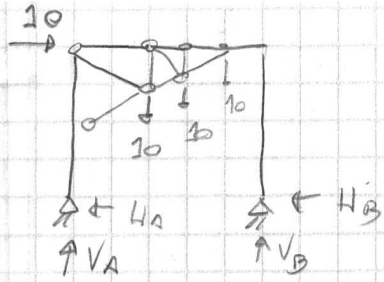
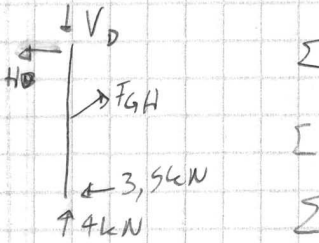


$\Sigma M_A = 0 = V_B \cdot 5m - 10kN(4m+2m+3m+4m) \rightarrow V_B = 26kN$

$V_A + V_B = 30kN \rightarrow V_A = 4kN$

$\Sigma M_C^{der} = 0 = H_B \cdot 4m - V_B \cdot 2m \rightarrow H_B = 6,5kN$

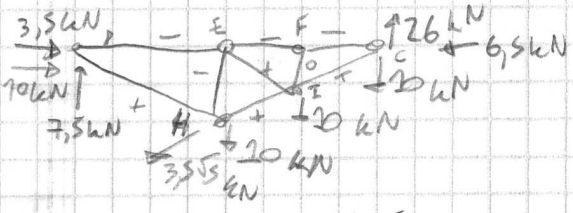
$H_A + H_B = 10kN \rightarrow H_A = 3,5kN$



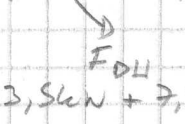
$\Sigma M_D = 0 = F_{GH} \frac{2}{\sqrt{5}} \cdot 2m - 3,5kN \cdot 4m \rightarrow F_{GH} = 3,5\sqrt{5}$

$\Sigma F_H = 0 = H_D + 3,5kN - 3,5\sqrt{5} \cdot \frac{2}{\sqrt{5}} \rightarrow H_D = 3,5kN$

$\Sigma F_V = 0 \rightarrow V_D = 4kN + 3,5\sqrt{5} \cdot \frac{1}{\sqrt{5}} = 7,5kN$



Nudo D

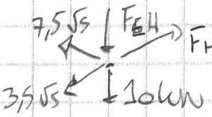


$F_{DH} \frac{1}{\sqrt{5}} = 7,5kN$ (+)

$F_{DH} = 7,5\sqrt{5}kN$ (−)

$F_{DE} = 13,5kN + 7,5\sqrt{5} \frac{2}{\sqrt{5}} = 28,5kN$

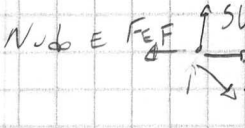
Nudo H



$F_{HI} \cdot \frac{2}{\sqrt{5}} = 7,5\sqrt{5} \cdot \frac{1}{\sqrt{5}} + 3,5\sqrt{5} \frac{2}{\sqrt{5}} \rightarrow F_{HI} = 11\sqrt{5}\ kN$ (+)

$F_{EH} + 10kN + 3,5\sqrt{5} \frac{\sqrt{5}}{\sqrt{5}} = 7,5\sqrt{5} \cdot \frac{1}{\sqrt{5}} + 11\sqrt{5} \frac{1}{\sqrt{5}} \rightarrow F_{EH} = 5kN$ (−)

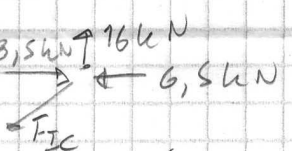
Nudo E



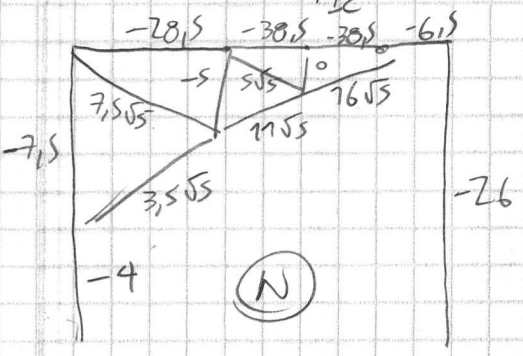
$F_{EI} \frac{1}{\sqrt{5}} = 5kN \rightarrow F_{EI} = 5\sqrt{5}kN$ (+)

