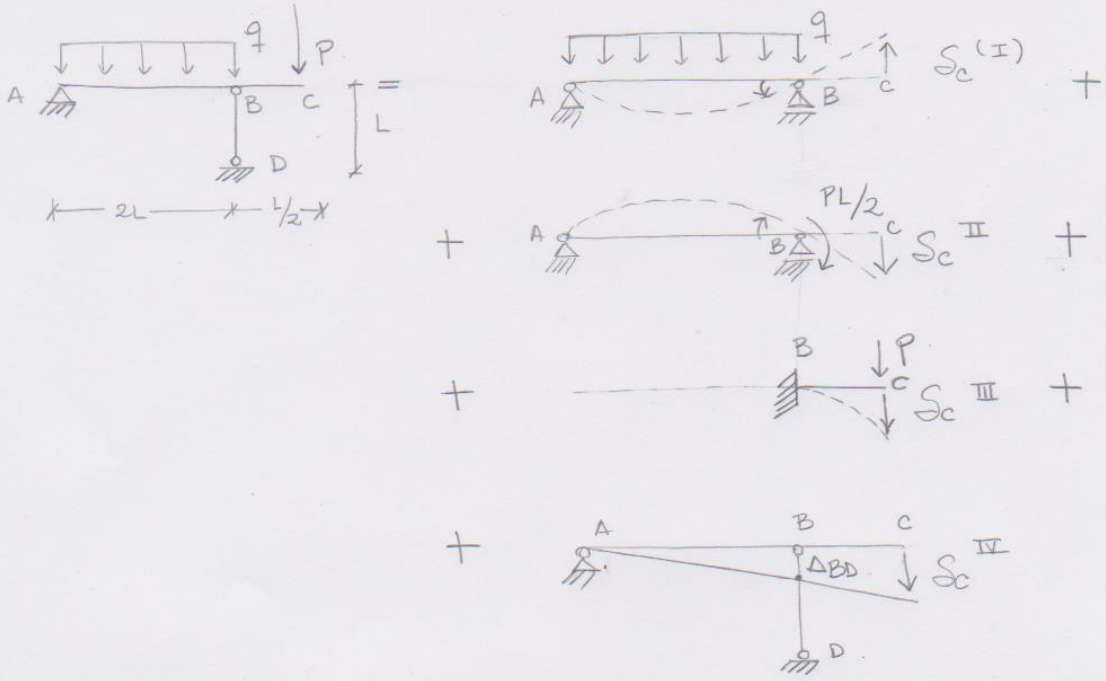
1)



$$\boxed{S_c = S_c^{I} - S_c^{II} - S_c^{III} - S_c^{IV}}$$

(I) $$\uparrow S_c^{I} = \overset{\curvearrowleft}{\theta_B}{}^{I} \cdot L_{BC} = \frac{q L_{AB}^3}{24 E_{AC} I_{AC}} \quad L_{BC} = \frac{q (2L)^3}{24 E_{AC} I_{AC}} \cdot \frac{L}{2} \rightarrow$$

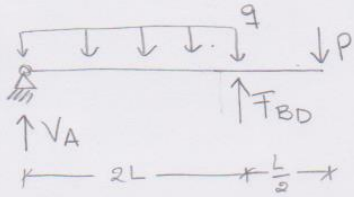
$$\rightarrow \boxed{\uparrow S_c^{I} = \frac{q L^4}{6 E_{AC} I_{AC}}}$$

(II) $$\downarrow S_c^{II} = \overset{\curvearrowright}{\theta_B}{}^{II} L_{BC} = \frac{M_B \cdot L_{AB}}{3 E_{AC} I_{AC}} \cdot L_{BC} = \frac{PL}{2} \cdot \frac{2L}{3 E_{AC} I_{AC}} \cdot \frac{L}{2} \rightarrow$$

$$\rightarrow \boxed{\downarrow S_c^{II} = \frac{P L^3}{6 E_{AC} I_{AC}}}$$

(III) $$\downarrow S_c^{III} = \frac{P (L_{BC})^3}{3 E_{AC} I_{AC}} = \frac{P L^3}{3 E_{AC} I_{AC} \cdot 8} \rightarrow \boxed{\downarrow S_c^{III} = \frac{PL^3}{24 E_{AC} I_{AC}}}$$

