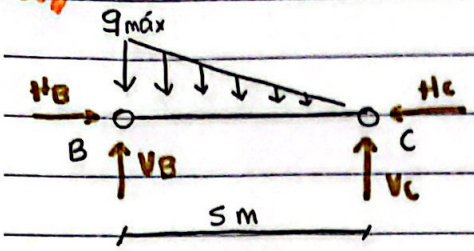
# Ejercicio 1

a)




$\cdot \sum V = 0 \Leftrightarrow V_B + V_C = q_{máx} \cdot \frac{5m}{2}$

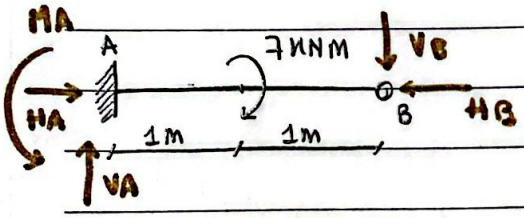
$\cdot \sum H = 0 \Leftrightarrow \boxed{H_B = H_C}$

$\cdot \sum M_C = 0 \Leftrightarrow V_B \cdot 5m = q_{máx} \cdot 2{,}5m \cdot \frac{2}{3} \cdot 5m$

$$\boxed{V_B = q_{máx} \cdot \frac{5}{3} m}$$

$\Rightarrow V_C = q_{máx} \cdot \frac{5m}{2} - V_B$

$$\boxed{V_C = q_{máx} \cdot \frac{5}{6} m}$$



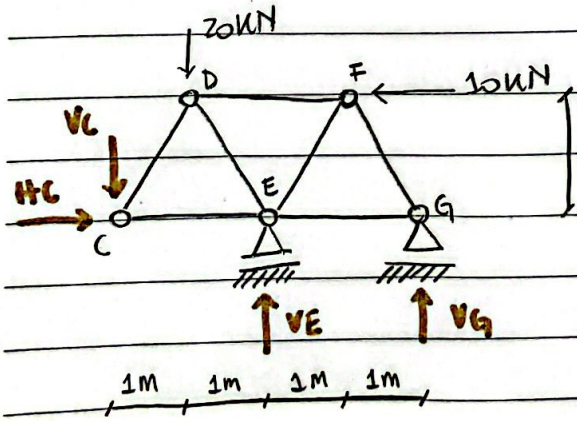

$\cdot \sum V = 0 \Leftrightarrow V_A = V_B$

$\Rightarrow \boxed{V_A = q_{máx} \cdot \frac{5}{3} m}$

$\cdot \sum H = 0 \Leftrightarrow \boxed{H_A = H_B}$

$\cdot \sum M_A = 0 \Leftrightarrow M_A = 7kNm + V_B \cdot 2m = 7kNm + q_{máx} \cdot \frac{10m^2}{3}$

$$\boxed{M_A = 7kNm + q_{máx} \cdot \frac{10m^2}{3}}$$




$\cdot \sum V = 0 \Leftrightarrow V_E + V_G = 20kN + V_C$

$V_E + V_G = 20kN + q_{máx} \cdot \frac{5}{6} m$

$\cdot \sum H = 0 \Leftrightarrow \boxed{H_C = 10kN}$ (*)

• $\Sigma M_G = 0 \iff 10\,kN \cdot 1m + 20\,kN \cdot 3m + V_C \cdot 4m = V_E \cdot 2m$

$70\,kNm + q_{máx} \cdot \frac{10}{3}\,m^2 = V_E \cdot 2m$

$\Rightarrow \boxed{V_E = 35\,kN + q_{máx} \cdot \frac{5}{3}\,m}$

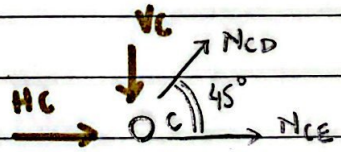
$\Rightarrow V_G = 20\,kN + q_{máx} \cdot \frac{5}{6}\,m - 35\,kN - q_{máx} \cdot \frac{5}{3}\,m$

