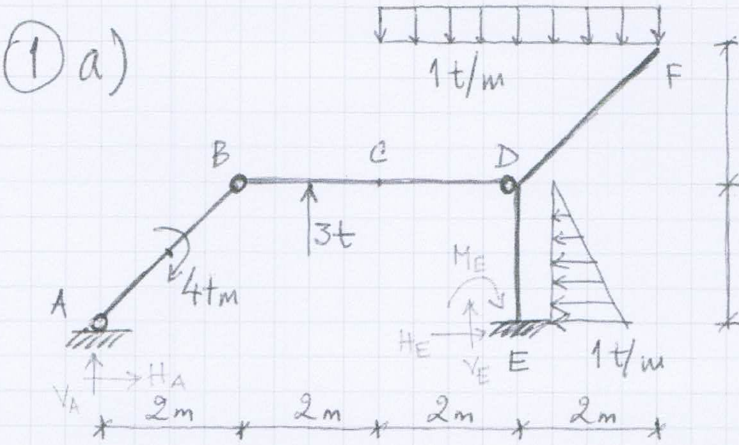
1 a)



$$\begin{cases} M_E^{izq} = 2V_A - 2H_A + 4 = 0 \\ M_D^{izq} = 6V_A - 2H_A + 4 + 3.3 - 1.2.1 = 0 \end{cases}$$

$$V_A - H_A + 2 = 0 \rightarrow H_A = V_A + 2$$

$$3V_A - H_A + \frac{11}{2} = 0$$

$$3V_A - V_A - 2 + \frac{11}{2} = 0$$

$$\boxed{V_A = -\frac{7}{4}} \quad \boxed{H_A = \frac{1}{4}}$$

• Eq. Vertical: $V_A + V_E + 3 - 1.4 = 0$

$$V_E = 4 - 3 - V_A \Rightarrow \boxed{V_E = \frac{11}{4}}$$

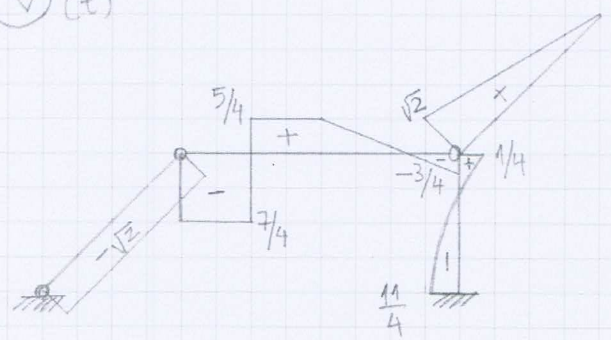
• Eq. Horizontal: $H_A + H_E - \frac{1.2}{2} = 0$

$$H_E = 1 - H_A \Rightarrow \boxed{H_E = \frac{3}{4}}$$

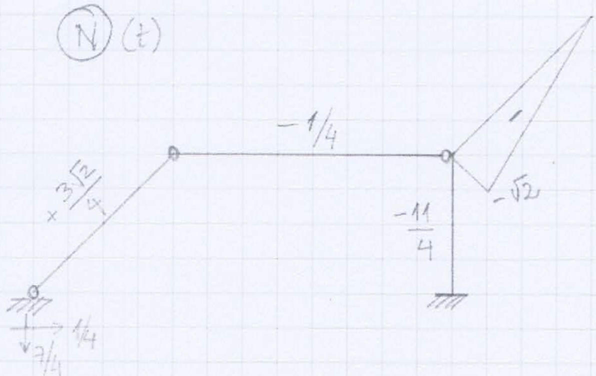
$$M_E = V_A \times 6 + 4 + 3.3 - \frac{1.2}{\cancel{2}}.\frac{\cancel{2}}{3}$$

$$\boxed{M_E = \frac{11}{6}} \simeq 1,83$$

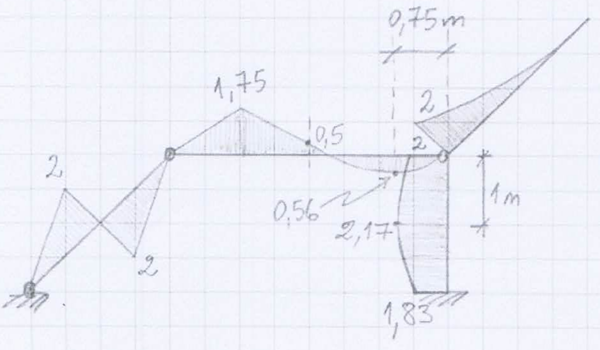
V (t)



