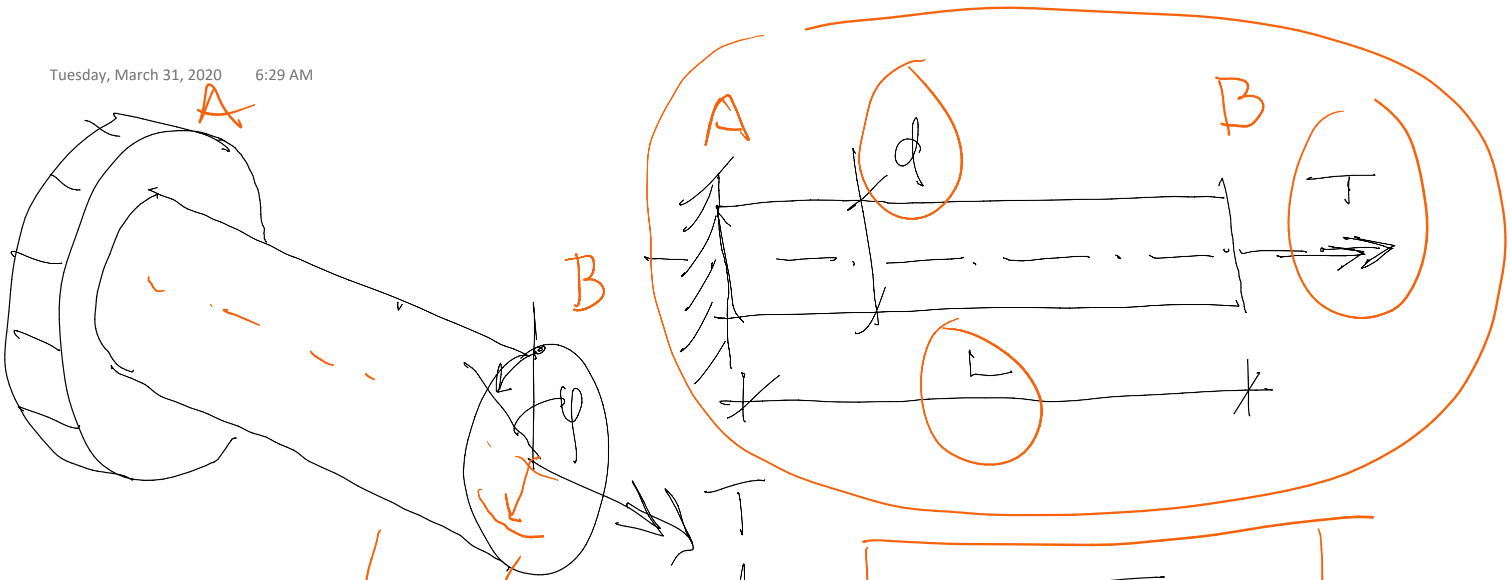
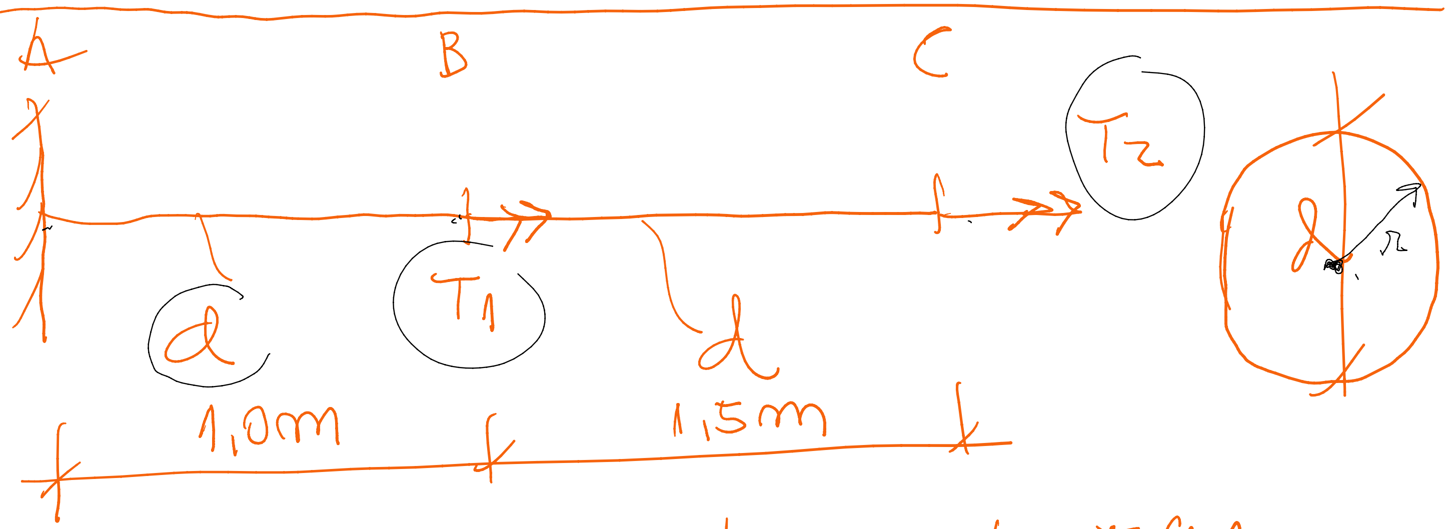
Tuesday, March 31, 2020 6:29 AM



