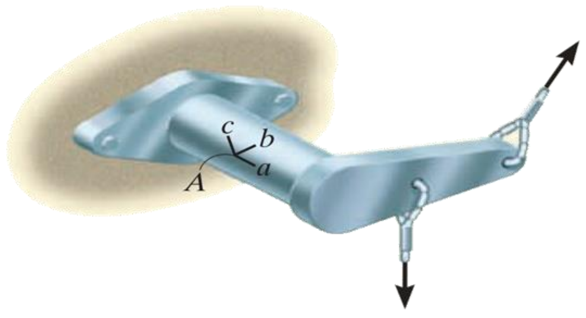
Resistência dos Materiais - Aula 1
Exercício 1:



$E = 200GPa$, $G = 76{,}9GPa$ e $\nu = 0{,}3$

$\varepsilon_a = 60 \times 10^{-6}$ $\quad\theta_a = 0°$
$\varepsilon_b = 135 \times 10^{-6}$ $\quad\theta_b = 60°$
$\varepsilon_c = 264 \times 10^{-6}$ $\quad\theta_c = 120°$

Aplicar equações que relacionam as deformações nos extensômetros com as deformações em x e y:

$$\varepsilon_a = \varepsilon_x * \cos^2(\theta_a) + \varepsilon_y * \text{sen}^2(\theta_a) + \gamma_{xy} * \text{sen}(\theta_a) * \cos(\theta_a)$$
$$\varepsilon_b = \varepsilon_x * \cos^2(\theta_b) + \varepsilon_y * \text{sen}^2(\theta_b) + \gamma_{xy} * \text{sen}(\theta_b) * \cos(\theta_b)$$
$$\varepsilon_c = \varepsilon_x * \cos^2(\theta_c) + \varepsilon_y * \text{sen}^2(\theta_c) + \gamma_{xy} * \text{sen}(\theta_c) * \cos(\theta_c)$$

$$60 \times 10^{-6} = \varepsilon_x * \cos^2(0°) + \varepsilon_y * \text{sen}^2(0°) + \gamma_{xy} * \text{sen}(0°) * \cos(0°)$$
$$135 \times 10^{-6} = \varepsilon_x * \cos^2(60°) + \varepsilon_y * \text{sen}^2(60°) + \gamma_{xy} * \text{sen}(60°) * \cos(60°)$$
$$264 \times 10^{-6} = \varepsilon_x * \cos^2(120°) + \varepsilon_y * \text{sen}^2(120°) + \gamma_{xy} * \text{sen}(120°) * \cos(120°)$$

$\varepsilon_x = 60 \times 10^{-6}$ $\quad\varepsilon_y = 246 \times 10^{-6}$ $\quad\gamma_{xy} = -149 \times 10^{-6}$

Aplicar Lei de Hooke Generalizada com $\sigma_z = 0Pa$

$$\varepsilon_x = \frac{1}{E}[\sigma_x - \nu * \sigma_y]$$

$$\varepsilon_y = \frac{1}{E}[\sigma_y - \nu * \sigma_x]$$

$$\gamma_{xy} = \frac{1}{G}\tau_{xy}$$

$$60 \times 10^{-6} = \frac{1}{200 \times 10^9}[\sigma_x - 0{,}3 * \sigma_y]$$

$$246 \times 10^{-6} = \frac{1}{200 \times 10^9}[\sigma_y - 0{,}3 * \sigma_x]$$

$$-149 \times 10^{-6} = \frac{1}{76{,}9 \times 10^9}\tau_{xy}$$

$\sigma_x = 29{,}4 \times 10^6 Pa$ $\quad\sigma_y = 58{,}0 \times 10^6 Pa$ $\quad\tau_{xy} = -11{,}46 \times 10^6 Pa$

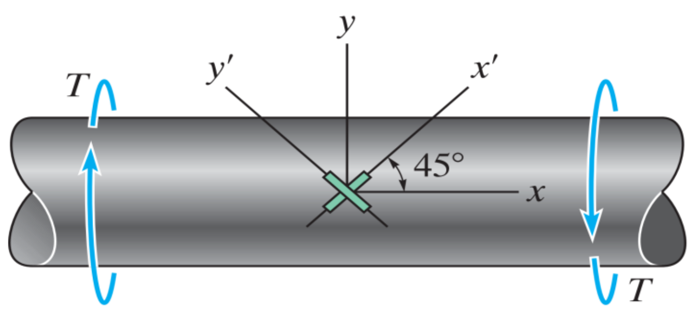
Tensões Principais:

$$\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_1 = \frac{29{,}4 \times 10^6 + 58{,}0 \times 10^6}{2} \pm \sqrt{\left(\frac{29{,}4 \times 10^6 - 58{,}0 \times 10^6}{2}\right)^2 + (-11{,}46 \times 10^6)^2}$$
$$\sigma_1 = 62 \times 10^6 Pa$$

$$\sigma_2 = \frac{29{,}4 \times 10^6 + 58{,}0 \times 10^6}{2} - \sqrt{\left(\frac{29{,}4 \times 10^6 - 58{,}0 \times 10^6}{2}\right)^2 + (-11{,}46 \times 10^6)^2}$$
$$\sigma_2 = 25{,}4 \times 10^6 Pa$$

Exercício 2:



$\varepsilon_{x'} = -80 \times 10^{-6}$ e $\varepsilon_{y'} = 80 \times 10^{-6}$

$E = 200GPa$, $G = 76{,}9GPa$ e $\nu = 0{,}3$

$\theta_{x'} = 45°$ e $\theta_{y'} = 135°$

$r = 0{,}015m$ e $D = 0{,}030m$

$$I_p = \frac{\pi * D^4}{32} = \frac{\pi * 0{,}030^4}{32} = 7{,}95 \times 10^{-8} m^4$$

Cisalhamento puro:

$$\varepsilon_x = \varepsilon_y = 0$$

Aplicar equações que relacionam as deformações nos extensômetros com as deformações em x e y:

$$\varepsilon_{x'} = \varepsilon_x * \cos^2(\theta_{x'}) + \varepsilon_y * \text{sen}^2(\theta_{x'}) + \gamma_{xy} * \text{sen}(\theta_{x'}) * \cos(\theta_{x'})$$
$$-80 \times 10^{-6} = 0 * \cos^2(45°) + 0 * \text{sen}^2(45°) + \gamma_{xy} * \text{sen}(45°) * \cos(45°)$$
$$\gamma_{xy} = -160 \times 10^{-6}$$

Aplicar Lei de Hooke para Cisalhamento:

$\gamma_{xy} = \frac{1}{G}\tau_{xy}$ $\quad -160 \times 10^{-6} = \frac{1}{76{,}9 \times 10^9} * \tau_{xy}$ $\quad \tau_{xy} = 12{,}308 \times 10^6 Pa$

Aplicar Equação da Tensão de Cisalhamento por Torque:

$\tau = \frac{T * \rho}{I_p}$ $\quad 12{,}308 \times 10^6 = \frac{T * 0{,}015}{7{,}95 \times 10^{-8}}$ $\quad T = 65{,}2Nm$