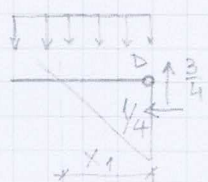
N (t)



M (tm)

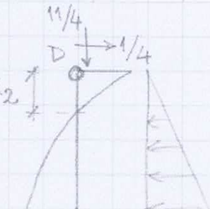


• Puntos donde se anula $\underline{V}$:



$$\frac{3}{4} - 1.x_1 = 0$$

$$\underline{x_1 = 3/4}$$



$$\frac{1}{4} - \frac{x_2}{2}.\frac{x_2}{2} = 0$$

$$\boxed{x_2 = 1}$$

* $M(\tfrac{1}{2}BC) = \frac{7}{4} \times 1 = 1,75$ tm

* $M_{máx}(CD) = \frac{3}{4} \times \frac{3}{4} = 0,56$ tm

* $M_{máx}(DE) = 2 + \frac{1}{4} \times 1 - \frac{1}{2}.\frac{1}{2}.\frac{1}{3} = 2,17$ tm

b) Momento máximo y directa máxima se dan en la barra DE

$$M_{DE}^{máx} = 2,17 \text{ tm}$$

$$N_{DE} = -2,75 \text{ t}$$

$$\sigma = \frac{M}{W} + \frac{N}{A} \leq \sigma_{adm} = 1,4 \text{ t/cm}^2$$

$$\sigma = \frac{217 \text{ tcm}}{W} + \frac{2,75 \text{ t}}{A} \leq 1,4 \text{ t/cm}^2$$

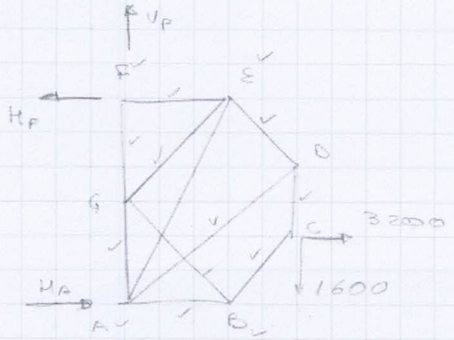
2PNI 12 → $\sigma = 2,08 > 1,4$ ✗

2PNI 14 → $\sigma = 1,40 = 1,40$ ✓ → SOLUCIÓN: $\boxed{2PNI14}$.

$s = c\ \mathrm{tg}\,\theta \Rightarrow 8 = c\ 1/2 \Rightarrow c = 16$

$q = 200\ \mathrm{kg/m} \Rightarrow H = cq = 3200\ \mathrm{kg}$

$V = H\ \mathrm{tg}\,\theta = 3200\ 1/2 = 1600$



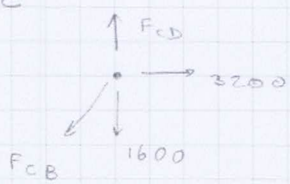
$H_A\ 3 = 1600 \times 2{,}5 - 3200 \times 2$

$H_A = -800$

$H_F = 3200 + H_A = 2400$

$V_F = 1600$

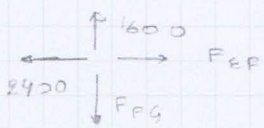
Nudo C



$\frac{F_{CB}}{\sqrt{2}} = 3200 \Rightarrow F_{CB} = 3200\sqrt{2}$

$F_{CD} = 1600 + \frac{F_{CB}}{\sqrt{2}} = 4800$

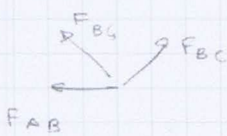
Nudo F



$F_{EF} = 2400$

$F_{FG} = 1600$

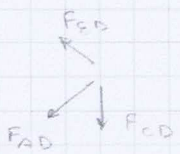
Nudo B



$\frac{F_{BC}}{\sqrt{2}} = -\frac{F_{BG}}{\sqrt{2}} \Rightarrow F_{BG} = -3200\sqrt{2}$

$F_{AB} = \frac{F_{BC}}{\sqrt{2}} - \frac{F_{BG}}{\sqrt{2}} = 3200 + 3200 = 6400$

