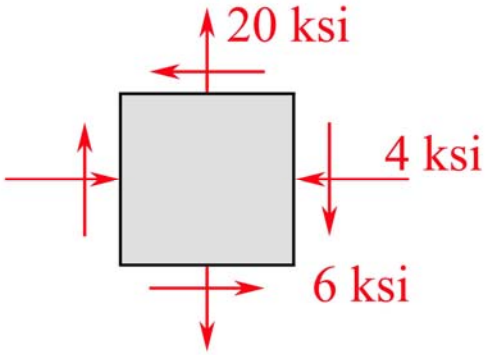
MEEG 3013 Quiz #7.m18.082

$$\sigma_{x'} = \frac{1}{2}(\sigma_x + \sigma_y) + \frac{1}{2}(\sigma_x - \sigma_y)\cos 2\theta + \tau_{xy}\sin 2\theta$$

$$\tau_{x'y'} = -\frac{1}{2}(\sigma_x - \sigma_y)\sin 2\theta + \tau_{xy}\cos 2\theta$$

For the state of stress as shown, make use of the above formulas to determine (*a*) the orientation θ_s of the planes of maximum in-plane shearing stress, (*b*) the corresponding normal stress σ.



$$\sigma_x = -4 \text{ ksi} \quad ① \qquad \tau_{xy} = -6 \text{ ksi} \quad ① \qquad \sigma_y = 20 \text{ ksi} \quad ①$$

$$\frac{d}{d\theta}(\tau_{x'y'}) = -(\sigma_x - \sigma_y)\cos 2\theta - 2\tau_{xy}\sin 2\theta = 0$$

$$\therefore \quad \tan 2\theta_s = -\frac{\sigma_x - \sigma_y}{2\tau_{xy}} = -2 \quad ②$$

$$2\theta_s = -63.435° \text{ or } 116.565° \qquad \theta_s = -31.717° \text{ or } 58.283°$$

$$\theta_s = -31.7° \quad ① \qquad \text{or} \qquad \theta_s = 58.3° \quad ①$$

$$\sigma = \sigma_{x'} = \frac{1}{2}(\sigma_x + \sigma_y) + \frac{1}{2}(\sigma_x - \sigma_y)\cos 2\theta_s + \tau_{xy}\sin 2\theta_s = 8$$

$$\sigma = 8 \text{ ksi} \quad ③$$