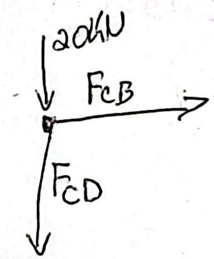
ALUNO: JOÃO VITOR DE O. FRAGA

MATRÍCULA: 537377

1.

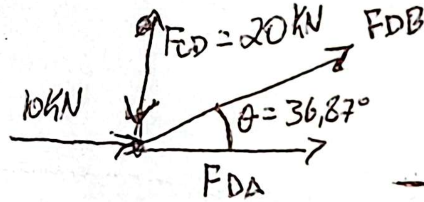
No ponto C:



$\rightarrow \sum F_x = 0 \therefore \boxed{F_{CB}=0}$

$\uparrow \sum F_y = 0 \therefore -20 - F_{CD} = 0 \therefore \boxed{F_{CD} = -20 = 20 KN (C)}$

No ponto D:



~~$\rightarrow \sum F_x = 0 \therefore F_{DA} +$~~

~~$\uparrow \sum F_y = 0 \therefore 20KN + F_{DB} sen 36,87 = 0 \therefore F_{DB} = -33,3 = 33,3KN (C)$~~

~~$\rightarrow \sum F_x = 0 \quad 10 + F_{DA} + F_{DB} \cos 36,87 = 0 \therefore F_{DA} = 33,3 \ldots \therefore F_{DA} = 16,64KN (T)$~~

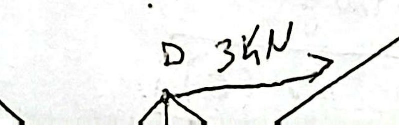
$\uparrow \sum F_y = 0 \therefore -20KN + F_{DB} sen 36,87 = 0 \therefore \boxed{F_{DB} = 33,3 KN (T)}$

$\rightarrow \sum F_x = 0 \therefore 10KN + F_{DA} + F_{CD} \cos 36,87 = 0 \therefore \boxed{F_{DA} = -36,64KN = 36,64KN (C)}$

2- $C_y = F_C \, sen 30$ e $C_x = F_C \cos 30$

$\curvearrowleft \sum M_A = 0 \therefore -4\cdot 2 + C_y \cdot 4 - 3\cdot 1,5 = 0 \therefore C_y = \frac{3\cdot 1,5 + 4\cdot 2}{4} = 3,125KN \therefore F_C = 6,25 \therefore C_x = 5,4KN$

$\rightarrow \sum F_x = 0 \therefore A_x + 3 - 5,4 \therefore A_x = 2,4KN \quad \uparrow \sum F_y = 0 \therefore A_y + 3,125 - 4 = 0 \therefore A_y = 0,875KN$

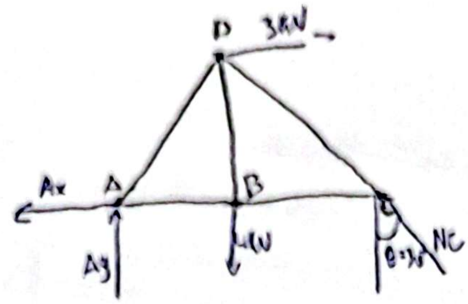


2. Podemos escrever

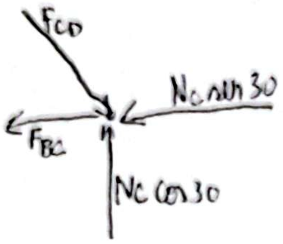
$\circlearrowleft \Sigma M_A = 0 \therefore N_C \cos 30°(4) - 3 \cdot 1,5 - 4 \cdot 2 \therefore N_C = \dfrac{3 \cdot 1,5 + 4 \cdot 2}{\cos 30° \cdot 4} = 3,608 \text{ kN (C)}$

$\rightarrow \Sigma F_x = 0: \; A_x + 3 - 3,608 \operatorname{sen} 30° \therefore A_x = -1,196 \therefore A_x = 1,196 \text{ (T)}$

$\uparrow \Sigma F_y = 0: \; A_y - 4 + 3,608 \cos 30° \therefore A_y = 0,875 \text{ kN (C)}$



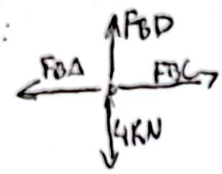
Em C:



$\uparrow \Sigma F_y = 0 \therefore N_C \cos 30° - F_{CD} \frac{3}{5} = 0 \therefore \boxed{F_{CD} = 5,206 \text{ kN (C)}}$

