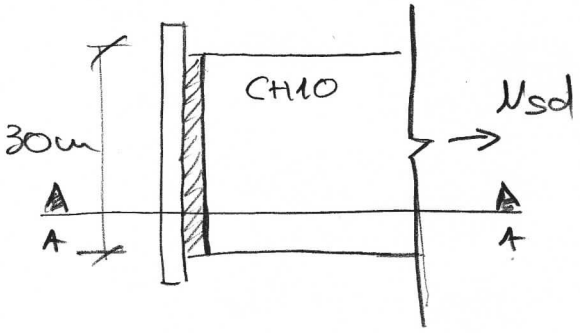
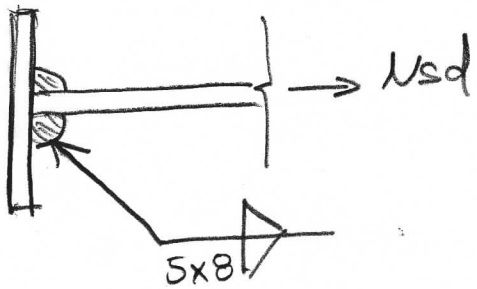
B3AM10BNA AÇO MR 250; ELETRODO E70;

VISTA



CORTE AA



Qol) QUAL O MÁXIMO Nsd POSSÍVEL DE SER APLICADO DE MODO QUE METAL BASE E METAL DE SOLDA AINDA RESISTAM? [kN]

$$t_w = \frac{d_{w1} d_{w2}}{\sqrt{d_{w1}^2 + d_{w2}^2}} = \frac{5 \times 8}{\sqrt{5^2 + 8^2}} = 4{,}24\ mm$$

$A_{MB\ CIS} = 30cm \times 0{,}8cm = 24\ cm^2$

$A_{MB\ TRAC} = 30cm \times 0{,}5cm = 15\ cm^2$

$A_w = 30cm \times 0{,}424cm = 12{,}72\ cm^2$

$F_{RW} = 2 \times 0{,}6 \times 12{,}72\ cm^2 \times 48{,}5\ kN/cm^2 / 1{,}35 = \boxed{548{,}37\ kN}$

$F_{RESC\ CIS} = 2 \times 0{,}6 \times 24\ cm^2 \times 25\ kN/cm^2 / 1{,}1 = 654{,}55\ kN$

$F_{RRUP\ CIS} = 2 \times 0{,}6 \times 24\ cm^2 \times 40\ kN/cm^2 / 1{,}35 = 853{,}33\ kN$

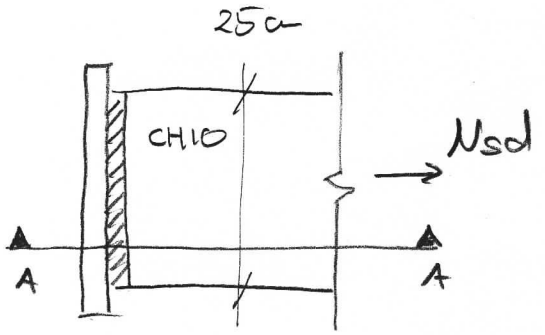
$F_{RESC\ TRAC} = 2 \times 15\ cm^2 \times 25\ kN/cm^2 / 1{,}1 = 681{,}82\ kN$

$F_{RRUP\ TRAC} = 2 \times 15\ cm^2 \times 40\ kN/cm / 1{,}35 = 888{,}88\ kN$

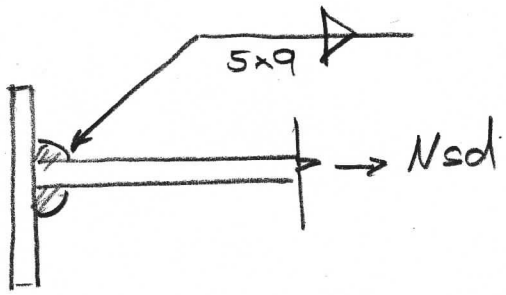
RESPOSTA: $N_{sd} = 548{,}37\ kN$

B3AM10CMA AÇO MR250 / ELETRODO E70

VISTA



CORTE AA



Q01) QUAL O MÁXIMO VALOR DE Nsd [kN] POSSÍVEL DE SER APLICADO APLICADO DE MODO QUE AS VERIF. DE METAL BASE E METAL DE SOLDA AMBAS SEJAM ATENDIDAS?

$$t_w = \frac{d_{w1}\, d_{w2}}{\sqrt{d_{w1}^2 + d_{w2}^2}} = \frac{5 \times 9}{\sqrt{5^2 + 9^2}} = 4{,}3708 \text{ mm}$$

$A_w = 25\text{cm} \times 0{,}43708\text{cm} = 10{,}927 \text{cm}^2$

$A_{MB_{TRAC}} = 25\text{cm} \times 0{,}5\text{cm} = 12{,}5 \text{cm}^2$

$A_{MB_{CIS}} = 25\text{cm} \times 0{,}9\text{cm} = 22{,}5 \text{cm}^2$

(Q01)

$F_{rd\,w} = 2 \times 0{,}6 \times 10{,}927 \text{cm}^2 \times 48{,}5 \text{kN/cm}^2 / 1{,}35 = \boxed{471{,}08 \text{ kN}}$

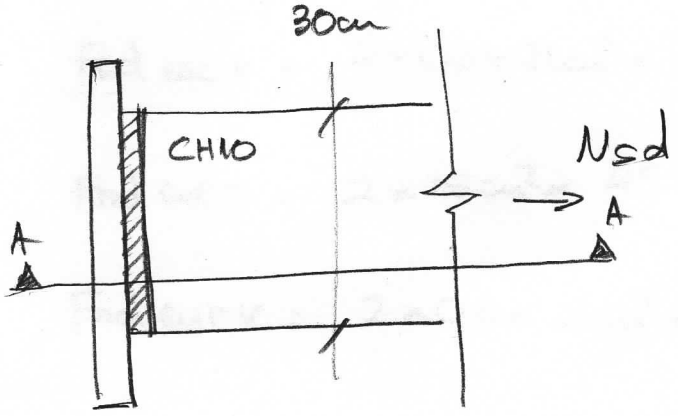
$F_{rd\,ESC_{TRAC}} = 2 \times 12{,}5 \text{cm}^2 \times 25 \text{kN/cm}^2 / 1{,}1 = 568{,}18 \text{ kN}$

$F_{rd\,RUP_{TRAC}} = 2 \times 12{,}5 \text{cm}^2 \times 40 \text{kN/cm}^2 / 1{,}35 = 740{,}74 \text{ kN}$

