ASSIGNMENT : 02

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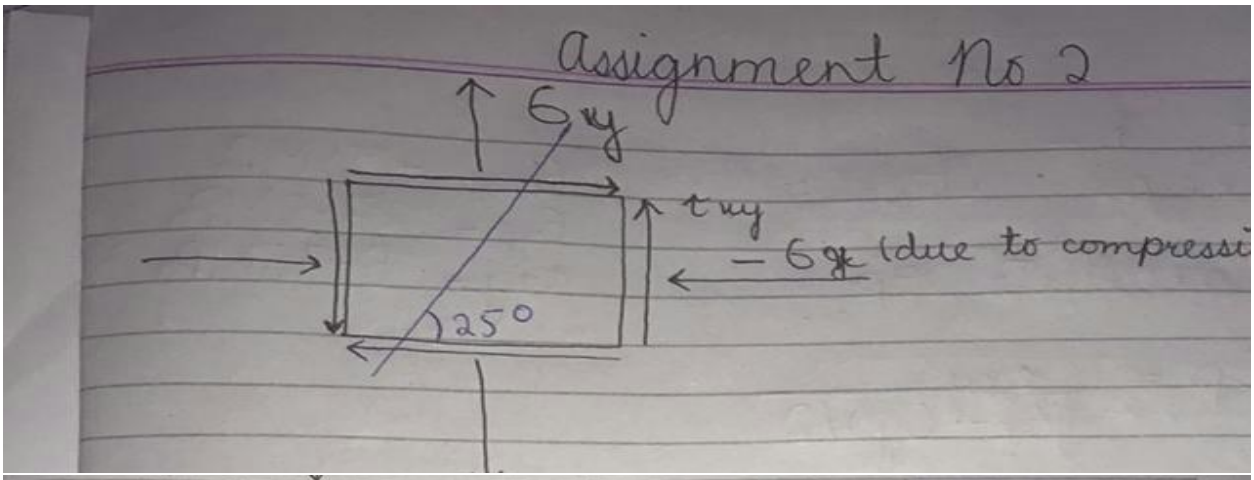
SUBJECT : MECHANICS OF SOLIDS -2

SUBMITTED TO : ENGR.SAQIB KHAN

Assignment No 2



$\sigma_x = -35$ MPa (compression)
$\sigma_y = 35/2 = +17.5$ MP (tensile)
$\tau_{xy} = 35/4 = +8.75$ MP (tensile
$\theta = -25°$ (c.w)

For part a

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

$$\sigma_{x'} = \frac{-35 + 17.5}{2} + \frac{(-35) - 17.5}{2}\cos(2\times(-25)) + 8.75\sin 2\times(-25)$$

$$\sigma_{x'} = \boxed{-32.32 \text{ MPa}}$$

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

$$\sigma_{y'} = \frac{-35 + 17.5}{2} - \frac{(-35) - (17.5}{2}\cos(2\times(-25)) - 8.75\sin 2\times(-25)$$

$$\sigma_{y'} = \boxed{14.826 \text{ MPa}}$$

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

$$\tau_{xy} = \frac{-(-35) - 17.5}{2}\sin 2(-25) + 8.75\cos 2(-25)$$

$$\tau_{x'y'} = \boxed{-14.48 \text{ MPa}}$$

For Part b

Principle stress:

$\sigma_x = -35MPa$

$\sigma_y = 17.5MPa$

$\tau_{xy} = 8.75MPa$

First calculate θ_p

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

$$\tan 2\theta_p = \frac{8.75}{(-35 - 17.5)/2}$$

$$2\theta_p = \tan^{-1}(-0.33)$$

$$\theta_p = \frac{-18.43}{2}$$

$$\theta_p = -9.217°$$

Principle stresses:

$$\sigma_1 = \frac{\sigma_x + \sigma_y}{2} + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

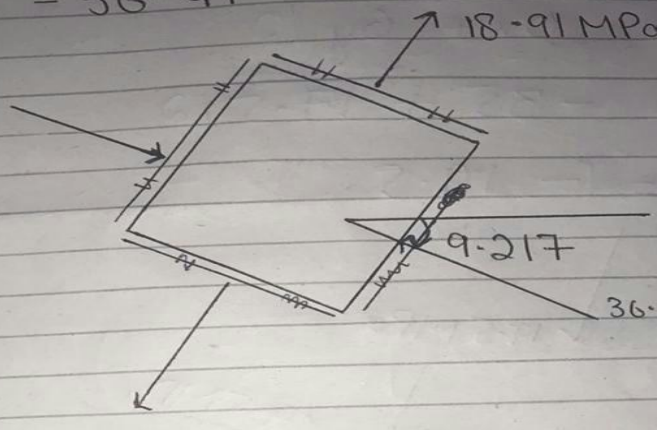
$$\sigma_1 = \frac{-35 + 17.5}{2} + \sqrt{\left(\frac{-35 - 17.5}{2}\right)^2 + (8.75)^2}$$

$$\sigma_1 = 18.91 \text{ MPa}$$

$$\sigma_2 = \frac{\sigma_x + \sigma_y}{2} - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_2 = \frac{-35 + 17.5}{2} - \sqrt{\left(-35 - 17.5\right)^2 + 8.75^2}$$

$$\sigma_2 = -36.41$$



Shear stress

calculate θ_s (orientation)

$$\tan 2\theta_s = \frac{-(\sigma_x - \sigma_y)/2}{\tau_{xy}}$$

$$\tan 2\theta_s = \frac{-(-35 - 17.5)/2}{8.75}$$

$$2\theta_s = \tan^{-1} 3$$

$$\theta_s = \frac{71.56}{2} \Rightarrow \theta_s = 35.78°$$

Max shear stress

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

$$\tau_{max} = \sqrt{\left(\frac{-35 - 17.5}{2}\right)^2 + 8.75^2}$$

$\tau_{max} =$ 27.66 MPa

Normal stress

$$\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2}$$

$$\sigma_{avg} = \frac{-35 + 17.5}{2}$$

$$\sigma_{avg} = -19.5$$