$\boxed{V_G = -15\,kN - q_{máx} \cdot \frac{5}{6}\,m}$

Como $H_C = 10\,kN$ por (*) $\Rightarrow \boxed{H_A = H_B = H_C = 10\,kN}$

b) Equilibrio en nodo C para obtener $N_{CE}$:

NODO C:




• $\Sigma H = 0 \iff H_C + \frac{N_{CD}}{\sqrt{2}} + N_{CE} = 0 \longrightarrow N_{CE} = -H_C - \frac{N_{CD}}{\sqrt{2}}$ (1)

• $\Sigma V = 0 \iff V_C = \frac{N_{CD}}{\sqrt{2}}$ (2) $\xrightarrow[(2)\text{ en }(1)]{\text{sust.}}$ $N_{CE} = -H_C - V_C =$

$= -10\,kN - q_{máx} \cdot \frac{5}{6}\,m$

$N_{CD} = V_C \cdot \sqrt{2} = q_{máx} \cdot \frac{5}{6}\,m \cdot \sqrt{2}$

para que $N_{CE} = -10\,kN - q_{máx} \cdot \frac{5}{6}\,m = -20\,kN$

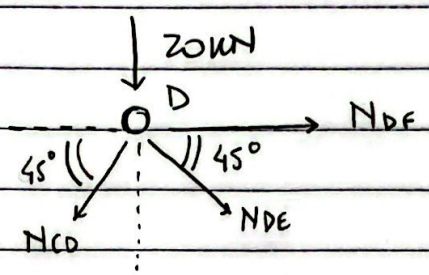
$\boxed{q_{máx} = 12\,kN/m}$

c) Para diagrama de directa (N): tomando $g_{máx} = 12\,kN/m$

NODO C → $N_{CE} = -20\,kN$

→ $N_{CD} = 12\,kN/m \cdot \frac{5\,m}{6} \cdot \sqrt{2} \cong 14{,}14\,kN$

NODO D:




$\cdot \Sigma V = 0 \iff 20\,kN + \frac{N_{CD}}{\sqrt{2}} + \frac{N_{DE}}{\sqrt{2}} = 0$

$\hookrightarrow N_{DE} = -20\,kN \cdot \sqrt{2} - N_{CD} \cdot =$

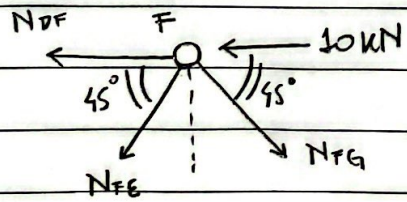
$= -20\,kN \cdot \sqrt{2} - 10\,kN \cdot \sqrt{2} =$

$= -30\,kN \cdot \sqrt{2} \cong -42{,}43\,kN$

$\cdot \Sigma H = 0 \iff N_{DF} + \frac{N_{DE}}{\sqrt{2}} = \frac{N_{CD}}{\sqrt{2}} \rightarrow N_{DF} = \frac{N_{CD} - N_{DE}}{\sqrt{2}}$

$N_{DF} = \frac{10\,kN \cdot \sqrt{2}}{\sqrt{2}} - \frac{(-30\,kN) \cdot \sqrt{2}}{\sqrt{2}} = 40\,kN$

NODO F:




$\cdot \Sigma V = 0 \iff \frac{N_{FE}}{\sqrt{2}} + \frac{N_{FG}}{\sqrt{2}} = 0 \rightarrow N_{FE} = -N_{FG}$

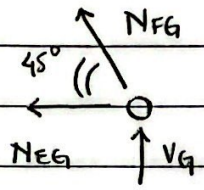
$\cdot \Sigma H = 0 \Leftrightarrow N_{DF} + \frac{N_{FE}}{\sqrt{2}} + 10\,kN = \frac{N_{FG}}{\sqrt{2}}$