Tensões de cisalhamento

$$\varphi = \frac{T \cdot L}{G \cdot I_p}$$

$$\tau_\rho = \frac{T}{I_p} \cdot \rho$$



$T_1 = 10kNm$ $T_2 = 5kN$ $d = 5\,cm$

$G = 80\,GPa$ $\tau_u = 110\,MPa$

a) τ_{max}: devido a $T_i \rightarrow$ $\tau = \frac{T}{I} \rho$

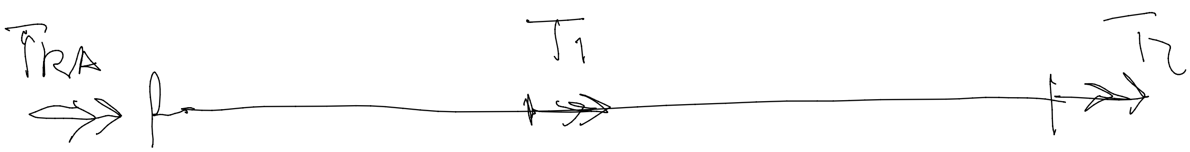
a) τ_{max}: devido a T_i → $\tau_T = \frac{T}{I_p} \cdot \rho$

$\rho_{max} = r$

$$I_p = \frac{\pi d^4}{32}$$

$$\tau_{T_{max}} = \frac{T}{I_p} \cdot r$$

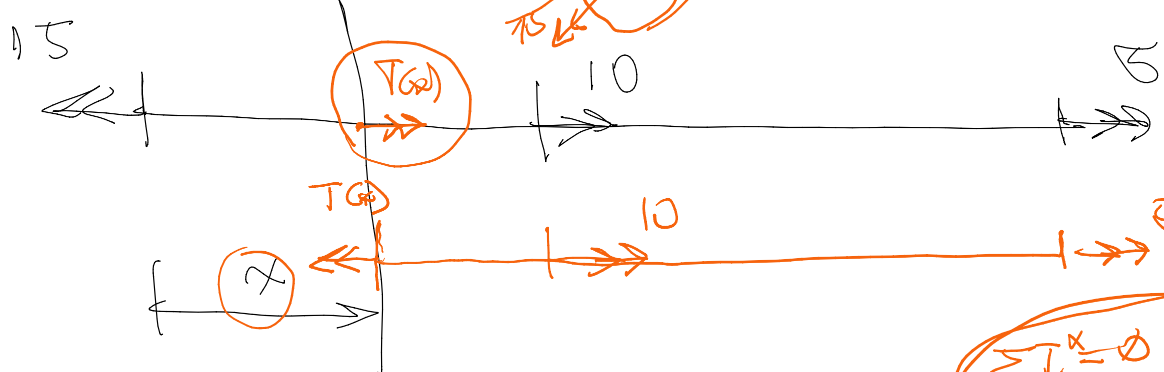
Det o diagrama de torção (T)



