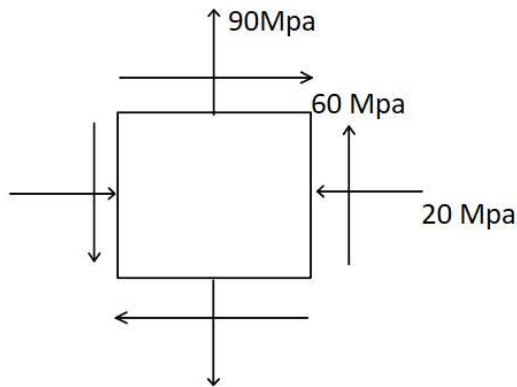
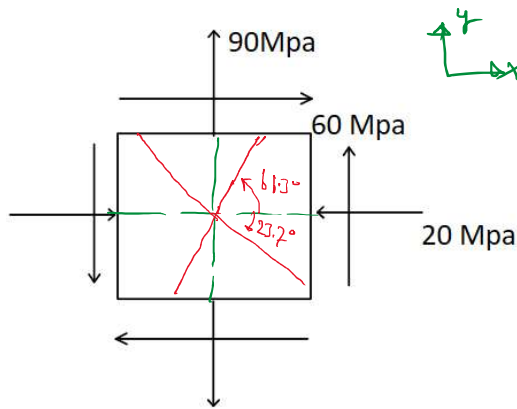


Find the location and magnitude of in-plane major and minor principal stresses:



Solution:



location:

$$\tan 2\theta_p = \frac{\tau_{xy}}{\frac{\sigma_x - \sigma_y}{2}}$$

$$\sigma_x = -20 \text{ MPa}; \quad \sigma_y = 90 \text{ MPa}; \quad \tau_{xy} = 60 \text{ MPa}$$

$$\Rightarrow \tan 2\theta_p = \frac{60}{\frac{-20 - 90}{2}} = -23.7^\circ, 66.3^\circ$$

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

$$\downarrow$$

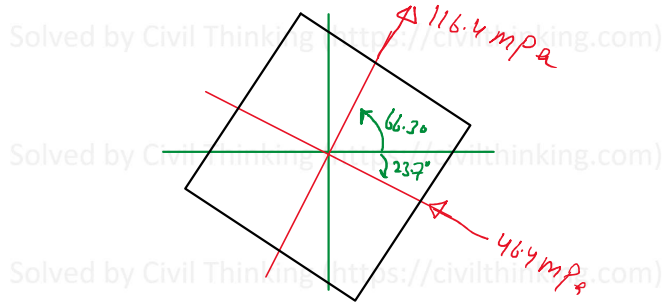
$$\sigma_p \quad \text{At } \theta_p = -23.7^\circ$$

$$= \frac{-20 + 90}{2} + \frac{-20 - 90}{2} \cos 2(-23.7) + 60 \sin 2(-23.7) = -46.4 \text{ MPa}$$

$$\text{At } \theta_p = 66.3^\circ$$

$$= 116.4 \text{ MPa}$$

$$\Rightarrow \sigma_{p1} = 116.4 \text{ MPa} @ \theta_{p1} = 66.3^\circ; \quad \sigma_{p2} = -46.4 \text{ MPa} @ \theta_{p2} = -23.7^\circ$$



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