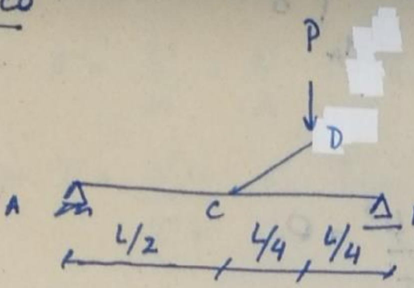
2do PARCIAL R1 2019

Teórico

a)



$\Rightarrow \sum M_A = 0 \Rightarrow R_B \cdot L = P \frac{3}{4} L$

$\Rightarrow R_B = \frac{3}{4} P$

$\Rightarrow \sum V = 0 \Rightarrow R_A + R_B = P$

$\Rightarrow R_A = \frac{1}{4} P$

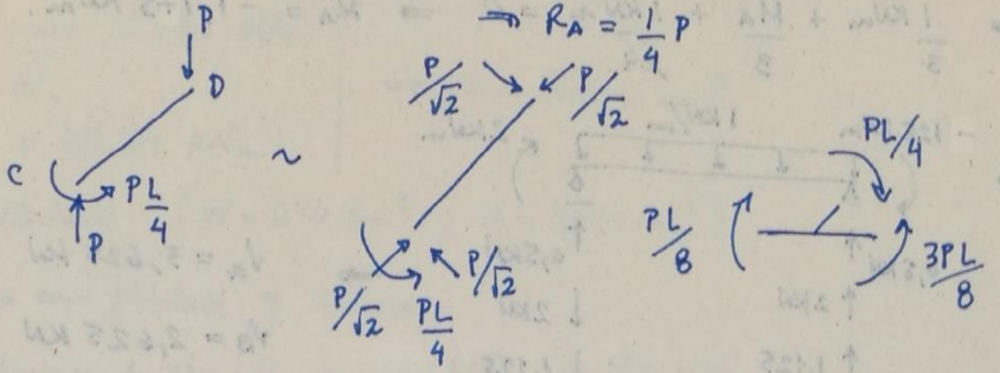
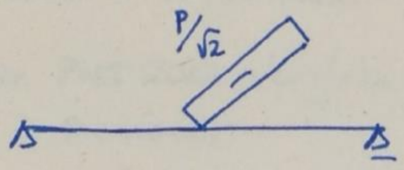
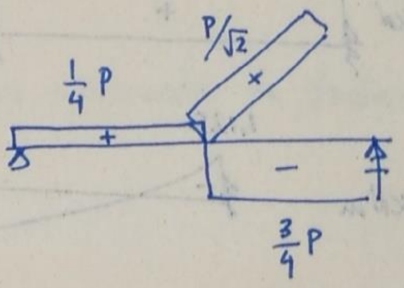


Diagrama.

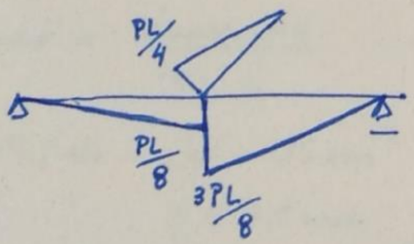
(N)



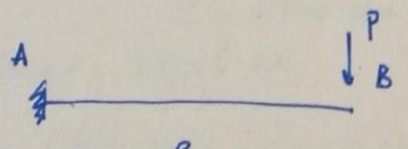
(V)



(M)



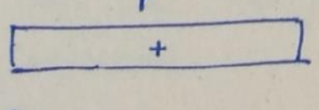
b)



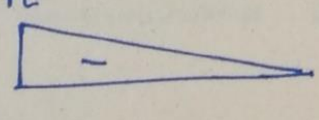
$\Rightarrow V_A = P$

$M_A = -PL$

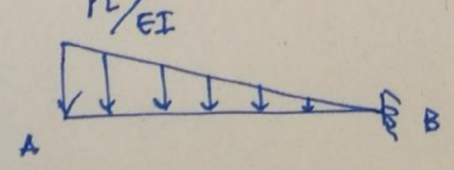
(V)



(M)



