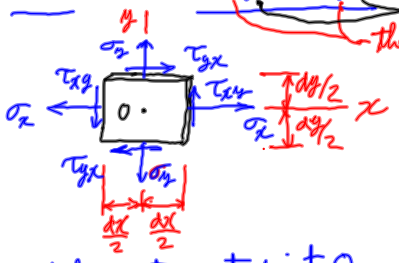
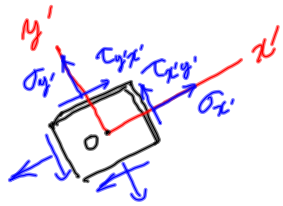
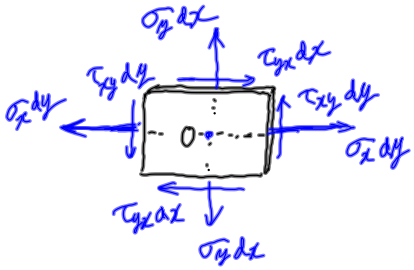
Show that $\tau_{xy} = \tau_{yx}$ — the axis to which the stress is parallel; the plane on which the stress acts





State of stress at point O

For equil. of the element, we write



$+\circlearrowleft \Sigma M_o = 0:$

$$dx\,(\tau_{xy}\,dy) - dy\,(\tau_{yx}\,dx) = 0$$

$$\tau_{xy}\,\cancel{dx\,dy} - \tau_{yx}\,\cancel{dy\,dx} = 0$$

$$\therefore \tau_{xy} - \tau_{yx} = 0$$

$$\boxed{\tau_{xy} = \tau_{yx}} \quad \text{Q.E.D.}$$

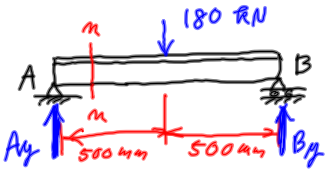
$$\boxed{q = \frac{VQ}{I}} \quad \text{V.V.}\cdots\text{I.}$$

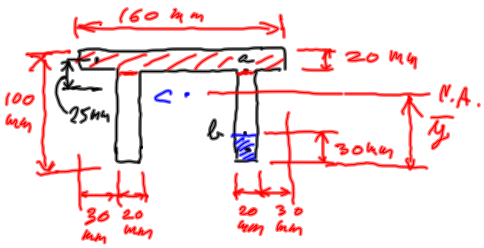
$$\tau = \frac{q}{t} \qquad \boxed{\tau = \frac{VQ}{It}} \quad \text{V.V.}\cdots\text{I.}$$

average shearing stress

$Q = b A_1$

6.21





$\tau_a = ?$ $\qquad \tau_b = ?$

$$\boxed{\tau = \frac{VQ}{It}}$$

Use POM_1 & POM_2 to find $\bar{y} = 65\,mm$

Use PAT to find $I = 5.8133 \times 10^{-6}\ m^4$

To find τ_a: $\quad A_y = B_y = 90\,kN = 90 \times 10^3\ N$

$V = 90 \times 10^3\ N, \quad I = 5.8133 \times 10^{-6}\ m^4, \quad t = 40\,mm = 0.04\,m$

$Q = 0.025\,(0.16)\,(0.02)\ m^3 \qquad \therefore \tau_a = \square\ N/m^2 \quad \boxed{\tau_a = \square\ Pa}$

To find τ_b:

V, I same as above $\quad t = 20\,mm = 0.02\,m$

$Q = (0.065 - 0.015)(0.02)(0.03)\ m^3 \qquad \therefore \tau_b = \square\ N/m^2 \quad \boxed{\tau_b = \square\ Pa}$