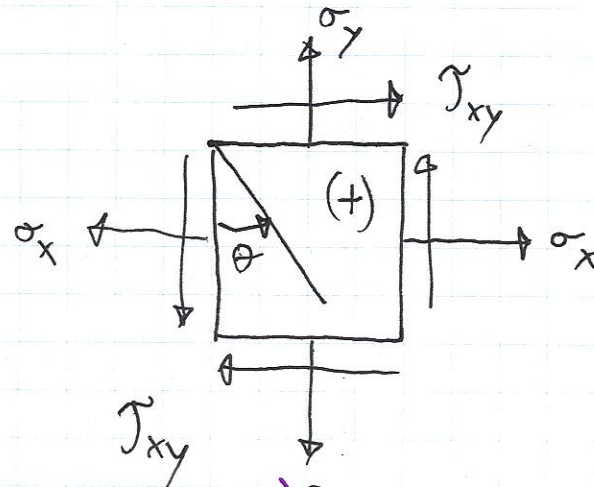


$$\sigma_x = 8 \text{ ksi}$$

$$\sigma_y = 4 \text{ ksi}$$

$$\tau_{xy} = 3 \text{ ksi}$$

POS. SIGN CONV.



MIN/MAX NORMAL STRESS (PRINCIPAL STRESSES)

$$\tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y} \Rightarrow 2\theta_{p1} = \tan^{-1} \left( \frac{2(3 \text{ ksi})}{8 \text{ ksi} - 4 \text{ ksi}} \right) = 56.3^\circ$$

$$2\theta_{p2} = 2\theta_{p1} \pm 180^\circ = 56.3^\circ - 180^\circ = -123.7^\circ$$

$$\theta_{p1} = 28.2^\circ$$

$$\theta_{p2} = -61.9^\circ$$

$$\sigma_\theta = \left( \frac{\sigma_x + \sigma_y}{2} \right) + \left( \frac{\sigma_x - \sigma_y}{2} \right) \cos 2\theta + \tau_{xy} \sin 2\theta$$

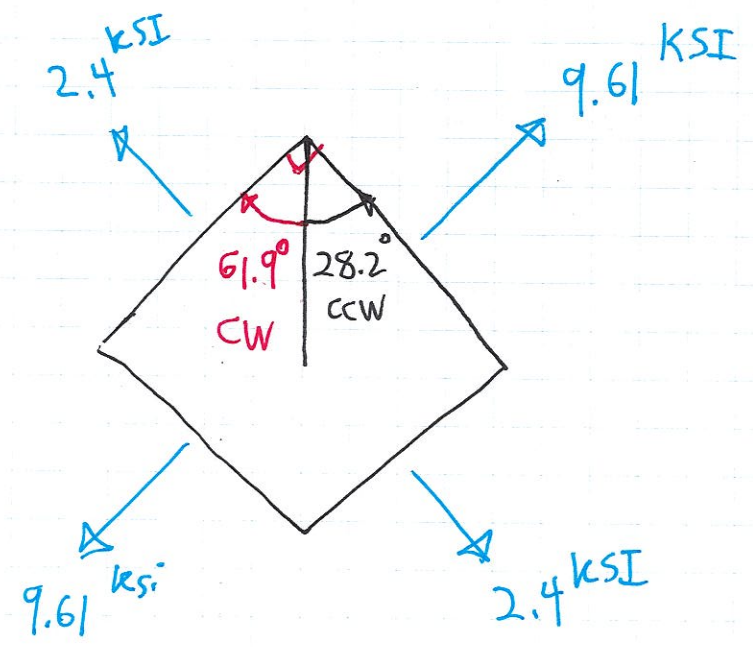
$$\sigma_{\theta_1} = \left( \frac{8 \text{ ksi} + 4 \text{ ksi}}{2} \right) + \left( \frac{8 \text{ ksi} - 4 \text{ ksi}}{2} \right) \cos(2 \cdot 28.2^\circ) + (3 \text{ ksi}) \sin(2 \cdot 28.2^\circ)$$

$\sigma_{\theta_1} =$  ~~9.61 ksi~~  $9.61 \text{ ksi}$   $\leftarrow$   $\begin{matrix} \text{Principal} \\ \text{Max Stress} \end{matrix}$   $@ 28.2^\circ$

$$\sigma_{\theta_2} = \left( \frac{8 + 4}{2} \right) + \left( \frac{8 - 4}{2} \right) \cos(2 \cdot -61.9) + (3) \sin(2 \cdot -61.9)$$

