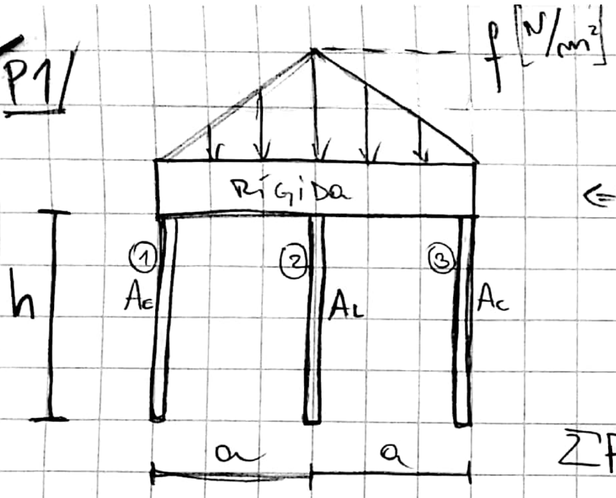
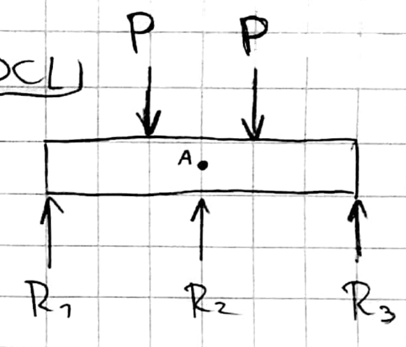
**P1/**




$\Leftrightarrow$

DCL/

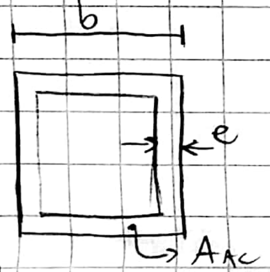



$$\Sigma F_y: \boxed{R_1 + R_2 + R_3 = 2P} \quad (1)$$

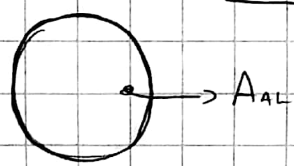
$$\Sigma M_A: \cancel{P \cdot \frac{a}{3}} + R_3 \cdot a - \cancel{P \frac{a}{3}} - R_1 \cdot a = 0$$

$$\Leftrightarrow \boxed{R_1 = R_3} \quad (2)$$

$A_c$:




$A_L$:




* Plataforma rígida se mantiene horizontal
$\Rightarrow$ las deformaciones deben ser iguales.

* Tubos 1 y 3/

$$\Delta L_1 + \Delta L_{T1} = \Delta L_3 + \Delta L_{T3}$$

$$\boxed{\Delta L = \frac{L_0 \cdot F}{A \cdot E}}$$

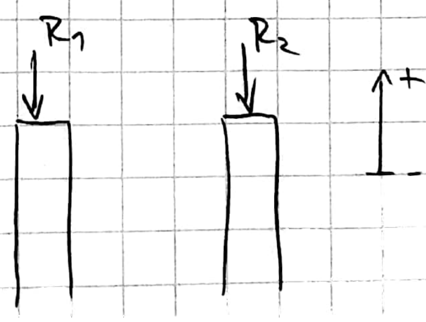
$$\boxed{\Delta L_T = \alpha \cdot \Delta T \cdot L_0}$$

$$-\frac{h \cdot R_1}{A_{AC} \cdot E_{AC}} + \alpha_{ac} \cdot \Delta T \cdot h = -\frac{h R_3}{A_{AC} \cdot E_{AC}} + \alpha_{ac} \Delta T \cdot h$$

$$\Rightarrow \boxed{R_1 = R_2} \rightarrow \text{igual que } (2)$$

* Tubos 1 y 2/

$$\Delta L_1 + \Delta L_{T1} = \Delta L_2 + \Delta L_{T2}$$



$$-\frac{\cancel{h}R_1}{A_{AC}\cdot E_{AC}}+\alpha_{AC}\,\Delta T\cdot\cancel{h}=-\frac{\cancel{h}R_2}{A_{AL}E_{AL}}+\alpha_{AL}\cdot\Delta T\cdot\cancel{h}$$

$$\Rightarrow \boxed{R_2=\left(\frac{R_1}{A_{AC}E_{AC}}+\Delta T(\alpha_{AL}-\alpha_{AC})\right)A_{AL}\cdot E_{AL}} \quad (3)$$

