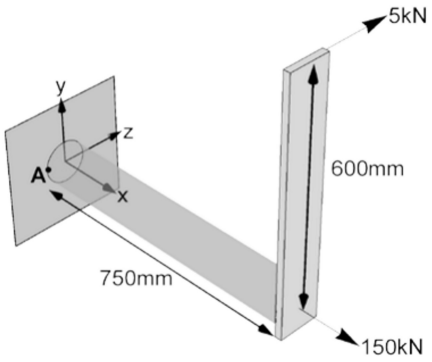
Final Exam Problem 6

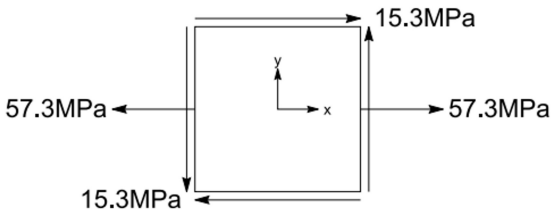
Friday, December 18, 2020 8:02 AM

Problem 6:

A circular shaft with a radius of 50 mm is loaded with two forces as shown below.

a. Using Mohr's Circle find the Principal Stresses at point A and sketch the principal stress element in the proper orientation.
b. Calculate the magnitudes of Normal and Shearing Stresses at point A, and verify your calculations match the stress element shown. Hint: there are three stresses you will need to consider.





A.)

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$R = \sqrt{28.65^2 + 15.3^2}$$

$$R = 32.48 \text{ MPa}$$

$$C = \left(\frac{\sigma_x + \sigma_y}{2}, 0\right)$$

$$C = \left(\frac{57.3}{2}, 0\right) = (28.65, 0)$$

$$\sigma_1 = \sigma_{Avg} + R = 28.65 + 32.48$$

$$\sigma_1 = 61.13 \text{ MPa}$$

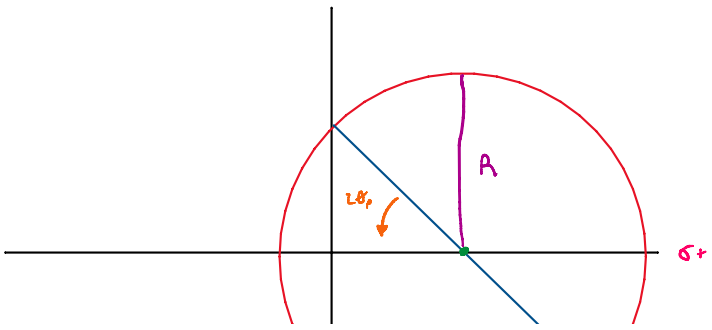
$$\sigma_2 = \sigma_{Avg} - R = 28.6 - 32.48$$

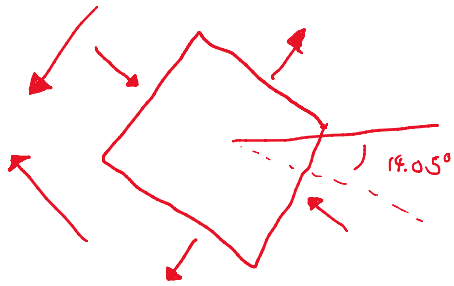
$$\sigma_2 = -3.829 \text{ MPa}$$

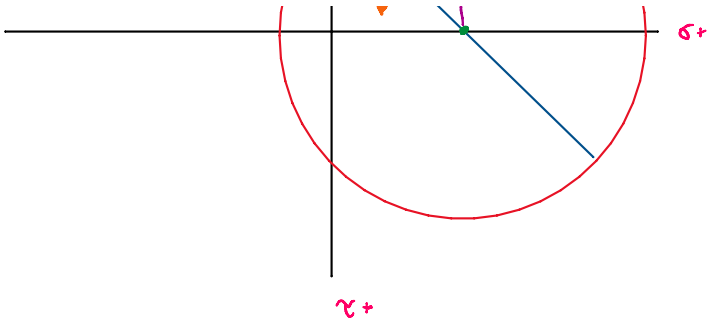
$$\frac{TA}{J}$$

$$\tan(2\theta_p) = \frac{15.3}{57.3}$$

$$\theta_p = 14.05^\circ$$







B.)

$$\sigma = \frac{N}{A}$$

$$\sigma_y = 0$$

$$\sigma_x = \frac{150 \times 10^3}{\pi (.05)^2} = 19.1 \text{ MPa}$$

$$\sigma_z = \frac{\frac{Tr}{J}}{A} = \frac{\frac{T(.05)}{\frac{1}{2}(c)^4}}{\pi (.05)^2}$$

$$\sigma_z = 604.29 \text{ MPa}$$