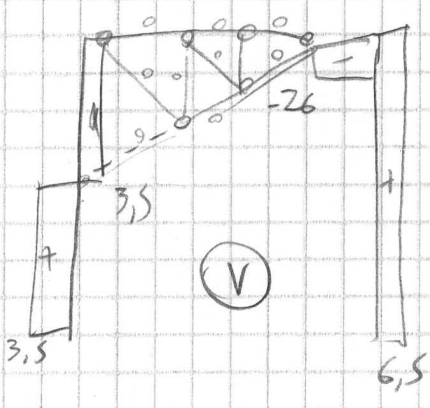
$F_{EF} = 28,5 + 5\sqrt{5} \cdot \frac{2}{\sqrt{5}} = 38,5kN$ (−) $\quad F_{FC} = F_{EF}$

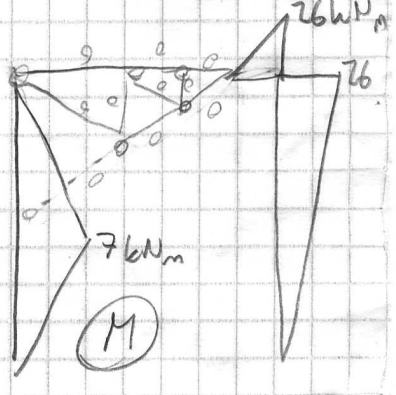
Nudo C



$F_{IC} \frac{1}{\sqrt{5}} = 16kN \rightarrow F_{IC} = 16\sqrt{5}\ kN$ (+)







- Mayor directo $-38kN$ $\quad a^2 \geq \frac{38,5kN}{14\ kN/cm^2} \quad a \geq 1,66cm$

- $M = 26kNm$ $\quad N = 26kN$ Aproximo $\quad W \geq \frac{2600kNcm}{14\ kN/cm^2} = 185,7cm^3$

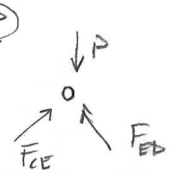
PNI 20 tiene $W = 214cm^3$ y $A = 33,5cm^2$

Verifico $\quad \sigma = \frac{2600kNm}{214cm^3} + \frac{26kN}{33,5cm^2} = 12,1\frac{kN}{cm^2} + 0,78\frac{kN}{cm^2} < 14\frac{kN}{cm^2}$

PNI 20 para barras con M y N

Ej.

por P

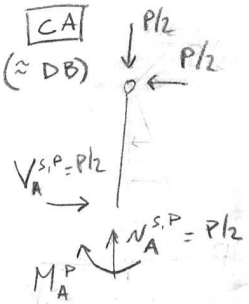


$\Sigma H = 0 \Rightarrow F_{CE} = F_{ED}$

$\Sigma V = 0 \rightarrow \frac{F_{CE}}{\sqrt{2}} \cdot 2 = P \Rightarrow F_{CE} = P/\sqrt{2}$

CE y ED bielas (sólo directas)

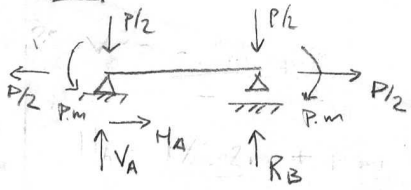
CA (≈ DB)



