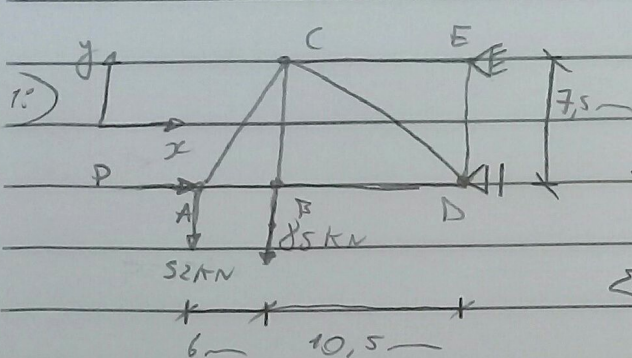


Mecânica dos Sólidos 3

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Engenharia Civil

AB2-P2



$$\sum F_y = 0 \Rightarrow V_E - 52 - 85 = 0$$

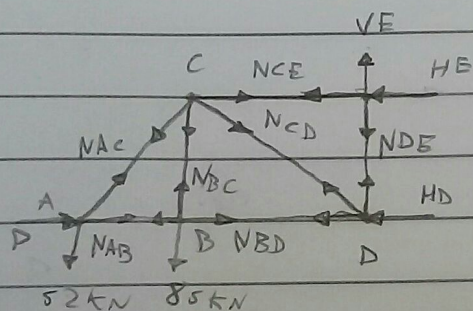
$$V_E = 137 \text{ kN}$$

$$\sum M_D = 0 \Rightarrow 52 \cdot 16,5 + 85 \cdot 10,5 - H_E \cdot 7,5 = 0$$

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

$$\sum F_x = 0 \Rightarrow -H_E - H_D + P = 0$$

$$H_D = 233,4 + P$$



$$L_{AC} = \sqrt{7,5^2 + 6^2} = 9,6 \text{ m}$$

$$L_{CD} = \sqrt{7,5^2 + 10,5^2} = 12,9 \text{ m}$$

Método dos Nós:

$$\text{Nó E: } \sum F_y = 0 \Rightarrow -N_{DE} + V_E = 0 \Rightarrow N_{DE} = 137 \text{ kN}$$

$$\sum F_x = 0 \Rightarrow -N_{CE} - H_E = 0 \Rightarrow N_{CE} = -233,4 \text{ kN}$$

$$\text{Nó D: } \sum F_y = 0 \Rightarrow N_{DE} + N_{CD} \cdot \frac{7,5}{12,9} = 0 \Rightarrow N_{CD} = -235,70 \text{ kN}$$

$$\sum F_x = 0 \Rightarrow -N_{BD} - H_D - N_{CD} \cdot \frac{10,5}{12,9} = 0 \Rightarrow N_{BD} = -41,6 - P$$

$$\text{Nó B: } \sum F_y = 0 \Rightarrow -N_{AB} + N_{BD} = 0 \Rightarrow N_{AB} = -41,6 - P$$

$$\sum F_x = 0 \Rightarrow N_{BC} - 85 = 0 \Rightarrow N_{BC} = 85 \text{ kN}$$

$$\text{Nó A: } \sum F_y = 0 \Rightarrow -52 + N_{AC} \cdot \frac{7,5}{9,6} = 0 \Rightarrow N_{AC} = 66,59 \text{ kN}$$

Aplicando a fórmula de Castiglione modificada com $P=0$.

$$\Delta_{DE} = \int_0^{10,5} \frac{N_{DE} \cdot 0}{EA} dx = 0$$

$$E = 200 \text{ GPa} = 2 \cdot 10^8 \text{ kPa}$$

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

$$\Delta_{CE} = \int_0^{10,5} \frac{N_{CE} \cdot 0}{EA} dx = 0$$

$$\Delta_{CD} = \int_0^{12,9} \frac{N_{CD} \cdot 0}{EA} dx = 0$$

$$\Delta_{BD} = \int_0^{10,5} \frac{N_{BD} \cdot (-1)}{EA} dx = 1,365 \cdot 10^{-6}$$

$$\Delta_{AB} = \int_0^6 \frac{N_{AB} \cdot 0}{EA} dx = 7,8 \cdot 10^{-7}$$

$$\Delta_{BC} = \int_0^{7,5} \frac{N_{BC} \cdot 0}{EA} dx = 0$$

$$\Delta_{AC} = \int_0^{9,6} \frac{N_{AC} \cdot 0}{EA} dx = 0$$

Logo, o deslocamento horizontal em A será:

$$\Delta = \Delta_{BD} + \Delta_{AB}$$

$$\Delta = 1,365 \cdot 10^{-6} + 7,8 \cdot 10^{-7}$$

$$\Delta = 2,145 \cdot 10^{-3} \text{ m} = 2,145 \text{ mm, de acordo com a resposta.}$$

$$2^o) \sigma_{adm} = 250 \text{ MPa}$$

$$I_z = 128 \cdot 10^6 \text{ cm}^4$$

$$E = 200 \text{ GPa} = 200000 \text{ N/mm}^2$$

$$I_y = 18,4 \cdot 10^6 \text{ cm}^4$$

$$n_z = 130$$

$$n^2 = 2$$

$$L = 9 \text{ m} = 9000 \text{ mm}$$

Força de tração de eixo z (k=2)

$$P_{cn1} = \frac{\pi^2 \cdot E \cdot I_z}{(k \cdot L)^2} = \frac{\pi^2 \cdot 200000 \cdot 128 \cdot 10^6}{(2 \cdot 9000)^2} = 779,82 \text{ kN}$$

Força de tração de eixo y (k=2)

$$P_{cn2} = \frac{\pi^2 \cdot E \cdot I_y}{(k \cdot L)^2} = \frac{\pi^2 \cdot 200000 \cdot 18,4 \cdot 10^6}{(2 \cdot 7000)^2} = 18530,68 \text{ kN}$$

$$P_{cn} = P_{cn1} = 779,82 \text{ kN}$$

Índice de esbeltez:

$$\lambda = \frac{kL}{r} = \frac{2 \cdot 9000}{130} = 138,46$$

$$n_z = 130$$

Tensão crítica:

$$\sigma_{cn} = \frac{\pi^2 E}{\lambda^2} = \frac{\pi^2 \cdot 200000}{138,46^2} = 102,36 \text{ MPa} < \sigma_{adm}$$

Critério de estabilidade

$$\sigma \leq \sigma_{cn} \Rightarrow P \leq P_{cn}$$

$$n \quad A \quad A \cdot n$$

$$P \leq 779,82 \Rightarrow P \leq 389,91 \text{ kN}$$

$$2$$