$\sum T^A = 0 \quad T_{RA} + T_1 + T_2 = 0 \;\therefore\; T_{RA} = -T_1 - T_2$

$T_{RA} = -10\ kNm - 5\ kNm$

$T_{RA} = -15\ kNm$



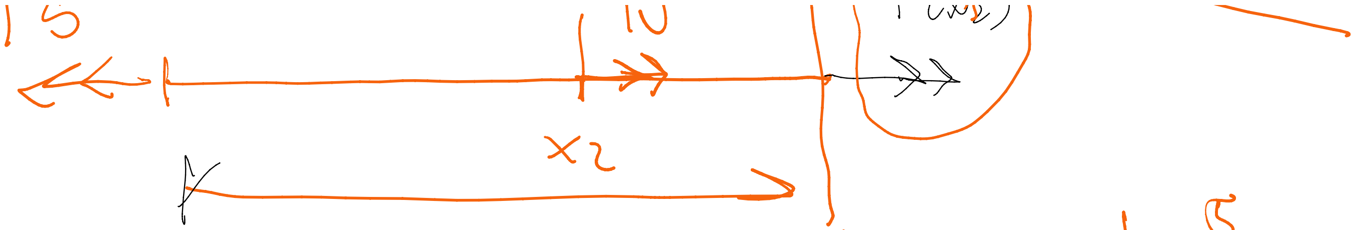
$\sum T = 0 \quad T(x) - 15 = 0 \quad 0 < x < 1m$