(IV)



$$\circlearrowleft \Sigma M_A = 0) \; -2Lq \cdot L + F_{BD} \cdot 2L - P \cdot 2{,}5L = 0$$

$$\rightarrow \boxed{F_{BD} = \frac{2{,}5P + 2qL}{2}}$$

$$\frac{\downarrow S_c^{\text{II}}}{2{,}5L} = \frac{\Delta_{BD}}{2L} \rightarrow \downarrow S_c^{\text{II}} = \frac{5}{4}\Delta_{BD}$$

$$\Delta_{BD} = \frac{F_{BD}\, L_{BD}}{E_{BD}\, A_{BD}} = \frac{2{,}5P + 2qL}{2} \cdot \frac{L}{E_{BD}\cdot A_{BD}}$$

$$\rightarrow \downarrow S_c^{\text{II}} = \frac{5}{8}(2{,}5P + 2qL)\frac{L}{E_{BD}\, A_{BD}}$$

$$\rightarrow S_c = \frac{qL^4}{6E_{AC}I_{AC}} - \frac{PL^3}{6E_{AC}I_{AC}} - \frac{PL^3}{24E_{AC}I_{AC}} - \frac{5}{8}(2{,}5P + 2qL)\frac{L}{E_{BD}A_{BD}} = 0$$

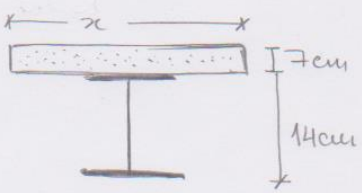
$$S_c = \frac{qL^3}{3E_{AC}I_{AC}} - \frac{5PL^2}{12E_{AC}I_{AC}} - \frac{25P}{8E_{BD}A_{BD}} - \frac{5qL}{2E_{BD}A_{BD}} = 0$$

$$q\left(\frac{L^3}{3E_{AC}I_{AC}} - \frac{2{,}5L}{E_{BD}A_{BD}}\right) - \frac{P}{4}\left(\frac{5L^2}{3E_{AC}I_{AC}} + \frac{25}{2E_{BD}A_{BD}}\right) = 0$$

$$\rightarrow q = \frac{\frac{P}{4}\left(\frac{5L^2}{3E_{AC}I_{AC}} + \frac{25}{2E_{BD}A_{BD}}\right)}{L\left(\frac{L^2}{3E_{AC}I_{AC}} - \frac{2{,}5}{E_{BD}A_{BD}}\right)}$$

2)

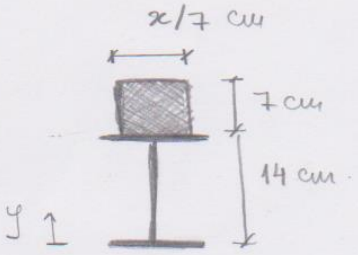
a) Hallar x / LN en interfaz de la sección.



S. Real

Homog. → a Acero

$n = \frac{30}{210} = \frac{1}{7}$



SHEq.

