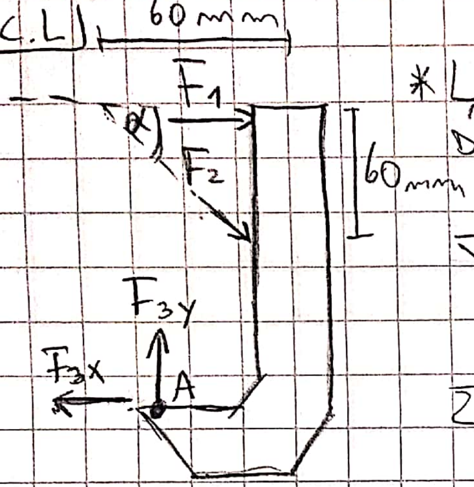
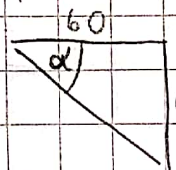
P1 Se toma la mandíbula de la derecha y se reemplazan los contactos con fuerzas.

D.C.L



* Las fuerzas son las que actúan directamente sobre el cuerpo.



$\Rightarrow \boxed{\alpha = 45°}$

$\sum F_x = \boxed{F_1 + F_2 \cdot \cos(\alpha) = F_{3x}}$ ①

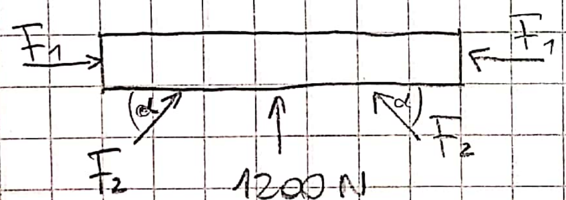
$\sum F_y = \boxed{F_{3y} = F_2 \cdot \operatorname{sen}(\alpha)}$ ②

Sumatoria de momentos respecto al punto A. $\leftarrow \sum M_A = \boxed{-F_1 \cdot 0{,}15 - F_2 \cdot \cos(\alpha) \cdot 0{,}09 - F_2 \cdot \operatorname{sen}(\alpha) \cdot 0{,}015 = 0}$ ③

$\Rightarrow \boxed{F_1 = \frac{-F_2}{0{,}15}\left(0{,}09 \cdot \cos(\alpha) + 0{,}015 \cdot \operatorname{sen}(\alpha)\right)}$

-> Falta 1 ecuación: Se hace sumatoria de fuerzas en la barra horizontal.

D.C.L.



$\sum F_x: \cancel{F_1} - \cancel{F_1} + \cancel{F_2} - \cancel{F_2} = 0$

↳ No sirve

$\sum F_y: 1200 + 2 \cdot F_2 \cdot \operatorname{sen}(\alpha) = 0$

$\Rightarrow \boxed{F_2 = -\frac{600}{\operatorname{sen}(\alpha)}}$

$\Rightarrow F_2 \approx -848{,}53$ ④

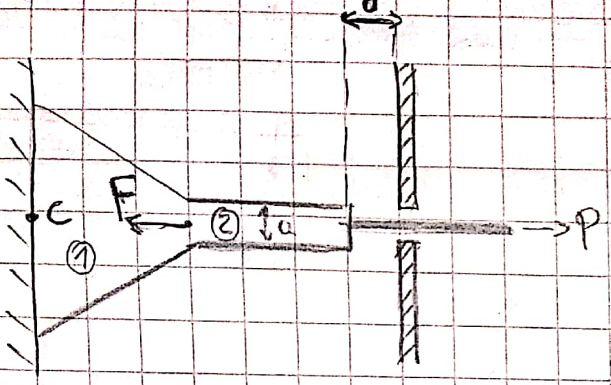
④ en ③ $\Rightarrow \boxed{F_1 \approx 420\ [N]}$

$\Rightarrow \boxed{F_{3x} = -180\ [N]}$ -> se pedía F_3

④ en ② $\Rightarrow \boxed{F_{3y} \simeq -600\ [N]}$

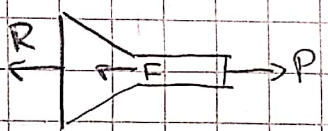
$|F_3| = \sqrt{F_{3x}^2 + F_{3y}^2} \Rightarrow \underline{|F_3| = 626{,}42\ [N]}$