$T(x) = 15\ kNm$

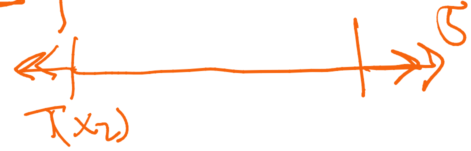
$\sum T^x = 0$

$T(x) - 10 - 5 = 0$

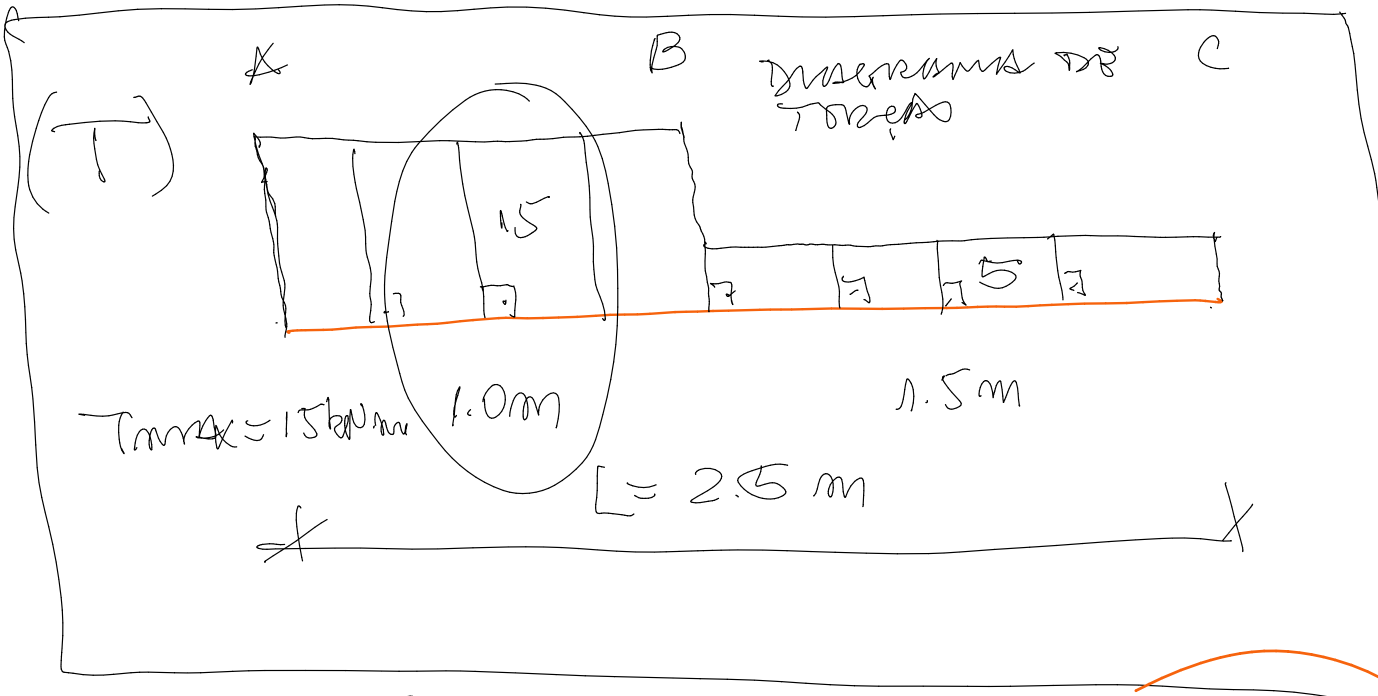
$T(x) = +15$



$$\sum T^{x_2} = 0 \qquad T_{(x_2)} + 10 - 15 = 0$$



$$\boxed{T(x_2) = 5\,kNm}$$



$$\tau_{T_{max}} = \frac{T_{max}}{I_p} \cdot r = \frac{15\,kN.m}{\frac{\pi d^4}{32}} \cdot \frac{d}{2} = \frac{16 \times 15\,kNm}{\pi d^3}$$

$$W_p = \frac{I_p}{d/2} = \frac{\pi d^{4}}{32} \cdot \frac{2}{d} = \frac{\pi d^3}{16}$$

$$\tau_{T_{max}} = 611\ MPa > \tau_u = ??$$

$$\tau_{act} \leq \tau_{adm} \qquad \gamma = \frac{\tau_u}{611} < 1\ !!$$

↓ ... mentira ...

$\sigma_{act} \leq \sigma_{adm}$ ... $\frac{...}{6 \Pi}$ ...

$\downarrow$

$\frac{T}{I_p} \cdot r \leq \frac{\tau_u}{\gamma_{coef\ seg}}$

a resistência é insuficiente.

Dado o coef. de segurança de $\gamma = 2$, det. o valor de d para o carregamento T_1 e T_2

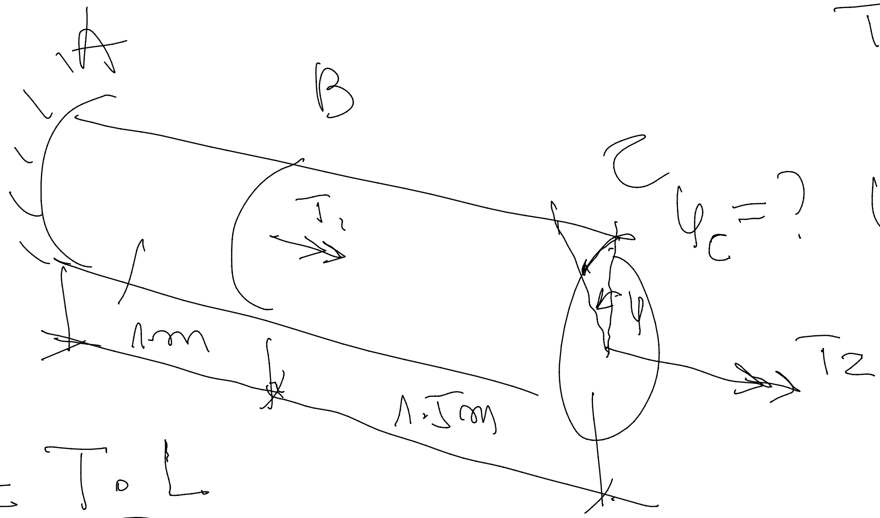
$\tau_{max} \leq \tau_{adm}$

$\downarrow$

$\frac{16\, T_{max}}{\pi d^3} \leq \left(\frac{\tau_u}{2} = \frac{110}{2}\right) \quad d^3 \geq \frac{16\, T_{max}}{55\pi}$

b) Calcular a rotação em C (ext. da barra)

