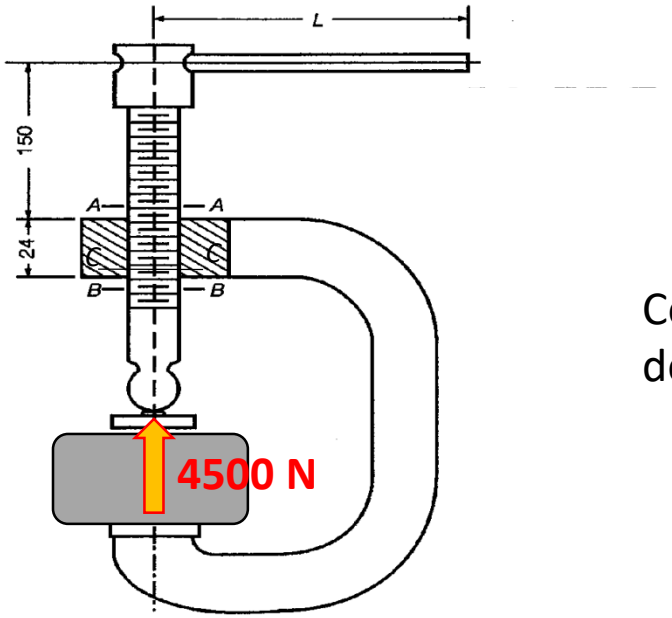
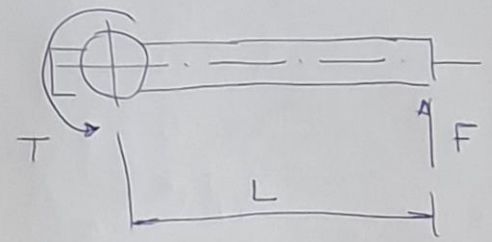
1- Determine o comprimento L para que o grampo seja acionado por uma força de 90 N
2- Determine as tensões nas seções AA e BB
3- Determine as tensões na seção correspondente ao primeiro filete engajado, logo acima de BB, incluindo a pressão no flanco (seção CC).



Considere um fator de concentração de tensão de 1,5 devido à rosca.

Rosca ½” – 13 UNC, 1 Entrada
Coeficiente de atrito nos filetes f = 0,12
Coeficiente de atrito no pivô f_c = 0,25
Raio médio do pivô r_c = 6,5 mm

1- Comprimento L



$T = F \times L$

$= 90 \times L$

$$T = F \frac{d_m}{2}\left(\frac{l + \pi f d_m \sec\alpha}{\pi d_m - f l \sec\alpha}\right) + \frac{F f_c d_c}{2}$$

$$T = 4500 \times \frac{11,43}{2}\left(\frac{1,95 + \pi\ 0,12 \times 0,45 \times \sec 30^\circ}{\pi \times 11,43 - 0,12 \times 1,95 \sec 30^\circ}\right) +$$

$$+ 4500 \times 0,25 \times 6,5 = 8.810,96$$

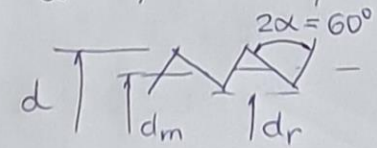
$$L = \frac{8.810,96\ N \cdot mm}{90\ N} = 98\ mm \cong 100\ mm$$

Rosca 1/2" - 13 UNC - 1 entrada

$l = p = \frac{1"}{13} = 0,07692" \cong 1,95\ mm$

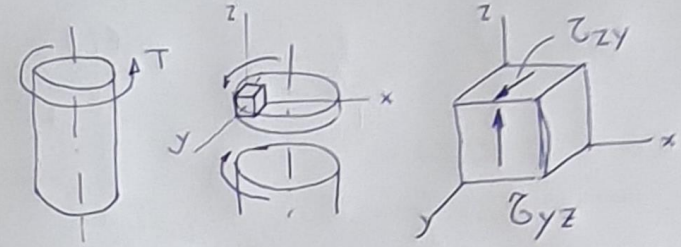
$d_m = d - 0,649\,519\,p = 0,45" \cong 11,43\ mm$

$d_r = d - 1,299\,038\,p = 0,40" \cong 10,16\ mm$



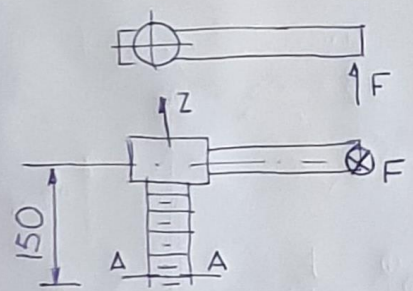
2.

