

⑧ = ⑨ : $P_c = 5300 \text{ f}$; $20/20$; $L_c = 4,6 \text{ f}$; $\sigma_c = 23$; $\sigma_c = 1,70$; $f_c = 4 \phi \frac{1}{2}$ (v.3)

⑬ = ⑤ = v.5.

204491938

(12)

Aleng

Laje 6

(altura 2.80m decima construção existente)

$$l_1 = l_2 = 4.60m; L = 400 \text{ fmm}^2; c = 1.00;$$

$$q_1 = q_2 = 0.577. 400 = 232 \text{ fmm}^2;$$

$$M_1 = M_2 = 1.583. 232. 4.60/2 = 275 \text{ mp.}$$

$$ed = 9 \text{ cm} = 1.5770. 452. 1.275; 355/1200 \text{ fmm}^2.$$

$$f_1 = 1. 206. 1.275 = 3.12 \text{ cm}^2 = 7 \phi^{7/16} \text{ pmm (3.16 cm)}$$

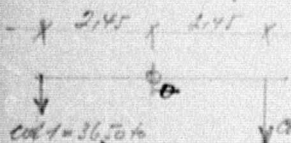
$$h_1 = 6.5 \text{ cm} = 1.392. 1.275; 425/1200 \text{ fmm}^2.$$

$$f_2 = 1. 240. 1.275 = 3.98 \text{ cm}^2 = 8 \phi^{7/16} \text{ pmm (3.96 cm)}$$

$$\text{Reações: } Q_1 = Q_2 = 4.60/2. 232 = 460 \text{ fmm}^2$$

Cálculo da estabilidade contra tombamento =

Página 14: Forças na Base - caso b):

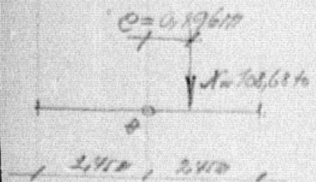


$$\text{Momento para } B = (72,58 - 36,56) \times 2,45 = 87 \text{ mt}$$

$$\text{Força normal } N = 36,5 + 72,58 = 108,68 \text{ t.}$$

$$\text{Excentricidade } e = \frac{M}{N} = \frac{87}{108,68} = 0,805 \text{ m.}$$

Calculando N com $\frac{195}{2} \text{ t}$, conforme desenho (cálculo gráfico) receberemos $e = \frac{87}{195} = 0,446 \text{ m}$, ou seja o cálculo gráfico marca $e = 0,90 \text{ m}$.



Coeficiente de segurança contra tombamento =

$$\text{Momento de estabilidade: } 108,68 \times 2,45 = 265 \text{ mp}$$

$$\text{Momento de tombamento: } 108,68 \times 1,896 = 77$$

$$\text{Coeficiente de segurança } \frac{265}{77} = 3,44 \text{ vezes.}$$

Porto Alegre, 5 de Novembro 1938

Américo Della Vecchia
Eng. Civil

④

8E91F445

2.0000 2.7500 3.5000 4.2500 5.0000

1000

175 = 100 + 75 = 150 = 100 + 50 = 150

124 30.01.1983

1999-2000 1999-2000

1990

$$x = \frac{1}{2} \left(\frac{1}{2} + \frac{1}{2} \right) = \frac{1}{2}$$

[Faint handwritten notes at the bottom of the page]

1/10/1917 - 10/10/1917

1. *Salmonella typhimurium* DT104

[Faint handwritten notes at the bottom of the page]



PREFEITURA MUNICIPAL DE PORTO ALEGRE
SMA - SERVIÇO DE DOCUMENTAÇÃO
SEÇÃO DE MICROFILMAGEM

AS PLANTAS E DESENHOS
QUE ULTRAPASSARAM A MEDI-
DA PADRÃO, CONSTANTES DÊS
TE PROCESSO, ESTÃO MICRO
FILMADAS NO FILME DE 35mm:

20449/938

SÉRIE A	NÚMERO 0049	
FLASH 06	DATA 28-5-75	
ARQ 001	GAV 02	BOX 03
QUANT. DE DOC. 07		

lib
PREPARADOR

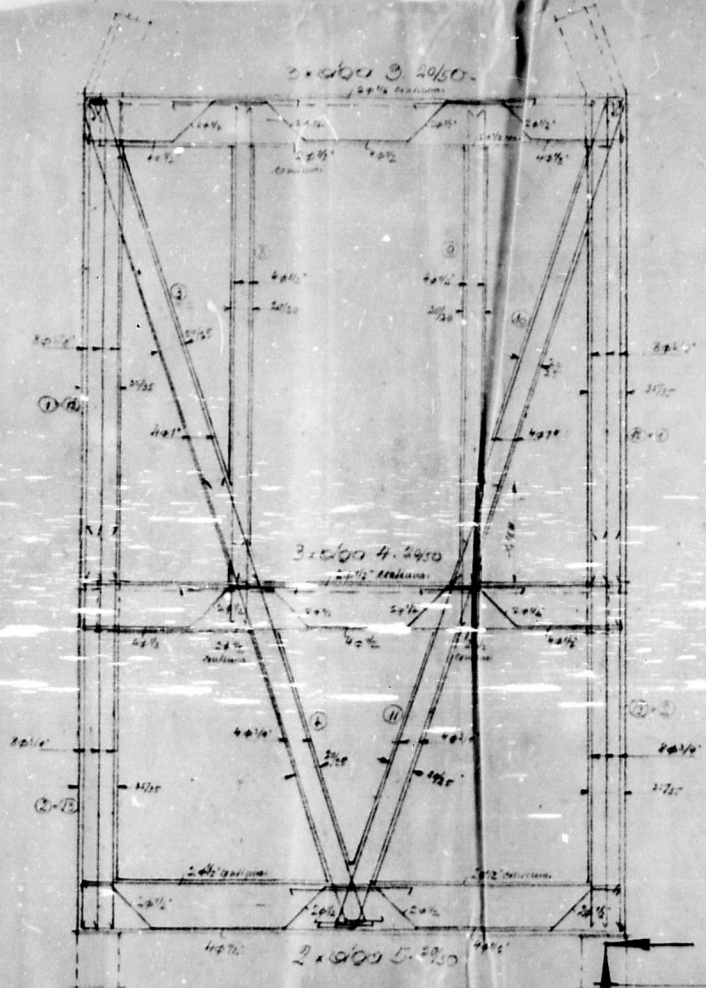
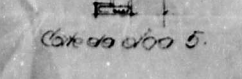
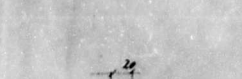
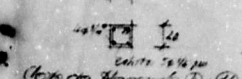
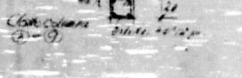
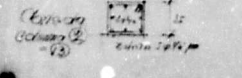
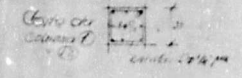
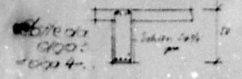
VISTO DO CHEFE

AS PLANTAS E DESSEMINOS
DE TERRACOTAS EM A. MED.
DE P. 1840. 001. 001. 001. 001.
DE P. 1840. 001. 001. 001. 001.
DE P. 1840. 001. 001. 001. 001.

1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001
1840	001	001	001	001

001/001/001

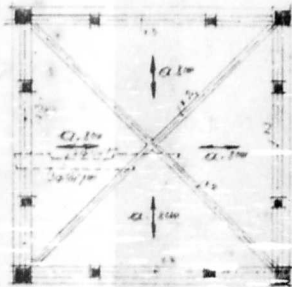
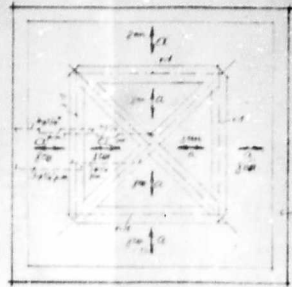
1840 001 001 001 001



Directorio do Obras
"SECCAO VI"
Data 24/10/1917

ESTA PLANTA FOI
RETIRADA DO PROC.
N. 20747/128
(1918 ANO)

Ornamento dos Logos.