$40\,kN + 10\,kN = \frac{N_{FG}}{\sqrt{2}} + \frac{N_{FG}}{\sqrt{2}}$

$\frac{50\,kN}{\sqrt{2}} = N_{FG} \Rightarrow N_{FE} = -35{,}36\,kN$

$35{,}36\,kN$

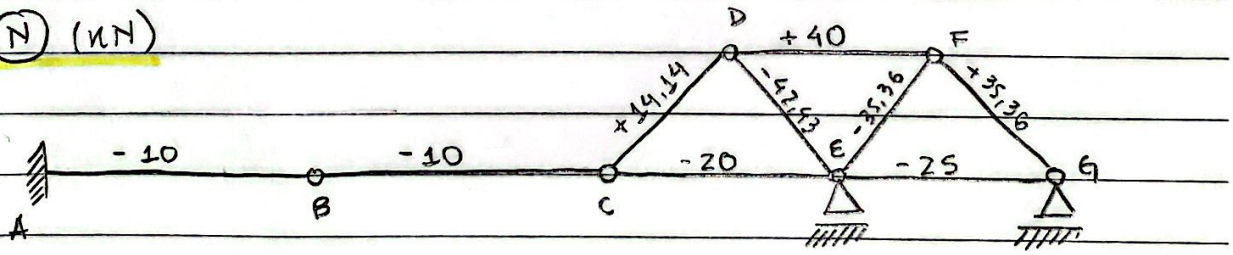
NODO G:




$\cdot \Sigma H = 0 \Leftrightarrow \frac{N_{FG}}{\sqrt{2}} + N_{EG} = 0 \longrightarrow N_{EG} = -\frac{N_{FG}}{\sqrt{2}}$

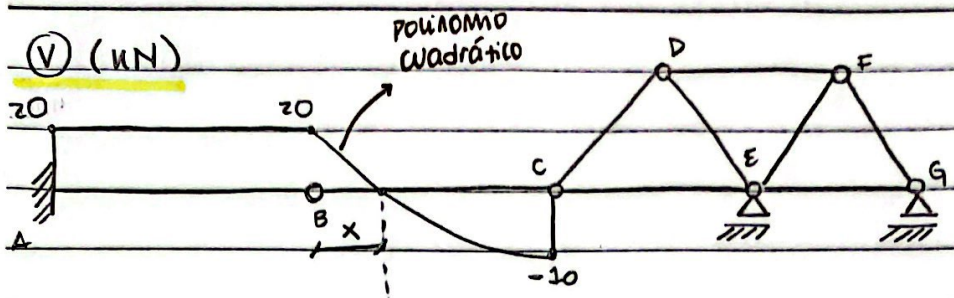
$N_{EG} = -25\,kN$

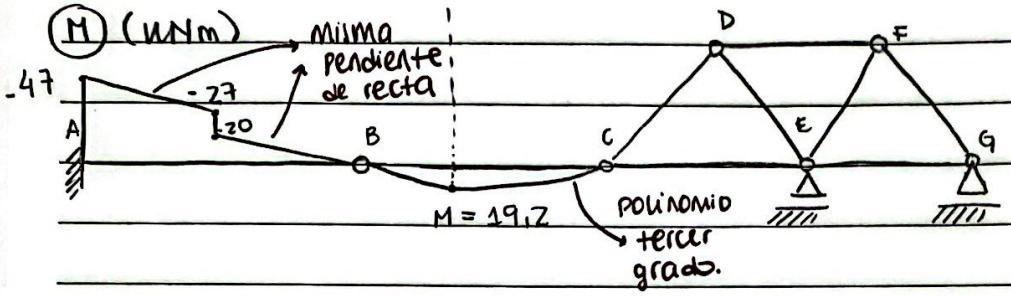
(N) (kN)




Para diagrama de cortante (V) obtengo el valor de las reacciones para $q_{máx} = 12\,kN/m$:

- $V_A = 20\,kN \uparrow$
- $H_A = 10\,kN \rightarrow$
- $M_A = 47\,kN\,G$
- $V_E = 55\,kN \uparrow$
- $V_G = 25\,kN \downarrow$




Para obtener x : $20kN - \left(12\,kN/m + 12\,kN/m - \frac{12}{5}\,x\,\frac{kN}{m^2}\right).\frac{x}{2} = 0$

$$20 - 12x + \frac{6}{5}x^2 = 0$$

↳ Bháskara :