Viga análoga

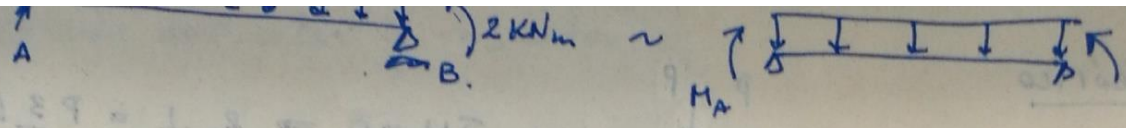


$\Rightarrow V_B = \theta_B = \frac{PL}{EI} \cdot \frac{L}{2} = \frac{PL^2}{2EI}$

$M_B = v_B = \frac{PL^2}{2EI} \cdot \frac{2L}{3} = \frac{PL^3}{3EI}$

$\Rightarrow \quad \theta_B = \frac{PL^2}{2EI}$ ↷

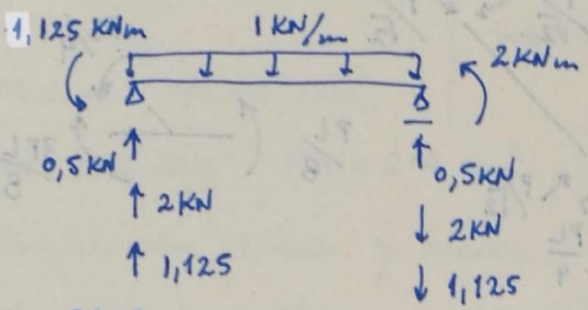
$v_B = \frac{PL^3}{3EI}$ ↓



$\Rightarrow \theta_A = 0$

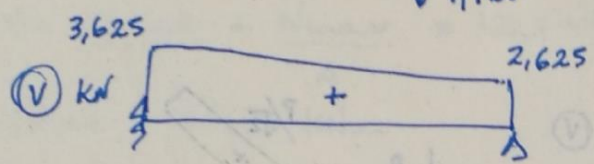
$$\theta_A = \frac{2\,KNm \cdot L}{6EI} + \frac{M_A L}{3EI} + \frac{1\,KN/m \cdot L^3}{24EI} = 0$$

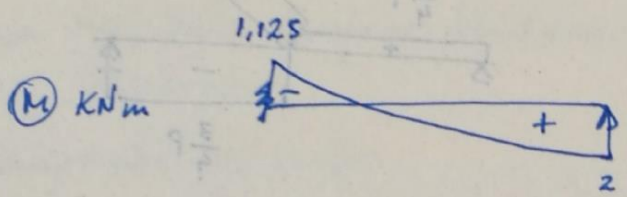
$$\Rightarrow \frac{1}{3}\,KNm + \frac{M_A}{3} + \frac{1\,KN}{24}m = 0 \Rightarrow M_A = -1{,}125\,KNm.$$



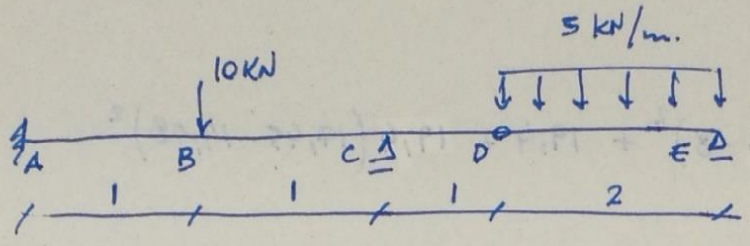
$\Rightarrow V_A = 3{,}625\,KN \uparrow$

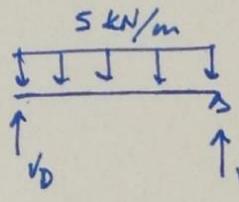
$V_B = 2{,}625\,KN \downarrow$



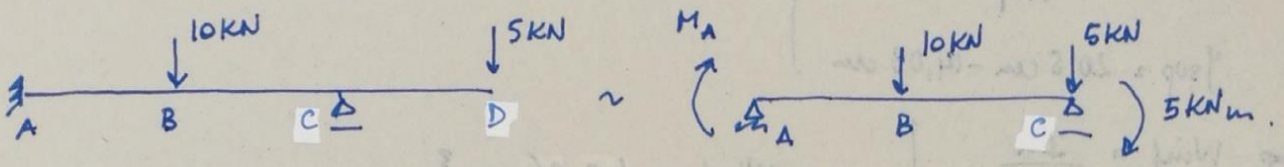


Ejercicio 1



a) 