Col. Henrique de Almeida
Proj. e constr. do Logos.

Comp. Const. Henrique de Almeida

Logos para pontos indicados
(Planos para)

Logos para pontos indicados
Logos para pontos indicados



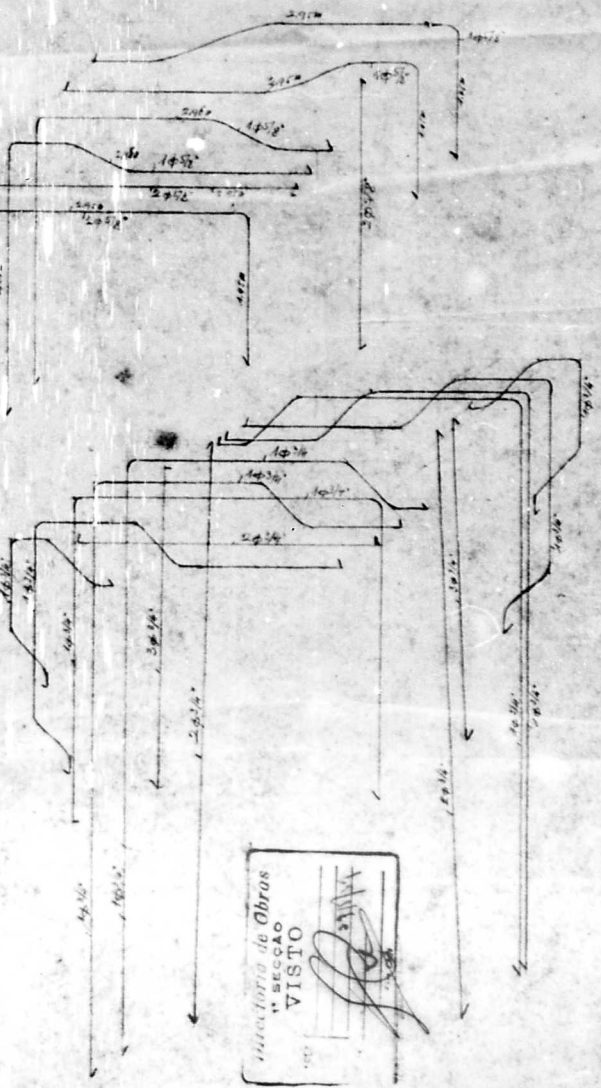
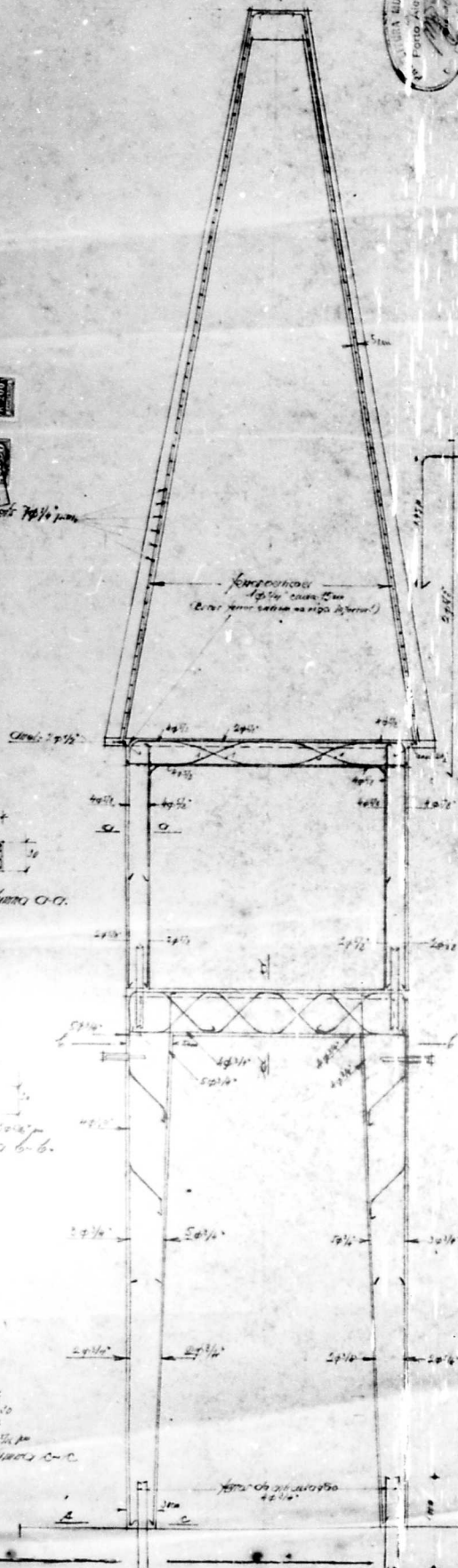
Coloque no ponto da: 20/50.