$\rightarrow \Sigma F_x = 0 \therefore -F_{BC} - N_C \operatorname{sen} 30° + F_{CD} \frac{4}{5} = 0 \therefore \boxed{F_{BC} = 2,36 \text{ kN (T)}}$

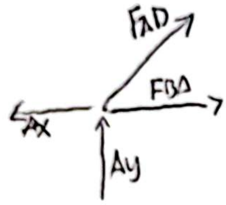
Em B:



$\uparrow \Sigma F_y = 0 \therefore F_{BD} - 4\text{kN} = 0 \therefore \boxed{F_{BD} = 4 \text{ kN (T)}}$

$\rightarrow \Sigma F_x = 0 \therefore F_{BC} - F_{BA} = 0 \therefore \boxed{F_{BA} = 2,36 \text{ kN (T)}}$

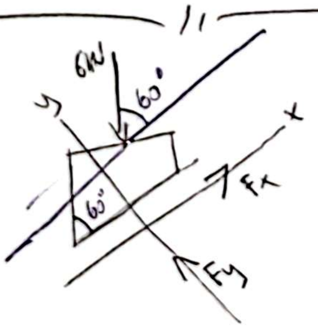
Em A:



$\uparrow \Sigma F_y = 0 \therefore A_y + F_{AD} \frac{3}{5} = 0 \therefore F_{AD} = \dfrac{-0,875 \cdot 5}{3} \therefore F_{AD} = -1,458 \text{ kN}$

$\therefore \boxed{F_{AD} = 1,458 \text{ kN (C)}}$

4.



$\nearrow \Sigma F_x = 0 \therefore F_x - 6 \cos 60° = 0 \therefore F_x = 3 \text{ kN}$

Temos a área dessa seção como $\dfrac{150 \cdot 150}{\cos 30} \therefore A = 25980,7 \text{ mm}^2$

Temos então que a tensão de cisalhamento é dada por:

$$\boxed{\tau_{a-a} = \frac{F_x}{A} = \frac{3 \cdot 10^3}{25980,7 \cdot (10^{-3})^2} = 115,47 \text{ kPa}}$$

$\nwarrow \Sigma F_y = 0 \therefore F_y - 6 \operatorname{sen} 60° = 0 \therefore F_y = 5,2 \text{ kN}$

Temos então que a tensão normal é dada por:

$$\boxed{\sigma_{a-a} = \frac{F_y}{A} = \frac{5,2 \cdot 10^3}{25980,7 (\cdot 10^{-3})^2} = 200,1 \text{ kPa}}$$

5. Temos $\sigma_x = 150\,MPa$ $\sigma_y = 100\,MPa$ $\tau_{xy} = 75\,MPa$ pela convenção e $\theta = 60°$

Agora definimos:

$$\sigma_{x'} = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta = \frac{150+100}{2} + \frac{150-100}{2}\cos 120 + 75\cdot\sin 120°$$

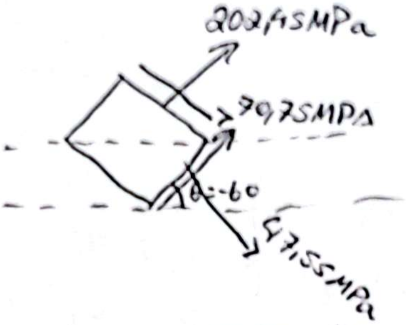
$\therefore 125 + (-12,5) + 64,95 \therefore$ ~~$\sigma_{x'}$ MPa~~ $\therefore \sigma_{x'} = 47,35$

$$\sigma_{y'} = \frac{\sigma_x+\sigma_y}{2} - \frac{\sigma_x-\sigma_y}{2}\cos 2\theta - \tau_{xy}\sin 2\theta = 125 - (-12,5) - (64,95)$$

~~$\therefore \sigma_{y'}$~~ $\therefore \sigma_{y'} = 202,45$

$$\tau_{x'y'} = \frac{-\sigma_x-\sigma_y}{2}\sin 120° + \tau_{xy}\cos 2\theta = \frac{-150-100}{2}\sin 120 + 75\cos 120 = +108,25 + (-37,5)$$

~~$\therefore \tau_{x'y'} = 140,75\,MPa$~~ $\tau_{x'y'} = 70,75\,MPa$



3- $\varepsilon_{AC} = \varepsilon_y = 0,01$

$\varepsilon_{AB} = \varepsilon_x = 0,0075$

$\varepsilon_y = \dfrac{L_{AC}' - L_{AC}}{L_{AC}} \therefore L_{AC}' = \varepsilon_y \cdot L_{AC} + L_{AC} \therefore L_{AC}' = 303\,mm$

