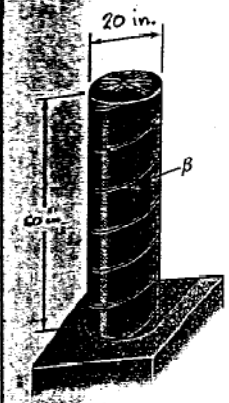
Problem 7.98

7.98 A basketball has a 300-mm outer diameter and a 3-mm wall thickness. Determine the normal stress in the wall when the basketball is inflated to a 120-kPa gage pressure.

$r = \frac{1}{2}d - t = 147\ \text{mm} = 147\times10^{-3}\ \text{m}$ $\quad p = 120\times10^{3}\ \text{Pa}$

$$\sigma_1 = \sigma_2 = \frac{pr}{2t} = \frac{(120\times10^{3})(147\times10^{-3})}{(2)(3\times10^{-3})} = 2.94\times10^{6}\ \text{Pa} \qquad \sigma = 2.94\ \text{MPa}$$

Problem 7.114



7.114 The cylindrical portion of the compressed-air tank shown is fabricated of 0.25-in.-thick plate welded along a helix forming an angle $\beta = 30°$ with the horizontal. Knowing that the allowable stress normal to the weld is 10.5 ksi, determine the largest gage pressure that can be used in the tank.

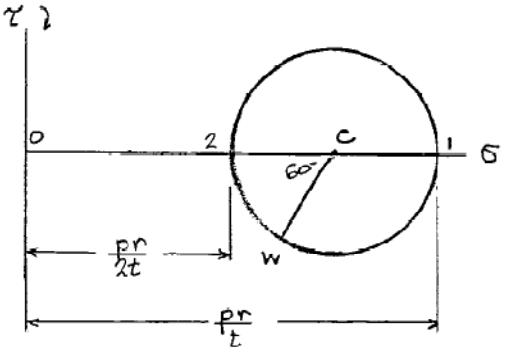
$r = \frac{1}{2}d - t = 10 - 0.25 = 9.75\ \text{in.}$

$$\sigma_1 = \frac{pr}{t}, \quad \sigma_2 = \frac{pr}{2t}$$

$$\sigma_{ave} = \frac{1}{2}(\sigma_1 + \sigma_2) = \frac{3}{4}\frac{pr}{t}$$

$$R = \frac{\sigma_1 - \sigma_2}{2} = \frac{1}{4}\frac{pr}{t}$$

$$\sigma_w = \sigma_{ave} - R\cos 60° = \frac{5}{8}\frac{pr}{t}$$



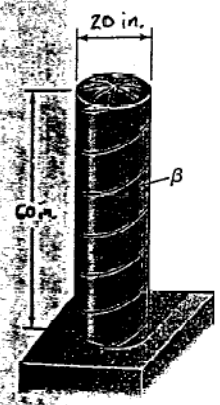
$$p = \frac{8}{5}\frac{\sigma_w t}{r} = \frac{(8)(10.5)(0.25)}{(5)(9.75)} = 0.43077\ \text{ksi}$$

$p = 431\ \text{psi}$

Problem 7.115

7.115 For the compressed-air tank of Prob. 7.114, determine the gage pressure that will cause a shearing stress parallel to the weld of 4 ksi.

7.114 The cylindrical portion of the compressed-air tank shown is fabricated of 0.25-in.-thick plate welded along a helix forming an angle $\beta = 30°$ with the horizontal. Knowing that the allowable stress normal to the weld is 10.5 ksi, determine the largest gage pressure that can be used in the tank.



$r = \frac{1}{2}d - t = 10 - 0.25$

$= 9.75$ in.