$\Rightarrow V_E = V_D = 5\,kN \Rightarrow \boxed{R_E = 5\,kN}$



$\theta_A = 0 \Rightarrow \frac{M_A \cdot 2m}{3EI} - \frac{5\,kNm \cdot 2m}{6EI} + \frac{10kN(2m)^2}{16EI} = 0$

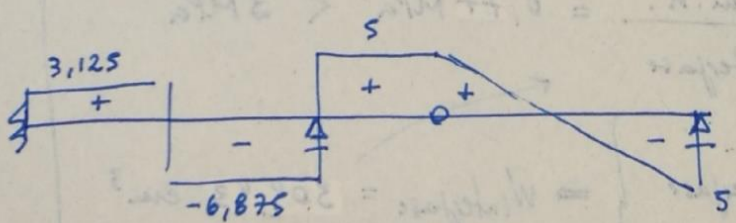
$\Rightarrow M_A = \frac{3 \cdot 5\,kNm}{6} - \frac{3 \cdot 10\,kN \cdot 2m}{16} \Rightarrow \boxed{M_A = -1{,}25\,kNm.}$

$\rightarrow \Sigma M_A = 0 \Rightarrow 5\,kN \cdot 3m + 10\,kN \cdot 1m = 1{,}25\,kNm + R_C \cdot 2m$

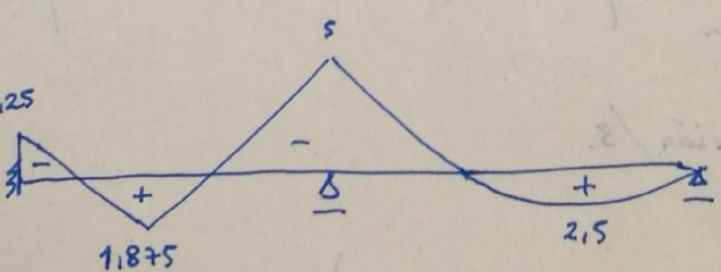
$\Rightarrow \boxed{R_C = 11{,}875\,kN}$

$\rightarrow \Sigma V = 0 \Rightarrow R_A + 11{,}875\,kN = 10\,kN + 5\,kN \Rightarrow \boxed{R_A = 3{,}125\,kN}$

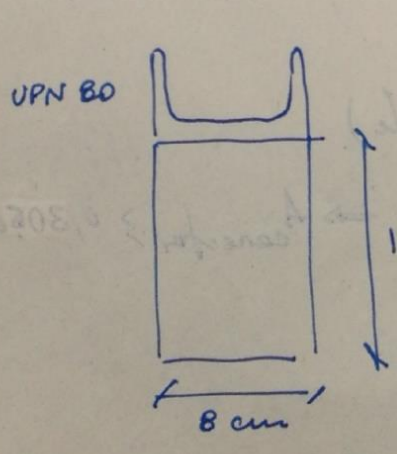
b) (V) (kN)



(M) (kNm)



c) Sección compuesta.



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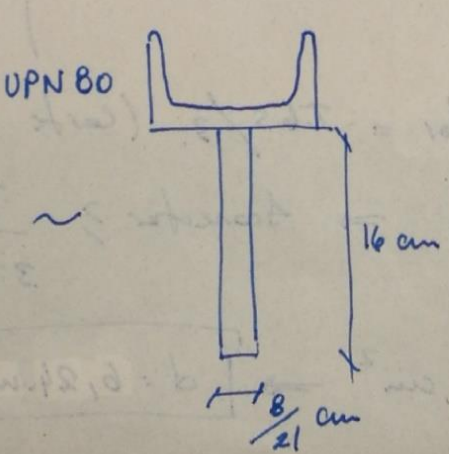