$\varepsilon_x = \dfrac{L_{AB}' - L_{AB}}{L_{AB}} \therefore L_{AB}' = \varepsilon_x L_{AB} + L_{AB} \therefore L_{AB}' = 403\,mm$

Definimos L_{BC} como: $L_{BC}^2 = L_{AB}^2 + L_{AC}^2 \therefore L_{BC} = 500\,mm$

Temos que $\gamma = \frac{\pi}{2} - \theta \therefore \theta = -\gamma + \frac{\pi}{2} \Rightarrow \theta = 89,71°$, pelo teorema do cosseno:

$$L_{BC}' = \sqrt{L_{AB}'^2 + L_{AC}'^2 - 2L_{AB}'\cdot L_{AC}'\cdot\cos\theta} = 502,988\,mm$$

Logo $\varepsilon_{BC} = \dfrac{L_{BC}' - L_{BC}}{L_{BC}} \therefore \boxed{\varepsilon_{BC} = 5,976\cdot 10^{-3}\,mm/mm}$

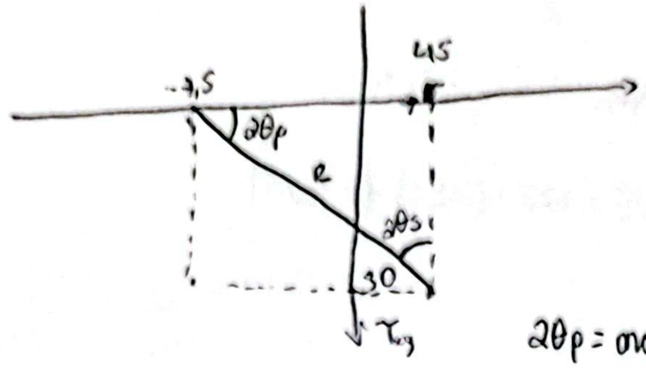
Scanné avec CamScanner

6-

$\tau_{xy} = 30MPa$, $\sigma_x = 45MPa$, $\sigma_y = -60MPa$

$\sigma_m = \dfrac{45 + (-60)}{2} = -7{,}5MPa$ $\quad P(\sigma_x, \tau_{xy}) = (45, 30)$

$R^2 = 30^2 + 52{,}5^2 \therefore R = 60{,}47MPa$



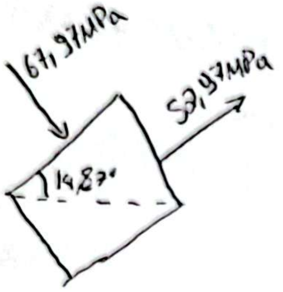
$\sigma_1 = -7{,}5 + 60{,}47 \therefore \boxed{\sigma_1 = 52{,}97MPa}$

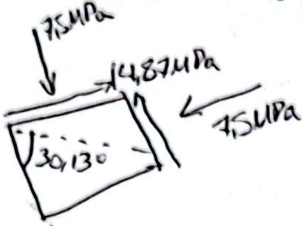
$\sigma_2 = -7{,}5 - 60{,}47 \therefore \boxed{\sigma_2 = -67{,}97MPa}$

$\boxed{\tau_{max} = R = 60{,}47MPa}$

$2\theta p = arctg\left(\dfrac{30}{52{,}5}\right) \therefore \theta p = \dfrac{1}{2} arctg\left(\dfrac{30}{52{,}5}\right) \therefore \boxed{\theta p = 14{,}87°}$

$2\theta s = arctg\left(-\dfrac{52{,}5}{30}\right) \therefore \theta s = \dfrac{1}{2} arctg\left(-\dfrac{52{,}5}{30}\right) \therefore \boxed{\theta s = -30{,}13°}$

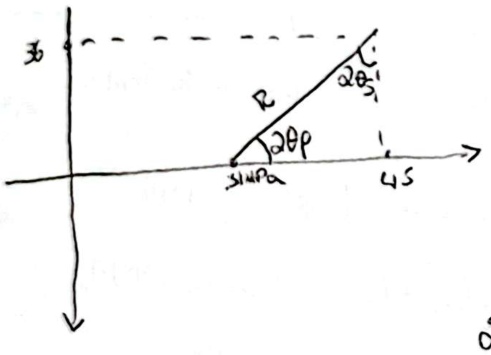




7- $\sigma_x = 45MPa$ $\quad \sigma_y = 17MPa$ $\quad \tau_{xy} = -36MPa$

$\sigma_m = \dfrac{45 + 17}{2} = 31MPa$ $\quad$ e $\quad P(\sigma_x, \tau_{xy}) = (45, -36)$