$\Sigma M_A = 0 \Rightarrow M_A^P = P/2 \cdot 2m$

$\Rightarrow M_A^P = P \cdot m$

AB



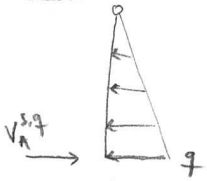
$\Sigma H = 0 \Rightarrow H_A = 0$

$\Sigma M_A = 0 \Rightarrow R_B = P/2$

$\Sigma V = 0 \Rightarrow V_A = P/2$

por q — CE y ED inactivas

CA

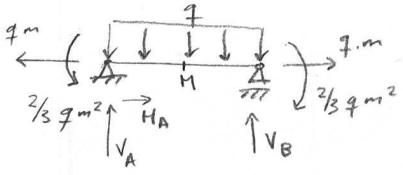


$M_A^q = \frac{q \cdot 2m \cdot (1/3) \cdot 2m}{2}$

$M_A^q = 2/3 \cdot q\, m^2$

$V_A^{s,q} = 2m \cdot q \cdot 1/2 = q \cdot m$

AB



$\Sigma H = 0 \Rightarrow H_A = 0$

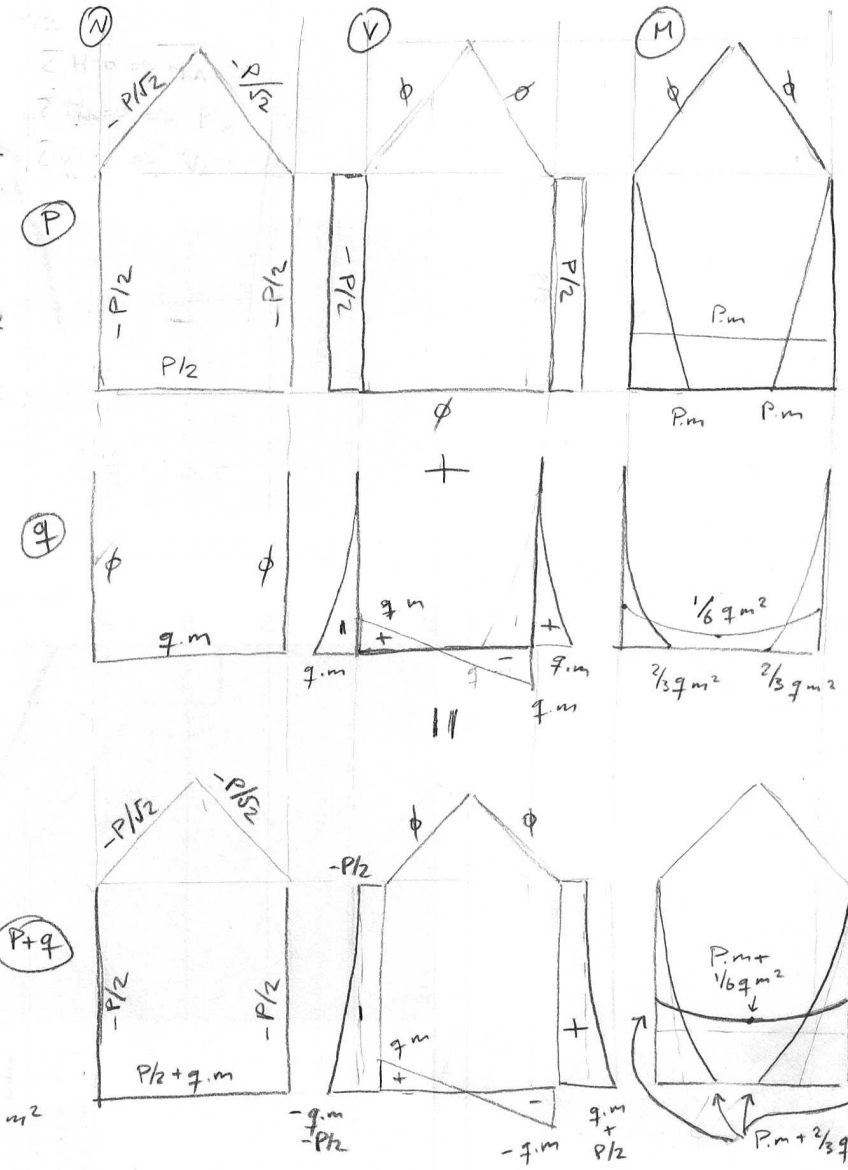
$\Sigma M_A = 0 \Rightarrow V_B = q \cdot m$

