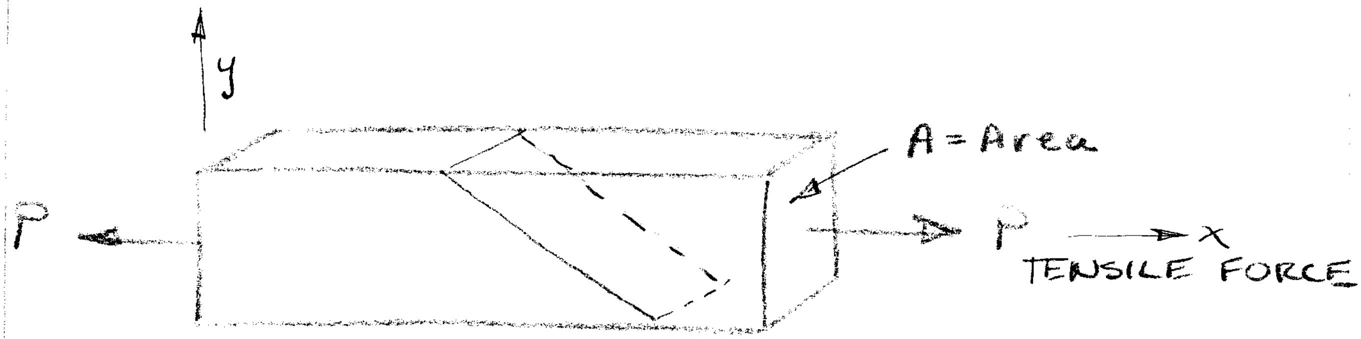
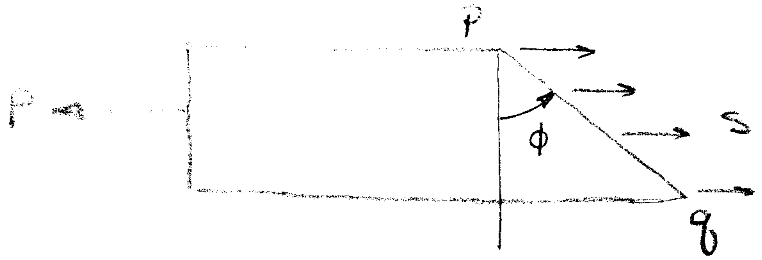
# UNIAXIAL STRESS + MOHR'S CIRCLE




$$A_{pq} = \frac{A}{\cos\phi}$$

s = STRESS OVER $A_{pq}$

$$s = \frac{P}{A_{pq}} = \frac{P\cos\phi}{A}$$

STRESS OVER A IS $\sigma_x = \dfrac{P}{A}$

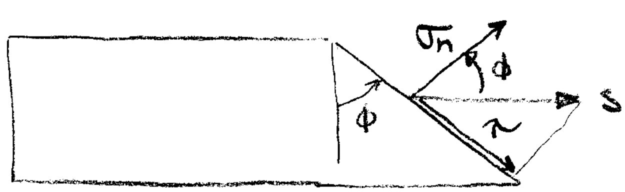
SO

(1) $s = \sigma_x \cos\phi$

AS $\phi$   $0 \to \frac{\pi}{2}$

$\sigma_x$   $\sigma_x \to 0$

CONSIDER COMPONENTS OF s ON $A_{pq}$




$\sigma_n$ = normal stress     $\tau$ = shear stress

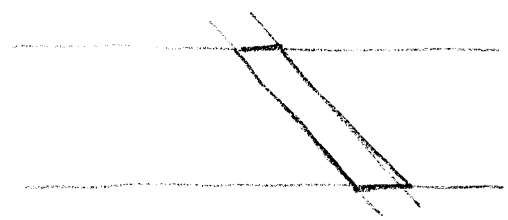
$$\sigma_n = s \cos\phi = \sigma_x \cos^2\phi$$

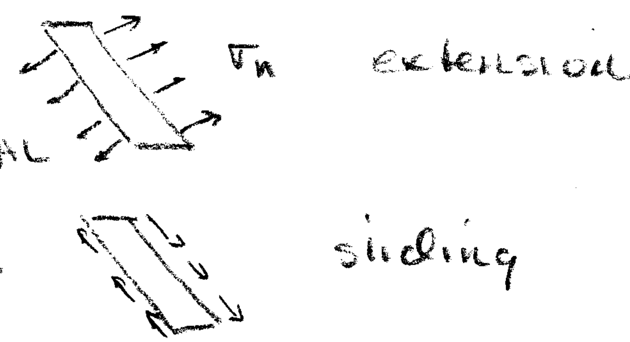
$$(2) \quad \tau = s \sin\phi = \sigma_x \cos\phi \sin\phi = \frac{\sigma_x}{2}\sin 2\phi$$

$$\tau \quad 0 \rightarrow \tau_{max} = \frac{\sigma_x}{2} \quad \text{as} \quad \phi \cdot \quad 0 \rightarrow \frac{\pi}{4}$$

maximum shear stress is 45° to normal stress in uniaxial tension

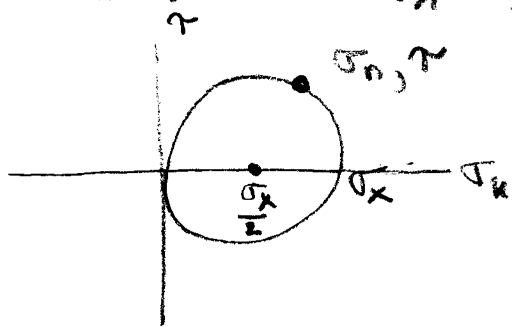
ELEMENT






2 MECHANICAL EFFECTS ON PLANAR ELEMENT INCLINED AT $\phi$

IF WE PLOT $\sigma_n$ vs $\tau$ ON AXES




(1) and (2) define a circle

MOHR'S CIRCLE

radius $\frac{\sigma_x}{2}$

centered at

$\frac{\sigma_x}{2}, 0$

EQ OF CIRCLE

$$(x - a)^2 + y^2 = r^2$$

SUBSTITUTING

$$\left(\sigma_n - \frac{\sigma_x}{2}\right)^2 + \tau^2 = \left(\frac{\sigma_x}{2}\right)^2$$

USING (1) + (2)

$$\cancel{\sigma_x^2}\cos^4\phi - \frac{2\sigma_x^2\cos^2\phi}{2} + \cancel{\left(\frac{\sigma_x}{2}\right)^2} + \frac{\sigma_x^2}{4}\overset{4\cos^2\phi\sin^2\phi}{\overset{\|}{\sin^2(2\phi)}} = \cancel{\left(\frac{\sigma_x}{2}\right)^2}$$

$$\cos^4\phi - \cos^2\phi + \cos^2\phi\sin^2\phi = 0$$

$$\cos^2\phi(\cos^2\phi - 1) + \cos^2\phi\sin^2\phi = 0$$

$$\cos^2\phi(-\sin^2\phi) + \cos^2\phi\sin^2\phi = 0$$

QED