$F_{rd\,ESC_{CIS}} = 2 \times 0{,}6 \times 22{,}5 \text{cm}^2 \times 25 \text{kN/cm}^2 / 1{,}1 = 613{,}64 \text{ kN}$

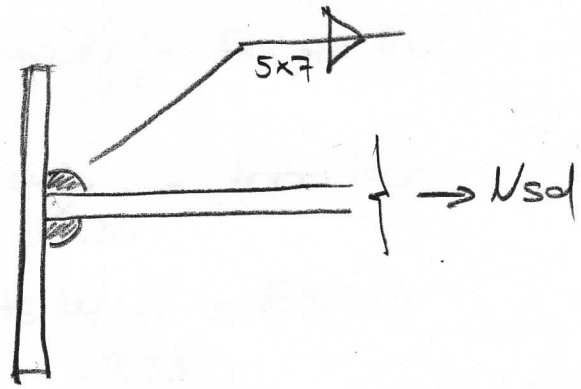
$F_{rd\,RUP_{CIS}} = 2 \times 0{,}6 \times 22{,}5 \text{cm}^2 \times 40 \text{kN/cm}^2 / 1{,}35 = 800 \text{ kN}$

B3 AM10 CNB (1,0 PONTO)



H 10mm

VISTA



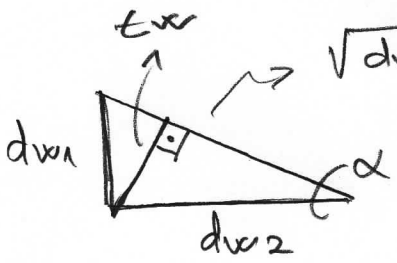
CORTE AA

AÇO AR 350; ELETRODO E70;

Q01) MÁXIMO Nsd POSSÍVEL DE SER APLICADO DE MODO QUE METAL BASE E METAL DE SOLDA AINDA RESISTAM? [kN]

$A_{MB_1}' = 0{,}5\,cm \times 30\,cm = 15\,cm^2$ (TRAÇÃO)

$A_{MB_2}' = 0{,}7\,cm \times 30\,cm = 21\,cm^2$ (CISALHAMENTO)



$\cos\alpha = dw_2 / \sqrt{dw_1^2 + dw_2^2}$

$\operatorname{sen}\alpha = dw_1 / \sqrt{dw_1^2 + dw_2^2}$

$tw = dw_2 \operatorname{sen}\alpha = dw_2\, dw_1 / \sqrt{dw_1^2 + dw_2^2}$

$tw = 0{,}7 \times 0{,}5 / \sqrt{0{,}7^2 + 0{,}5^2} = 0{,}40687\,cm$

$A_w' = 0{,}40687\,cm \times 30\,cm = 12{,}206\,cm^2$ (CIS SOLDA)

$$Frd_{ESCT} = 2 \times 15cm^2 \times \frac{35 kv/cm^2}{1,1} = 954,55 kv$$

$$Frd_{ESCV} = 2 \times 0,6 \times 21cm^2 \times \frac{35 kv/cm^2}{1,1} = 801,82 kv$$

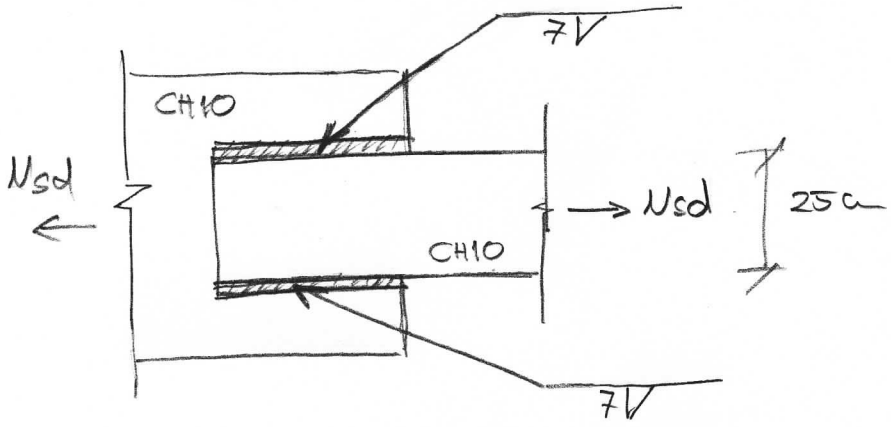
$$Frd_{RUPT} = 2 \times 15cm^2 \times \frac{45 kv/cm^2}{1,35} = 1000 kv$$

$$Frd_{RUPV} = 2 \times 0,6 \times 21cm^2 \times \frac{45 kv/cm^2}{1,35} = 840 kv$$

$$Frd_W = 2 \times 0,6 \times 12,206 cm^2 \times \frac{48,5 kv/cm^2}{1,35} = 526,21 kv$$

B3AM10BMA

- AÇO MR250
- ELETRODO E60



Q01) MÁXIMO Nsd P/ QUE AS CHAPAS NÃO ESCOEM?

Q02) MÍNIMO COMPRIMENTO DE FILETE P/ QUE Q01 SEJA ATENDIDA?

$$Rdt_{ESB} = (25cm \times 1cm) \times 25 kN/cm^2 / 1,1 = \boxed{568,18\ kN} \quad Q01$$

$$Frd_W = 0,6 \times 0,7 \times 0,7cm \times Lw \times 41,5 kN/cm^2 / 1,35 = 9,0378\ Lw$$

$$Frd_{ESC} = 0,6 \times 0,7cm \times Lw \times 25 kN/cm^2 / 1,1 = 9,5455\ Lw$$

$$Frd_{RUP} = 0,6 \times 0,7cm \times Lw \times 40 kN/cm^2 / 1,35 = 12,444\ Lw$$

IGUALANDO: $2 Frd_W = Rdt_{ESB}$

$$2 \times 9,0378\ kN/cm \cdot Lw = 568,18\ kN$$

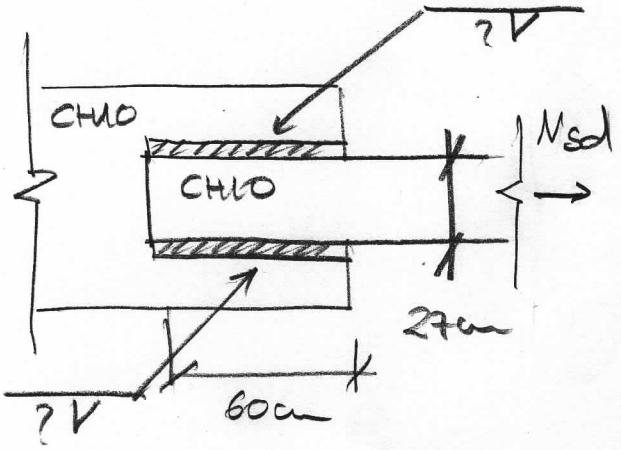
$$Lw = \frac{568,18}{2 \times 9,0378} = 31,433cm \simeq 320\ mm$$

$320\ mm < 100\ dw = 700mm$ ok $\beta = 1$

Q02 $\boxed{320\ mm}$

B3AM10CM1

- Aço MR250
- E60
- Nsd = 900kN



Qual a mínima perna de solda necessária p/ que as verificações de metal base e metal de solda sejam atendidas?