con (3) y (2) en (1)

$$\Rightarrow 2R_1+A_{AL}\cdot E_{AL}\left[\frac{R_1}{A_{AC}E_{AC}}+\Delta T(\alpha_{AL}-\alpha_{AC})\right]=2P$$

$$\Leftrightarrow R_1\left(2+\frac{A_{AL}E_{AL}}{A_{AC}E_{AC}}\right)=2P+A_{AL}E_{AL}\cdot\Delta T(\alpha_{AC}-\alpha_{AL})$$

$$\Rightarrow \boxed{R_1=\left[2P+A_{AL}E_{AL}\cdot\Delta T(\alpha_{AC}-\alpha_{AL})\right]\frac{A_{AC}E_{AC}}{2A_{AC}E_{AC}+A_{AL}E_{AL}}}$$

$$\Rightarrow \boxed{R_2=\left[\frac{2P+A_{AL}E_{AL}\,\Delta T(\alpha_{AC}-\alpha_{AL})}{2A_{AC}E_{AC}+A_{AL}E_{AL}}+\Delta T(\alpha_{AL}-\alpha_{AC})\right]A_{AL}\cdot E_{AL}}$$

$(\Delta T=0)$

$\Rightarrow$ Sin cambio de temperatura: $R_2\approx 30$ KN

$\Rightarrow \sigma_2\approx 95{,}5$ MPa

Si el esfuerzo de fluencia del aluminio es de $\sigma_{0AL}=120$ MPa

$\Rightarrow \boxed{F.S.=\frac{\sigma_{0AL}}{\sigma_2}\approx 1{,}25}$

$\hookrightarrow \boxed{\begin{array}{l}R_1=R_3=110\text{ KN}\\ \sigma_1=\sigma_3=286\text{ MPa}\end{array}}$

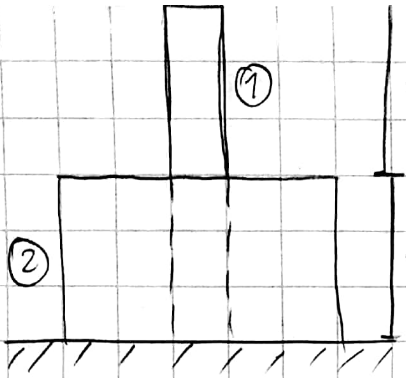
$\Rightarrow$ Con cambio de temperatura: $R_2\approx 38{,}5$ KN

$\Rightarrow \sigma_2\approx 122{,}6$ MPa

$122{,}6>\sigma_{0AL}\Rightarrow$ Falla

$\hookrightarrow \boxed{\begin{array}{l}R_1=R_3\approx 106\text{ KN}\\ \sigma_1=\sigma_3\approx 275\text{ MPa}\end{array}}$

P2)




1° se supone que no toca la pared superior

Zona 1)

$$\Delta L_1 = \alpha_A \cdot \Delta T \cdot L$$

$$\Rightarrow \boxed{\Delta L_1 = 0{,}001434 \text{ m}}$$

Zona 2)

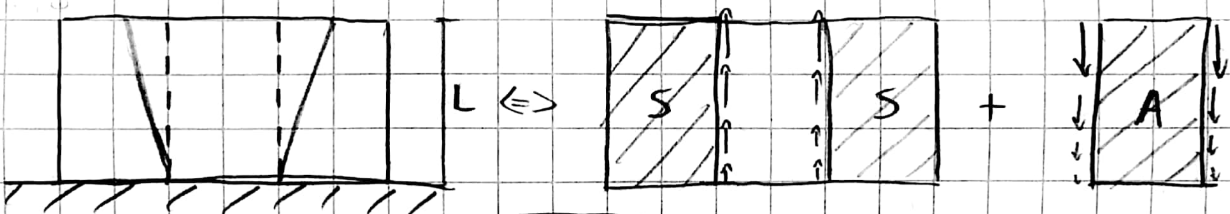
Def acero = Def. aluminio

$$\boxed{\Delta L_{TS} + \Delta L_S = \Delta L_{TA} + \Delta L_A} \quad (*)$$

$$\Delta L_{TS} = \alpha_S \cdot \Delta T \cdot L = \underline{0{,}000648 \text{ m}}$$

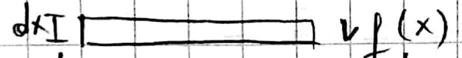
$$\boxed{\Delta L_{TA} = 0{,}001434 \text{ m}}$$

