Problema 1.

$$\varepsilon_A = 500\times10^{-6}, \quad \varepsilon_B = 150\times10^{-6}, \quad \varepsilon_C = 350\times10^{-6}$$

$$\varepsilon_A = \varepsilon_{xx}$$

$$\varepsilon_B = \varepsilon(45°) = \frac{\varepsilon_{xx}+\varepsilon_{yy}}{2} + \frac{\varepsilon_{xx}-\varepsilon_{yy}}{2}\cos(90°) + \varepsilon_{xy}\sin(90°) = \frac{\varepsilon_{xx}+\varepsilon_{yy}}{2} + \varepsilon_{xy}$$

$$\varepsilon_C = \varepsilon_{yy}$$

$$\varepsilon_{xx} = \varepsilon_A = 500\times10^{-6}$$

$$\varepsilon_{yy} = \varepsilon_C = 350\times10^{-6}$$

$$\varepsilon_{xy} = \frac{2\varepsilon_B - (\varepsilon_A+\varepsilon_C)}{2} = -275\times10^{-6}$$

$$\left.\begin{aligned}\varepsilon_{xx} &= \frac{\sigma_{xx}}{E} - \nu\frac{\sigma_{yy}}{E}\\ \varepsilon_{yy} &= -\nu\frac{\sigma_{xx}}{E} + \frac{\sigma_{yy}}{E}\end{aligned}\right\} \Rightarrow \left\{\begin{aligned}\sigma_{xx} &= \frac{E}{1-\nu^2}(\varepsilon_{xx}+\nu\,\varepsilon_{yy}) = 133\,\text{MPa}\\ \sigma_{yy} &= \frac{E}{1-\nu^2}(\nu\,\varepsilon_{yy}+\varepsilon_{xx}) = 110\,\text{MPa}\end{aligned}\right.$$

$$\varepsilon_{xx} = \frac{1+\nu}{E}\sigma_{xy} \quad\Rightarrow\quad \sigma_{xy} = \frac{E}{1+\nu}\varepsilon_{xy} = -42{,}3\,\text{MPa}$$

$$\varepsilon_{zz} = -\frac{\nu}{1-\nu}(\varepsilon_{xx}+\varepsilon_{yy}) \quad\Rightarrow\quad \varepsilon_{zz} = -364\times10^{-6}$$

$$\sigma_m = \frac{\sigma_{xx}+\sigma_{yy}}{2} = 121\,\text{MPa}, \quad \text{R} = \sqrt{\left(\frac{\sigma_{xx}-\sigma_{yy}}{2}\right)^2 + \sigma_{xy}^2} = 43{,}9\,\text{MPa}$$

$$\sigma_{\text{I}} = \sigma_m + R = 165\ \text{MPa}, \quad \sigma_{\text{II}} = \sigma_m - R = 77{,}6\ \text{MPa}$$

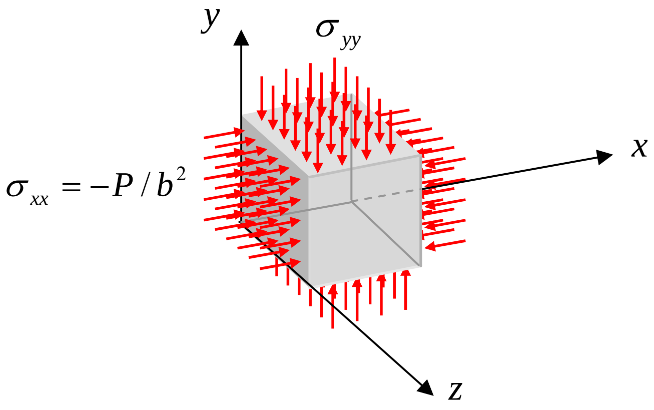
$$\sigma_1 = \sigma_{\text{I}} = 165\ \text{MPa}, \quad \sigma_2 = \sigma_{II} = 77{,}6\ \text{MPa} \quad \text{e} \quad \sigma_3 = \sigma_{zz} = 0$$

$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2} = 82{,}5\ \text{MPa}$$

Problema 2.

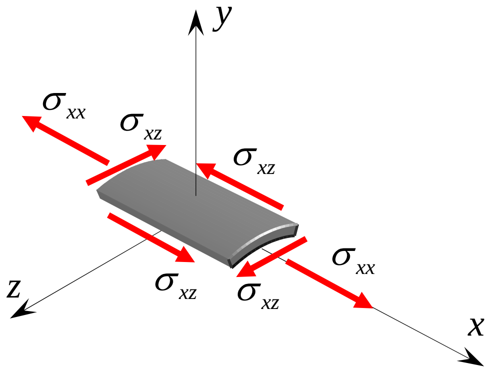
$$\sigma_{xx} = -P/b^2, \sigma_{yy} = ?, \sigma_{zz} = 0$$

$$\varepsilon_{xx} = ?, \varepsilon_{yy} = 0, \varepsilon_{zz} = ?$$



$$\left.\begin{aligned}\varepsilon_{xx} &= -\frac{P}{Eb^2} - \nu\frac{\sigma_{yy}}{E}\\ 0 &= \nu\frac{P}{Eb^2} + \frac{\sigma_{yy}}{E}\\ \varepsilon_{zz} &= \nu\frac{P}{Eb^2} - \nu\frac{\sigma_{yy}}{E}\end{aligned}\right. \Rightarrow \quad \begin{aligned}&\sigma_{xx} = -\frac{P}{b^2},\quad \sigma_{yy} = -\nu\frac{P}{b^2},\quad \sigma_{zz} = 0\\ &\varepsilon_{xx} = -\frac{(1-\nu^2)P}{Eb^2},\quad \varepsilon_{yy} = 0,\quad \varepsilon_{zz} = \frac{\nu(1+\nu)P}{Eb^2}\end{aligned}$$

Problema 3.



$$\sigma_{xx}(0, D/2) = -\frac{D}{2}\frac{(-PL)}{\pi D^3 t/8} = \frac{4PL}{\pi D^2 t}$$

$$\sigma_{xz}(0, D/2) = \frac{D}{2}\frac{T}{\pi D^3 t/4} = \frac{2T}{\pi D^2 t}$$

$$\varepsilon_{xx} = \frac{\sigma_{xx}}{E} \Rightarrow \varepsilon_{xx} = \frac{4PL}{\pi D^2 tE} \Rightarrow P = \frac{\pi D^2 tE}{4L}\varepsilon_{xx}$$

$$\varepsilon_{xy} = \frac{2\varepsilon_c - (\varepsilon_{xx} + \varepsilon_{zz})}{2} = \frac{\sigma_{xz}}{2G} \Rightarrow T = \pi D^2 tG\left[\frac{2\varepsilon_c - (\varepsilon_{xx} + \varepsilon_{zz})}{2}\right]$$

Problema 4

$$\max\{|\sigma_{xx}|\} = |\sigma_{xx}(L/2, \pm h/2)| = \frac{h}{2}\frac{(qL^2/8)}{(bh^3/12)} = \frac{3}{4}\frac{qL^2}{bh^2}$$

Estado uniaxial de tensão: $\sigma_1 = \frac{3}{4}\frac{qL^2}{bh^2},\ \sigma_2 = \sigma_3 = 0$

$$\tau_{\max} = \frac{\sigma_1 - \sigma_3}{2} = \frac{\sigma_1}{2} = \frac{3}{8}\frac{qL^2}{bh^2} < \tau_Y \quad \Rightarrow \quad L < \sqrt{\frac{8bh^2\tau_Y}{3q}}$$