$T_1 = 10$ e $T_2 = 5$



$\varphi_C = ?$ $\quad \varphi_C = \varphi_{BA} + \varphi_{CB}$

$\varphi = \frac{T \cdot L}{G\, I_p}$

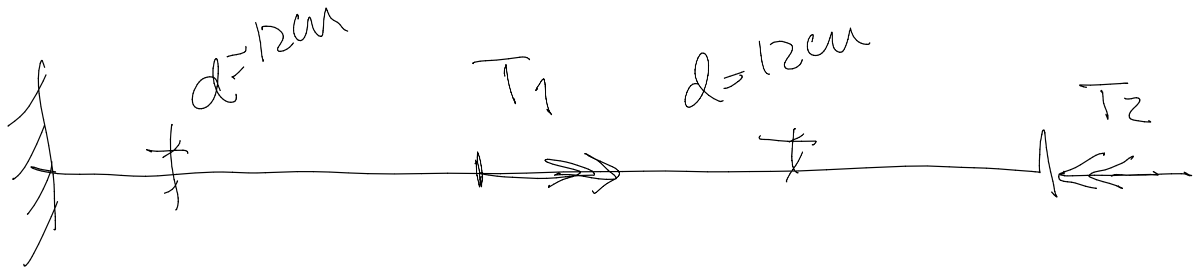
$\varphi_C = \frac{T_{AB} \cdot L_{AB}}{G \cdot I_p} + \frac{T_{BC} \cdot L_{BC}}{G I_p} = \left(\frac{15kNm \times 1m}{G I_p}\right) + \left(\frac{5kNm \times 1.5m}{G I_p}\right)$