$\sigma_{\theta_2} = 2.4 \text{ ksi}$   $\leftarrow$   $\text{Min Principal Stress}$   $@ -61.9^\circ$

PROP. ORIENTED SKETCH



MIN/MAX SHEAR STRESS

$$\sigma_x = 8 \text{ ksi}$$

$$\sigma_y = 4 \text{ ksi}$$

$$\tau_{xy} = 3 \text{ ksi}$$

$$\tan 2\theta_s = - \left( \frac{\sigma_x - \sigma_y}{2\tau_{xy}} \right) \Rightarrow 2\theta_{s1} = \tan^{-1} \left( - \frac{(8 \text{ ksi} - 4 \text{ ksi})}{2(3 \text{ ksi})} \right) = \underline{-33.7^\circ}$$

$$2\theta_{s2} = -33.7^\circ + 180^\circ = \underline{146.3^\circ}$$

$$\theta_{s1} = -16.85^\circ$$

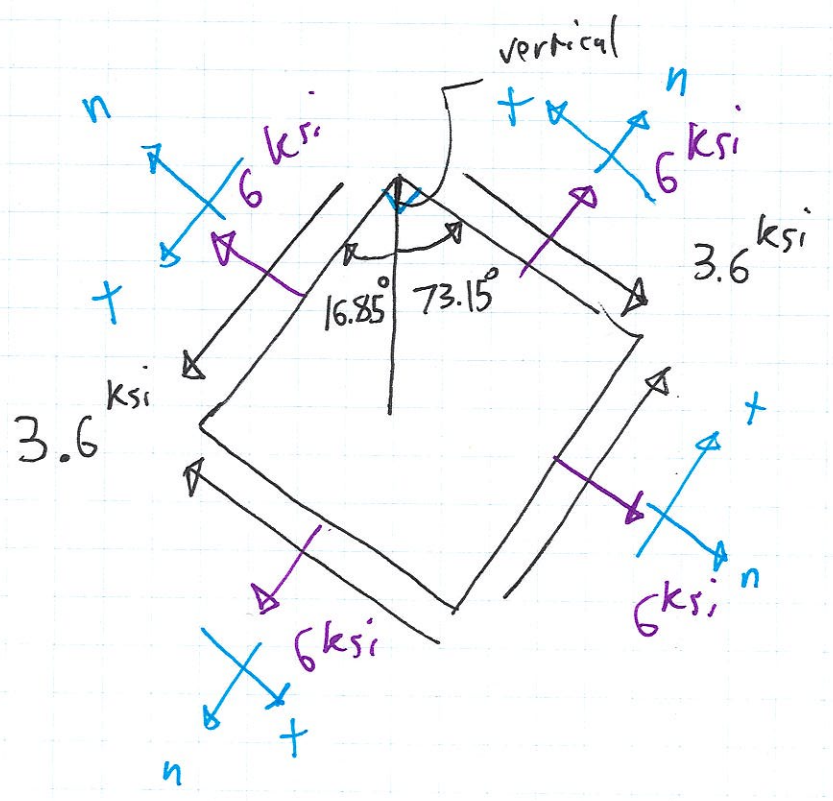
$$\theta_{s2} = 73.15^\circ$$

$$\tau_\theta = - \left( \frac{\sigma_x - \sigma_y}{2} \right) \sin 2\theta + \tau_{xy} \cos 2\theta$$

$$\tau_{\theta_1} = - \left( \frac{8-4}{2} \right) \sin(-33.7^\circ) + (3) \cos(-33.7^\circ) = 3.6 \text{ ksi}$$

$$\tau_{\theta_2} = - \left( \frac{8-4}{2} \right) \sin(146.3^\circ) + 3 \cos(146.3^\circ) = -3.6 \text{ ksi}$$

PROP. ORIENTED SKETCH



$$\begin{aligned}\sigma_{\theta_1} &= \left( \frac{\sigma_x + \sigma_y}{2} \right) + \left( \frac{\sigma_x - \sigma_y}{2} \right) \cos(2\theta) + \tau_{xy} \sin 2\theta \\ &= \left( \frac{8+4}{2} \right) + \left( \frac{8-4}{2} \right) \cos(2 \cdot -16.85^\circ) + (3) \sin(2 \cdot -16.85^\circ) = 6 \text{ ksi}\end{aligned}$$

$$\sigma_{\theta_2} = \left( \frac{8+4}{2} \right) + \left( \frac{8-4}{2} \right) \cos(2 \cdot 73.15^\circ) + 3 \sin(2 \cdot 73.15^\circ) = 6 \text{ ksi}$$