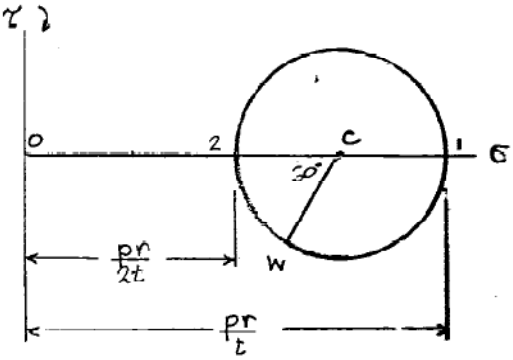
$\sigma_1 = \frac{pr}{t}$, $\sigma_2 = \frac{pr}{2t}$

$\sigma_{ave} = \frac{1}{2}(\sigma_1 + \sigma_2) = \frac{3}{4}\frac{pr}{t}$

$R = \frac{\sigma_1 - \sigma_2}{2} = \frac{1}{4}\frac{pr}{t}$

$\tau_w = R \sin 60°$

$= \frac{\sqrt{3}}{8}\frac{pr}{t}$



$$p = \frac{8}{\sqrt{3}}\frac{\tau_w t}{r} = \frac{8}{\sqrt{3}} \cdot \frac{(4)(0.25)}{9.75} = 0.47372 \text{ ksi}$$

$p = 474$ psi

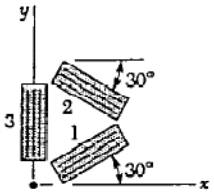
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Problem 7.145

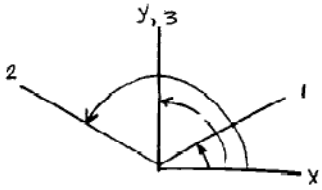
7.145 The strains determined by the use of the rosette shown during the test of a machine element are

$$\epsilon_1 = +600\mu \qquad \epsilon_2 = +450\mu \qquad \epsilon_3 = -75\mu$$

Determine (*a*) the in-plane principal strains, (*b*) the in-plane maximum shearing strain.



$\theta_1 = 30°$
$\theta_2 = 150°$
$\theta_3 = 90°$



$$\epsilon_x \cos^2\theta_1 + \epsilon_y \sin^2\theta_1 + \gamma_{xy} \sin\theta_1 \cos\theta_1 = \epsilon_1$$

$$0.75\,\epsilon_x + 0.25\,\epsilon_y + 0.43301\,\gamma_{xy} = 600\mu \quad (1)$$

$$\epsilon_x \cos^2\theta_2 + \epsilon_y \sin^2\theta_2 + \gamma_{xy} \sin\theta_2 \cos\theta_2 = \epsilon_2$$

$$0.75\,\epsilon_x + 0.25\,\epsilon_y - 0.43301\,\gamma_{xy} = 450\mu \quad (2)$$

$$\epsilon_x \cos^2\theta_3 + \epsilon_y \sin^2\theta_3 + \gamma_{xy} \sin\theta_3 \cos\theta_3 = \epsilon_3$$

$$0 + \epsilon_y \quad 0 = -75\mu \quad (3)$$

Solving (1), (2), and (3) simultaneously,

$$\epsilon_x = 725\,\mu, \quad \epsilon_y = -75\,\mu, \quad \gamma_{xy} = 173.21\,\mu$$

$$\epsilon_{ave} = \frac{1}{2}(\epsilon_x + \epsilon_y) = 325\,\mu$$

$$R = \sqrt{\left(\frac{\epsilon_x - \epsilon_y}{2}\right)^2 + \left(\frac{\gamma_{xy}}{2}\right)^2} = \sqrt{\left(\frac{725 + 75}{2}\right)^2 + \left(\frac{173.21}{2}\right)^2} = 409.3\,\mu$$

(a) $\epsilon_a = \epsilon_{ave} + R = 734\,\mu$ $\qquad \epsilon_a = 734\,\mu$

$\epsilon_b = \epsilon_{ave} - R = -84.3\,\mu$ $\qquad \epsilon_b = -84.3\,\mu$

(b) $\gamma_{max\,(in\text{-}plane)} = 2R = 819\,\mu$ $\qquad \gamma_{max} = 819\,\mu$