P2



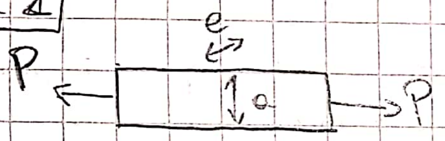
a)

D.C.L



$$-R - F + P = 0 \Rightarrow \boxed{R = P - F} \quad ①$$

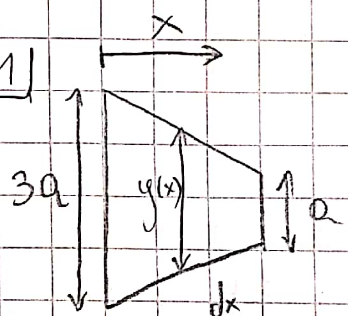
zona 2



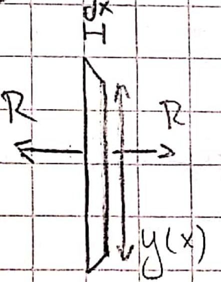
$$\frac{\Delta L_2}{L/2} = \varepsilon_2 = \frac{\sigma_2}{E} = \overbrace{\frac{P}{a \cdot e}}^{\sigma} \cdot \frac{1}{E}$$

$$\Rightarrow \boxed{\Delta L_2 = \frac{PL}{2Eae}} \quad ②$$

zona 1



$$\left.\begin{array}{l} y(0) = 3a \\ y(L/2) = a \end{array}\right\} y(x) = -\frac{4a}{L}x + 3a$$



$$\frac{\Delta dx}{dx} = \frac{R}{e \cdot y(x)} \cdot \frac{1}{E} \quad \Big/ \int_0^{L/2} dx$$

$$\Leftrightarrow \underbrace{\int_0^{L/2} \Delta dx}_{\Delta L_1} = \frac{R}{eE} \int_0^{L/2} \frac{1}{y(x)} dx$$

$$\Delta L_1 = \frac{R}{eE}\cdot \ln(y(x))\Big|_0^{L/2} \cdot \left(-\frac{L}{4a}\right) \Rightarrow \Delta L_1 = \frac{-LR}{4eE\cdot a}\ln\left(\frac{a}{3a}\right)$$

$$\Rightarrow \boxed{\Delta L_1 = \frac{LR}{4eEa}\ln(3)} \; (3) \quad ; \quad (1) \text{ en } (3) \Rightarrow \boxed{\Delta L_1 = \frac{L(P-F)}{4eEa}\cdot \ln(3)}$$

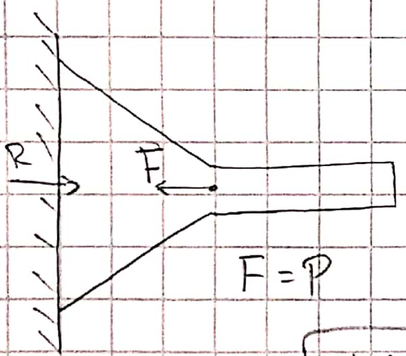
$$\Delta L_1 + \Delta L_2 \overset{!}{=} d$$

$$\Leftrightarrow \frac{L(P-F)}{4eEa}\cdot \ln(3) + \frac{PL}{2Eea} = d$$

$$\Rightarrow \boxed{P = \frac{4\cdot a\cdot d\cdot e\cdot E + F\cdot L\cdot \ln(3)}{L\cdot(\ln(3)+2)}}$$

$\Rightarrow \boxed{P = 5095{,}5\,[N]} \Rightarrow \boxed{R = -2904{,}5} \Rightarrow$ Zona 1 está en compresión. Zona 2 está en tracción.

b)