$Nsd' = 900kN/2 = 450kN$

$Frd_{w_1} = 0,6 \times 0,7 \times dw \times 60cm \times 41,5 kN/cm^2 / 1,35$

$Frd_{w_1} = 774,67\,dw$

$Frd_{esc_1} = 0,6 \times dw \times 60cm \times 25 kN/cm^2 / 1,1$

$Frd_{esc_1} = 818,18\,dw$

$Frd_{rup_1} = 0,6 \times dw \times 60cm \times 40 kN/cm^2 / 1,35$

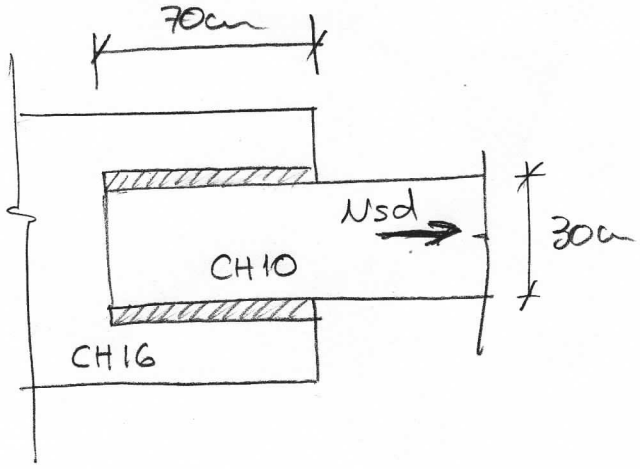
$Frd_{rup_1} = 1066,7\,dw$

$774,67\,dw = 450 \quad dw = \frac{450}{774,67} = 0,58089 = 6\,mm$

$600\,mm = 100 \times dw(6mm) \rightarrow \beta = 1$

Resposta: $dw = 6mm$

B3 AM10B NB



- AÇO AR350
- ELETRODOS E60
- Nsd = 1100 kN

Q01) QUAL A MÍNIMA PERNA DE SOLDA NECESSÁRIA P/ QUE AS VERIFICAÇÕES DE:
- METAL DE SOLDA
- METAL BASE

SEJAM ATENDIDAS?

① FORÇAS RESISTENTES P/ FILETE:

$$F_w = \frac{0{,}42 \times d_w L_w}{\gamma_{w2}} \times f_w = \frac{0{,}42 \times d_w \times 70cm}{1{,}35} \times 41{,}5\ kN/cm^2$$

$$F_w = 903{,}77\ kN/cm\ d_w \Leftarrow \text{MENOR FORÇA RESIST.}$$

$$F_{MB\,ESC} = \frac{0{,}6 \times d_w L_w f_y}{\gamma_{a1}} = \frac{0{,}6 \times d_w \times 70cm \times 35\ kN/cm^2}{1{,}1}$$

$$F_{MB\,ESC} = 1336{,}4\ kN/cm\ d_w$$

$$F_{MB\,RUP} = \frac{0{,}6 \times d_w L_w f_u}{\gamma_{a2}} = \frac{0{,}6 \times d_w \times 70cm \times 45\ kN/cm^2}{1{,}35}$$

$$F_{MB\,RUP} = 1400\ kN/cm\ d_w$$

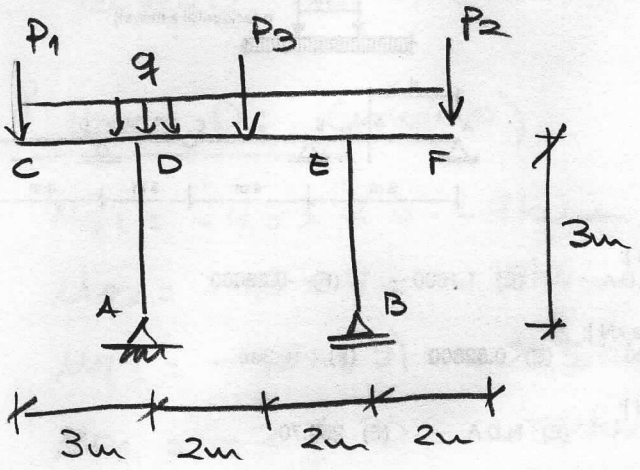
② CÁLCULO DE d_w: $N_{sd}/2 = F_w$

$$1100\ kN/2 = 903{,}77\ kN/cm\ d_w \rightsquigarrow d_w = \frac{550}{903{,}77}\ cm = 0{,}6086\ cm$$

$$\boxed{d_w \approx 7\ mm}$$

$$\begin{cases} d_{w\,MÁX} = 10mm - 1{,}5mm = 8{,}5mm\ \text{OK!} \\ d_{w\,MÍN} = 5mm\ \text{OK!} \end{cases}$$

B3AM12AMA



- GARAGEM;
- COMB. NORMAIS ELU;
- CARREG. DE LONGA DURAÇÃO;

			γ	ψ_0
q_1:	PESO PRÓP.	2kN/m	1,4	–
q_2:	OCUPAÇÃO	4kN/m	1,4	0,8
q_3:	VENTO	-5kN/m	1,4	0,5
P_1:	EQUIP.	20kN	1,4	0,8
P_2:	"	20kN	1,4	0,8
P_3:	"	40kN	1,4	0,8

PEDE-SE: Q01) MÁX. MOMENTO FLETOR EM CDEF; [kNm]