$\varphi_C = \frac{1}{...}\left(15 \times 1 + 5 \times 1{,}5\right)$

$$\varphi_c = \frac{1}{GJ_p}\left(15\times 1 + 5\times 1{,}5\right)$$

$\varphi_c = 0{,}792$ grau ou $\varphi_c = 0{,}14$ rad

Ex 2

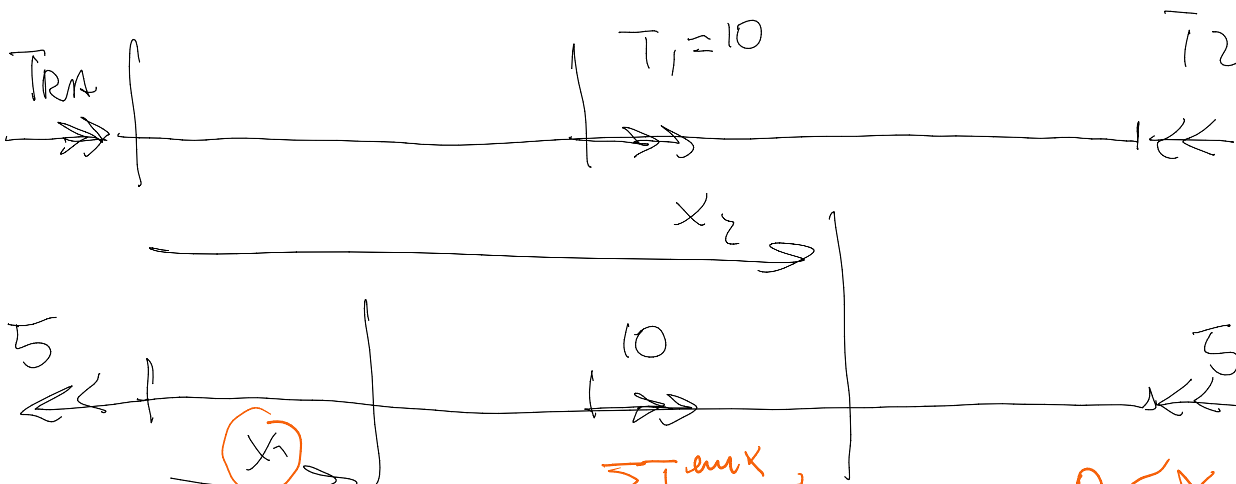


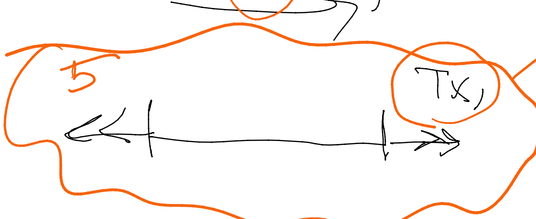
Calculo do Torque

$T_{RA} + 10 - 5 = 0$

$T_{RA} = -5$

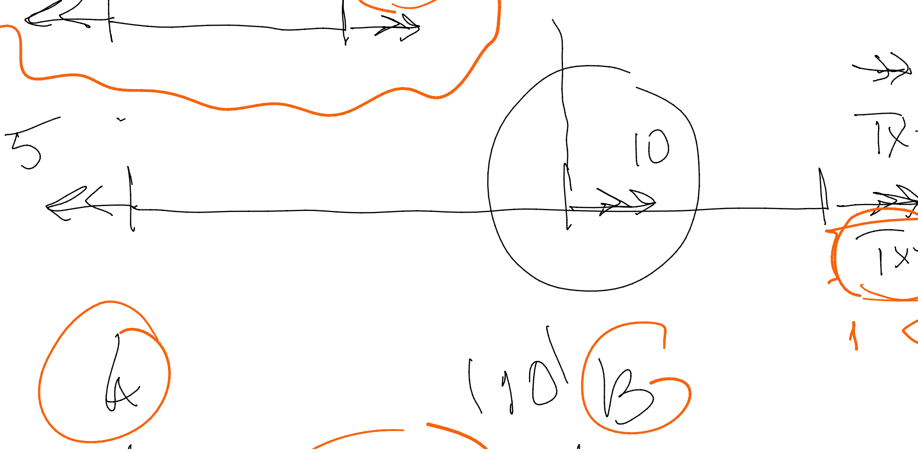
kN.m





$\sum T^{eix} = 0$

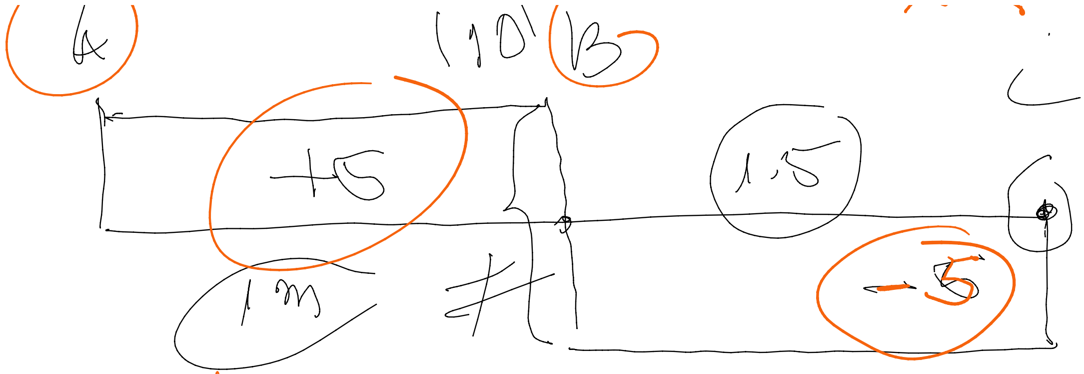
$T_{x_1} - 5 = 0$; $T(x_1) = 5$; $0 < x_1 < 1\,m$



$T_{x_2} + 10 - 5 = 0$

$T_{x_2} = -5$ kNm

$1 < x_2 < 2{,}5\,m$



$$\varphi = \frac{T \cdot L}{G I_p}$$