Ornamento para vertical - 20/50 - com Ornaments para as colunas verticais
Ornamento para vertical - 20/50 - com Ornaments para as colunas verticais

Esc. 1-25, Projeto de uma Torre de Torção - Cimento armado.

Officina de Cálculo
Engenharia e Arquitetura
Imperador
Construtor

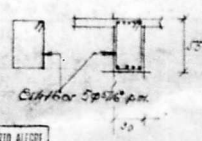
Projeto de uma Torre de Torção *Cimento armado* *Escala 1:25*



Com colunas c-c.
2.9m
4.6m
1.4m

Com colunas b-b.
2.9m
4.6m
1.4m

Com colunas c-c.
2.9m
4.6m
1.4m

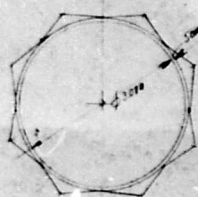
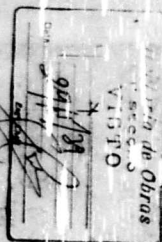


Com colunas c-c

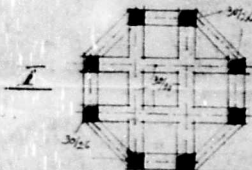
ESTE MATERIAL DE PORTO ALEGRE
 ESTA PLANTA FOI
 RETIRADA DO PROC.
 Nº 20749/938

Projeto de uma Torre de Vigia Esc. 1:50 Elemento construtivo

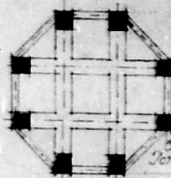
Corte I-I,



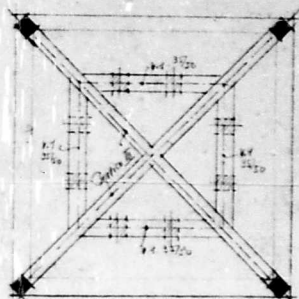
Corte a-a,



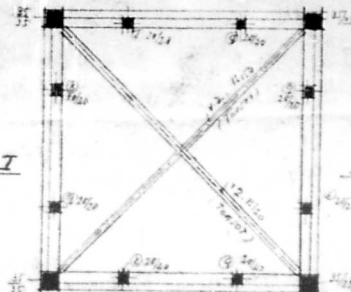
Corte b-b,