Q02) MÍN. MOMENTO FLETOR EM CDEF; [kNm]

$$M_{qC} = -q\frac{4^2}{2} = -q\frac{3^2}{2} = -4{,}5q$$

$$M_{qE} = -q\frac{L^2}{2} = -q\frac{2^2}{2} = -2q$$

$$M_{qDE} = \frac{-4{,}5q - 2q}{2} + q\frac{4^2}{8} = -1{,}25q$$

$$M_{P1C} = -3P_1 \qquad M_{P1E} = 0$$

$$M_{P1DE} = -1{,}5P_1$$

$$M_{P2E} = -2P_1 \qquad M_{P1D} = 0$$

$$M_{P2DE} = -1P_1$$

$$M_{P3DE} = \frac{Pab}{L} = \frac{P_3 \times 2 \times 2}{4} = +P_3$$

$$M_{P3D} = 0 \qquad M_{P3E} = 0$$

- MÍNIMO NO PONTO D
- MÁXIMO NO MEIO DA BARRA DE

PONTO D: (MÍNIMO)

$M_{q1} = -4,5 \times 2 = -9\,kN\cdot m$

$M_{q2} = -4,5 \times 4 = -18\,kN\cdot m$

$M_{q3} = -4,5 \times (-5) = +22,5\,kN\cdot m$ (DESPREZAR)

$M_{P1} = -2 \times 20 = -40\,kN\cdot m$

$M_{P2} = 0$

$M_{P3} = 0$

- COMB 1: (P1) (Q02)

$M_{sd1} = [1,4 \times (-9)] + 1,4(-40) + [1,4(-18)0,8] = -88,76\,kN\cdot m$ //

- COMB 2: (q2)

$M_{sd2} = [1,4 \times (-9)] + 1,4(-18) + [1,4(-40)0,8] = -82,6\,kN\cdot m$

PONTO NO MEIO DE DE: (MÁXIMO)

$M_{q1} = -1,25 \times 2 = -2,5\,kN\cdot m$

$M_{q2} = -1,25 \times 4 = -5,0\,kN\cdot m$ (DESPREZAR)

$M_{q3} = -1,25 \times (-5) = +6,25\,kN\cdot m$

$M_{P1} = -1,5 \times 20 = -30\,kN\cdot m$ (DESPREZAR)

$M_{P2} = -1 \times 20 = -20\,kN\cdot m$ (DESPREZAR)

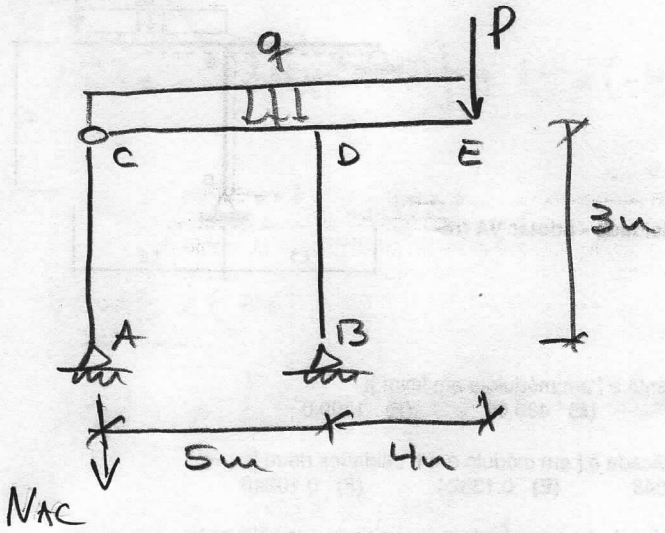
$M_{P3} = \quad = +40\,kN\cdot m$

- COMB 3: (P3) (Q01)

$M_{sd3} = [0,9 \times (-2,5)] + 1,4(40) + [1,4 \times 6,25 \times 0,5] = +58,125\,kN\cdot m$ //

B3AM12ANA

→ COMB. NORMAIS ELU / CARREG. DE LONGA DURAÇÃO:



		γ	ψ_0
$q_1 = 3kN/m$	PESO PRÓPRIO	1,4	—
$q_2 = 5kN/m$	OCUPAÇÃO	1,4	0,8
$P_1 = 25kN$	EQUIP. (MÓVEL)	1,4	0,8
$q_3 = 4kN/m$	VENTO ①	1,4	0,5
$q_4 = -5kN/m$	VENTO ②	1,4	0,5

Q01) MÁXIMO ESF. AXIAL EM AC [kN];

Q02) MÍNIMO ESF. AXIAL EM AC [kN];

Cargas q: $\Sigma M_B = 0 \curvearrowleft (+) \quad N_{AC} \times 5 + q \times 9 \times 0,5 = 0$

$$N_{AC} = -\frac{9 \times 0,5}{5} q \qquad N_{AC_q} = -0,9q$$

Cargas P: $\Sigma M_B = 0 \curvearrowleft (+) \quad N_{AC} \times 5 + 4 \times P = 0$

$$N_{AC_P} = 4P/5 \qquad N_{AC_P} = 0,8P$$

$N_{q1} = -0,9 \times 3kN/m = -2,7kN$

$N_{q2} = -0,9 \times 5kN/m = -4,5kN$

$N_{P1} = 0,8 \times 25kN = +20kN$

$N_{q3} = -0,9 \times 4kN/m = -3,6kN$

$N_{q4} = -0,9 \times (-5)kN/m = +4,5kN$

COMB 1 (q2)

$N_{sd1} = [1,4 \times (-2,7)] + 1,4 \times (-4,5) + [1,4 \times (-3,6) \times 0,5]$

$= -12,6 \text{ kN}$ /

COMB 2 (q1)

$N_{sd2} = [0,9 \times (-2,7)] + 1,4 \times (20) + [1,4 \times (4,5) \times 0,5]$

$= +28,72 \text{ kN}$ /

COMB 3 (q3)

$N_{sd3} = [1,4 \times (-2,7)] + 1,4 \times (-3,6) \times 0,75 + [1,4 \times (-4,5) \times 0,8]$

$= -12,6 \text{ kN}$ /

COMB 4 (q4)