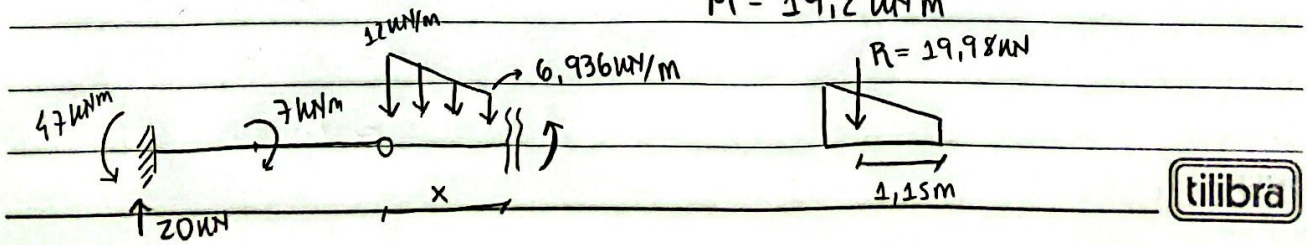
$$x = \frac{12 \pm \sqrt{144 - 4.\frac{6}{5}.20}}{2.6/5}$$

$x =$ → 7,89 m ✗ Descarto por ser superior a 5m.
→ 2,11 m

$$\boxed{x = 2,11\,m}$$

Para obtener M : $M + 47kN - 20kN.4,11m - 7kNm + 19,98\frac{kN}{m}.1,15m = 0$

↳ $M \cong 19,2\,kNm$



# Ejercicio 2

**Parte A**

- Reacciones en apoyo:

$\sum F_H = 0 \implies H_F = 100kN \leftarrow$

$\sum M_F = 0 \Rightarrow 8m \times V_A + 2m \times 100kN = (4m + 2m) \times 100kN + 8m \times 50kN \Rightarrow V_A = 100kN \uparrow$

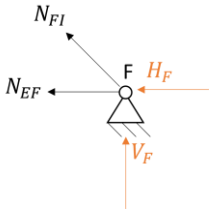
$\sum F_V = 0 \implies V_F = 250kN - V_A \Rightarrow V_F = 150kN \uparrow$

- Por condiciones geométricas

$N_{DH} = 0kN$

$N_{AB} = -V_A = -100kN$

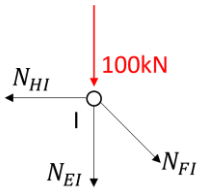
- Nodo F




$\sum F_V = 0 \implies V_F + \frac{\sqrt{2}}{2} N_{FI} = 0 \Rightarrow N_{FI} = -212kN$

$\sum F_H = 0 \implies N_{EF} + 100kN + \frac{\sqrt{2}}{2} N_{FI} = 0 \Rightarrow N_{EF} = 50kN$

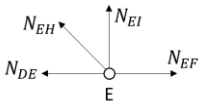
- Nodo I




$\sum F_H = 0 \implies N_{HI} = \frac{\sqrt{2}}{2} N_{FI} = -150kN$

$\sum F_V = 0 \implies 100kN + N_{EI} + \frac{\sqrt{2}}{2} N_{FI} = 0 \Rightarrow N_{EI} = 50kN$

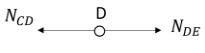
- Nodo E




$\sum F_V = 0 \implies N_{EI} + \frac{\sqrt{2}}{2} N_{EH} = 0 \Rightarrow N_{EH} = -71kN$

$\sum F_H = 0 \implies N_{EF} = N_{DE} + \frac{\sqrt{2}}{2} N_{EH} \Rightarrow N_{DE} = 100kN$

- Nodo D

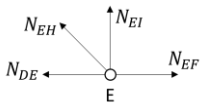



$\sum F_H = 0 \implies N_{CD} = N_{DE} = 100kN$

- Nodo H

$$\sum F_V = 0 \implies 100kN + \frac{\sqrt{2}}{2}N_{EH} + \frac{\sqrt{2}}{2}N_{CH} = 0 \Rightarrow N_{CH} = -71kN$$

