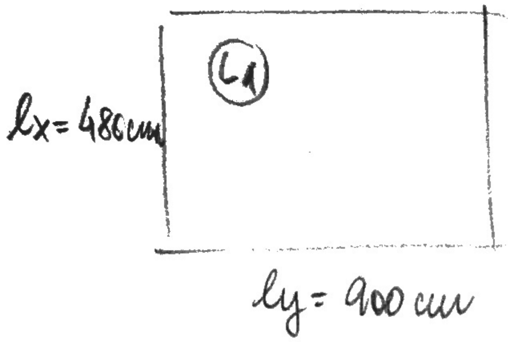
GABARITO P2

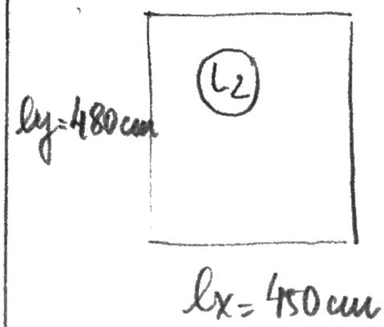
a) PRÉ-DIMENSIONAMENTO

• LAJES



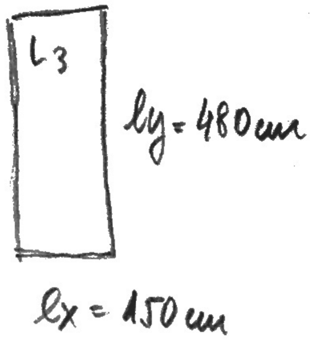
$\frac{l_y}{l_x} = 1{,}875 < 2 \rightarrow$ armada em duas direções

$h_1 = \frac{l_x}{40} = \underline{\underline{12\ cm}}$



$\frac{l_y}{l_x} \cong 1{,}07 < 2 \rightarrow$ armada em duas direções

$h_2 = \frac{l_x}{40} = 11{,}25 \rightarrow \underline{\underline{12 cm}}$



$\Downarrow$

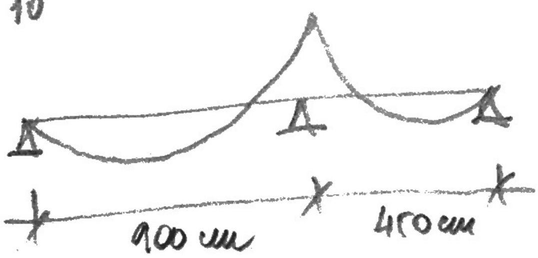
laje em balanço

$h_3 = \frac{l_x}{15} = \underline{\underline{10 cm}}$

• VIGAS

$h = \frac{L_0}{10}$

$\boxed{V_1 = V_2}$



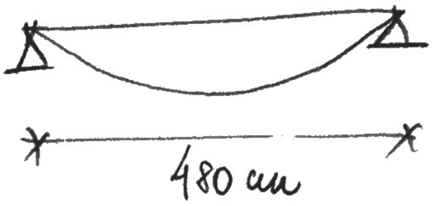
1º trecho: $h_1 = \frac{0{,}75 \times 900}{10} \cong 70cm$

2º trecho: $h_2 = \frac{0{,}75 \times 450}{10} \cong 35cm$

1º trecho: $h_1 = \frac{0{,}75 \times 900}{10} = 67{,}5 \rightarrow 70 cm \quad \therefore \quad b \times h = \underline{\underline{15 cm \times 70 cm}}$

2º trecho: $h_2 = \frac{0{,}75 \times 450}{10} = 33{,}75 \rightarrow 35 cm \quad \therefore \quad b \times h = \underline{\underline{15 cm \times 35 cm}}$

$\boxed{V_3 = V_4 = V_5}$



$h = \frac{480}{10} = 48 \rightarrow 50\ cm$

$\underline{b \times h = 15 \times 50\ cm}$

- PILARES

_P1

- $N_1 = A_{inf} \times P \times n^o\ pav.$

$\left(\frac{9\,m}{2} \times \frac{4{,}80\,m}{2}\right) \times 12\,\frac{kN}{m^2} \times 3 = \underline{388{,}8\ kN}$