D.C.L)




$$\hookrightarrow \left.\begin{array}{l} f(0) = 0 \\ f(L) = F \end{array}\right\} \boxed{f(x) = \frac{F}{L} x}$$

Aluminio)




$$\frac{\Delta dx}{dx} = \frac{-f(x)}{A_A \cdot E_A} \Big/ \int_0^L$$

$$\int_0^L \Delta dx = \frac{-1}{A_A E_A} \cdot \int_0^L f(x)\, dx$$

$$\Rightarrow \Delta L_A = \frac{-F}{2 A_A E_A \cancel{L}} \cdot L^{\cancel{2}} \Rightarrow \boxed{\Delta L_A = \frac{-F \cdot L}{2 A_A E_A}}$$

Acero: mismo resultado pero en sentido opuesto.

$$\Delta L_S = \frac{F \cdot L}{2 A_S E_S}$$

en (*) $0{,}000648 + \frac{F \cdot L}{2 A_S E_S} = 0{,}001434 - \frac{F \cdot L}{2 A_A E_A}$

$$\Rightarrow \boxed{F = (0{,}001434 - 0{,}000648)\left(\frac{A_S E_S \cdot A_A E_A}{A_S E_S + A_A E_A}\right) \cdot \frac{2}{L}}$$

con $A_S = 0{,}0027\,[m^2]$  $E_S = 205{,}8\,[GPa]$

$A_A = 0{,}0035\,[m^2]$  $E_A = 68{,}6\,[GPa]$

$\Rightarrow F = 878.517\,[N]$

$\boxed{\Delta L_A = -0{,}00054884\,[m]}$

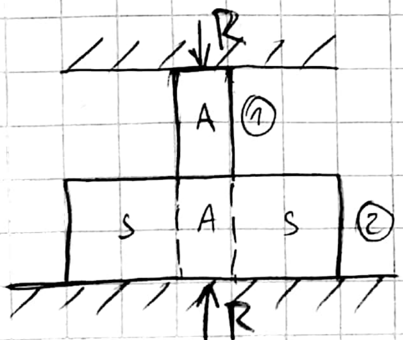
$\boxed{\Delta L_S = 0{,}00023716\,[m]}$

$\Delta L_{TOT} = \Delta L_{TS} + \Delta L_S + \Delta L_1$

$= 0{,}0023916$

$\Rightarrow$ Si toca

$\boxed{\Delta L_{tot} - \Delta = 0{,}0013916}\,[m]$




Zona 1

D.C.L


$\boxed{\Delta L_1 = \frac{-R}{A_A} \cdot \frac{L}{E_A}}$

$\boxed{\Delta L_{1\,tot} = 0{,}001434 - \frac{R \cdot L}{A_A E_A}}$

Zona 2

$\Delta L_{TS} = 0{,}000648$ ; $\Delta L_{TA} = 0{,}001434$ → igual que antes

Ahora la eq. (*) queda:

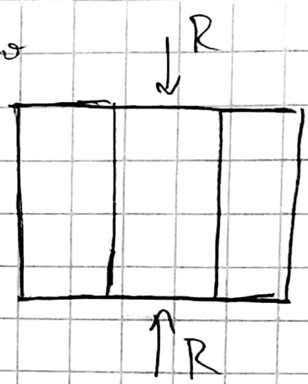
$\boxed{\Delta L_{TS} + \Delta L_S + \Delta L_{RS} = \Delta L_{TA} + \Delta L_A + \Delta L_{RA}}$ (**)

↳ se agrega la deformación por R

③ Aluminio


$$\boxed{\Delta L_{RA} = -\frac{R\cdot L}{A_A E_A}}$$

Acero




$$\boxed{\Delta L_{RS} = \frac{-R\cdot L}{A_A E_A}}$$

en ★★

$$0{,}000648 + \frac{F\cdot L}{2A_S E_S} - \frac{R\cdot L}{A_S E_S} = 0{,}001434 - \frac{FL}{2A_A E_A} - \frac{RL}{A_A E_A}$$

$$\Rightarrow F = \frac{2(0{,}001434 - 0{,}000648)}{L}\left(\frac{A_A E_A \cdot A_S E_S}{A_A E_A + A_S E_S}\right) + 2R\left(\frac{A_A E_A - A_S E_S}{A_A E_A + A_S E_S}\right) = 878517{,}6 - R\cdot 0{,}7931$$

