Ejercicio 1

Parte A

- $\Sigma F_V = 0: V_A + V_F = 5\frac{kN}{m}.4m + P$
- $\Sigma F_H = 0: H_A + H_F = 5\frac{kN}{m}.4m$
- $M_C^{izq} = 0: 5\frac{kN}{m}.4m.2m + H_A.6m = V_A.4m$
- $M_C^{der} = 0: 30kNm + P.2m + 5\frac{kN}{m}.4m.3m = V_F.1m + H_F.6m$

Imponiendo que $V_A = 16kN$.

$$\begin{cases} V_F - P = 20kN - 16kN = 4kN \\ H_A + H_F = 20kN \\ H_A = \dfrac{16kN.4m - 40kNm}{6m} = 4kN \\ V_F + 6H_F - 2P = 30kN + 60kN \end{cases}$$

Entonces:

- $P = 10kN$
- $H_A = 4kN$
- $H_F = 16kN$
- $V_F = 14kN$

Parte B

Momento en B:

- $M_B = H_A.6m = 24kNm \circlearrowright$

El momento se anula en la barra *BC* en:

- $24kNm = \frac{16kN + (16kN - 5\frac{kN}{m}x)}{2}x \Rightarrow x = 2{,}4m$

El momento antihorario máximo en *BC* es:

- $M = \frac{(0{,}8m)^2.5\frac{kN}{m}}{2} = 1{,}60kNm$

Cambio de solicitaciones en *C:*

- $N_C^{der} = \frac{N_C^{izq}\sqrt{2}}{2} + \frac{V_C^{izq}\sqrt{2}}{2} = \frac{-4kN\sqrt{2}}{2} + \frac{-4kN\sqrt{2}}{2} = -4\sqrt{2}\ kN = -5{,}66kN$
- $V_c^{der} = -\frac{N_C^{izq}\sqrt{2}}{2} + \frac{V_C^{izq}\sqrt{2}}{2} = \frac{4kN\sqrt{2}}{2} + \frac{-4kN\sqrt{2}}{2} = 0kN$

Solicitaciones en *DE:*

- $N_{DE} = -\frac{P\sqrt{2}}{2} = -7{,}07kN$
- $V_{DE} = -\frac{P\sqrt{2}}{2} = -7{,}07kN$

Momentos en nodo D:

- $M_D^{DE} = V_{DE}.1m.\sqrt{2} = 10kNm \circlearrowright$

- $M_D^{CD} = 0kNm$
  $\Rightarrow M_D^{DF} = 10kNm \ \circlearrowleft$

Cambio de solicitaciones en D:

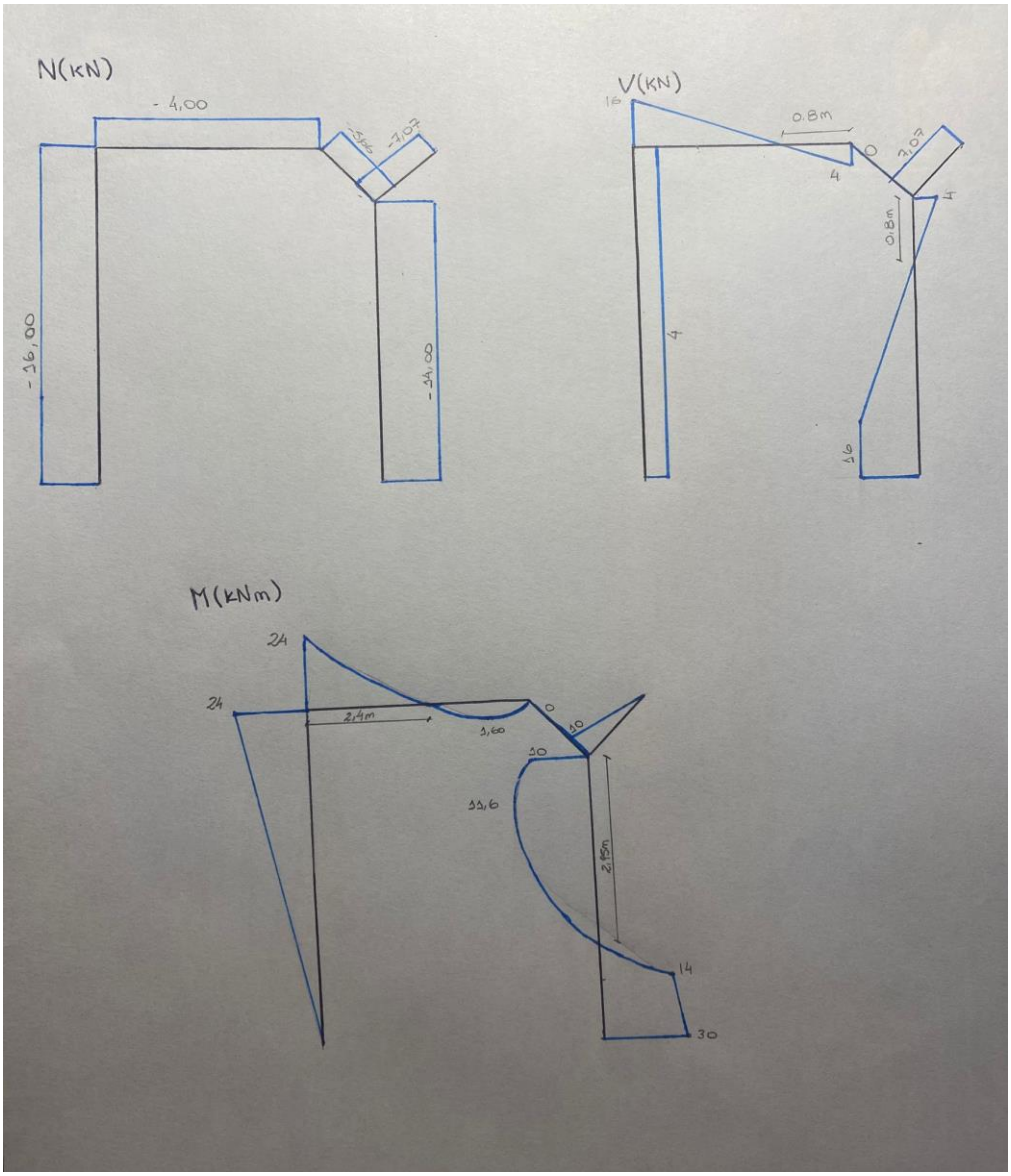
- $N_D^{DF} = \frac{N_D^{CD}\sqrt{2}}{2} + \frac{N_D^{DE}\sqrt{2}}{2} + \frac{V_D^{DE}\sqrt{2}}{2} = \frac{\sqrt{2}}{2}(-7{,}07kN - 7{,}07kN - 5{,}66kN) = -14kN$
- $V_D^{DF} = +\frac{N_D^{CD}\sqrt{2}}{2} - \frac{N_D^{DE}\sqrt{2}}{2} + \frac{V_D^{DE}\sqrt{2}}{2} = \frac{\sqrt{2}}{2}(-7{,}07kN + 7{,}07kN - 5{,}66kN) = -4kN$

Momento máximo antihorario en *DF es:*

- $M = 10kNm + \frac{(0{,}8m)^2.5\frac{kN}{m}}{2} = 11{,}60kNm$

El momento se anula en *DF en:*

- $11{,}60kNm = \frac{5\frac{kN}{m}(x-0{,}8m)\text{^}2}{2} \Rightarrow x = 2{,}95m$



Parte C

Sección con cortante máximo

1) En la barra DF y BC, V= $16kN$.

$$\tau = \frac{V\mu}{Ib} < \tau_{adm}$$

Secciones con mayor momento y directa:

2) En la barra AB con $M = 24kNm$ y $N = 16kN$.
3) En la barra DF con $M = 30kNm$ y $N = 14kN$.

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

Pre dimensiono con $M_{max} = 30kNm$: $W > \frac{M_{max}}{\sigma_{adm}} = 214{,}3cm^3$

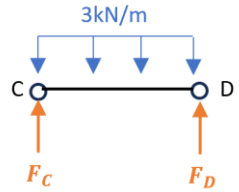
Tomo PNI 220: $W = 278cm^3; A = 39{,}5cm^2; I = 3060cm^4; \mu = 162cm^3; b = 8{,}1mm$

1) $\frac{V\mu}{Ib} = 10{,}5MPa < \tau_{adm}$
2) $\frac{M}{W} + \frac{N}{A} = 90{,}4MPa < \sigma_{adm}$
3) $\frac{M}{W} + \frac{N}{A} = 111{,}5MPa < \sigma_{adm}$

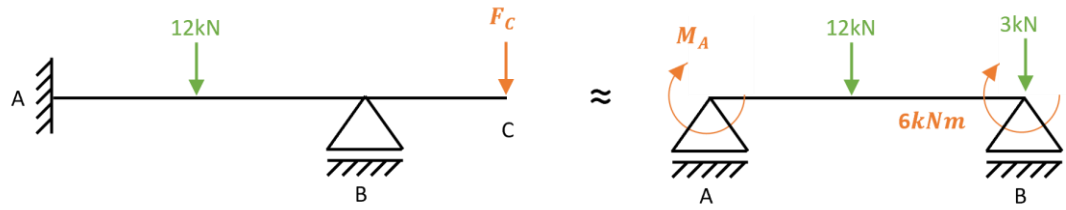
Dimensiono con ***PNI 220***.