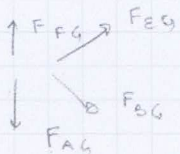
Nudo D



$$\left.\begin{aligned} \frac{F_{ED}}{\sqrt{2}} &= -F_{AD}\frac{2{,}5}{\sqrt{10{,}25}} \\ \frac{F_{ED}}{\sqrt{2}} &= F_{CD} + F_{AD}\frac{2}{\sqrt{10{,}25}} \end{aligned}\right\} \begin{aligned} F_{CD} &= \frac{-2{,}5-2}{\sqrt{10{,}25}}\ F_{AD} \\ F_{AD} &= -3415 \end{aligned}$$

$\Rightarrow F_{ED} = 3771$

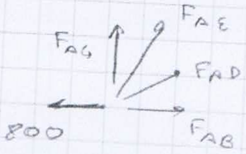
Nudo G



$\frac{F_{EG}}{\sqrt{2}} = -\frac{F_{BG}}{\sqrt{2}} \Rightarrow F_{EG} = 3200\sqrt{2}$

$F_{AG} = F_{FG} + \frac{F_{EG}}{\sqrt{2}} - \frac{F_{BG}}{\sqrt{2}} = 1600 + 3200 + 3200 = 8000$

Nudo A



$$\frac{3\,F_{AE}}{\sqrt{11,25}} = -F_{AG} - \frac{2\,F_{AD}}{\sqrt{10,25}} \Rightarrow F_{AE} = -6559$$

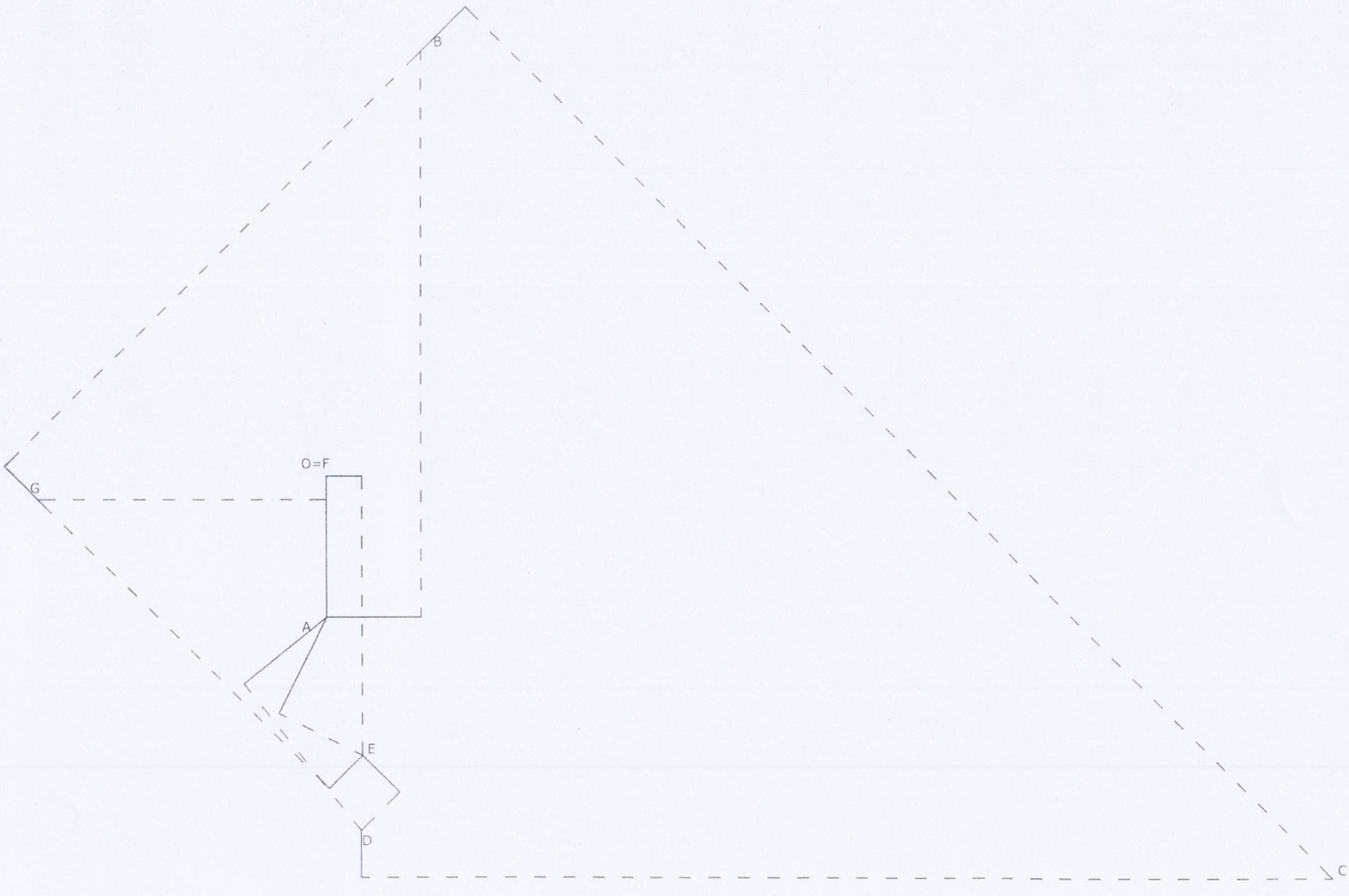
$$200 = \frac{1,5}{\sqrt{11,25}} F_{AE} + \frac{2,5}{\sqrt{10,25}} F_{AD} + F_{AB} =$$

