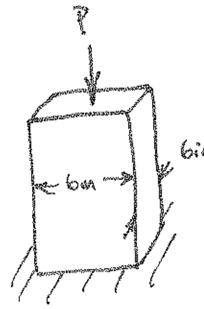
8.29. SOLUTION

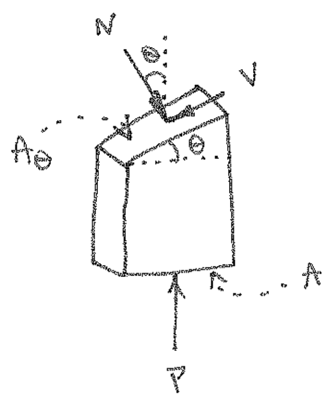


$P = 240$ Kips. Determine

a. max normal stress + plane on which it occurs, and

b. max shear stress + plane on which it occurs.

FBD:



$$\sum \vec{F} = \vec{0} \Rightarrow \vec{N} + \vec{V} = \vec{P}.$$

$$N = P\cos\theta$$

$$V = P\sin\theta$$

$$A_\theta = \frac{A}{\cos\theta}$$

so $\sigma = \frac{N}{A_\theta} = \frac{P}{A}\cos^2\theta$

$$\tau = \frac{V}{A_\theta} = \frac{P}{A}\cos\theta\sin\theta.$$

a. Max σ occurs when $\boxed{\theta = 0}$ (Let's consider $-\frac{\pi}{2} < \theta < \frac{\pi}{2}$)

and is equal to $\sigma_{max} = \frac{P}{A}$

$$\sigma_{max} = \frac{P}{A} = \frac{240 \text{ Kips}}{36 \text{ in}^2} = \boxed{6.67 \text{ ksi}}$$

b. max τ occurs when $\frac{d\tau}{d\theta} = 0$.

$$0 = \frac{d\tau}{d\theta} \Rightarrow \frac{P}{A}\left[\cos^2\theta - \sin^2\theta\right] = 0 \Rightarrow \boxed{\theta = \pm\frac{\pi}{4}}$$

$$\tau_{max} = \frac{P}{A}\left(\frac{1}{\sqrt{2}}\cdot\frac{1}{\sqrt{2}}\right) = \frac{P}{2A} = \frac{240 \text{ kips}}{2\cdot 36 \text{ in}^2} = \boxed{3.33 \text{ ksi}}$$