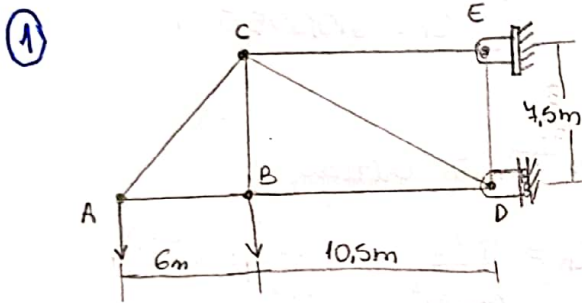


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Profº: Adeildo . Data: 24/09/2021

Mecânica dos Sólidos 3
Prova 4



Dados :

$$A = 1600 \text{ mm}^2$$
$$= 0,0016 \text{ m}^2$$

$$E = 200 \text{ GPa}$$

$$= 200 \times 10^6 \text{ KN/m}^2$$

$$b_m = 6000 \text{ mm}$$

$$10,5\text{m} = 10500\text{ mm}$$

$$7.5 \text{ m} = 7500 \text{ mm}$$

$$E = 200 \text{ GPa}$$

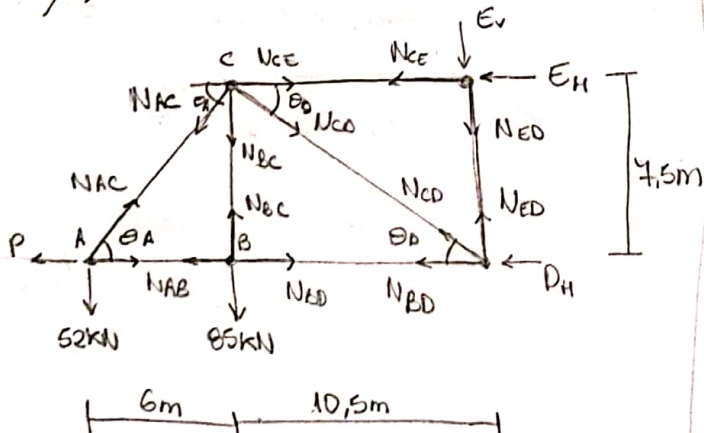
$$= 200 \times 10^6 \text{ KN/m}^2$$

$$b_m = 6000 \text{ mm}$$

$$10,5\text{m} = 10500\text{ mm}$$

$$7.5 \text{ m} = 7500 \text{ mm}$$

→ métodos dos nós em A



$$\theta_A = \arctg\left(\frac{4.5}{6}\right) = 51.34^\circ$$

$$\Theta_D = \arctg\left(\frac{4,5}{10,5}\right) = 35,53^\circ$$

$$\Sigma F_{HA}: N_{AB} - P + N_{AC} \cos \theta_A = 0$$

$$N_{AB} = 0 - 41,59 \text{ kN}$$

$$\Sigma F_{VA}: N_A \cos 30^\circ - 52 = 0$$

$$N_{Ac} = \frac{52}{0,78} = 66,59 \text{ m}$$

$$\Sigma F_{HB} : -N_{AB} + N_{ED} = 0$$

$$N_{ED} = N_{AB}$$

$$\Sigma F_{VB}: N_{BC} - 85 = 0$$

$$N_{BC} = 85 \text{ kN}$$

$$\sum F_{NC}: N_{CE} + N_{CD} \cos \theta_D - N_{AD} \cos \theta_A = 0$$

$$N_{CE} = -233.4 \text{ kN}$$

$$\sum F_{vc} : -N_{BC} - N_{CD} \sin \theta_D - N_{AC} \sin \theta_A = 0$$

$$N_{CD} = -235,74 \text{ kN}$$

$$\Sigma F_{HD}: -N_{CD} \cos \theta_D - D_H - N_{BD} = 0$$

$$D_H = P + 233,4 \text{ kN}$$

$$\Sigma F_{VD}: N_{ED} + W_{CD} \sin \theta_D = 0$$

$$N_{ED} = -137 \text{ kN}$$

$$\Sigma F_{HE}: -E_H - N_{CE} = 0$$

$$E_H = 233,4 \text{ kN}$$

$$\Sigma F_{VE}: -E_v - N_{ED} = 0$$

$$E_v = 137 \text{ kN}$$

$$\rightarrow E_H = 233,4 \text{ kN } (\rightarrow)$$

$$\rightarrow E_v = 137,0 \text{ kW } (\uparrow)$$

$$\rightarrow D_H = P + 233,4 \text{ kN} (\leftarrow)$$

Trucko	N (kN)	$\frac{\Delta N}{\Delta P}$	N (P/P=0)	L (m)