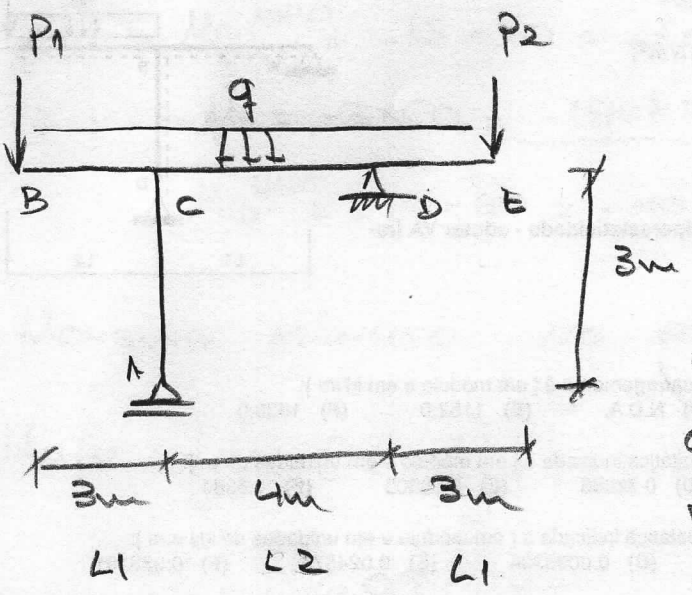
$N_{sd4} = [0,9 \times (-2,7)] + 1,4 \times (4,5) \times 0,75 + [1,4 \times (20) \times 0,8]$

$= 24,695 \text{ kN}$ /

Q01) 28,72 kN

Q02) -12,6 kN

B3AM12AN3



- COMB. NORMAIS ELU;
- CARREG. DE LONGA DURAÇÃO;
- BIBLIOTECA (TIPO DE EDIF.)
- CARGAS PERMANENTES DE GRANDE VARIABILIDADE;

		γ	ψ_0
$q_1 = 1{,}5$ kN/m	P. PROP.	1,4	-
$q_2 = 3{,}5$ kN/m	OCUP.	1,4	0,8
$P_1 = 40$ kN	OCUP.	1,4	0,8
$P_2 = 60$ kN	OCUP.	1,4	0,8

Q01) Máx. M_{sd} em BCDE ? [kN m]

Q02) Mín M_{sd} em BCDE ? [kN m]

q: $M_C = M_D = -qL_1^2/2 = -q \times 3^2/2 = -4{,}5q$

$M_{CD}^{MEIO} = -4{,}5q + qL_2^2/8 = -4{,}5q + 2q = -2{,}5q$

P_1: $M_C = -P_1 \times L_1 = -3P_1$

$M_{CD}^{MEIO} = -P_1 \times L_1/2 = -1{,}5P_1$

P_2: $M_D = -P_2 \times L_1 = -3P_2$

$M_{CD}^{MEIO} = -P_2 \times L_1/2 = -1{,}5P_2$

q_1: $M_C = M_D = -4{,}5 \times 1{,}5 = -6{,}75$ kN m

q_1: $M_{CD}^{MEIO} = -2{,}5 \times 1{,}5 = -3{,}75$ kN m

q_2: $M_C = M_D = -4{,}5 \times 3{,}5 = -15{,}75$ kN m

q_2: $M_{CD}^{MEIO} = -2{,}5 \times 3{,}5 = -8{,}75$ kN m

P_1 : $M_C = -3 \times 40 = -120\,kNm$

$M_{CD}^{MEIO} = -1,5 \times 40 = -60\,kNm$

P_2 : $M_D = -3 \times 60 = \underline{-180\,kNm}$

$M_{CD}^{MEIO} = -1,5 \times 60 = -90\,kNm$

MOMENTO MÍNIMO NO PONTO D:

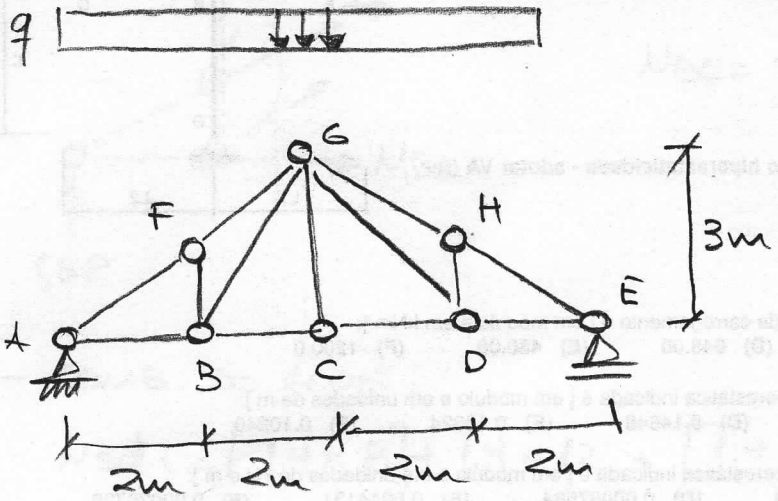
$$M_{MÍN} = \left[1,4 \times (-6,75)\right] + 1,4\,(-180) + \left[1,4\,(-15,75) \times 0,8\right]$$

$$= \underline{-276,09\,kNm} \;//$$

MOMENTO MÁXIMO: AO LONGO DE TODA VIGA OCORREM SOMENTE MOMENTOS NEGATIVOS EXCETO

B3 AM3 AM4

→ CONÍFERA C30;
→ COMB. NORMAIS ELU;
→ CARGAS DE LONGA DUR;
→ AMBIENTE CLASSE 3 UMID;
→ GARAGEM;



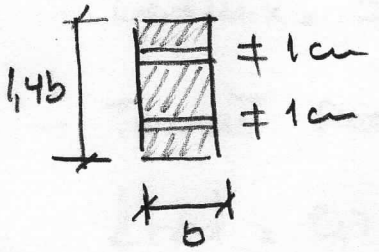
CARGAS:

$q_1 = 8\,kN/m$ PESO PRÓPRIO (GRANDE VARIAB.)

$q_2 = 12\,kN/m$ ACID. MANUT.

$q_3 = 16\,kN/m$ VENTO

FLEXÃO

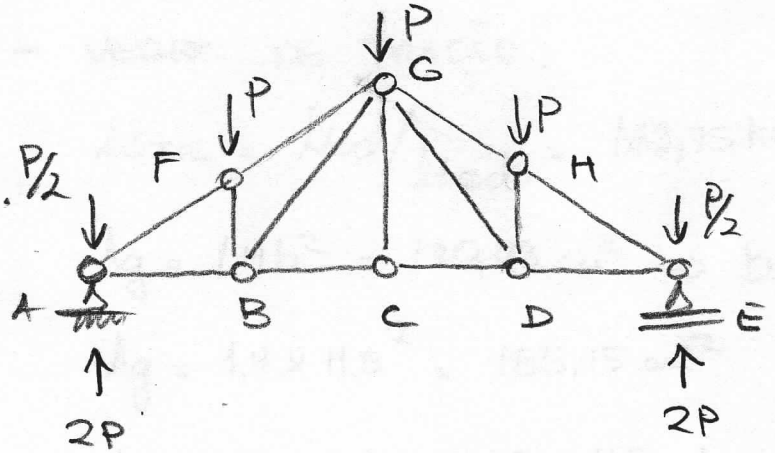


Madeira : 9,5cm

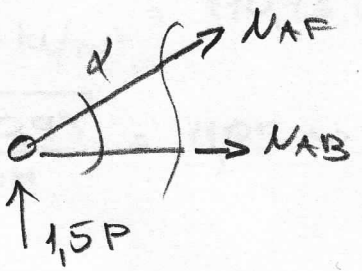
Q01) Máximo Nsd no banzo inferior?