$A_1 = \frac{N_1}{\sigma} = \frac{388{,}8\ kN}{1\ kN/cm^2} = \underline{388{,}8\ cm^2}$ $(b \times h = A_1)$

adotando $b = 19\,cm \Rightarrow \underline{b \times h = 19 \times 21\ cm^2}$

_P5

- $N_5 = \left[\left(\frac{9}{2} + \frac{4{,}50}{2}\right) \times \frac{4{,}80}{2}\right] \times 12 \times 3 = 583{,}2\ kN$

$A_5 = \frac{N_5}{\sigma} = \underline{583{,}2\ cm^2} \Rightarrow \underline{b \times h = 19 \times 31\ cm^2}$

b) Levantamento de cargas atuantes nas lajes L_2 e L_3

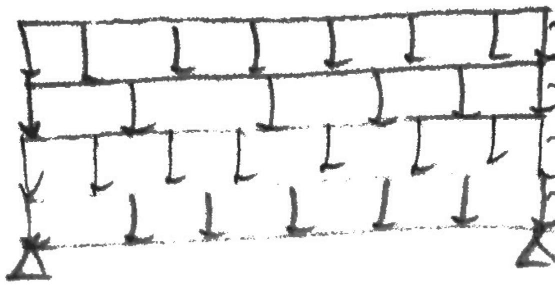
	L_2	L_3
peso próprio (p.p) (kN/m^2)	3,0	2,5
peso revestimento (p.rev) (kN/m^2)	1,0	1,0
sobrecarga (kN/m^2)	2,0	2,0
total - p (kN/m^2)	6,0	5,5

$p.p = \gamma_c \times h_{laje}$

$p.rev = 1{,}0\ kN/m^2$

$q = 2{,}0\ kN/m^2$

c) CARGAS ATUANTES NA VIGA J



- peso próprio (p.p.) = $\gamma_c \times b \times h = 25 \times 0,15 \times 0,50 \cong 1,88$ kN/m

- peso da alvenaria (p.alv) = $\gamma_{alv} \times e_{alv} \times h_{alv} = 13 \times 0,15 \times (3 - 0,50) \cong 4,88$ kN/m

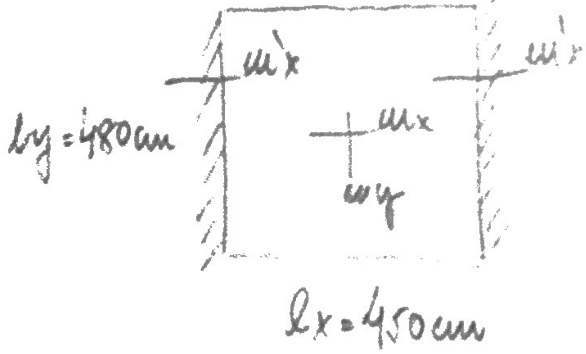
- $py_{L2} = px_{L2} \cdot \left(2 - \frac{l_x}{l_y}\right) \cong 7,18$ kN/m, sendo $px_{L2} = \frac{p\,l_x}{4}$

- $py_{L3} = p \cdot l_x = 8,25$ kN/m

d) Dimensionamento e detalhamento da laje L2 ($p = 6\,kN/m^2$)

L2

tabela de Czerny => 4B



$\frac{l_y}{l_x} = 1,07$

interpolando

l_y/l_x	α_x	α_y	β_x
1,05	29,9	46,4	13,8
1,07	29,1	46,9	13,6
1,10	28	47,7	13,2

$$\frac{1,07 - 1,05}{1,10 - 1,05} = \frac{\alpha_x - 29,9}{28 - 29,9}$$

$$m_x = \frac{p\,l_x^2}{\alpha_x} = 4,17\ kN.m/m$$

$$m_y = \frac{p\,l_y^2}{\alpha_y} = 2,59\ kN.m/m$$

$$m'_x = \frac{-p\,l_x^2}{\beta_x} = -8,96\ kN.m/m$$

p/. $h = 10\,cm$; $4\,mm \leq \phi \leq \frac{h}{8}$; tabela 7.2 $\Rightarrow c = 2\,cm$

