Day. M T W T F S

Date: __/__/__

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Section No B

Paper MOS = II.

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University Iqra National University Peshawar

Q NO(01).

Solution :- Given Data.

$\delta_x = -40 Mpa$

$\delta_y = 70 MPa.$

$\tau_{xy} = -50 MPa.$

We need to find $\delta_{x_2}, \delta_{y_2}$.

and $\tau_{x_1 y_1}$

When $\theta = -15^\circ$

NOW

Substitude numerical values into transformation eq.

We know that.

$$\delta_{x_1} = \frac{\delta_x + \delta_y}{2} + \frac{\delta_x - \delta_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

So

$$\delta_{x_1} = \frac{-40+70}{2} + \frac{(-40-70)}{2} \cos 2(-15) + (-50) \sin 2(-15^\circ)$$

$$\delta_{x_1} = -7.63 MPA$$

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Now For (δy_2).

$$\delta y_2 = \frac{\delta x + \delta y}{2} - \frac{\delta x - \delta y}{2} \cos 2\theta - T_{xy} \sin 2\theta.$$

$$\delta y_2 = \frac{-40+70}{2} - \frac{(-40-70)}{2} \cos 2(-15) - (-50) \sin 2(-15)$$

$$\boxed{\delta y_2 = 37.63 \text{ MPA}.}$$

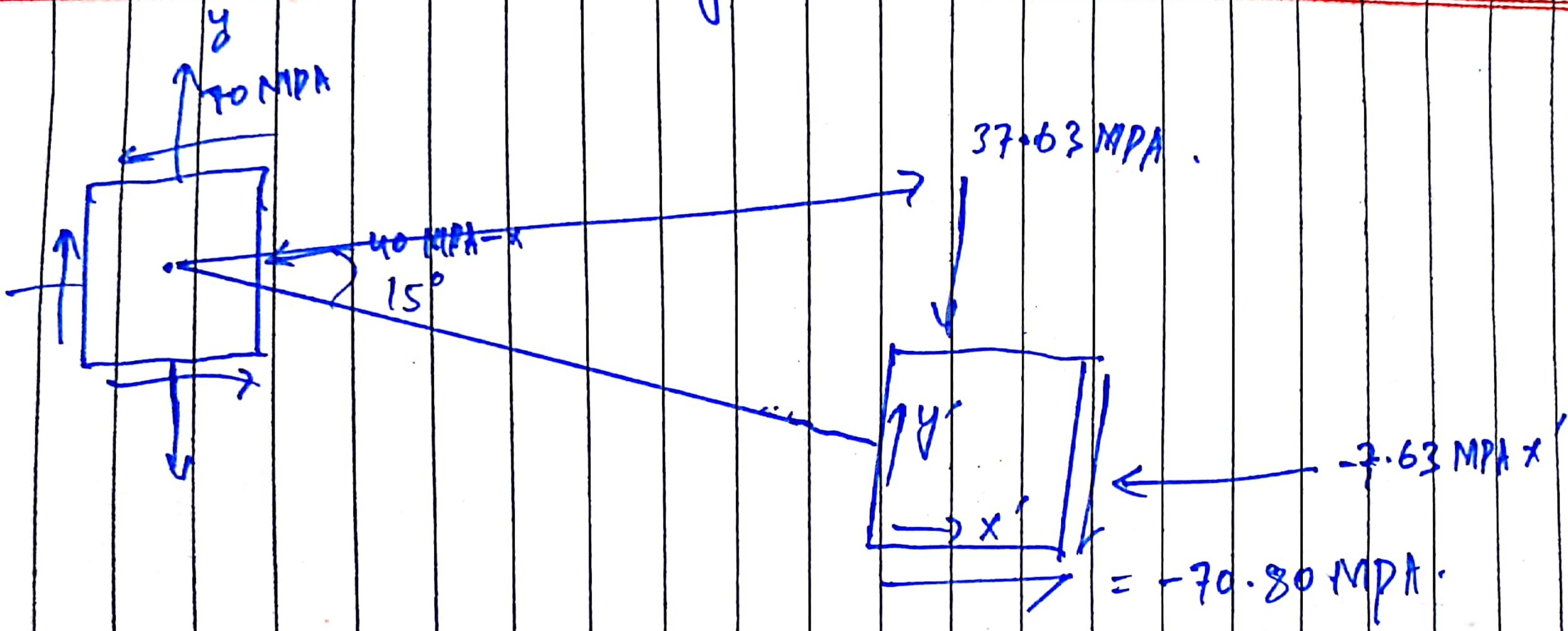
$$T_{x_2 y_2} = -\frac{(\delta x - \delta y)}{2} \sin 2\theta + T_{xy} \cos 2\theta$$

~~$T_{x_2 y_2} = -\frac{(\delta x - \delta y)}{2} \sin$~~

$$T_{x_2 y_2} = -\frac{(-40-70)}{2} \sin 2(-15) + (-50) \cos 2(-15)$$

$$\boxed{T_{x_2 y_2} = -70.80 \text{MPA}.}$$

Diagram



Q No (02) part (a).

First we find principal plane.

We know that.

$$\tan 2\theta_p = \frac{2\gamma_{xy}}{\varepsilon_x - \varepsilon_y}$$

$$\tan 2\theta_p = \frac{2(-50)}{-40-70}$$

$$\tan 2\theta_p = 0.9091$$

$$2\theta_p = \tan^{-1}(0.9091).$$

$$\theta_p = \frac{42.27}{2}$$

$$\theta_p = 21.14^\circ \text{ (For x-axis).}$$

$$2\theta_p = 42.27 + 180.$$

$$\theta_p = \frac{222.27}{2}$$

$$\theta_p = 111.135^\circ \text{ (For y-axis.}$$

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① Now we find principles stress.

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

$$\sigma_1 = \frac{-40+70}{2} + \sqrt{\left(\frac{(-40-70)}{2}\right)^2 + (-50)^2}$$

$$\sigma_1 = 89.33 \text{ MPA}.$$

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

$$\sigma_2 = \frac{-40+70}{2} - \sqrt{\left(\frac{-40-70}{2}\right)^2 + (-50)^2}$$

$$\sigma_2 = -59.33 \text{ MPA}$$

Now we check which angle goes with which principles stress.

$$\sigma_{x_2} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

$$= \frac{40+70}{2} + \left(\frac{-40-70}{2}\right)(\cos 2(21.14) + (-50)\sin 2(21.14)$$

$$\sigma_{x_1} = -59.33 \text{ MPA}.$$

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Hence,

$\sigma_1 = 84.33 \text{ MPA}$ with $\theta_{p_2} = 111.135°$

$\sigma_2 = -59.33 \text{ MPA}$ with $\theta_{p_2} = 21.14°$.

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Q No (2) part (b).

Find Max in-plane Shear stress.

$$\tau_{max\ in\ plan} = \sqrt{(\sigma_x - \sigma_y)^2 + \tau_{xy}}$$

$$= \sqrt{\left(\frac{-40-70}{2}\right)^2 + (-50)^2}$$

$$\{\tau_{max\ in\ plan} = 74.3\ MPa.\}$$

$$\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2} = \frac{-40+70}{2}.$$

$$\{\sigma_{avg} = 15$$

Now we have to find Max Shear plan.

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

$$= \frac{(-40-70)/2}{-50}$$

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$$\tan 2\theta_s = -1.1$$

$$\theta_s = \frac{1}{2} \tan^{-1}(-1.2)$$

$$\theta_s = \frac{1}{2} \tan^{-1}(-2.2)$$

$$\theta_s = -23.90.$$