AA



$$\tau = \tau_{yz} = \frac{16T}{\pi d_r^3} = \frac{16 \times 8810,96}{\pi (10,16)^3} \Rightarrow$$

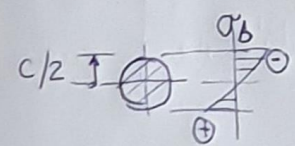
$\tau_{yz} = 42,76\ MPa$



$M_f = F \times 150\ mm$

$M_f = 90\ N \times 150\ mm$

$$\sigma_b = \frac{M_f\, c}{I} = \frac{(90 \times 150)\ (10,16/2)}{\pi (10,16)^4/64}$$



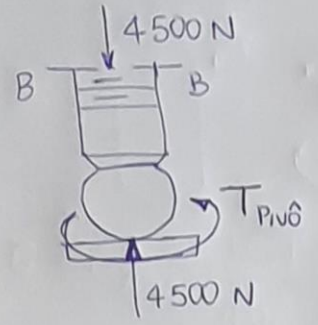
$\sigma_b = 131,12\ MPa$

$c/2 = d_r/2$ $\quad \sigma_b = \sigma_z$

$$\sigma' = \sqrt{\sigma^2 + 3\tau^2} = \sqrt{131,12^2 + 3 \times 42,76^2}$$

$= 150,59\ MPa \quad (\times 1,5)$

BB



$$T_{PIVÔ} = \frac{F f_c d_c}{2} = 4500 \times 0{,}25 \times 6{,}5 = 7.312{,}5\ N \cdot mm$$

$$\sigma = \frac{F}{A} = \frac{4500\ N}{\pi\, d_r^2/4} = \frac{4500}{\frac{\pi (10{,}16)^2}{4}} = 55{,}5\ MPa = \sigma_z$$

$$\tau = \frac{16\, T_{PIVÔ}}{\pi d_r^3} = \frac{16 \times 7.312{,}5}{\pi (10{,}16)^3} = 35{,}83\ MPa = \tau_{yz}$$

CC

$$\begin{cases} \sigma_x = \dfrac{6 \times (0{,}38F)}{\pi d_r P} = 164{,}84\ MPa \\ \sigma_y = 0 \\ \sigma_z = -\dfrac{4F}{\pi d_r^2} = -55{,}5\ MPa \end{cases}$$

$$\begin{cases} \tau_{xy} = 0 \\ \tau_{yz} = \dfrac{16\, T}{\pi d_r^3} = 42{,}79\ MPa \\ \tau_{zx} = 0 \end{cases}$$

Pressão no Flanco:

$$\sigma_B = -\frac{F}{\pi d_m n_t P/2} = -\frac{2\,(0{,}38\,F)}{\pi d_m P}$$

$$= 24{,}4\ MPa$$

$\sigma' =$

$$\sigma' = \frac{1}{\sqrt{2}} \left\{ (164,84 - 0)^2 + [0 - (-55,5)]^2 + (-55,5 - 164,84)^2 + \right.$$

$$\left. + 6(42,79)^2 \right\}^{1/2} = 211,88 \text{ MPa}$$

Não há tensão de cisalhamento na face x, então σ_x é uma tensão principal, logo as outras duas tensões principais são:

$$\frac{0 + (-55,5)}{2} \pm \sqrt{\left(\frac{0 - (-55,5)}{2}\right)^2 + 42,79^2} =$$

$$= \begin{matrix} 23,25 \\ \end{matrix} ; -56,26$$

Ordenando: $\sigma_1 ; \sigma_2 ; \sigma_3 = 164,84 ; 23,25 ; -56,26$

$$\tau_{máx} = \frac{\sigma_1 - \sigma_3}{2} = \frac{164,84 - (-56,26)}{2}$$

$$= 110,55 \text{ MPa}$$

$(\times 1,5)$