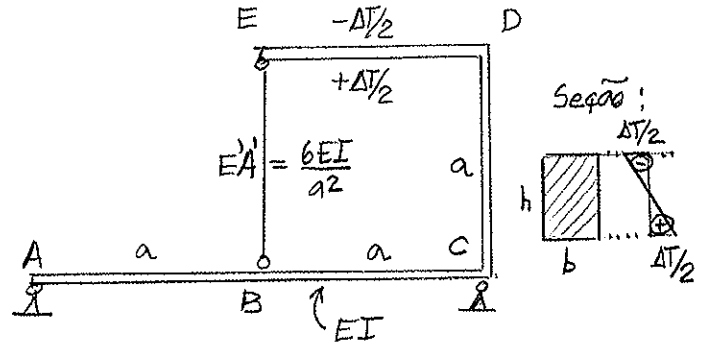
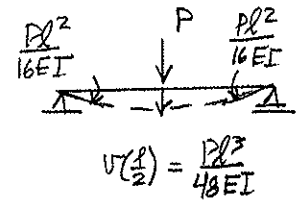
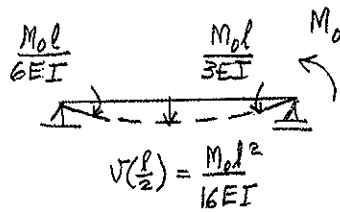
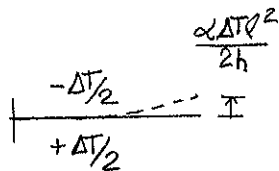


Ex.

Determine a força normal na barra EB quando o trecho ED é submetido ao gradiente de temperatura indicado na figura. (Despreze o efeito da deformação axial por ΔT na barra ABCDE)



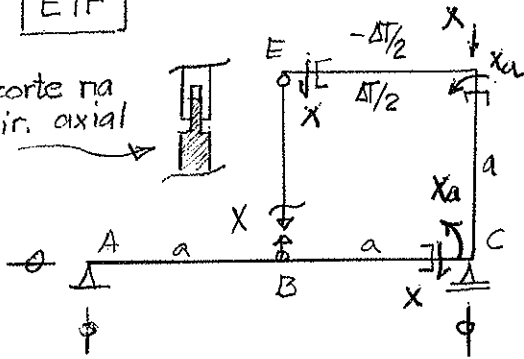
Dados:



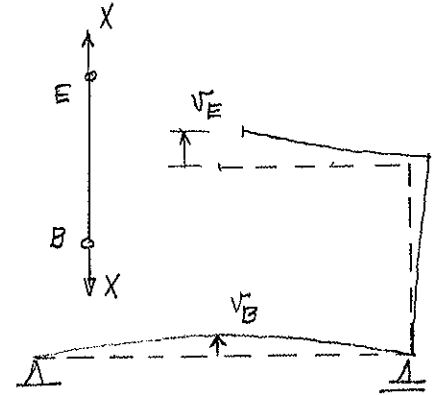
a) $GH = (3 \text{ vinc. ext.} + 2 \text{ vinc. int.}) - 3 \text{ eqs. equil.} = 1$

b) EIF

corte na dir. axial



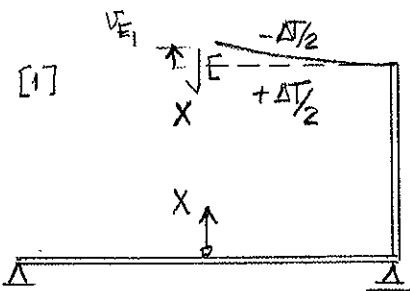
$\rightarrow H_A = 0$
 $\uparrow R_A + R_C = 0$
 $\curvearrowright R_A \times 2a = 0$
 $R_A = 0$
 $R_C = 0$



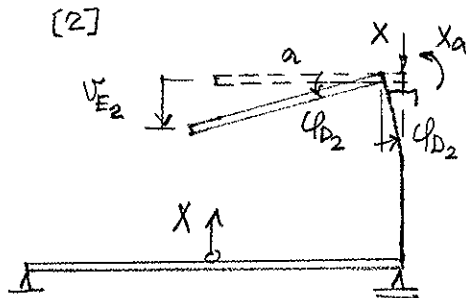
• compatibility: $V_E - V_B = \Delta l_{EB}$

c) Cálculo das deslocamentos na EIF.

$\Delta l_{EB} = \frac{Xa}{E'A'} = \frac{Xa^3}{6EI}$

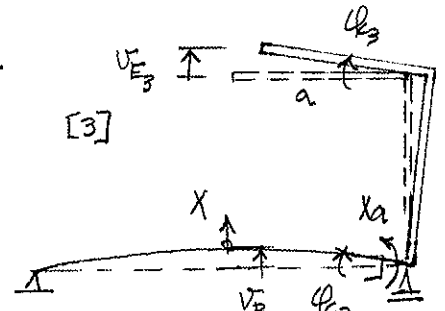


$V_{E1} = \frac{\alpha \Delta T a^2}{2h} - \frac{Xa^3}{3EI}$



$\varphi_{A2} = \frac{(Xa)a}{EI}$

$V_{E2} = \varphi_{D2} \times a = \frac{Xa^3}{EI}$



$V_{B3} = \frac{X(2a)^3}{48EI} - \frac{(Xa)(2a)^2}{16EI} = -\frac{Xa^3}{12EI}$

$\varphi_{C3} = \frac{X(2a)^2}{16EI} - \frac{(Xa)2a}{3EI} = -\frac{5Xa^2}{12EI}$

$V_{E3} = \varphi_{C3} \times a = -\frac{5Xa^3}{12EI}$

d) Equação de compatibilidade

(↑) $V_E - V_B = \Delta l_{EB}$

$(V_{E1} - V_{E2} + V_{E3}) - (V_{B3}) = + \Delta l_{EB}$

$(\frac{\alpha \Delta T a^2}{2h} - \frac{Xa^3}{3EI} - \frac{Xa^3}{EI} - \frac{5Xa^3}{12EI}) - (-\frac{Xa^3}{12EI}) = \frac{Xa^3}{6EI}$

$\frac{Xa^3}{EI} (\frac{1}{3} + 1 + \frac{5}{12} - \frac{1}{12} + \frac{1}{6}) = \frac{\alpha \Delta T a^2}{2h}$

$\frac{4+12+5-1+2}{12} \frac{Xa^3}{EI} = \frac{\alpha \Delta T a^2}{2h}$

$X = \frac{3}{11} \frac{\alpha \Delta T EI}{a h} = N_{EB}$

$V_E = \frac{\alpha \Delta T a^2}{2h} - \frac{(4+12+5) Xa^3}{12 EI}$

$= \frac{\alpha \Delta T a^2}{h} (\frac{1}{2} - \frac{21}{12} \times \frac{1}{11})$

$= \frac{1}{44} \frac{\alpha \Delta T a^2}{h} (\uparrow)$

Diagrama

(M) $\frac{\alpha \Delta T EI}{h}$