$$= -\frac{1,5}{\sqrt{11,25}} 6559 - \frac{2,5}{\sqrt{10,25}} 3415 + 6400 = 800 \checkmark$$

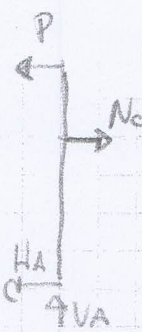
Barra	N	ℓ (m)	$\Delta\ell = N\ell / E\Omega$
AB	6400	1,5	9600
BC	$3200\sqrt{2}$	$\sqrt{2}$	6400
CD	4800	1	4800
DE	3771	$\sqrt{2}$	5333
EF	2400	1,5	3600
FG	1600	1,5	2400
AG	8000	1,5	12 000
AD	−3415	$\sqrt{10,25}$	−10 933
AE	−6559	$\sqrt{11,25}$	$-21999/2 = = -11000$
GE	$3200\sqrt{2}$	$1,5\sqrt{2}$	$9600/2 = 4800$
GB	$-3200\sqrt{2}$	$1,5\sqrt{2}$	$-9600/2 = -4800$

$$\vec{f_c} = \frac{102\,876}{E\Omega}$$

$$\downarrow f_c = \frac{40951}{E\Omega}$$

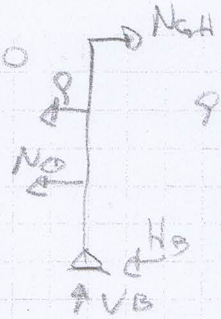


B
O=F
G
A
E
D
C

a) 

$V_A = 0 \qquad P.3L - N_{CD}.2L = 0$

$N_{CD} = 3P/2 \rightarrow H_A = P/2$



$V_B = 0$

$q + \frac{3P}{2} + H_B = N_{GH}$

$\frac{3P}{2}L + 2qL - 3N_{GH}L = 0$

$N_{FG} = \frac{P}{2} + \frac{2q}{3}$

$\Delta l_{GH} = 2\Delta l_{CD} \Rightarrow \left(\frac{P}{2} + \frac{2q}{3}\right)\frac{L}{E\Omega} = 2 \cdot \frac{3P}{2}\frac{L}{E.3\Omega} \Rightarrow \frac{P}{2} + \frac{2q}{3} = P$

$\frac{2q}{3} = \frac{P}{2} \rightarrow \boxed{P = \frac{4q}{3}}$

$\sigma_{adm}^{FG} = 1400 kg/cm^2 \geq \left(\frac{4q}{3.2} + \frac{2q}{3}\right) \cdot \frac{1}{\Omega} = \frac{4}{3}\frac{q}{\Omega} \rightarrow q_{adm} = 1050 kg$

$\sigma_{adm}^{CD} = 1400 kg/cm^2 \geq \frac{3P}{2.3\Omega} \rightarrow P \leq 2 \times 1400 kg/cm^2 = 2800 kg$