Ejercicio 2

Parte A



$F_C = F_D = 3kN$

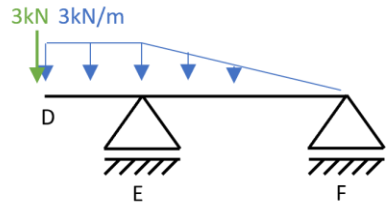


$\theta_A = \frac{M_A.4m}{3EI} - \frac{6kNm.4m}{6EI} + \frac{12kN.(4m)^2}{16EI} = 0$

$\Longrightarrow M_A = \frac{6kNm}{2} - \frac{3.12kN.4m}{16} = -6kNm$

$\Sigma M_A = 0 \Rightarrow M_A + V_B.4m = 3kN.6m + 12kN.2m \Rightarrow V_B = 9kN$

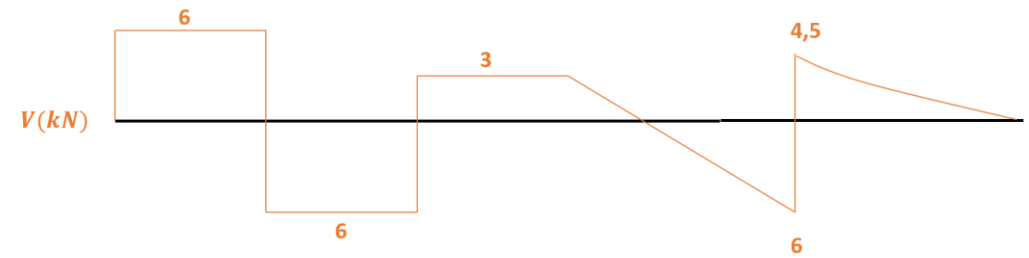
$\Sigma F_V = 0 \Rightarrow V_A = 12kN + 3kN - V_B = 6kN$

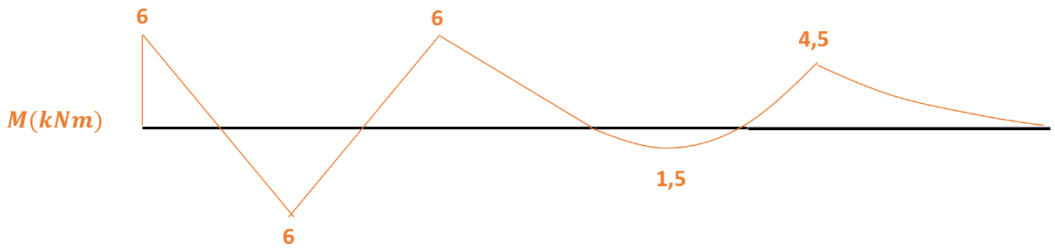


$\Sigma M_F = 0 \Rightarrow V_E.3m = 3kN.4m + \frac{3kN}{m}.1m.3{,}5m + \frac{3kN}{m}.\frac{3m}{2}.2m \Rightarrow V_E = 10{,}5kN$

$\Sigma F_V = 0 \Rightarrow V_F = \frac{3kN}{m}.1m + \frac{3kN}{m}.\frac{3m}{2} + 3kN - V_E = 0kN$

Parte B





Parte C

$$n = \frac{E_{madera}}{E\_acero} = \frac{10GPa}{210GPa} = \frac{1}{21}$$

$$y_G = \frac{15cm.1cm.20{,}5cm + 1cm.20cm.10cm}{35cm^2} = 14{,}5cm$$

$$I_h = \frac{15cm.(1cm)^3}{12} + \frac{1cm(20cm)^3}{12} + 15cm.1cm.(6cm)^2 + 20cm.1cm(4{,}5cm)^2 = 1613cm^4$$

$$y_{sup} = 21cm - y_G = 6{,}5cm \quad y_G = y_{inf}$$

$$W_{sup} = \frac{I_h}{y_{sup}} = 248cm^3 \quad W_{inf} = \frac{I_h}{y_{inf}} = 111cm^3$$

$$\sigma_{max,acero} = \frac{M_{max}}{W_{sup}} = \frac{6kNm}{248cm^3} = 24MPa < 140MPa$$

$$\sigma_{C,max,madera} = \sigma_{T,max,madera} = \frac{M_{max}}{W_{inf}}.n = \frac{6kNm}{111cm^3}.\frac{1}{21} = 2{,}57MPa < 3MPa$$

Parte D

$$\mu_G = 15cm.1cm(20{,}5cm - 14{,}5cm) = 90cm^3$$

$$\tau b = \frac{V_{max}\mu_G}{I_h} = 33{,}48kN/m$$

$$\tau_{adm} \geq \frac{F_{conector}}{A_{conector}} = \frac{\tau bs}{2A_{conector}} = \frac{\tau bs}{2\left(\frac{\pi\phi^2}{4}\right)} \Longrightarrow \phi \geq \sqrt{\frac{2\tau bs}{\pi\tau_{adm}}} = 7{,}8mm$$

$$\Rightarrow \phi = 8mm$$