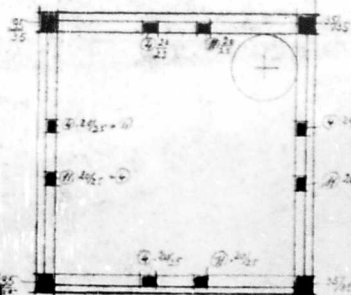
Corte c-c,



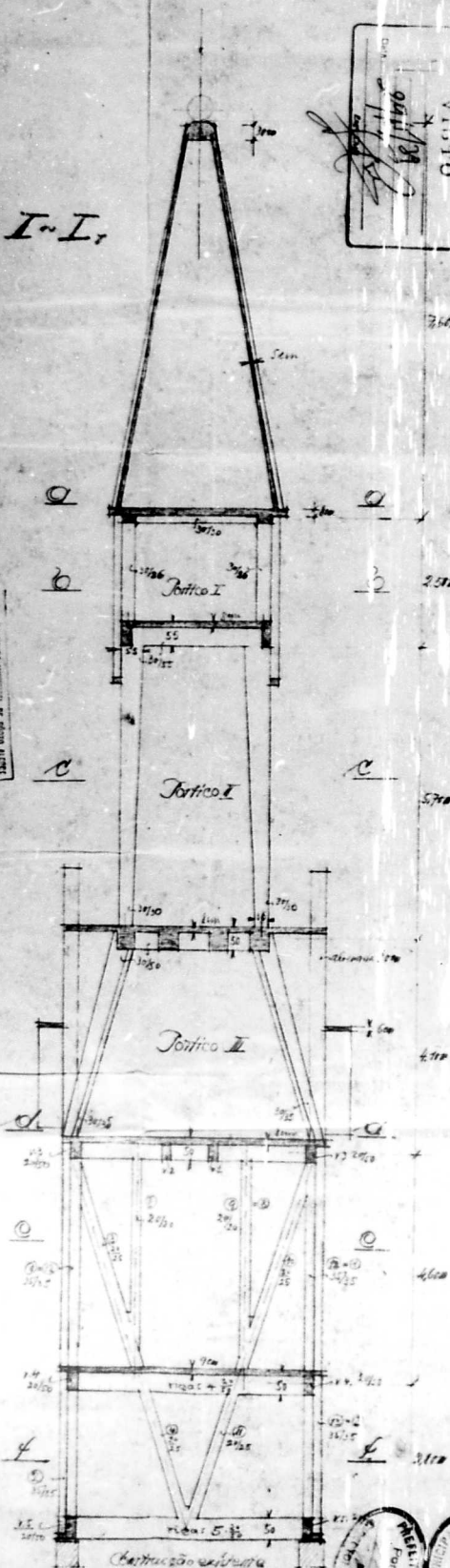
Corte d-d,



Corte e-e,



Corte f-f,



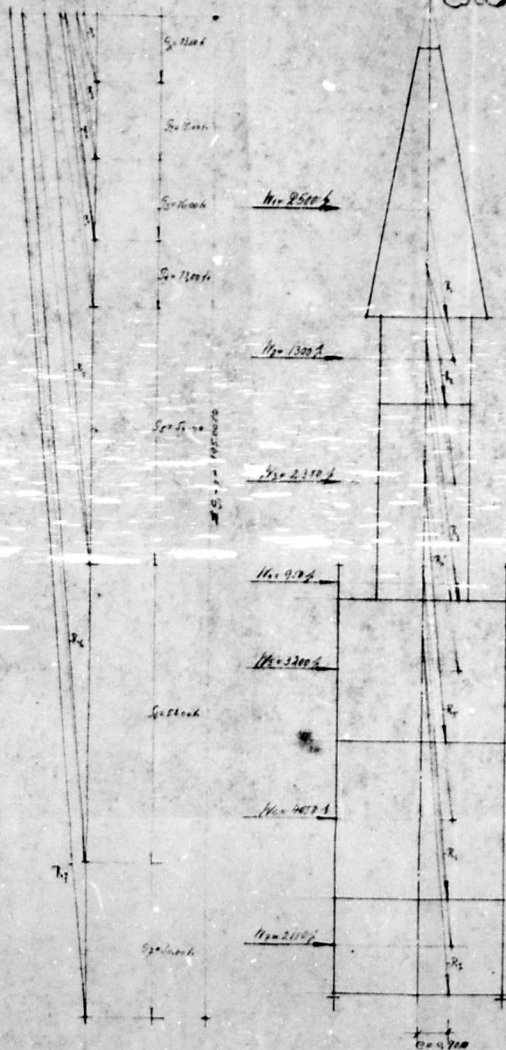
ESTADO DO RIO DE JANEIRO
 SECRETARIA DE OBRAS
 PROJETO DE OBRAS
 Nº 20749/1938



Projeto de Obras
 Estado do Rio de Janeiro
 Secretaria de Obras
 Projeto de Obras
 Nº 20749/1938

Foras de vento, estabilidade.

Exatos: os complementos: 1.95,
das Forças : 1 km = 5 tons.



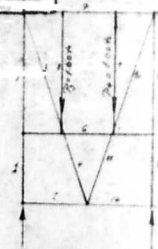
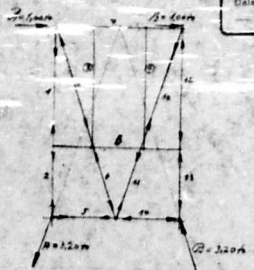
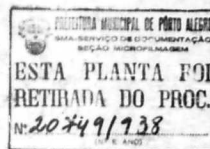
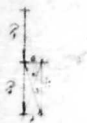
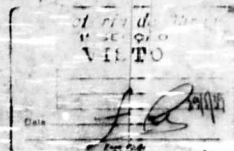
Projeto de uma Yhte de Tereja,
Chirrejo oimado,

M. H. Hansen de Copenhague Danemark
Imper.
Comte. Fournier & Delle Svinge



Mantos, Gamora para Foros de vento. T, T₂, R, R, T₂

Exercs. das componentes: $1\text{cm} = 1\text{m}$
das forçers: $1\text{cm} = 500\text{for}$



