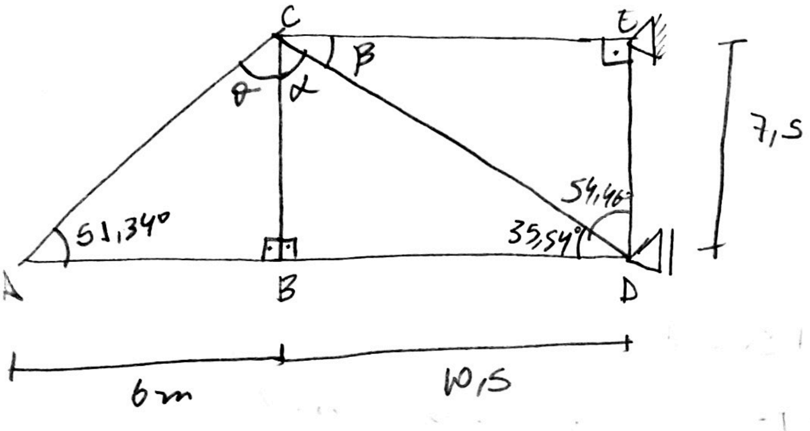
Resoluções AB2P2

1) Em posse das cotas, calcula-se os ângulos presentes nas barras:

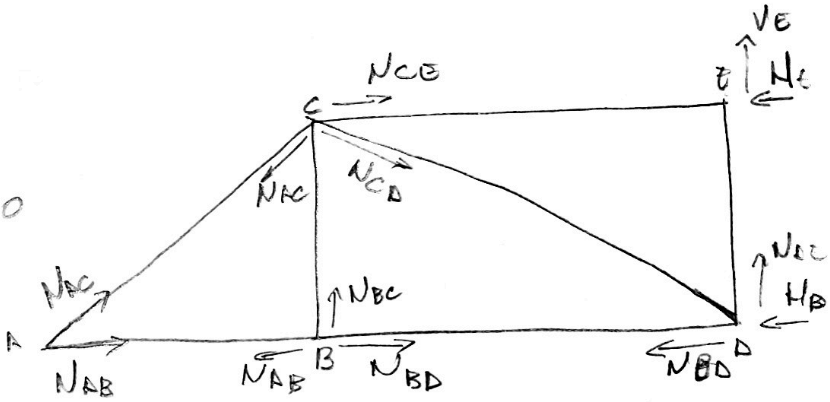


$\theta = tg^{-1}\left(\frac{6}{7,5}\right) = \underline{38,66°}$

$\alpha = tg^{-1}\left(\frac{10,5}{7,5}\right) = \underline{54,46}$

$\beta = tg^{-1}\left(\frac{7,5}{10,5}\right) = \underline{35,54°}$

Pelo método dos nós pode-se encontrar as tensões atuantes nas barras; Logo:



Nó D:

$\Sigma F_x = 0 \therefore -H_D - N_{BD} - N_{CD} \cdot \cos(35,54°) = 0$

$\Sigma F_y = 0 \therefore N_{DE} + N_{CD} \cdot \cos(54,46°) = 0$

$\underline{N_{DE} = 237,5 \cdot 0,58 = 137,00 KN}$

Nó B:

$\Sigma F_x = 0 \therefore N_{BD} = N_{AB} \Rightarrow N_{BD} = -41623,7 \; KN$

$\Sigma F_y = 0 \therefore N_{CB} - 85 = 0 \therefore \underline{N_{CB} = 85 KN}$

Nó A:

$\Sigma F_x = 0 \therefore N_{AB} + N_{AC} \cdot \cos(51,34°) + P = 0 \Rightarrow N_{AB} + 0,625 \cdot 66,6 + P = 0 \Rightarrow \underline{N_{AB} = -41,623,7 + P}$

$\Sigma F_y = 0 \therefore N_{AC} \cdot sen(51,34°) - 52 = 0 \Rightarrow N_{AC} = \underline{66,6 KN}$

Nó C:

$\Sigma F_x = 0 \therefore N_{CE} - N_{AC} \cdot sen(38,66°) + N_{CD} \cdot \cos(35,54°) = 0 \Rightarrow N_{CE} - 41,6 + 191791,43$

$\underline{N_{CE} = 233,39 KN}$

$\Sigma F_y = 0 \therefore -N_{AC} \cdot \cos(38,66°) - N_{CB} - N_{CA} \cdot \cos(54,46°) = 0$

$-52004,16 - 85000 = 0,58 N_{CD} \Rightarrow \underline{N_{CA} = -235,7 KN}$

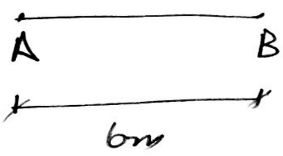
Nó E

$\Sigma F_x = 0 \therefore -N_E - N_{CE} = 0 \Rightarrow \underline{N_E = -233{,}39\,kN}$

$\Sigma F_y = 0 \therefore V_E - N_{DE} = 0$

Calculando para as barras, tem-se que:

ΔB:

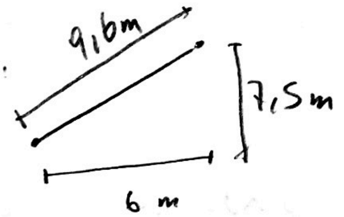


$$\Delta_{AB} = \int_0^6 \frac{-41623{,}70 - P}{E \cdot A}(-1)\,dx = \int_0^6 \frac{41623{,}70 + P}{EA}\,dx$$

$$= \left(\frac{41623{,}70 + \cancel{P}^{\,0}}{EA}\right) x \Big|_0^6 = -\cancel{\frac{41623{,}70 \cdot 0}{200 \cdot 10^9 \cdot 0{,}0016}}^{\,0} + \frac{41623{,}70 \cdot 6}{200 \cdot 10^9 \cdot 0{,}0016} = \underline{0{,}0008\,m}$$

OBS: Uma vez que $P=0$!!

ΔAC:



$$\Delta_{AC} = \int_0^{9,6} \frac{66598}{E \cdot A} \cdot 0\,dx = 0, \text{ pois } \underline{\frac{\partial N_{AC}}{\partial P} = 0}$$

$$\Delta_{BD} = \int_0^{10,5} \frac{-41623{,}70 - P}{EA} \cdot (-1)\,dx = \int_0^{10,5} \frac{41623{,}70 + P}{EA} = \left(\frac{41623{,}70 + 0}{EA}\right) x \Big|_0^{10,5}$$

$$\frac{41623{,}70}{200 \cdot 10^9 \cdot 0{,}0016} \cdot 10{,}5 - \frac{41623{,}70}{200 \cdot 10^9 \cdot 0{,}0016} \cdot 0 \Rightarrow \underline{\Delta_{BD} = 0{,}0014\,m}$$

$$\Delta_{CD} = \int_0^{12,7} \frac{-235700}{E \cdot A} \cdot 0 \, dx \Rightarrow \underline{\Delta_{CD} = 0} \qquad \frac{\partial N_{CD}}{\partial P} = 0$$

$$\Delta_{DE} = \int_0^{7,5} \frac{137005}{E \cdot A} \cdot 0 \cdot dx \Rightarrow \underline{\Delta_{DE} = 0} \qquad \frac{\partial N_{DE}}{\partial P} = 0$$

$$\Delta_{CE} = \int_0^{10,5} \frac{233395}{E\,A} \cdot 0 \cdot dx = \underline{0} \qquad \frac{\partial N_{CE}}{P} = 0$$

$$\Delta_{BC} = \int_0^{7,5} \frac{85000}{E \cdot A} \cdot 0 \cdot dx = 0 \qquad \frac{\partial N_{BC}}{\partial P} = 0$$

$$\Delta_A = \Sigma \Delta_i \Rightarrow \Delta_A = \Delta_{AB} + \Delta_{AC} + \Delta_{BC} + \Delta_{BD} + \Delta_{CD} + \Delta_{CE} + \Delta_{DE}$$

$$\Delta_A = 0{,}0008 + 0{,}0014 + 0 + 0 + 0 + 0 + 0 + 0 = \underline{0{,}0022 \text{ m}}$$

Pelo fato da força P ter o sentido adotado como positivo para a direita ($\xrightarrow{+}$), no ponto B, o deslocamento será de 2,2mm para a direita.

② Dividindo o problema em planos de trabalho,

No plano $\underline{xz}$, tem-se que:

Considerando $\underline{K=2}$

$$P_{cr} = \frac{\pi^2 \cdot E \cdot J_y}{(K \cdot L)_y^2} = \frac{\pi^2 \cdot 200 \cdot 10^9 \cdot 18,4 \cdot 10^{-9}}{(2 \cdot 0,7)_y^2} = \underline{915,10\,KN}$$

No plano xy:

$$P_{cr} = \frac{\pi^2 \cdot E \cdot J_z}{(K \cdot L)_z^2} = \frac{\pi^2 \cdot 200 \cdot 10^9 \cdot 128 \cdot 10^{-6}}{(2 \cdot 9)_z^2} = \underline{779,82\,KN}$$

Adota-se, então, o valor do P_{cr} igual a 779,82KN.

Calculando a tensão crítica:

$$\sigma_{cr} = \frac{\pi^2 \cdot E}{\left(\frac{K \cdot L}{r}\right)^2} = \frac{\pi^2 \cdot 200 \cdot 10^9}{\left(\frac{18}{130 \cdot 10^{-3}}\right)^2} = \underline{102,9\,MPa}$$

Índice de esbeltez:

$$\lambda_z = \frac{L_z}{r_z} = \frac{K \cdot L}{r_z} = \frac{2 \cdot 9 \cdot 10^3}{130} = \underline{138,5}$$

Como $\sigma_{cr} < \sigma_{adm}$, o P_{cr} adotado se confirma.

Pelo critério de estabilidade:

$$\sigma \leq \frac{\sigma_{cr}}{\eta_P} \Rightarrow \frac{P}{A} \leq \frac{P_{cr}}{A\,\eta_P}; \quad P \leq \frac{779,82}{2} \leq \underline{389,91\,KN}$$

JU