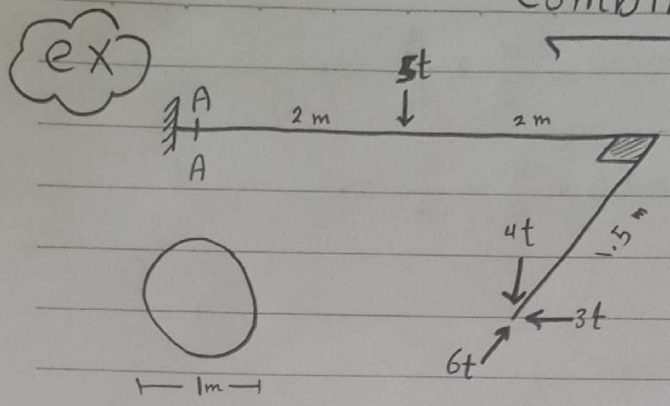
Combined stress

ex



Solution ↓

*) straining actions:-

$N = -3t$

$M_x = 5*2 + 4*4 = 26\ t.m$

$M_y = -6*4 = -24 + 4.5 = -19.5\ t.m$

$Q_x = 6\ t \rightarrow$

$Q_y = 9\ t \downarrow$

$M_t = 4*1.5 = 6\ t.m$ ↶

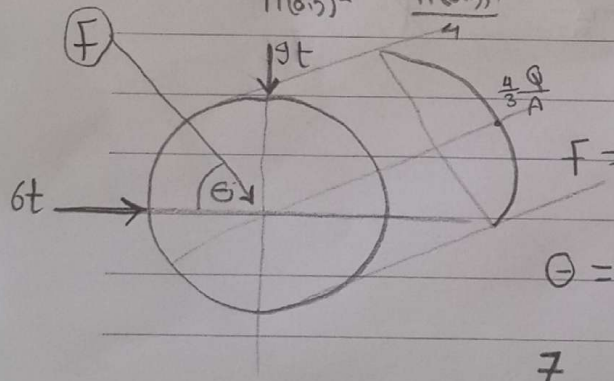
*) Properties of Area:-

$A = \pi(0.5)^2$

$I_x = \frac{\pi(0.5)^4}{4} = I_y$

$$\sigma = \frac{-3}{\pi(0.5)^2} + \frac{26}{\frac{\pi(0.5)^4}{4}} y + \frac{-19.5}{\frac{\pi(0.5)^4}{4}} x$$

ونعوض بالنقطة المطلوبة

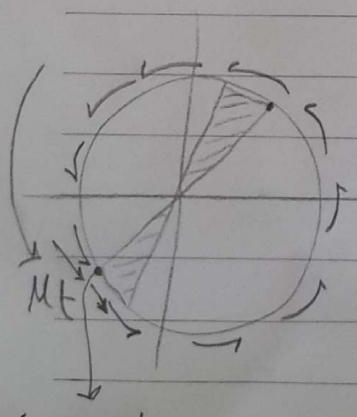


$F = \sqrt{(9)^2 + (6)^2} = 10.8\ t$

$\theta = \tan^{-1}\frac{9}{6} = 56.3^\circ$

$\tau_s = \frac{4}{3}\frac{Q}{A} = \frac{4}{3} * \frac{10.8}{\pi(0.5)^2} = 18.33\ t/m^2$

« Due to shear »



$\tau_t = \frac{M_t \cdot R}{I_P} = \frac{6*0.5}{\frac{\pi}{2}(0.5)^4} = 30.56\ t/m^2$

$\tau_{max} = 30.56 + 18.33 = 48.89\ t/m^2$

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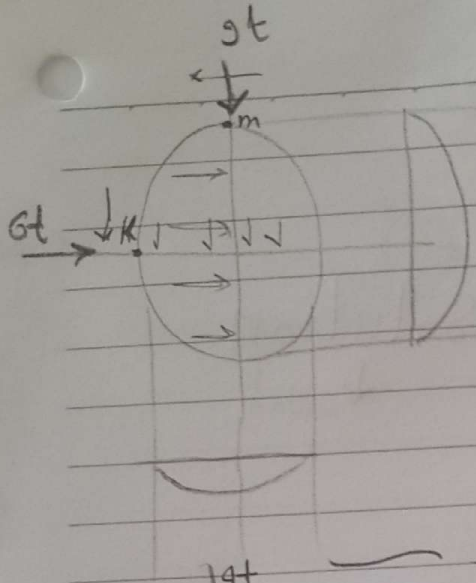
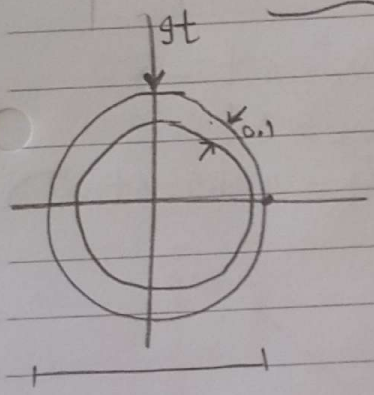