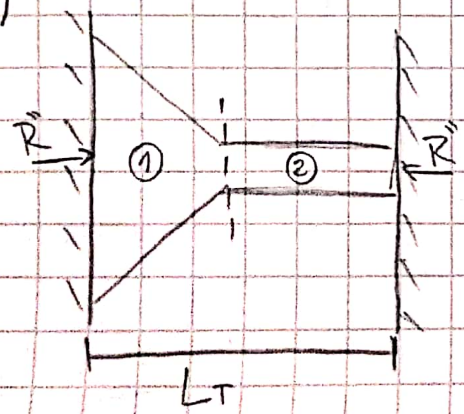


$$\Delta L_1' = \frac{-F\cdot L}{4Eea}\cdot \ln(3)$$

$F = P \quad \Rightarrow \boxed{\Delta L_1' \approx -0{,}0025\;[m]}$

$\boxed{|\Delta L_1'| > d \Rightarrow \text{Si toca}}$

c)

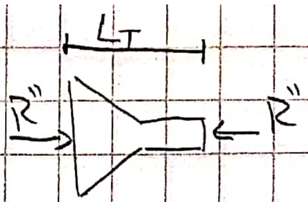


$L_T = \frac{L}{2} + \frac{L}{2} - |\Delta L_1'| + d$: Distancia entre paredes

$L_{0T} = \frac{L}{2} + \frac{L}{2}$: Longitud total de la placa antes de aplicar F y P

$\Delta L'' = L_T - L_{0T} = d - |\Delta L_1'|$: compresión total de la placa

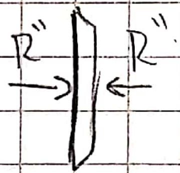
$$\Rightarrow \boxed{\Delta L'' = -0{,}5 \text{ [mm]}}$$



Nuevamente:

Zona 2 $\quad \boxed{\Delta L_2'' = \dfrac{R'' \cdot L}{2Eea}}$

Zona 1 $\quad \boxed{\Delta L_1'' = \dfrac{R'' \cdot L}{4Eea} \cdot \ln(3)}$



$$\Delta L_1'' + \Delta L_2'' = |\Delta L''|$$

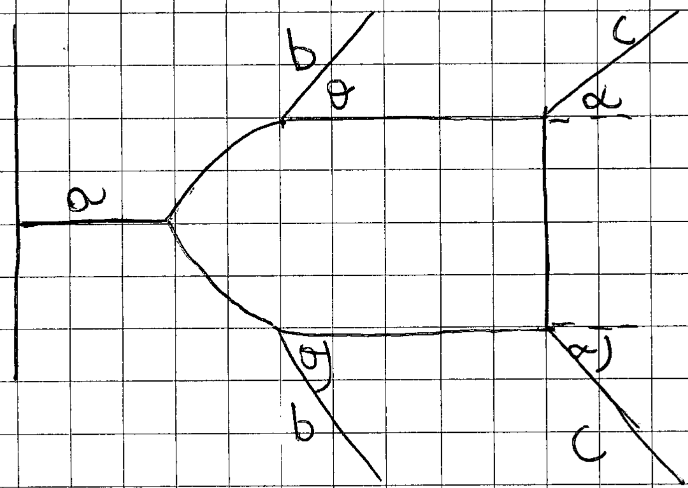
$$\Leftrightarrow \frac{R'' \cdot L}{4Eea} \cdot \ln(3) + \frac{R'' \cdot L}{2Eea} = 0{,}0005$$

$$\Rightarrow \frac{R'' \cdot L}{2Eea}\left(\frac{\ln(3)}{2} + 1\right) = 0{,}0005$$

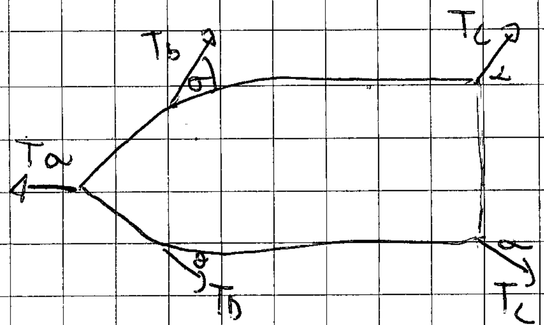
$$\Rightarrow \boxed{R'' = \frac{2Eea}{L} \cdot \frac{2}{(\ln(3)+2)} \cdot 0{,}0005}$$

$$\Rightarrow \boxed{R'' = 564{,}77 \text{ [N]}}$$

P2)



