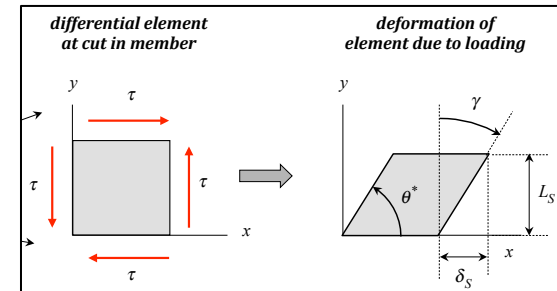


Lecture 3 summary: shear stress and strain

- SHEAR STRAIN AND STRESS:**

$$\gamma = \frac{\delta_s}{L_s}$$

$$\tau = G\gamma \quad ; \quad G = \frac{E}{2(1+\nu)}$$



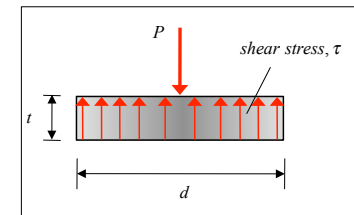
- APPLICATIONS:**

- Punching a circular hole:

$$\tau = \frac{P}{A} \quad ; \quad A = \pi dt \quad (\text{for a circular hole})$$

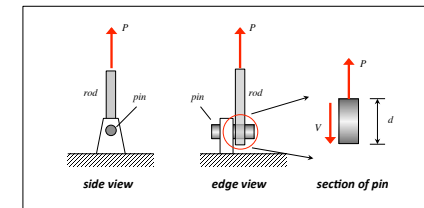
- Shear stress in pin:

$$\tau = \frac{V}{A} \quad ; \quad A = \pi(d/2)^2 \quad (\text{for a circular pin})$$

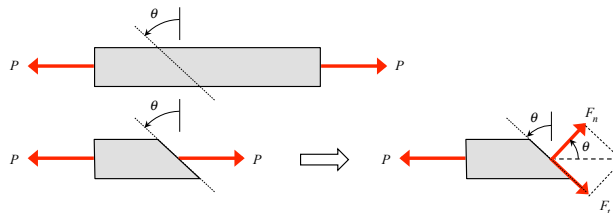


FBD of sheet metal slug under punch

SINGLE-SIDED PIN CONNECTION



- YES, THERE IS SHEAR STRESS IN AXIAL LOADING!**



$$\sigma = \frac{F_n}{A_c} = \frac{P \cos \theta}{A / \cos \theta} = \frac{P}{A} \cos^2 \theta = \frac{P}{2A} (1 + \cos 2\theta)$$

$$\tau = \frac{F_t}{A_c} = \frac{P \sin \theta}{A / \cos \theta} = \frac{P}{A} \cos \theta \sin \theta = \frac{P}{2A} \sin 2\theta$$