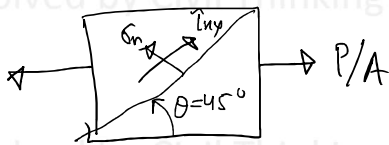
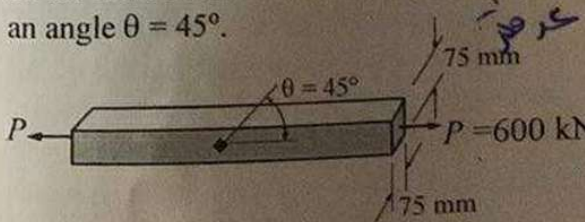


Question 3

A prismatic steel bar of 75 mm x 75 mm square cross section is subjected to a tensile load $P = 600$ kN (see figure). Determine the normal and shear stresses on all faces of an element rotated through an angle $\theta = 45^\circ$.



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

$$\sigma_n = \frac{P}{A} = \frac{600 \times 10^3 \text{ N}}{75 \times 75 \text{ mm}^2} = 106.66 \text{ N/mm}^2$$

$$\sigma_y = 0, \quad \cos 2\theta = \cos 2 \times 45^\circ = 0$$

$$\tau_{ny} = 0$$

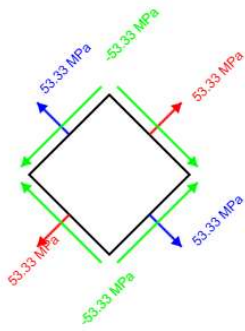
$$\Rightarrow \sigma_n = 53.33 \text{ MPa}$$

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

$$\sin 2\theta = \sin 2 \times 45^\circ = \sin 90^\circ = 1$$

$$\tau_{ny} = 0$$

$$\Rightarrow \tau_{ny} = -53.33 \text{ MPa}$$



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