$n = \frac{E_m}{E_a} = \frac{10}{210} = \frac{1}{21}$

$$\Rightarrow y_{gh} = \frac{\frac{8}{21}\cdot 8 \cdot 16 + 11 \cdot 17{,}45}{\frac{8}{21}\cdot 16 + 11} = 14{,}08 \text{ cm}$$

$$\Rightarrow I_h = \frac{\frac{8}{21}\cdot 16^3}{12} + \frac{8}{21}\cdot 16\,(14{,}08 - 8)^2 + 19{,}4 + 11\,(17{,}45 - 14{,}08)^2$$

$$\Rightarrow Ih = 499{,}68 \text{ cm}^4$$

$$\Rightarrow W_{sup} = \frac{Ih}{y_{sup}} \quad y_{sup} = 20{,}5 \text{ cm} - 14{,}08 \text{ cm} \Rightarrow W_{sup} = 77{,}83 \text{ cm}^3$$

$$\Rightarrow W_{inf} = \frac{Ih}{y_{inf}} \quad y_{inf} = 14{,}08 \text{ cm} \Rightarrow W_{inf} = 35{,}49 \text{ cm}^3$$

SECCIÓN C

$$\Rightarrow \sigma_a^{max} = \frac{5 \text{ KNm}}{77{,}83 \cdot 10^{-6} \text{ m}^3} = 64{,}24 \text{ MPa} < 140 \text{ MPa}$$

$$\sigma_{m_c}^{max} = \frac{5 \text{ KNm} \cdot n}{35{,}49 \cdot 10^{-6} \text{ m}^3} = 6{,}71 \text{ MPa} < 8 \text{ MPa}.$$

$$\sigma_{m_t}^{max} = \frac{5 \text{ KNm} \cdot n.}{W_{interfase}} = 0{,}91 \text{ MPa} < 3 \text{ MPa}$$

$$W_{interfase} = \frac{Ih}{y_{interfase}} \quad y_{interfase} = 1{,}92 \text{ cm} \Rightarrow W_{interfase} = 260{,}25 \text{ cm}^3$$

Verifica

d) $F_{conector} = F_{conexión}/3.$

$F_{conexión} = \tau_b s$

$$\tau_b = \frac{V \mu_g}{Ih.}$$

$$\mu_g = \frac{8}{21}\cdot 16 \cdot (14{,}08 - 8) = 37{,}06 \text{ cm}^3$$

$V_{max} = 6{,}875$ KN

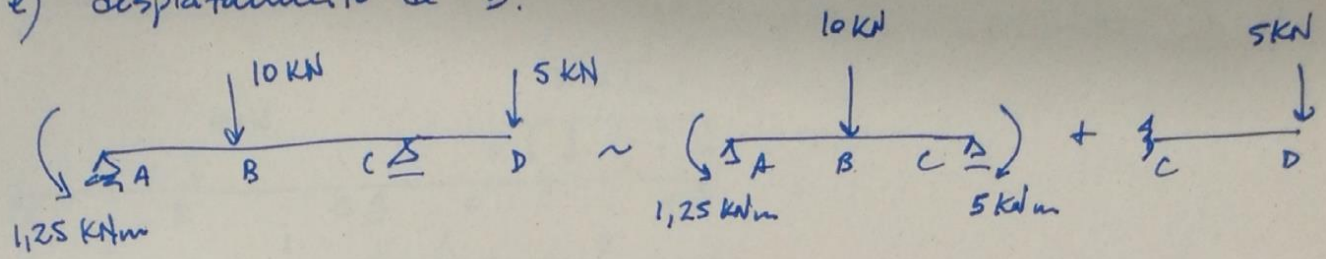
$\Rightarrow \tau_b = 50{,}99$ kN/m.

$V_{conector}^{max} = F_{conector} = \tau_b s/3.$ (corte simple).

$$\frac{V_{conector}^{max}}{A_{conector}} \leq \tau_{adm} \Rightarrow A_{conector} \geq \frac{\tau_b s}{3\tau_{adm}} \Rightarrow A_{conector} \geq 0{,}364 \text{ cm}^2$$

$$\Rightarrow \frac{\pi d^2}{4} = 0{,}364 \text{ cm}^2 \Rightarrow \boxed{d = 7 \text{ mm.}}$$

e) desplazamiento de D.