adotando $\phi = 10\,mm$, temos:

$$d_x = h - c - \frac{\phi_x}{2} = 7{,}5\,cm$$

$\Rightarrow m_x = 4{,}17\ kN.m/m = 417\ kN.cm/m$

$$x = 1{,}25 . d \left[1 - \sqrt{1 - \frac{\overset{=417 \times 1{,}4}{Md}}{0{,}425 . \underset{=100}{b} . \underset{=7{,}5^2}{d^2} . \underset{=\frac{3{,}0}{1{,}4}}{f_{cd}}}} \right] = 0{,}55\,cm$$

$$\frac{x}{d} = 0{,}07 < 0{,}45 \Rightarrow \text{ductilidade ok!}$$

$$A_s = \frac{\overset{=1{,}4 \times 417}{Md}}{\underset{=\frac{50}{1{,}15}}{f_{yd}} (\underset{=7{,}5}{d} - 0{,}4 \underset{=0{,}55}{x})} = 1{,}85\ cm^2/m$$

$$A_{s,\min}^{+} = 0{,}67 . \underset{=0{,}15\%\ \text{(ver tabela)}}{\rho_{\min}} \times \underset{=100}{b}\ \underset{=10}{h} = 1\ cm^2/m \quad \text{ok!}$$

$$\phi = 10\,mm \rightarrow A_{s1} = \frac{\pi d^2}{4} = 0{,}78\,cm^2 \rightarrow s = \frac{100 . 0{,}78}{1{,}85} = 42{,}16\,cm$$

$$8\,cm \leq s \leq \begin{cases} 2 \times 10\,cm \\ 20\,cm \end{cases} \Rightarrow s = 20\,cm \Rightarrow A_s = \frac{100 \times 0{,}78}{20} = 3{,}9\ cm^2/m$$

adotando $\phi = 6.3 \rightarrow A_{s1} = 0{,}31\,cm^2 \rightarrow s = \frac{100 \times 0{,}31}{1{,}85} = 16{,}8\,cm$ ok!

adotar $\boxed{\phi 6.3\ c/\ 16\,cm}$

$m_y^{+} = 2{,}59 \text{ kN.m/m} = 259 \text{ kN.cm/m}$, adotando $\phi_y = 6.3$ mm

$d_y = \overset{=10}{h} - \overset{=2}{c} - \overset{=0.63}{\phi_x} - \dfrac{\overset{=0.63}{\phi_y}}{2} = 7$ cm

$259 \times 1{,}4 = 362{,}60$

$x = 1{,}25\, \underset{\underset{7\text{cm}}{\parallel}}{d} \left[1 - \sqrt{1 - \dfrac{M_d}{0{,}425 \times \underset{\underset{100}{\parallel}}{b} \times \underset{\underset{7^2}{\parallel}}{d^2} \times \underset{\underset{\frac{3}{1{,}4}}{\parallel}}{f_{cd}}}} \right] = 0{,}18$ cm

$\dfrac{x}{d} = 0{,}025 < 0{,}45$ ductilidade ok!

$A_s = \dfrac{\overset{=362{,}60}{M_d}}{\underset{\underset{43{,}5}{\parallel}}{f_{yd}} (\underset{\underset{7}{\parallel}}{d} - 0{,}4 \underset{\underset{0{,}18}{\parallel}}{x})} = 1{,}20 \text{ cm}^2$

$A_{s,\min} = \overset{=0{,}15\%}{\rho_{\min}} \times \overset{=100}{b} \times \overset{=10}{h} = 1{,}5 \text{ cm}^2/\text{m}$, $\therefore$ $\boxed{\text{adotar } A_{s,\min}}$

$\phi 6.3 \rightarrow A_{s1} = 0{,}31 \text{ cm}^2 \rightarrow s = \dfrac{100 \times 0{,}31}{1{,}5} = 20{,}7$ cm

adotar $\boxed{\phi 6.3 \text{ c/20 cm}}$