$R^2 = 14^2 + 36^2 \therefore R = 38{,}63MPa$



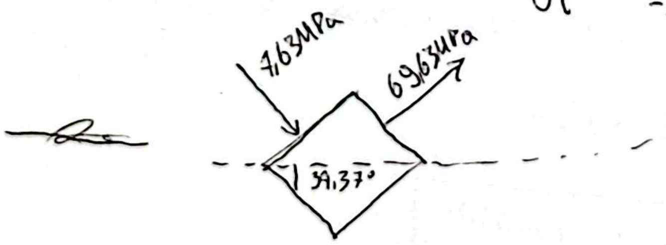
$\sigma_1 = 31 + 38{,}63 \therefore \boxed{\sigma_1 = 69{,}63MPa}$

$\sigma_2 = 31 - 38{,}63 \therefore \boxed{\sigma_2 = -7{,}63MPa}$

$\boxed{\tau_{max} = R = 38{,}63MPa}$

$2\theta p = arctg\left(\dfrac{-36}{14}\right) \therefore \theta p = \dfrac{1}{2} arctg\left(\dfrac{-36}{14}\right) \therefore \boxed{\theta p = -34{,}37°}$

$2\theta s = arctg\left(-\dfrac{14}{-36}\right) \therefore \theta p = \dfrac{1}{2} arctg\left(\dfrac{14}{36}\right) \therefore \boxed{\theta s = 10{,}63°}$



8- ① Se refere ao ponto de tensão de ruptura, onde a partir desse valor de deformação o material se rompe;

② é o ponto de limite de resistência, quando a tensão passa desse ponto o material começa a sofrer estricção; ~~após~~

④ Limite de elasticidade, onde a partir desse ponto o material se deforma de maneira permanente, não voltando mais a sua forma original;

⑤ A região elástica onde a tensão e elasticidade crescem de maneira linear, além disso, se a carga for removida, o material retorna a sua forma original.

⑥ Estricção,

9- Temos o item ⓐ como verdadeiro, pois sabemos que no início do experimento estamos trabalhando ~~em~~ na região elástica, onde se é respeitada a lei de Hooke e a deformação e tensão crescem de maneira proporcional

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10- Materiais Dúcteis:

- Apresentam grande deformação plástica antes da fratura podendo ser alongados ou moldados sem se romper de imediato. Ex: Aço, Cobre e Alumínio;

Materiais FRÁGEIS:

- São aqueles que se rompem com pouca ou nenhuma deformação plástica quando se é submetido a alguma carga. Ex: Vidro, Cerâmica e Concreto.

11- A equação de deformação média é dada por $\varepsilon = \frac{A_s' - A_s}{A_s}$, onde $A_s = 150mm$ e $A_s' = 175mm$

$\therefore \varepsilon = \frac{175-150}{150} \therefore \boxed{\varepsilon = 0,1667 mm/mm}$

12- Definimos $a_0 = 400mm$ e $b_0 = 300mm$ $\Delta A_x = 3mm$ $\Delta A_y = 2mm$

$\Delta B_x = 5mm$ $\Delta B_y = 4mm$

$\Delta C_x = 2mm$ $\Delta C_y = 2mm$

$\alpha = \frac{\Delta C_x}{b_0 + \Delta C_y} \therefore \alpha = 6{,}622 \cdot 10^{-3} rad$

$\beta = \theta = \frac{\Delta B_y - \Delta C_y}{a_0 + \Delta B_x - \Delta C_x} \therefore \beta = 4{,}963 \cdot 10^{-3} rad \to$ Temos: $(\gamma_C)_{xy} = -(\alpha + \beta) \therefore \boxed{(\gamma_C)_{xy} = -11{,}585 \cdot 10^{-3} rad}$

$(\gamma_D)_{xy} = \alpha + \beta \therefore \boxed{(\gamma_D)_{xy} = 11{,}585 \cdot 10^{-3} rad}$

13- $\sigma = \frac{P}{A}$, $A = \pi r^2 = \frac{\pi d^2}{4}$, $d = 15 \cdot 10^{-3} m \therefore A = \frac{\pi \cdot (15 \cdot 10^{-3})^2}{4} \therefore A = 1{,}767 \cdot 10^{-4} m$

$\therefore \sigma = \frac{300}{1{,}767 \cdot 10^{-4}} \therefore \sigma = 1{,}697{,}79 \cdot 10^{3} Pa$, temos que $E = \frac{\sigma}{\varepsilon} \therefore \varepsilon = \frac{\sigma}{E}$