DCL (Paso 1), sin el motor encendido



$\Rightarrow \sum F_x \Rightarrow -T_a + 2T_b\cos\theta + 2T_c\cos\alpha = 0 \quad (1)$

Hooke $\Rightarrow \quad \sigma_a = \varepsilon_a E = \dfrac{T_a}{A}$

$$\Rightarrow T_a = E\cancel{A}\left(\frac{l_{1a} - l_{0a}}{l_{0a}}\right) \quad (2)$$

$$\Rightarrow T_b = EA\left(\frac{l_{1b} - l_{0b}}{l_{0b}}\right) \quad (3)$$

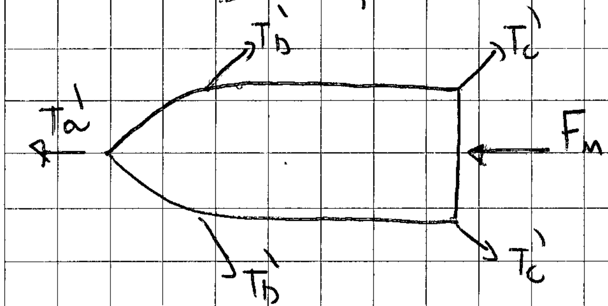
$$T_c = EA\left(\frac{l_{1c} - l_{0c}}{l_{0c}}\right) \quad (4)$$

$\Rightarrow$ (2), (3) y (4) en (1)

$$\Rightarrow -\left(\frac{l_{1a}-l_{0a}}{l_{0a}}\right)EA + 2\left(\frac{l_{1b}-l_{0b}}{l_{0b}}\right)EA\cos\theta$$

$$+2\left(\frac{l_{1c}-l_{0c}}{l_{0c}}\right)EA\cos\alpha = 0 \quad (*)$$

ahora DCL, con el motor encendido



$$\Rightarrow \sum F_x \Rightarrow -T_a' + 2T_b'\cos\theta + 2T_c'\cos\alpha = F_m \quad (5)$$

$$\sigma_a = \frac{T_a'}{A} = \varepsilon_a' E \Rightarrow T_a' = AE\left(\frac{l_{2a}-l_{0a}}{l_{0a}}\right) \quad (6)$$

$$T_b' = AE\left(\frac{l_{2b}-l_{0b}}{l_{0b}}\right) \quad (7)$$

$$T_c' = AE\left(\frac{l_{2c}-l_{0c}}{l_{0c}}\right) \quad (8)$$

(6), (7) y (8) en (5)

$$\Rightarrow -\left(\frac{l_{2a}-l_{0a}}{l_{0a}}\right)EA + 2\left(\frac{l_{2b}-l_{0b}}{l_{0b}}\right)EA\cos\theta$$

$$+ 2\left(\frac{l_{2c}-l_{0c}}{l_{0c}}\right)EA\cos\alpha = -F_M \quad (**)$$

ahora $(**) - (*)$

$$\Rightarrow -\left(\frac{l_{2a}-l_{1a}}{l_{0a}}\right)EA + 2\left(\frac{l_{2b}-l_{1b}}{l_{0b}}\right)EA\cos\theta$$

$$+ 2\left(\frac{l_{2c}-l_{1c}}{l_{0c}}\right)EA\cos\alpha = -F_M$$

se distingue que $l_{2a}-l_{1a} = (l_{2b}-l_{1b})\cos\theta$
$= (l_{2c}-l_{1c})\cos\alpha = \delta a$ [1]

$$\Rightarrow -\frac{\delta a}{l_{0a}} + \frac{2\delta a}{l_{0b}} + \frac{2\delta b}{l_{0c}} = -\frac{F_M}{EA}$$

$$\Rightarrow \delta a = \frac{-F_M}{EA\left(\frac{-1}{a}+\frac{2}{b}+\frac{2}{c}\right)} \quad //$$

[1] Esto se debe a que el bote no se deforma, es decir, todos sus partes avanzan la misma distancia