Further from, the $P_1, P_2 = 1$ to 1000

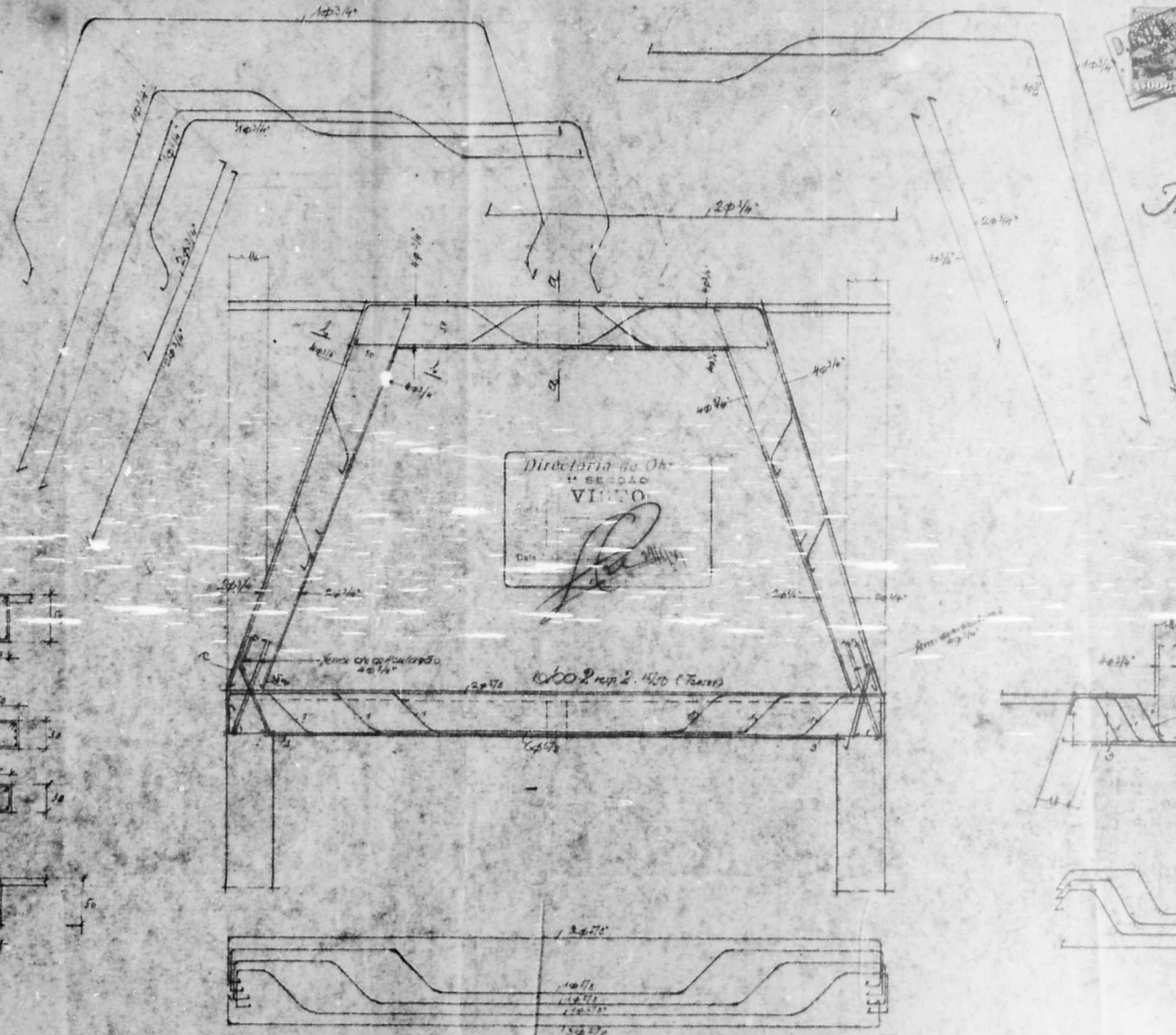
1	- 10000
2	- 10000
3	- 10000
4	- 10000
5	- 10000
6	- 10000
7	- 10000
8	- 10000
9	- 10000
10	- 10000
11	- 10000
12	- 10000
13	- 10000
14	- 10000

Texten von der 1. u. 2. Abt.

2007	2008
1	+0.00
2	+0.00
3	+0.00
4	+0.00
5	+0.00
6	+0.00
7	+0.00
8	+0.00
9	+0.00
10	+0.00
11	+0.00
12	+0.00
13	+0.00
14	+0.00

Teatier 1906, etc. De la...

Age	Sex	Weight
1	♂	~ 0.5 lb
2	♂	~ 0.5 lb
3	♂	~ 0.5 lb
4	♂	~ 0.5 lb
5	♂	♂
6	♂	♂
7	♂	♂ 0.5 lb
8	♂	♂
9	♂	♂
10	♂	~ 0.5 lb
11	♂	~ 0.5 lb
12	♂	~ 0.5 lb
13	♂	~ 0.5 lb
14	♂	~ 0.5 lb