$\Sigma V = 0 \Rightarrow V_A = q \cdot m$

$\Sigma M^D = 0$

$M_M = q \cdot m \cdot m - q \cdot m \frac{1}{2} m + \frac{2}{3} q \cdot m^2 =$

$M_M = \left(\frac{6-3-4}{6}\right) q\, m^2 = -1/6\, q\, m^2$



b) $100\ MPa = \frac{q \cdot m}{33{,}5\ cm^2} + \frac{2}{5} \frac{q\, m^2}{214\ cm^3} \Rightarrow 10\ \frac{KN}{cm^2} = q \cdot m \left(\frac{1}{33{,}5\ cm^2} + \frac{200}{3.214}\ \frac{cm}{cm^3}\right) \Rightarrow q_{adm} = 29{,}3\ KN/m$

c) por q

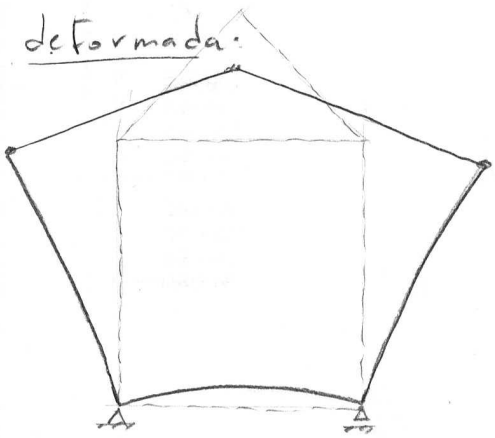
$\theta_A^q(\curvearrowleft) = \frac{2/3\, q\, m^2 \cdot 2m}{2EI} - \frac{q \cdot (2m)^3}{24EI} = \frac{1}{3} \frac{q\, m^3}{EI}$

$\delta_C^q(\leftarrow) = \frac{q \cdot (2m)^4}{30EI} + \frac{1}{3} \frac{q\, m^3}{EI} \cdot 2m = 1{,}2 \frac{q\, m^4}{EI}$

× P $\theta_A^P(\curvearrowleft) = \frac{P\, m \cdot 2m}{2EI} = \frac{P\, m^2}{EI}$

$\delta_C^P(\leftarrow) = \frac{P/2 \cdot (2m)^3}{3EI} + \frac{P \cdot m^2}{EI} \cdot 2m = 3{,}33 \frac{P\, m^3}{EI}$

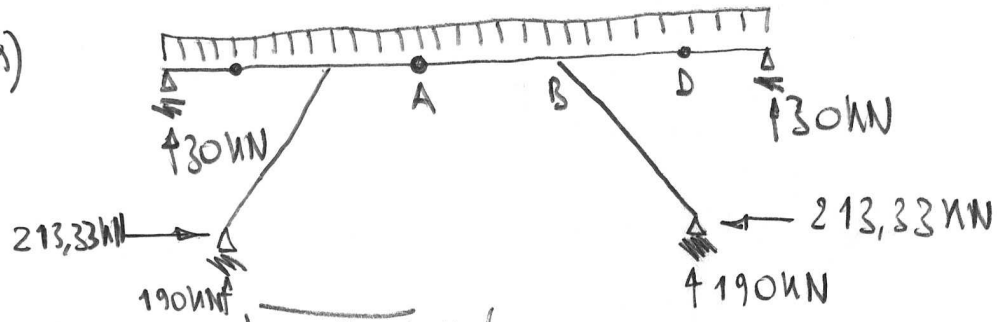
deformada:



$\delta_C(\leftarrow) = \frac{1{,}2 \cdot 29{,}3\ KN/m \cdot m^4}{4280\ KN\, m^2} + \frac{3{,}33\ P\, m^3}{4280\ KN\, m^2} = 0{,}015\ m$

