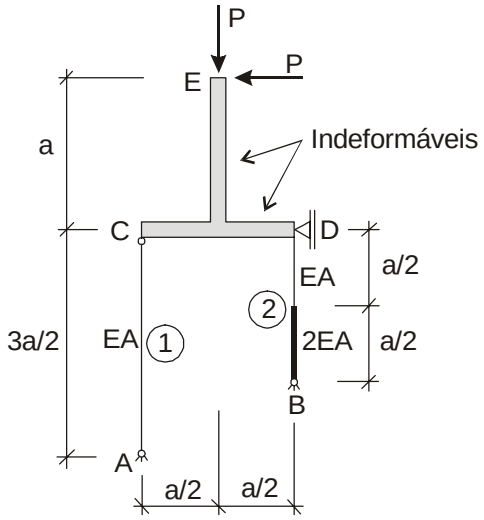
PEF-2201 Resistência dos Materiais e Estática das Construções I

1ª Prova – 13/09/2002

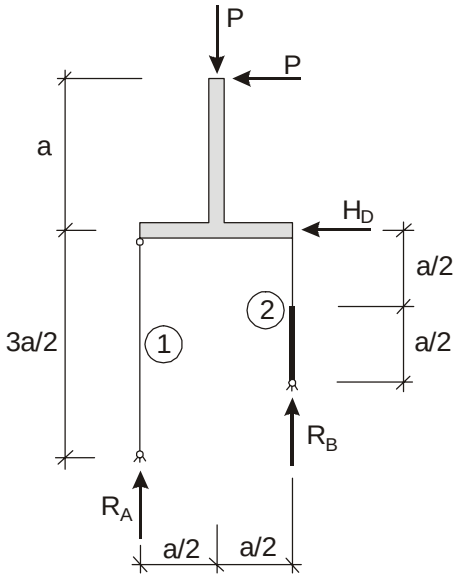
Questão 1 (5,0 pontos)

Calcular as forças normais nas barras 1 e 2 e as componentes do deslocamento do ponto E.



Resposta:

A estrutura é isostática! Assim, pode-se determinar as reações por meio das equações de equilíbrio.



$$\sum H = 0 \quad H_D = P \quad (1)$$

$$\sum V = 0 \quad R_A + R_B = P \quad (2)$$

$$\sum M = 0 \quad R_A \frac{a}{2} = Pa + R_B \frac{a}{2} \quad (3)$$

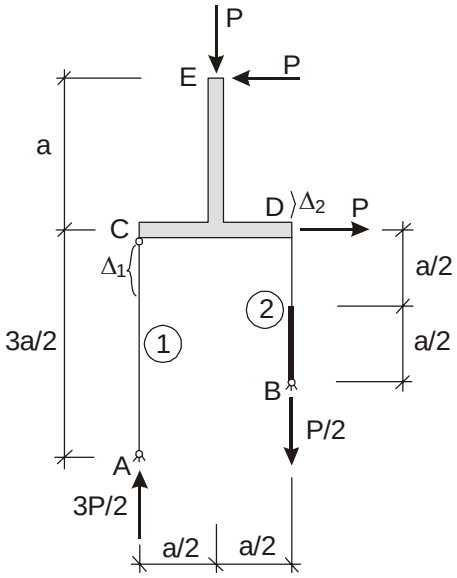
$$(3) \rightarrow R_A = 2P + R_B$$

$$\text{Em } (2) \rightarrow 2P + R_B + R_B = P \quad \therefore \quad R_B = -\frac{P}{2}$$

$$\text{Em } (2) \rightarrow R_A - \frac{P}{2} = P \quad \therefore \quad R_A = \frac{3P}{2}$$

Portanto, $F_1 = \frac{3P}{2}$ (compressão)

e $F_2 = \frac{P}{2}$ (tração) (1,0 ponto)



As variações de comprimento das barras 1 e 2 são:

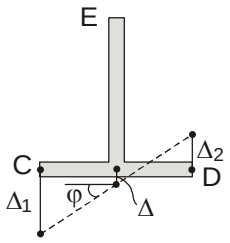
(1,0 ponto) $\Delta_1 = \dfrac{F_1 l}{(EA)} = \dfrac{3P}{2}\cdot\dfrac{3a}{2}\cdot\dfrac{1}{EA} =$

$= \dfrac{9}{4}\dfrac{Pa}{EA}$ (encurtamento)

(1,0 ponto) $\Delta_2 = \dfrac{P}{2}\cdot\dfrac{a}{2}\cdot\dfrac{1}{2EA} + \dfrac{P}{2}\cdot\dfrac{a}{2}\cdot\dfrac{1}{EA} =$

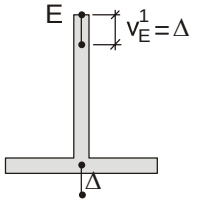
$= \dfrac{3}{8}\dfrac{Pa}{EA}$ (alongamento)

Determinação dos deslocamentos:



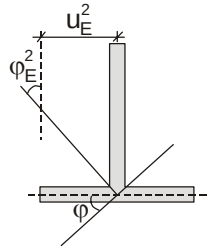
$$\Delta = \frac{|\Delta_1| - \Delta_2}{2} = \left(\frac{9}{4} - \frac{3}{8}\right)\cdot\frac{Pa}{EA}\cdot\frac{1}{2} = \frac{15}{16}\frac{Pa}{EA}$$

$$\varphi = \frac{|\Delta_1| + \Delta_2}{a} = \left(\frac{9}{4} + \frac{3}{8}\right)\cdot\frac{Pa}{EA}\cdot\frac{1}{a} = \frac{21}{8}\frac{P}{EA}$$



1) Devido a Δ apenas,

$v_E^1 = \Delta = \dfrac{15}{16}\dfrac{Pa}{EA} \downarrow \quad \left(0{,}9375\dfrac{Pa}{EA}\right)$ (1,0 ponto)



2) Devido a φ apenas,

$u_E^2 = \varphi\, a = \dfrac{21}{8}\dfrac{Pa}{EA} \leftarrow \left(2{,}6250\dfrac{Pa}{EA}\right)$ (0,5 ponto)

$\varphi_E^2 = \varphi = \dfrac{21}{8}\dfrac{P}{EA} \quad \left(2{,}6250\dfrac{P}{EA}\right)$ (0,5 ponto)

Ou ainda,

$u_E = \varphi\, a = \dfrac{|\Delta_1| + \Delta_2}{a}\cdot a = |\Delta_1| + \Delta_2$ e

$v_E = \dfrac{|\Delta_1| - \Delta_2}{2}$