Además $P = \frac{4q}{3} \rightarrow P \leq \frac{4}{3}(1050 kg) = 1400 kg = P_{adm}$

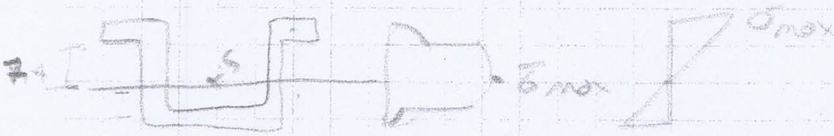
$\boxed{P_{adm} = 1400 kg} \qquad \boxed{q_{adm} = 1050 kg}$

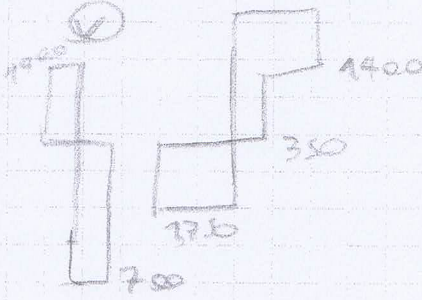
b) 

$y_G = \frac{24 \times 2 \times 1 + 2 \times 12 \times 2 \times 8 + 2 \times 6 \times 2 \times 15}{24 \times 2 + 2 \times 12 \times 2 + 2 \times 6 \times 2} = \frac{792}{120} = 6,6 cm$

$I_x = \frac{24 \times 2^3}{12} + 24 \times 2(6,6-1)^2 + 2 \times \left[\frac{2 \times 12^3}{12} + 12 \times 2 \times (8-6,6)^2 + \frac{6 \times 2^3}{12} + 6 \times 2 \times (15-6,6)^2\right] =$

$I_x = 3892,8 cm^4$





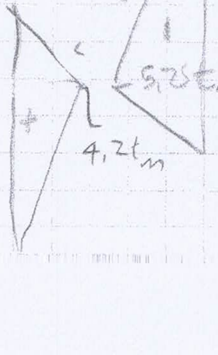
$S = 6 \times 2 \times 2 \times (15 - 6,6) + 2(12-4,6) \times 2 \times \frac{(12-4,6)}{2} =$

$S = 201,6 + 109,5 = 311,1 cm^3$

$\tau_{max} = \frac{1750 kg \cdot 311,1 cm^3}{3892,8 cm^4 \times 4 cm} = 34,96 kg/cm^2$

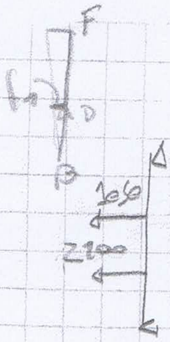
(M)

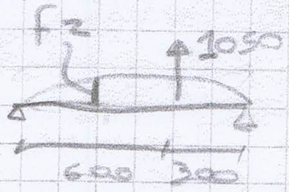
$\sigma_{max} = \frac{525000 kg cm}{3892,8 cm^4} \cdot 9,4 cm = 1267,7 kg/cm^2$



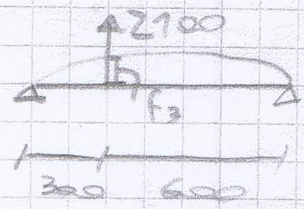
c) f_C

$$\Delta l_{GH} = \frac{1400 \times 300}{E \cdot 1\,cm^2} cm = 0{,}2\,cm \rightarrow f_1 = \frac{0{,}2\,cm}{3}$$





$$|f_2| = \frac{1050 \times 300 \times 300\,(900^2 - 300^2 - 300^2)}{6 \times 900 \times 2100\,000 \cdot 3892{,}8} = 1{,}35\,cm$$



$$f_3 = \frac{2100 \times 600 \times 300\,(900^2 - 600^2 - 300^2)}{6 \times 900 \times 2100\,000 \cdot 3892{,}8} = 3{,}08\,cm$$

$$f_D = 0{,}2\,cm + 1{,}35\,cm + 3{,}08\,cm = 4{,}63\,cm$$

$$f_C = \Delta l_{CD} + f_D = \frac{2100 \times 300}{2100000 \cdot 3} + 4{,}63\,cm = \boxed{4{,}73\,cm}$$

El desplazamiento de C es de 4,73 cm en dirección horizontal, hacia la izquierda.