$\Rightarrow P = \frac{(0{,}015 - 0{,}0082)\, m \cdot 4280\ KN}{3{,}33\ m} \Rightarrow \boxed{P = 8{,}72\ KN}$

a)



Aislo DE → $N_E = 30\,kN$ | Eq global | $\Sigma M_C = 0 \rightarrow 0 = 16V_C + 19\times30kN - 22\times20kN\times8 - 30kN\times3$

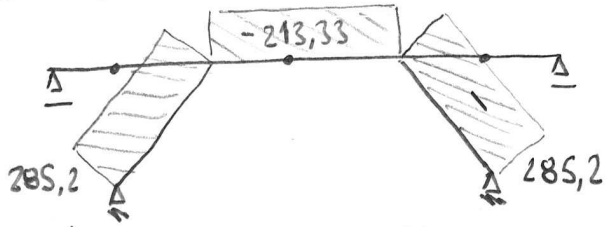
↳ $V_C = 190\,kN$

Eq en 1/2 estructura $\Sigma M_A = 0$

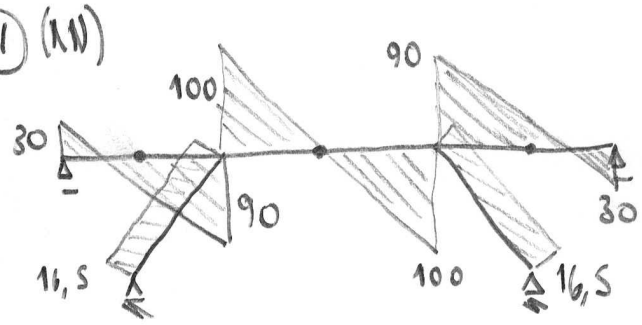
↳ $20kN\times11\times5{,}5 - 30kN\times11 - 190kN\times8 + H_C\times3 = 0$

↳ $H_C = 213{,}33\,kN$

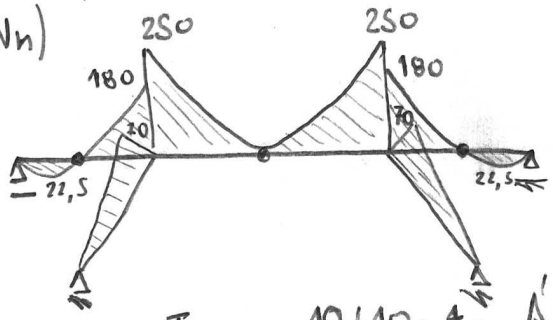
b) (N) (kN)



(V) (kN)



(M) (kNm)



c) PNI 36 → $I_{x\,PNI} = 19610\,cm^4$; $A' = 97{,}1\,cm^2$

$I_{TOT} = I_{PNI} + 2\times\left[15\times h\times\left(36/2 + h\right)^2 + 15\times h^3/12\right]$; $Y_{TOT}^{sup\,e\,inf} = 36/2 + h$

$A'_{TOT} = 97{,}1 + 2\times15\times h$

$\tau_{máx} = \frac{M\cdot Y}{I_{TOT}} + N/A \leq E\,\varepsilon_{máx}$

-Seccional a estudiar punto: - B por AB y fibra inferior (1)

- B " BC y " " (2)

Tanteo $h = 10\,mm$

(1) $\tau_{máx} = 175{,}7 \leq 134$ X

(2) $\tau_{máx} = 66{,}9 \leq 134$

$h = 15\,mm$

(1) $\tau_{máx} = 152{,}5 \leq 134$ X

(2) $\tau_{max} = 58{,}6 \leq 134$

$h = 20\,mm$

(1) $\tau_{máx} = 134{,}7 \leq 134$ X

(2) $\tau_{máx} = 52 \leq 134$

$h = 21\,mm$

(1) $\tau_{máx} = 131{,}6 \leq 134$ ✓

(2) $\tau_{máx} = 50{,}9 \leq 134$

$\Rightarrow$ **$h = 21\,mm$**