$\therefore \varepsilon = \frac{1697{,}79 \cdot 10^{3}}{2{,}7 \cdot 10^{9}} \therefore \varepsilon = 6{,}28 \cdot 10^{-4} \to \delta = \varepsilon \cdot L = 6{,}28 \cdot 10^{-4} \cdot 200 \cdot 10^{-3} = \boxed{1{,}256 \cdot 10^{-4} m}$

$\nu = -\frac{\varepsilon'}{\varepsilon}$, onde ε' é a deformação lateral e ε a axial

$\therefore 0{,}4 = \frac{-\varepsilon'}{1{,}256 \cdot 10^{-4}} \therefore \varepsilon' = -2{,}512 \cdot 10^{-4} \to \Delta d = d\,\varepsilon' = 15 \cdot 10^{-3} \cdot (-2{,}512 \cdot 10^{-4}) \therefore \boxed{\Delta d = -3{,}768 \cdot 10^{-6} m}$

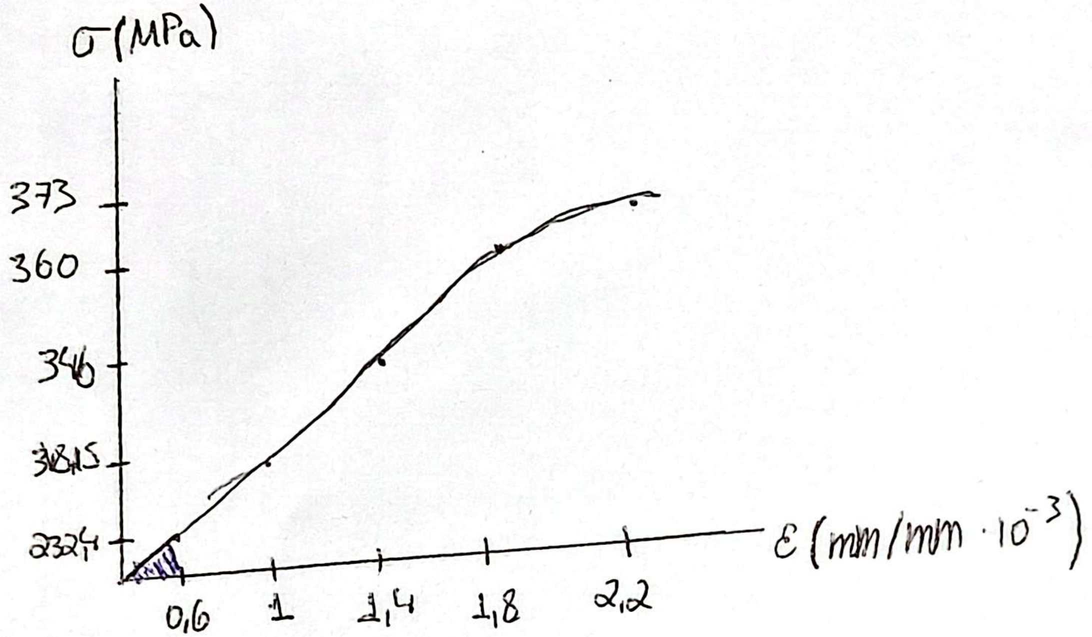
14- $\varepsilon = 0{,}001 mm/mm$ $\varepsilon_2 = 0{,}00243 mm/mm$, $A = 2200 mm^2$, $E_{al} = 70 \cdot 10^{9} Pa$

$\sigma = \varepsilon E_{al}$ $\to$ Para ε: $0{,}001 \cdot 70 \cdot 10^{9} \Rightarrow \sigma = 70 \cdot 10^{6} Pa$

$\to$ Para ε_1: $0{,}00243 \cdot 70 \cdot 10^{9} \Rightarrow \sigma_1 = 170{,}1 \cdot 10^{6} Pa$

$\sigma = \frac{P}{A} \therefore P = A\sigma \therefore \Delta P = A \Delta\sigma \therefore \Delta P = 2200 \cdot (10^{-3})^2 \cdot (170{,}1 - 70) \cdot 10^{6} \therefore \boxed{\Delta P = 220{,}22 \cdot 10^{3} N}$

15-



$$E = \frac{\sigma}{\varepsilon} = \frac{232{,}4 \cdot 10^{6}}{6 \cdot 10^{-4}} \therefore \boxed{E = 387{,}3\ GPa}$$

$$Un = \frac{\sigma \varepsilon}{2} = \frac{232{,}4 \cdot 10^{6} \cdot 6 \cdot 10^{-4}}{2} \therefore Ur = \boxed{69{,}72\ kJ/m^3}$$