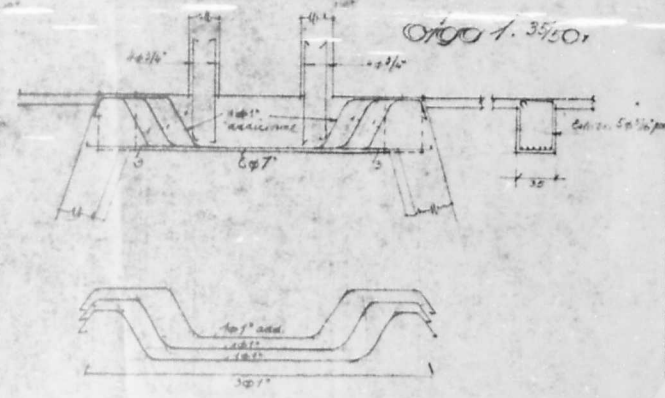
Imperadores
Constantinos

Projeto de uma Torre
de 1979/81
Cimento amarelo
Exp. 1-25,

Directoria de Obr
" SECCAO
VITTO
Data



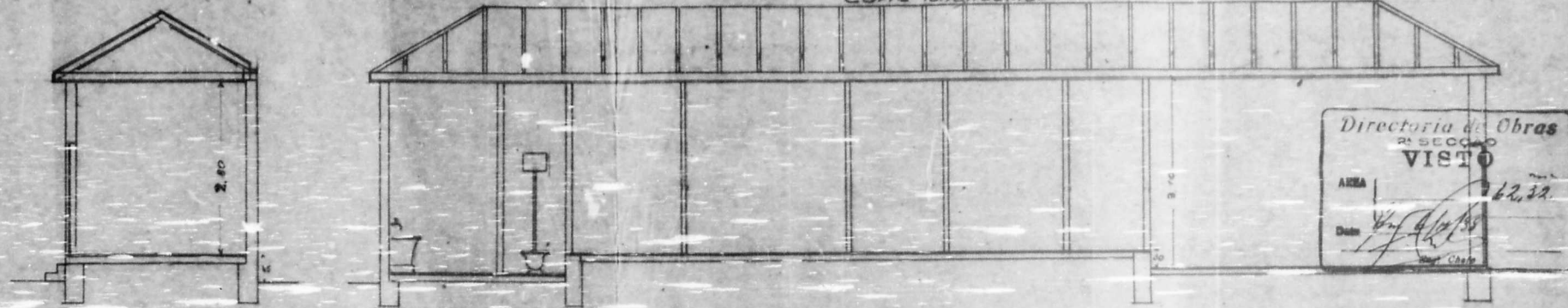
Orig 1. 35/50.



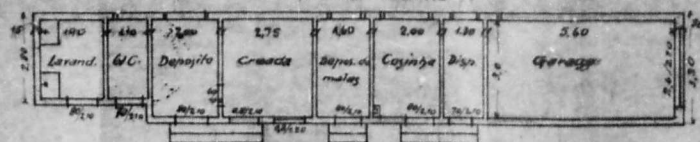
PLANTA PARA UM AUGMENTO DO PROJETO do SNR DR. AJARIÇO TROIS
NA AV. GETÚLIO VARGAS Nº 169



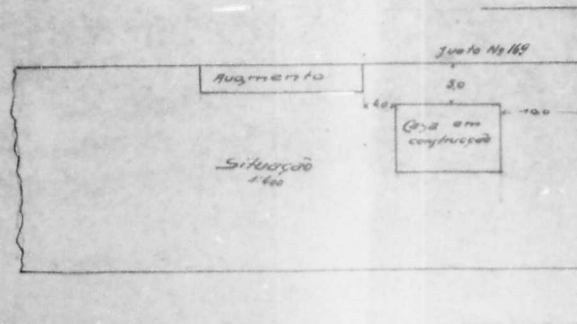
Corte longitudinal



planta baixo



SECRETARIA MUNICIPAL DE PORTO ALEGRE
SMA-SERVIÇO DE DOCUMENTAÇÃO
SEÇÃO MICROFILMAGEM
**ESTA PLANTA FOI
RETIRADA DO PROC.
Nº 203.49/938**
(Nº E ANO)



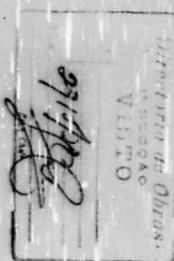
Mário Paul

Projeto da Torre
da Capella
do Divino E. Santo

Escala 1:50

Imperador:

Construtor: *Amador Silva Lima*



SECRETARIA MUNICIPAL DE PORTO ALEGRE
DIVISÃO DE DOCUMENTAÇÃO
SEÇÃO MICROFILMAGEM
ESTA PLANTA FOI
RETIRADA DO PROC.
N. 20749/938
17. 6. 1965