$\rightarrow \delta_D^1 = \frac{PL^3}{3EI} = 1,59 \text{ mm} \downarrow$

$\rightarrow \delta_D^2 = \overrightarrow{\theta_C} \cdot 1m \downarrow$

$\overrightarrow{\theta_C} = \frac{M_A \cdot L}{6EI} + \frac{M_C L}{3EI} - \frac{PL^2}{16EI} = 1,19 \times 10^{-3} \curvearrowright$ $\Big\} \; \delta_D^2 = 1,19 \text{ mm} \downarrow$

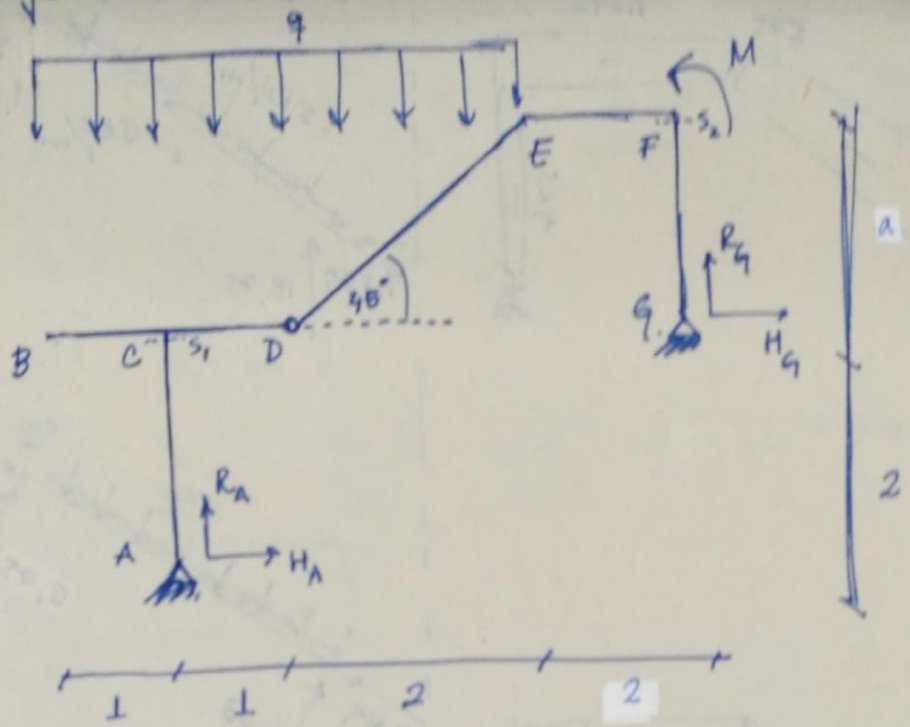
$\Rightarrow \boxed{\delta_D = 2,78 \text{ mm} \downarrow}$

c) Sección media DE

$\sigma^{max}_{m,T} = \frac{2,5 \text{ KNm} \cdot n}{W_{inf}} = 3,35 \text{ MPa} > 3 \text{ MPa}$

$\Rightarrow$ No verifica

Ejercicio Parcial Pórtico.



$q = 10\ kN/m$

$M = 15\ kNm$

$E = 210\ GPa$

a) Hallar reacciones y trazar diagramas de solicitaciones.

$\Sigma V = 0 \rightarrow R_A + R_G = q \cdot 4m$ (I)

$\Sigma H = 0 \rightarrow H_A + H_G = 0$ (II)

$\Sigma M_A = 0 \rightarrow R_G \cdot 5m + M = H_G \cdot 2m + q \cdot 4m \cdot 1m$ (III)

$\Sigma M_D^{izq} = 0 \rightarrow H_A \cdot 2m + q \cdot 2m \cdot 1m = R_A \cdot 1m.$ (IV)

$$\rightarrow \begin{cases} R_A + R_G = 40 \\ H_A + H_G = 0 \\ 5R_G - 2H_G = 25 \\ 2H_A - R_A = -20 \end{cases} \rightarrow \begin{cases} R_G = 40 - R_A \\ H_G = -H_A. \end{cases}$$

$$\rightarrow \begin{cases} 5(40 - R_A) + 2H_A = 25 \\ 2H_A - R_A = -20 \end{cases} \rightarrow -4R_A = -155 \rightarrow \boxed{R_A = 38{,}75\ kN}$$