$$\tau_m = 30.56 - \frac{4}{3} * \frac{9}{A} = \checkmark$$

$$\tau_K = 30.56 + \frac{4}{3} * \frac{9}{A} = \checkmark$$

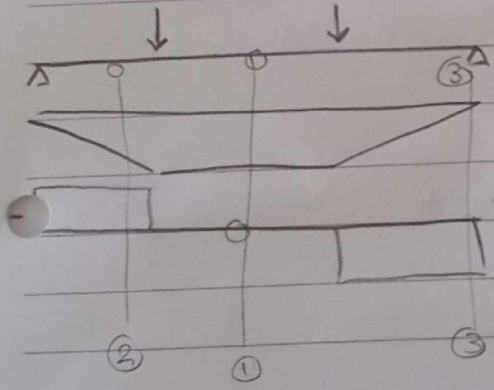


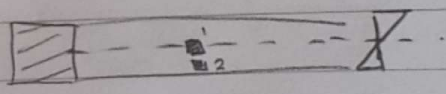
$$\tau = \frac{9}{I} * \frac{S}{b}$$

$$S = \left[\frac{\pi}{2} * (0.5)^2 * \frac{4 * 0.5}{3\pi}\right] - \left[\frac{\pi}{2} * (0.4)^2 * \frac{4 * 0.4}{3\pi}\right]$$

$$b = 0.2$$

$$\therefore \tau = \checkmark$$





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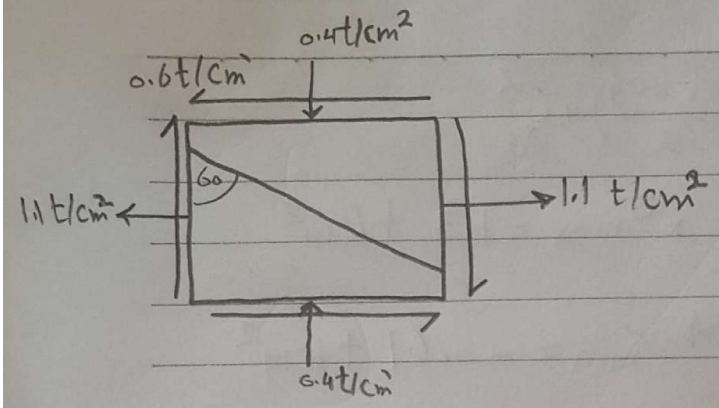
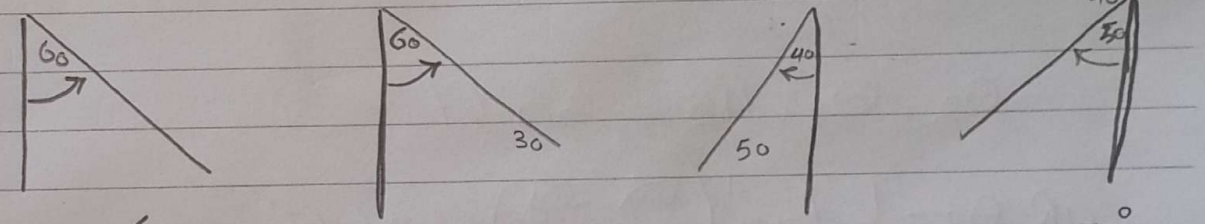


find equivalent:
* N.S, S.S acting on this Plane.
* The Principle stress, their Direction.
* The max S.S, associated N.S.