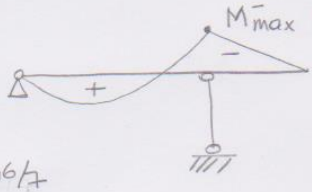
Busco x / $y_G = 14\,cm$

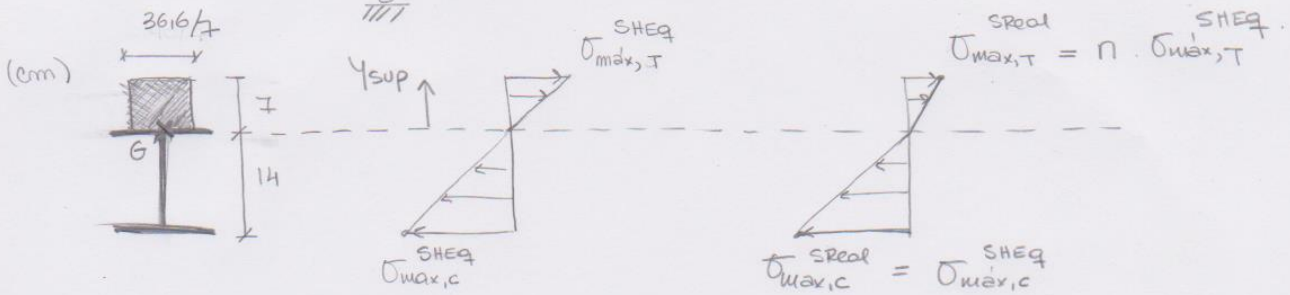
$$y_G = \frac{(18{,}3)(7) + (x/7)(7)(17{,}5)}{(x/7)7 + 18{,}3}\ cm = 14\,cm$$

$$\Rightarrow \quad 128{,}1\,cm^2 + 17{,}5\,x\,cm^2 = 14\,x\,cm^2 + 256{,}2\,cm^2 \Rightarrow$$

$$\Rightarrow \quad 3{,}5\,x\,cm^2 = 128{,}1\,cm^2 \longrightarrow \boxed{x = 36{,}6\,cm}$$

b)





$$I_{SH}\,(cm^4) = \frac{\left(36{,}6/7\right)7^3}{12} + \left(\frac{36{,}6}{7}\right)(7)(3{,}5)^2 + 573 + (18{,}3)(7)^2 \longrightarrow$$

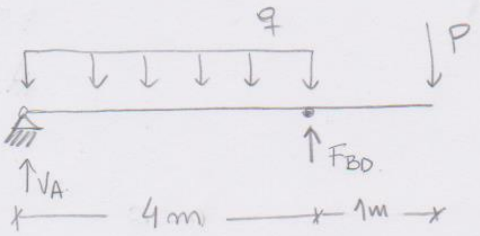
$$\rightarrow \boxed{I_{SHEq} = 2057{,}17\,cm^4} \quad ; \quad \boxed{y_{sup} = 0{,}07\,m}$$

$$\sigma^{SH}_{max,T} = \frac{M \cdot y_{sup}}{I_{SH}} = \frac{P(Nm) \cdot 0{,}07\,m}{2057{,}17 \times 10^{-8}\,m^4}$$

$$\sigma_{máx,T}^{S.Real} = n\,\sigma_{máx,T}^{SH} = \frac{1}{7}\cdot\frac{P(Nm)\cdot 0{,}07m}{20571{,}7\times10^{-8}\,m^4} \leq \sigma_{adm,H}^{TRAC} = 2{,}5\times10^{6}\,Pa$$

$$\Rightarrow P \leq 5142{,}5\,N \Rightarrow \boxed{P \leq 5{,}14\,kN}$$

c) i)



$\Sigma M_A = 0)\ -4q\cdot 2 + F_{BD}\cdot 4 - 5P = 0$

$$F_{BD} = \frac{80+5}{4}\,kN$$

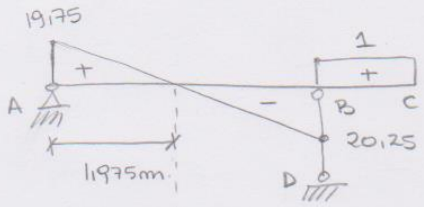
$$\rightarrow \boxed{F_{BD} = 21{,}25\,kN}$$