Q02) Mínimo "b" p/ que o Banzo Inf. atenda à verif. de tração?

$P = 2q$



BARRA AB



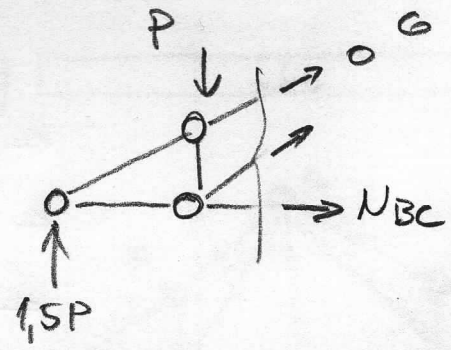
$\cos\alpha = 4/5 \quad \operatorname{sen}\alpha = 3/5$

$\Sigma F_V = 0 \quad N_{AF}\operatorname{sen}\alpha + 1{,}5P = 0 \quad N_{AF} = -1{,}5P/\operatorname{sen}\alpha$

$N_{AF} = -\frac{3}{2}P\frac{5}{3} = -\frac{5}{2}P$

$N_{AB} = -N_{AF}\cos\alpha = +\frac{5}{2}P \times \frac{4}{5} = \underline{2P}$ //

BARRA BC



$\Sigma M_G = 0$ ↻+

$1,5P \times 4 - P \times 2 - N_{BC} \times 3 = 0$

$N_{BC} = \frac{1}{3}(6P - 2P) = \frac{4}{3}P$

- COMB. DE AÇÕES:

$N_{sd1} = [1,4 \times 8] + 1,4 \times 12 + [1,4 \times 16 \times 0,5] = 39,2\ kN/m$

$N_{sd2} = [1,4 \times 8] + 1,4 \times 16 \times 0,75 + [1,4 \times 12 \times 0,8] = 41,44\ kN/m$

$N_{sd\,máx} = 2P = 2 \times 2q = 4 \times 41,44 = \boxed{165,75\ kN}$ Q01

- TENSÃO RESIST. DE TRAÇÃO:

$f_{td} = 0,7 \times 98 \times 98 \times (30/977)\,/\,1,8 = 9,697\ MPa$

$f_{td} = 0,9697\ kN/cm^2$

- VERIF. DE TRAÇÃO:

$A_{ÚTIL} = N_{sd} / f_{td} = 165,75\ kN / 0,9697\ kN/cm^2 = 170,93\ cm^2$

$A_g = 1,4b^2 = 170,93\ cm^2 \rightarrow b = \sqrt{\frac{170,93}{1,4}} = 11,05 \rightsquigarrow 11,5\ cm$

$A_g = 1,4 \times 11,5^2 = 185,15\ cm^2$

$A_F = 2 \times b \times 1 = 2 \times 11,5 \times 1 = 23\ cm^2$

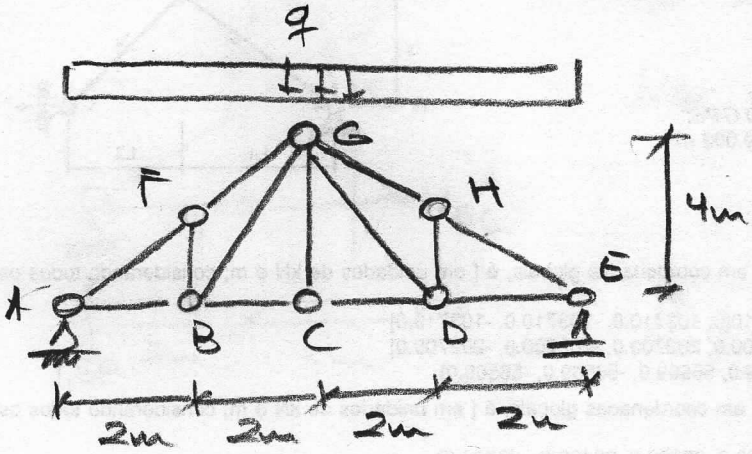
$A_F / A_g = 23\ cm^2 / 185,15\ cm^2 = 0,124\ (12,4\%)$

$A_{ÚTIL} = 1,4b^2 - 2b = 170,93$ $\quad b' = -10,36\ cm$ $\quad b'' = 11,78\ cm$

Q02 $\boxed{b = 12\ cm}$ $\quad \frac{A_F}{A_g} = \frac{2b}{1,4b^2} = \frac{1}{0,7b} = \frac{1}{0,7 \times 12} = 0,119$ ok

BIBLIANA

→ CONÍFERA C25;
→ CARREG. DE LONGA DURAÇÃO;
→ AMB. DE UMIDADE CLASSE 3;
→ GARAGEM;
→ COMB. NORMAIS ELU;



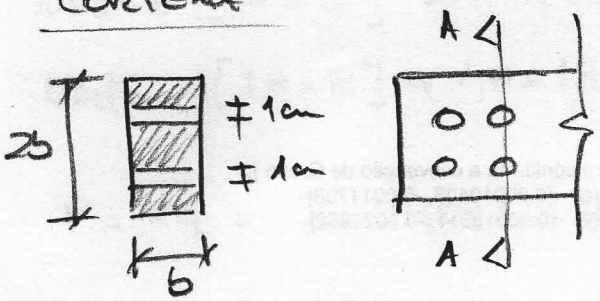
CARGAS:

$q_1 = 8\,kN/m$ PESO PRÓPRIO (GRANDE VARIABILIDADE)

$q_2 = 16\,kN/m$ ACIDENTAL;

$q_3 = 18\,kN/m$ VENTO;