Solution

$\sigma_x = +1.1 \ t/cm^2$ $\quad \tau_{xy} = +0.6 \ t.cm$

$\sigma_y = -0.4 \ t/cm^2$ $\quad \theta =$



$\theta = +60$ $\quad \theta = +60$ $\quad \theta = -40^\circ$ $\quad \theta = -50^\circ$

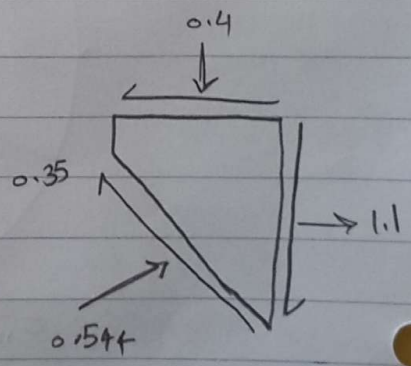
حالات الـ (θ) بقيسها من المحور المايل

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

$$= -0.544 \ t/cm^2$$

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

$$= 0.35 \ t/cm^2$$



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$$* \sigma_{max\ min} = \left(\frac{\sigma_x + \sigma_y}{2}\right) \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right) + \tau_{xy}^2}$$

$$= 0.36 \pm 0.96$$

$\sigma_{max} = 1.3\ t/cm^2$

$\sigma_{min} = -0.61\ t/cm^2$

$$\theta_1 = \frac{1}{2} \tan^{-1}\left(\frac{-2\tau_{xy}}{\sigma_x - \sigma_y}\right) = -19.33^\circ$$

associated $S.S = 0.0$

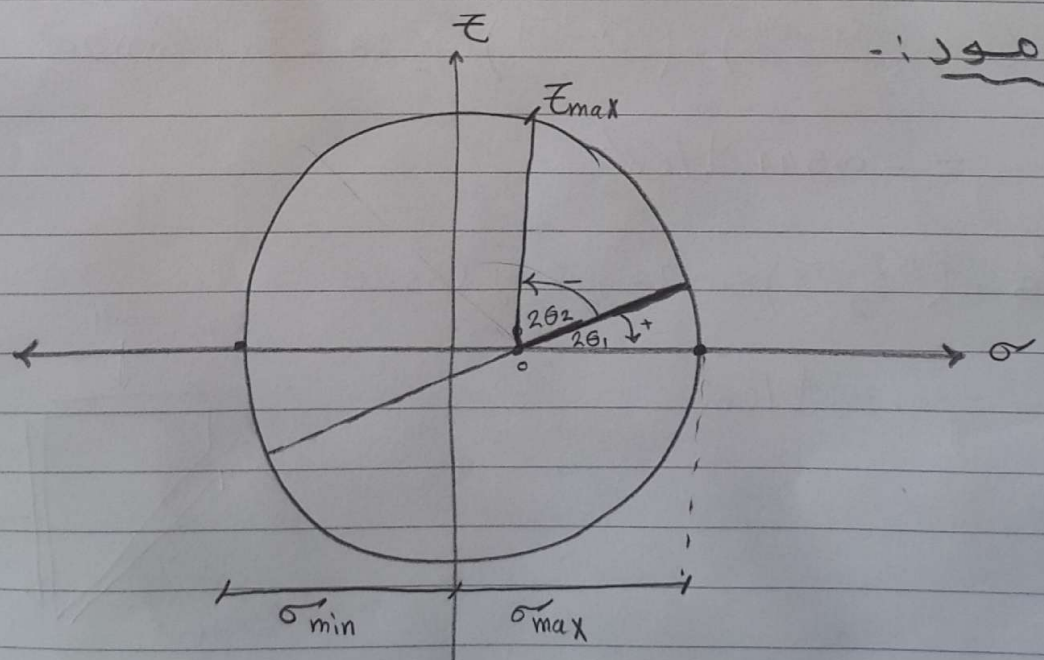
$$* \tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right) + \tau_{xy}^2} = 0.96\ t.cm$$

$$\theta_2 = \theta_1 + 45^\circ = 25.67^\circ$$

OR $$\theta_2 = \frac{1}{2} \tan^{-1}\left(\frac{\sigma_x - \sigma_y}{2\tau_{xy}}\right) = 26.67^\circ$$

associated $N.S = \frac{\sigma_x + \sigma_y}{2} = 0.35\ t/cm^2$

* دائرة مور :-



$A = (\sigma_x, \tau_{xy}) = (1.1, 0.6)$

$B = (\sigma_y, \tau_{xy}) = (0.4, -0.6)$