$\Sigma V = 0)\ V_A + F_{BD} - 4q - P = 0$

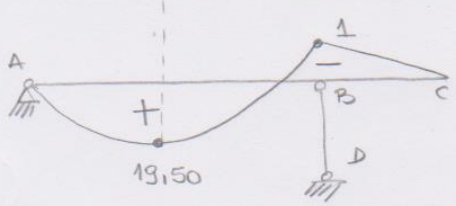
$$\rightarrow \boxed{V_A = 19{,}175\,kN}$$

Diagramas -

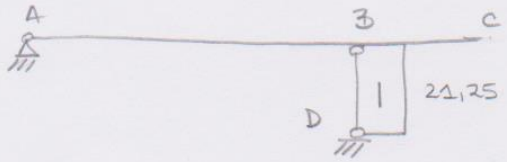
V (kN)



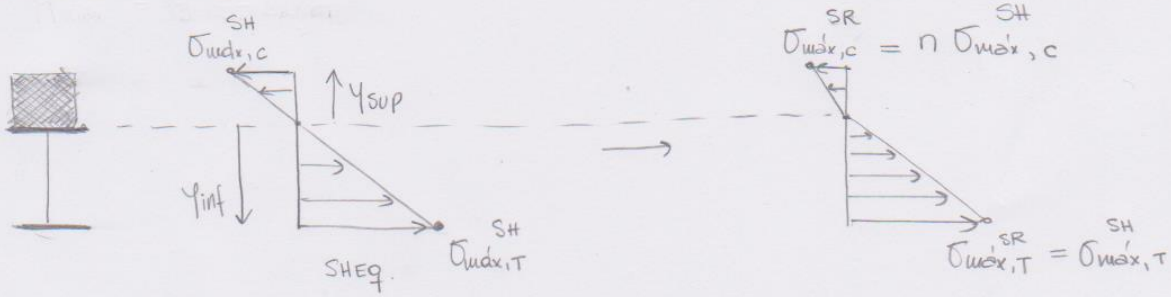
M (kNm)



N (kN)



ii) $M_{máx} = 19{,}50\,kNm$



$y_{sup} = 7cm \qquad y_{inf} = 14cm$ -

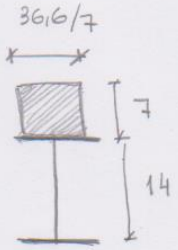
- $\sigma^{SR}_{máx,C} = \frac{1}{7} \cdot \frac{(19,50 \times 10^3 \, Nm) \cdot (0,107 \, m)}{(2057,7 \times 10^{-8} \, m^4)} = 9,48 \, MPa \leq 25 \, MPa = \sigma^{COMP}_{adm,H}$ ✓

- $\sigma^{SR}_{máx,T} = \frac{(19,5 \times 10^3 \, Nm)(0,14 m)}{(2057,7 \times 10^{-8} \, m^4)} = 132,67 \, MPa \leq 140 \, MPa = \sigma^{TRAC}_{adm,A}$ ✓

iii) $q_{int} \cdot s \leq F_{adm,C} \rightarrow s \leq \frac{F_{adm}}{q_{INT}}$

$\rightarrow V_{máx} = 20,25 \, kN$; $I_{SH} = 2057,7 \times 10^{-8} \, m^4$

$\rightarrow q_{interfaz} = \frac{\mu_{int} \cdot V_{máx}}{I_{SH}}$



- $\mu_{INT} = \left(\frac{36,6}{7}\right)(7)(3,5) = 128,1 \, cm^3$

$\Rightarrow q_{INT} = \frac{(128,1 \times 10^{-6} \, m^3)(20,25 \times 10^3 \, N)}{(2057,7 \times 10^{-8} \, m^4)}$

$= 126,06 \times 10^3 \, N/m$

$\Longrightarrow s \leq \frac{F_{adm,C}}{q_{INT}} = \frac{16 \times 10^3 \, N}{126,06 \times 10^3 \, N/m} = 0,127 \, m$

$\Longrightarrow \boxed{s \leq 12 cm}$