$$\rightarrow \boxed{R_G = 1{,}25\ kN}$$

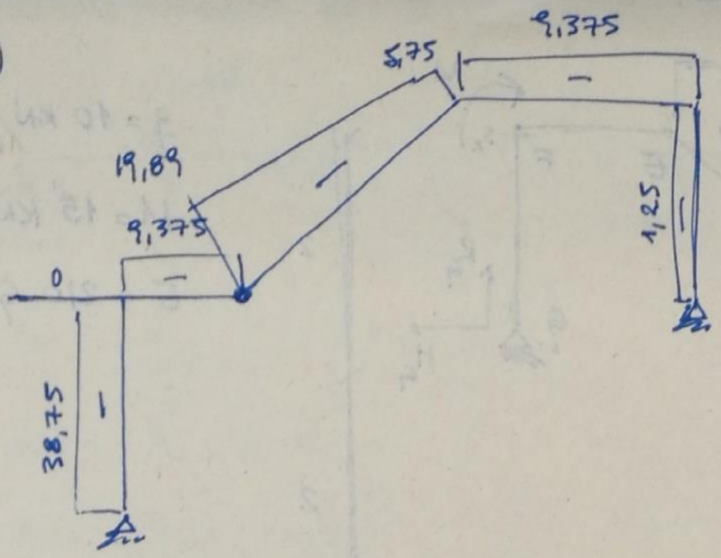
$$\rightarrow \boxed{H_A = 9{,}375\ kN} \rightarrow \boxed{H_G = -9{,}375\ kN}$$

b) Hallar a para que los momentos en las secciones S_1 y S_2 sean iguales en módulo.

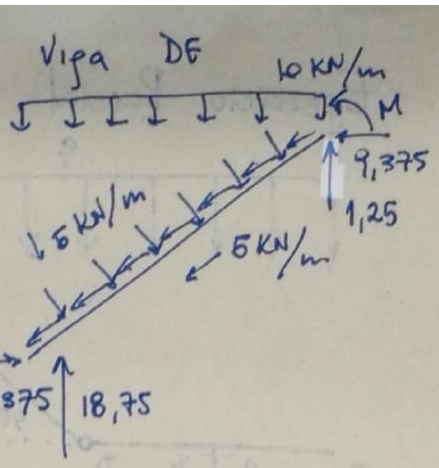
$$\rightarrow \begin{cases} |M_{S_1}| = |H_A|\ 2m \\ |M_{S_2}| = |H_G|\ a \\ \rightarrow \Sigma F_H = 0 \rightarrow |H_A| = |H_G| \end{cases} \rightarrow a = 2m.$$

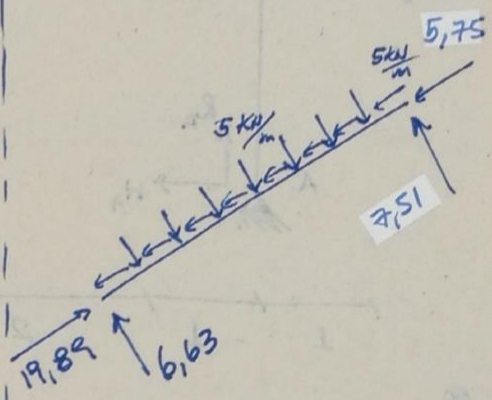
Diagramas

N (KN)