AB	-P-41,6	-1	-41,6	6
AC	66,59	0	66,59	0,6
CB	85	0	85	7,5
CE	233,4	0	233,4	10,5
CD	-235,7	0	-235,7	12,9
BD	-P-41,6	-1	-41,6	10,5
ED	137	0	137	7,5

→ Teorema de Castiglione

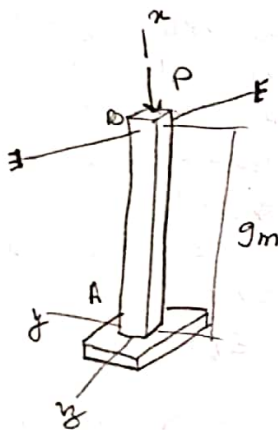
$$\Delta_A = \frac{1}{AE} \cdot \sum N \cdot \frac{\partial N}{\partial P} \cdot L$$

$$\Delta_A = \frac{1}{AE} \left(N_{AB} \cdot \frac{\partial N_{AB}}{\partial P} \cdot L_{AB} + N_{BD} \cdot \frac{\partial N_{BD}}{\partial P} \cdot L_{BD} \right)$$

$$\Delta_A = \frac{1}{3,2 \cdot 10^5} \left((-41,6)(-1) \cdot 6 + (-41,6)(-1) \cdot (10,5) \right)$$

$$\Delta_A = 0,002145 \text{ m}$$

(2)



Dados:

$$\sigma_{adm} = 250 \text{ MPa}$$

$$E = 200 \text{ GPa} = 200 \cdot 10^9 \text{ Pa}$$

$$I_z = 128 \cdot 10^6 \text{ mm}^4 = 1,28 \cdot 10^{-4} \text{ m}^4$$

$$I_y = 18,4 \cdot 10^6 \text{ mm}^4 = 1,84 \cdot 10^{-5} \text{ m}^4$$

$$r_z = 130 \text{ mm} = 0,13 \text{ m}$$

$$n_f = 2$$

$$P_{cr} = \frac{\pi^2 EI}{(kL)^2}$$

→ Para o plano xy, temos $k=2$

$$P_{cr} = \frac{\pi^2 EI_z}{(kL)^2} = \frac{\pi^2 \cdot 200 \cdot 10^9 \cdot 1,28 \cdot 10^{-4}}{(2 \cdot 9)^2}$$

$$P_{cr} = 779.820,59 \text{ N}$$

→ Para o plano xz, temos $k=7$

$$P_{cr} = \frac{\pi^2 EI_y}{(kL)^2} = \frac{\pi^2 \cdot 200 \cdot 10^9 \cdot 1,84 \cdot 10^{-5}}{(9 \cdot 0,7)^2}$$

$$P_{cr} = 915.095,59 \text{ N}$$

→ Tensão crítica

$$\sigma_{cr} = \frac{\pi^2 E}{(kL/r)^2} = \frac{\pi^2 \cdot 200 \cdot 10^9}{\left(\frac{2 \cdot 9}{0,13}\right)^2}$$

$$= \frac{\pi^2 \cdot 200 \cdot 10^9}{(138,5)^2} = 102.960.687,887$$

$$\sigma_{cr} = 102,96 \text{ MPa}$$

→ Sendo a $\sigma_{adm} = 250 \text{ MPa}$

temos que:

$$\sigma_{adm} > \sigma_{crítica}$$

Portanto, temos

$$\frac{P}{A} \leq \frac{P_{cr}}{A n_f} \quad \text{utiliza-se o } P_{cr} \text{ menor}$$

$$P \leq \frac{779.820,59}{2}$$

$$P \leq 389 \text{ N}$$