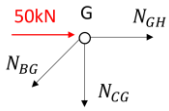
$$\sum F_H = 0 \implies N_{HI} + \frac{\sqrt{2}}{2}N_{EH} = N_{GH} + \frac{\sqrt{2}}{2}N_{CH} \Rightarrow N_{GH} = -150kN$$




- Nodo G

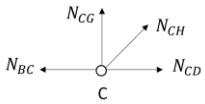
$$\sum F_H = 0 \implies 100kN + N_{GH} = \frac{\sqrt{2}}{2}N_{BG} \Rightarrow N_{BG} = -71kN$$

$$\sum F_V = 0 \implies \frac{\sqrt{2}}{2}N_{BG} + N_{CG} = 0 \Rightarrow N_{CG} = 50kN$$




- Nodo C

$$\sum F_H = 0 \implies N_{CD} + \frac{\sqrt{2}}{2}N_{CH} = N_{BC} \Rightarrow N_{BC} = 50kN$$




**Parte B**

$N_{AB} = -100kN$

$\sigma_{adm} = 20MPa; E = 11GPa; u_{adm} = 1{,}5mm$

$\sigma_{max} = \frac{100kN}{\Omega}; \sigma_{min} = \frac{100kN}{2\Omega} \qquad \Rightarrow l_{min} = 8cm$

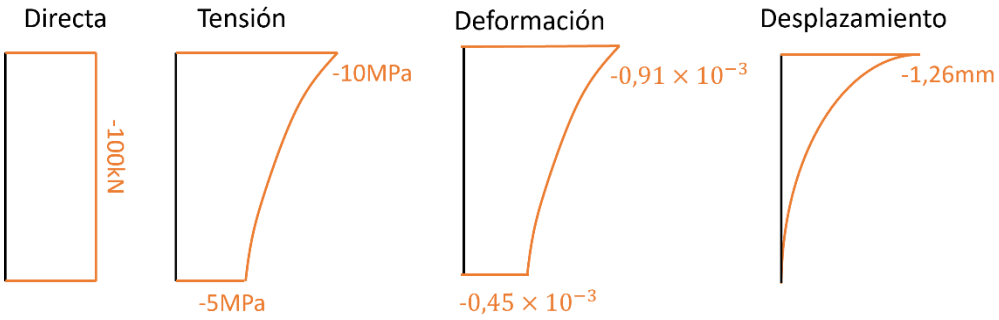
$\varepsilon_{max} = \frac{100kN}{\Omega \times 11GPa}; \varepsilon_{min} = \frac{100kN}{2A \times 11GPa}$

$u = \int_0^l \frac{N}{E(\Omega + \frac{\Omega z}{l})} dz = \frac{Nl}{E\Omega}\int_0^1 \frac{1}{(1+Z)} dz = \frac{Nl}{E\Omega}\ln(1+z)|_0^1 = \frac{Nl}{E\Omega}\ln(2) \qquad \Rightarrow l_{min} = 10cm$

Entonces $l = 10cm$

$\sigma_{max} = 10MPa; \qquad \sigma_{min} = 5MPa; \varepsilon_{max} = 0{,}91 \times 10^{-3}; \varepsilon_{max} = 0{,}45 \times 10^{-3}; u = 1{,}26mm$

**Parte C**




**Parte D**

Compresión máxima: $212\ kN$

Área necesaria: $\frac{N}{\sigma_{adm}} = 17{,}68\ cm^2$

$A = r^2\pi - (r-e)^2\pi \Rightarrow r_{min} = 6\ cm\ (A = 18{,}06\ cm^2)\ ;\ e = 0{,}5\ cm$

**Parte E**

Tracción máxima: $100\ kN$

Área necesaria: $\frac{N}{\sigma_{adm}} = 7{,}14\ cm^2$

$A = l^2 - (l-2e)^2 \Rightarrow l_{min} = 3\ cm\ (A = 8{,}00\ cm^2)\ ;\ e = 1\ cm$