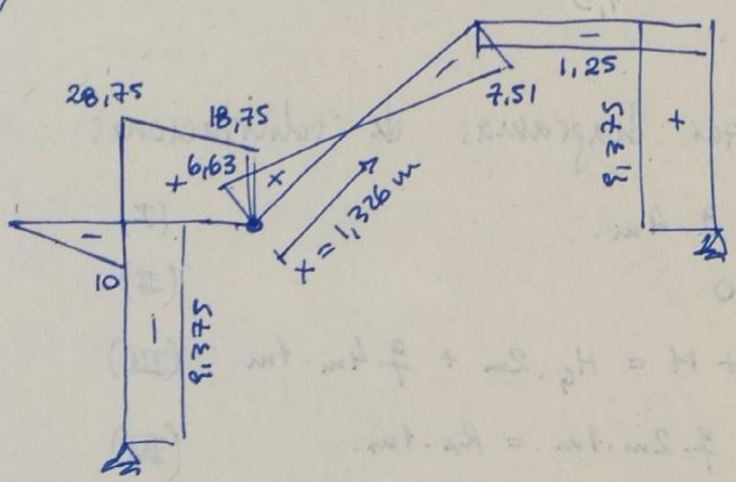


Viga DF



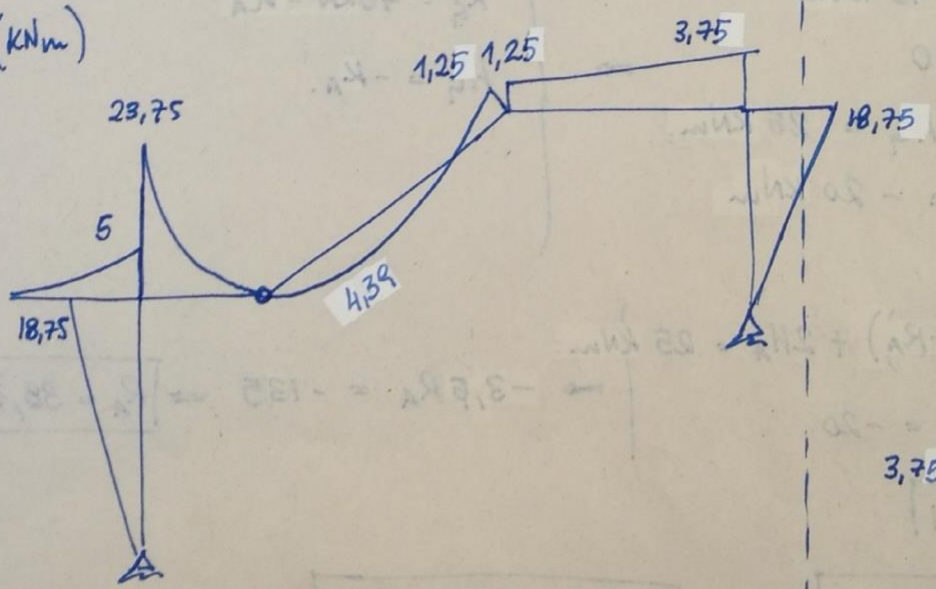


V (KN)

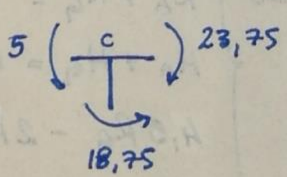


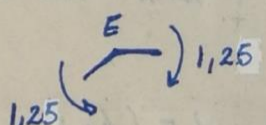
$6{,}63 = 5x \rightarrow x = 1{,}326\ m$

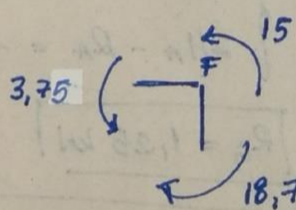
M (KNm)



Equilibrio de Nudos.







b) Dimensionar con un único perfil PNI considerando tensiones normales y rasantes.

$\rightarrow \sigma = \frac{M}{W} + \frac{N}{A} < \sigma_{adm} = 140\ MPa$

$\rightarrow \tau = \frac{V \mu}{I b} < \tau_{adm} = 70\ MPa$

Predimensionamiento

$\sigma = \frac{M_{max}}{W} < 140\ MPa$

$M_{max} = 23,75\ KNm$

$\Rightarrow W = 169,6\ cm^3$

$\Rightarrow$ PNI 200 ($W = 214\ cm^3$; $A = 33,4\ cm^2$)

Verifico con M_{max} y N_{max}.

$\sigma = \frac{M_{max}}{W} + \frac{N_{max}}{A} = 122,6\ MPa < 140\ MPa$

$N_{max} = 38,75\ KNm$

$\Rightarrow$ PNI 200 Verifica tensiones normales en todas las secciones.

Comprobo rasantes

$\tau_{max} = \frac{V_{max} \cdot \mu_G}{I \cdot b}$

PNI 200 : $\mu_G = 125\ cm^3$

$b = 7,5\ mm$

$I = 2140\ cm^4$

$V_{max} = 28,75\ KN$

$\Rightarrow \tau_{max} = 22,4\ MPa < 70\ MPa$

$\Rightarrow$ PNI 200 Verifica tensiones rasantes en todas las secciones.

$\Rightarrow$ Dimensiono con **PNI 200**