CORTE AA

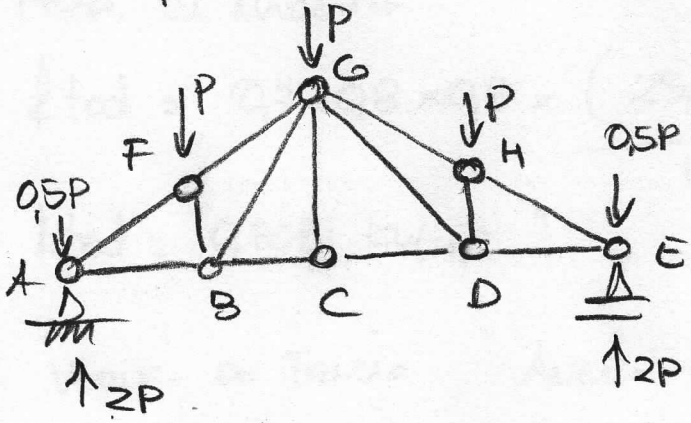


* b EM MODULAÇÃO DE 0,5 cm

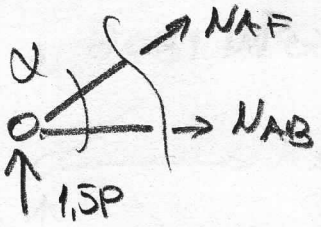
Q01) Usol MIX NO BANZO INF.

Q02) b mínimo necessário no banzo inferior

$P = 2q$



BARRA AB:



$\alpha = 45°$

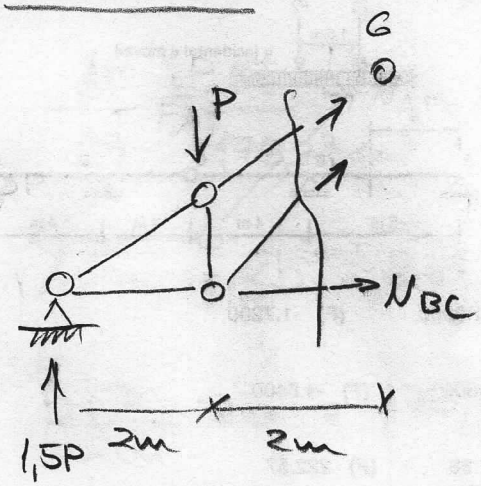
$\Sigma F_V = 0 \quad N_{AF}\frac{\sqrt{2}}{2} + 1{,}5P = 0$

$N_{AF} = -1{,}5\frac{2}{\sqrt{2}}P$

$N_{AF} = -\frac{3}{\sqrt{2}}P \qquad \Sigma F_H = 0 \qquad +N_{AF}\frac{\sqrt{2}}{2} + N_{AB} = 0$

$N_{AB} = -\frac{\sqrt{2}}{2}N_{AF} = \frac{\sqrt{2}}{2}\times\frac{3}{\sqrt{2}}P = 1{,}5P$ //

BARRA BC



$\Sigma M_G = 0$ ↻ (+)

$1,5P \times 4 - P \times 2 - N_{BC} \times 4 = 0$

$N_{BC} = \frac{1}{4}(6P - 2P) = \frac{4P}{4} = P$

$N_{sd\ máx}$: 1,5P

- COMBINAÇÕES:

$N_{sd1} = [1,4 \times 8] + 1,4 \times 16 + [1,4 \times 18 \times 0,5] = 46,2\ kN/m$

$N_{sd2} = [1,4 \times 8] + 1,4 \times 18 \times 0,75 + [1,4 \times 16 \times 0,8] = 48,02\ kN/m$

$P = 2q = 2 \times 48,02\ kN/m = 96,04\ kN$

$N_{sd\ máx} = 1,5 \times 96,04 = \boxed{144,06\ kN}$ Q01

- PROP. DA MADEIRA

$f_{td} = 0,7 \times 0,8 \times 0,8 \times \frac{(25/0,77)}{1,8} = 8,081\ MPa$

$f_{td} = 0,8081\ kN/cm^2$

- VERIF. DE TRAÇÃO $A_{NEC} = N_{sd\ máx} / f_{td}$

$A_{NEC} = 144,06\ kN / 0,8081\ kN/cm^2 = 178,27\ cm^2$

$A_g = b \times 25 = 25b$ $\quad 25b = 178,27\ cm^2$

$b = \sqrt{\frac{178,27}{2}} = 9,441\ cm \sim 9,5\ cm$ (P/ÁREA BRUTA)

$A_F = (9{,}5cm \times 1cm) \times 2 = 19cm^2$

$\frac{A_F}{A_g} = \frac{19\ cm^2}{178{,}27cm^2} = 0{,}1065$ (POUCO ACIMA DO LIMITE)

$A_{ÚTIL} = 2b^2 - 2 \times 1 \times b$

$2b^2 - 2b = 178{,}27$

Q02

$b' = -8{,}954$

$b'' = 9{,}954 \rightsquigarrow \boxed{10cm}$

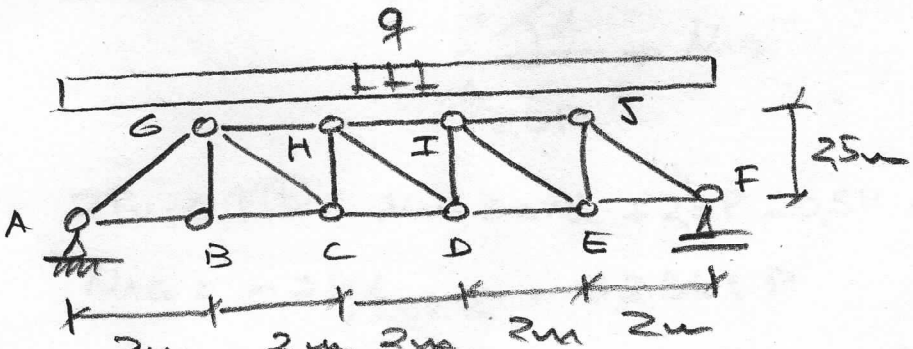
$A_g = 10 \times 20 = 200cm^2$

$A_F = 2 \times 10 \times 1 = 20cm^2$

$\frac{20}{200} = 0{,}10$ 10% NO LIMITE

B3M13NB

- CONÍFERA C20
- AMBIENTE CLASSE 3 UMID.
- CARGAS DE LONGA DUR.
- COMB. NORMAIS ELU;
- GARAGEM
- MODULAÇÃO DE 0,5m



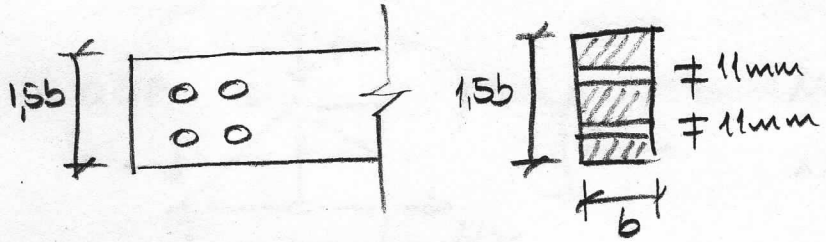
Cargas:

q_1 = 10kN/m peso próprio

q_2 = 20kN/m ocupação

q_3 = 15kN/m vento

FIXAÇÃO NAS EXTREMIDADES DAS PEÇAS:



MANTENDO A PROPORÇÃO 1,5b x b:

Q01) Máximo Nsd no banzo inferior; [kN]

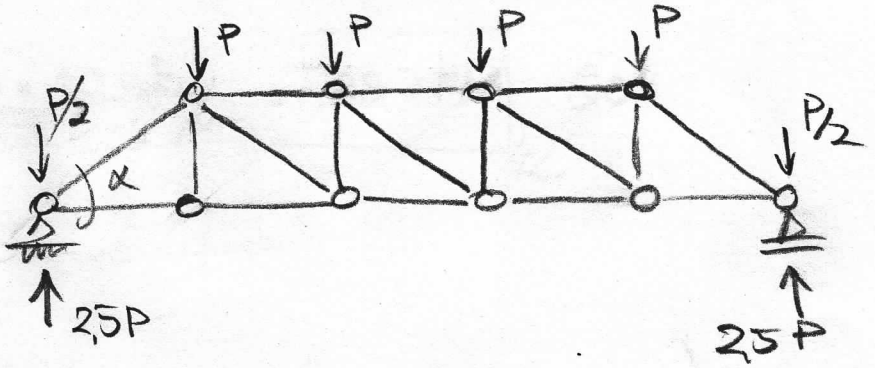
Q02) Mínimo "b" (na modulação) p/ que o banzo atenda a verificação de tração;

① COMB. DE AÇÕES ELU:

$$q_{sd1} = [1,4 \times 10] + 1,4 \times 20 + [1,4 \times 15 \times 0,5] = 52,5 \text{ kN/m}$$

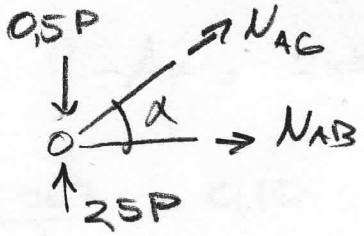
$$q_{sd2} = [1,4 \times 10] + 1,4 \times 15 \times 0,75 + [1,4 \times 20 \times 0,8] = 52,15 \text{ kN/m}$$

$P = 2q$



$$\cos\alpha = \frac{2}{\sqrt{2^2+2,5^2}} = 0,6247 \qquad \text{sen}\,\alpha = \frac{2,5}{\sqrt{2^2+2,5^2}} = 0,7809$$

BARRA AB:

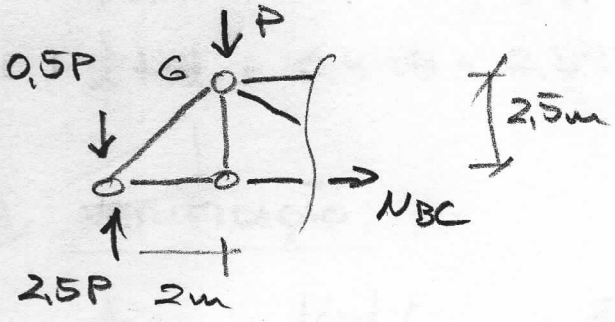


$\Sigma F_V = 0 \uparrow \oplus \quad N_{AG} \operatorname{sen}\alpha + 2{,}5P - 0{,}5P = 0$

$N_{AG} = -2P / \operatorname{sen}\alpha = -2{,}561\,P$

$N_{AB} = -N_{AG} \cos\alpha = +2{,}561P \times 0{,}6247 = \underline{1{,}6P}$ //

BARRA BC:

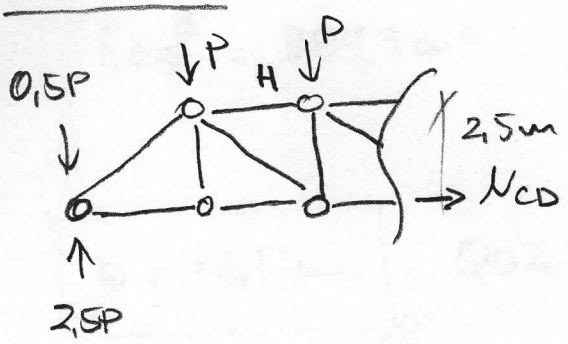


$\Sigma M_G = 0 \quad \curvearrowleft \oplus$

$N_{BC} \times 2{,}5 - 2P \times 2 = 0$

$N_{BC} = 4P / 2{,}5 = \underline{1{,}6\,P}$ //

BARRA CD



$\Sigma M_H = 0 \quad \curvearrowleft \oplus$

$N_{CD} \times 2{,}5 + P \times 2 - 2P \times 4 = 0$

$N_{CD} = \dfrac{8P - 2P}{2{,}5} = \underline{2{,}4\,P}$ //

$N_{sd\,MÁX} = 2{,}4P = 2{,}4 \times 2q = 4{,}8q$

$N_{sd\,MÁX} = 4{,}8 \times 52{,}5\,kN/m = \boxed{252\,kN}$ //

Q01

$A_g = 1{,}5b^2$ $\quad A_F = 2 \times b \times 1{,}1 = 2{,}2b$

$\frac{2{,}2b}{1{,}5b^2} = \frac{1{,}467}{b} = 0{,}10 \quad b = \frac{1{,}467}{0{,}10} = 14{,}67$

→ A partir de $b = 15\,cm$ $\quad A_g = A_{ÚTIL}$

(2) PROP. DA MADEIRA:

$k_{mod} = 0{,}7 \times 98 \times 98 = 0{,}448$

$f_{tok} = 20\,MPa / 0{,}77 = 25{,}97\,MPa$

$f_{td} = 0{,}448 \times 2{,}597\ kN/cm^2 / 1{,}8 = 0{,}6464\ kN/cm^2$

(3) VERIFICAÇÃO:

$A_{NEC} = N_{sd} / f_{td} = 252\,kN / 0{,}6464\ kN/cm^2 = 389{,}9\,cm^2$

$1{,}5b^2 = 389{,}9\,cm^2 \quad b = \sqrt{389{,}9 / 1{,}5} = 16{,}12\,cm$

$A_g = A_{ÚTIL}$

$\boxed{b = 16{,}5\,cm}$ Q02