Por otro lado se debe cumplir que:

$$\Delta L_{1TOT} + \Delta L_{2tot} = 0{,}001$$

como $\Delta L_{2TOTS} = \Delta L_{2TOTA}$ usaremos sólo el aluminio

$$0{,}001434 - \frac{RL}{A_A E_A} + \Delta L_{TA} + \Delta L_A + \Delta L_{RA} = 0{,}001$$

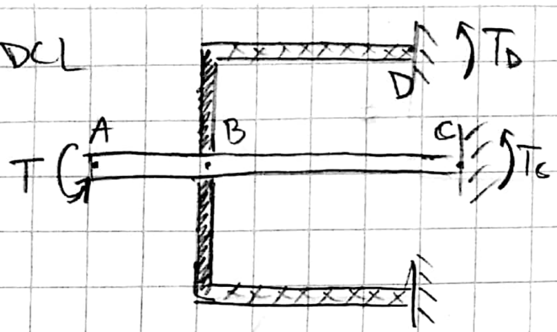
$$\Leftrightarrow 0{,}001434 - \frac{RL}{A_A E_A} + 0{,}001434 - \frac{L}{2A_A E_A}\cdot F - \frac{RL}{A_A E_A} = 0{,}001$$

$$\Rightarrow R = \frac{0{,}001165\,(A_A E_A - L\cdot 2{,}3515\cdot 10^8)}{L}$$

$$\Rightarrow \boxed{R \approx 658.433\ [N]}$$

Scanned by CamScanner

P3) DCL

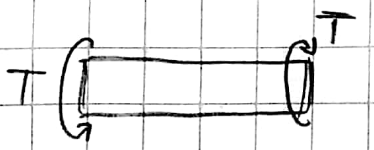



$\theta_A$ ?

$$\boxed{\theta_A = \theta_{BA} + \theta_B} \quad (1)$$

$$\Sigma M = T - T_C - T_D = 0$$
$$\Rightarrow \boxed{T = T_C + T_D} \quad (2)$$

$\theta_{BA}$)



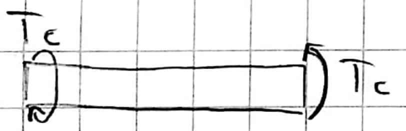

$$T = \frac{G\,\theta\,J}{L}$$

$$\Rightarrow \boxed{\theta_{AB} = \frac{T \cdot L_1}{G_{AC} \cdot J_{AC}}} \quad (3)$$

$$\text{con } J_{AC} = \frac{\pi\, D^4}{32}$$

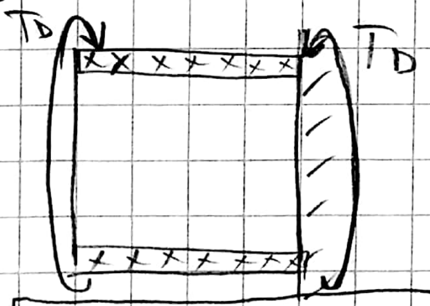
$\theta_B$)

barra)




$$\Rightarrow \boxed{\theta_B = \frac{T_C \cdot L_3}{G_{AC} \cdot J_{AC}}} \quad (4)$$

tubo)




$$\Rightarrow \boxed{\theta_B = \frac{T_D \cdot L_2}{G_{br} \cdot J_{br}}} \quad (5)$$

$$\text{con } J_{br} = \frac{\pi}{32}\left[D^4 - (D - 2t)^4\right]$$

$$(4) = (5) \Rightarrow \boxed{T_C = \frac{L_2}{L_3} \cdot \frac{G_{AC} J_{AC}}{G_{br} J_{br}} \cdot T_D} \quad \text{en } (2)$$

$$\Rightarrow \boxed{T_D = T\left(\frac{1}{1 + \frac{L_2}{L_3}\frac{G_{AC} J_{AC}}{G_{br} J_{br}}}\right)}$$

en (5) $\Rightarrow$ $$\boxed{\theta_B = T\left(\frac{L_2 L_3}{L_3 G_{br} J_{br} + L_2 G_{AC} J_{AC}}\right)}$$ (6)

(6) y (3) en (1)

$$\Rightarrow \boxed{\theta_A = \frac{T L_1}{G_{AC} J_{AC}} + T\left(\frac{L_2 L_3}{L_3 G_{br} J_{br} + L_2 G_{AC} J_{AC}}\right)}$$