

Week 6 - Shear Stress and Shear Beams

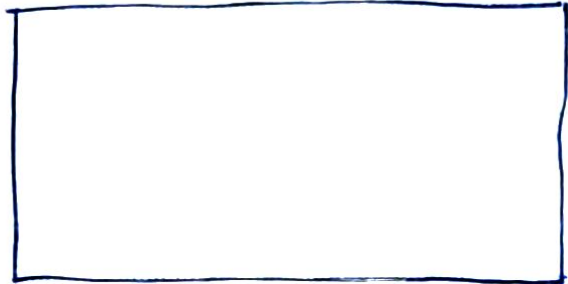
Shear Stress

##EJFU##

- If two opposite forces act parallel, this is shear

- The average shear stress, τ can be found from:

$$\tau = \frac{V}{A} = \frac{P}{A}$$

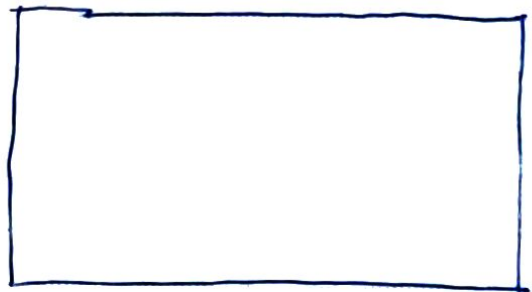


##53D6##

- Consider a volume element subject to a shear force, V .

##RTTV##

- Force equilibrium requires shear stress acting on two parallel faces.



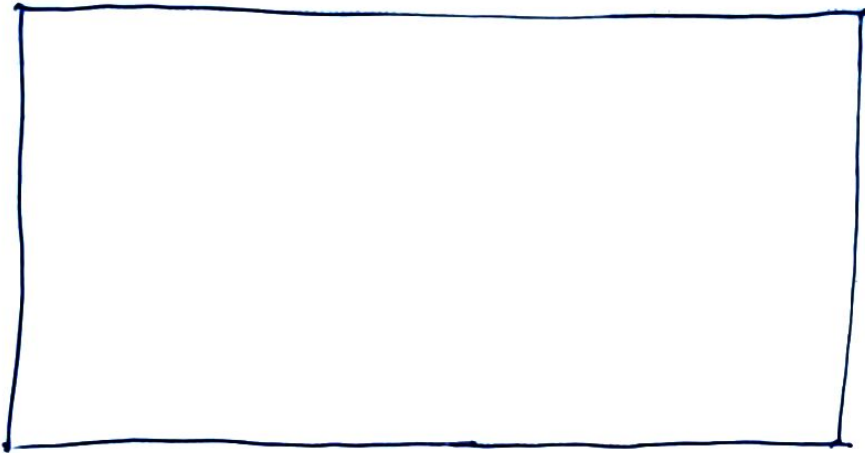
$$\begin{aligned} M &= \tau A L \\ &= \tau b d L \end{aligned}$$

- The shear stresses on the vertical faces must be accompanied by a set of shear stresses acting on the horizontal faces.

$$\tau = \tau'$$

Shear Strain

- If an object is fixed on one plane, and subjected to a shear stress, the opposite plane will deform.



##DI40##

$$\frac{\tau}{\gamma} = G, \text{ where } G \text{ is the shear modulus}$$

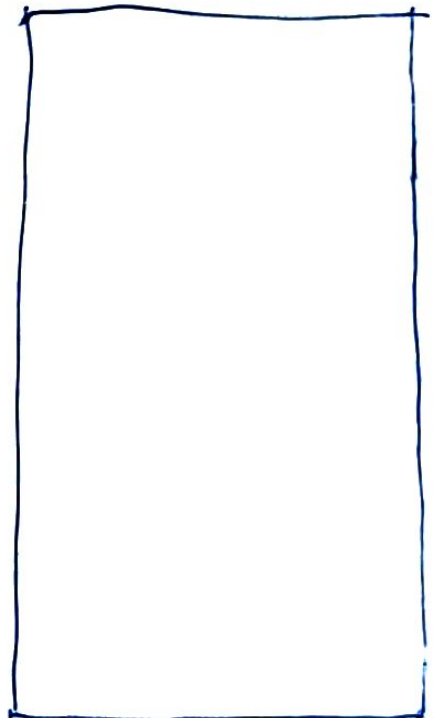
Examples ##POPH##

A) $\tau @ P$ B) τ_{max}

a) $V = 3 \text{ kN}$

$$I = \frac{bd^3}{12} = \frac{1}{12} \times 100 \times 125^3$$
$$= 16.28 \times 10^6 \text{ mm}^4$$

$$Q = y_c A = (12.5 + \frac{1}{2}(50)) \times 50 \times 100$$
$$= 18.75 \times 10^4 \text{ mm}^3$$



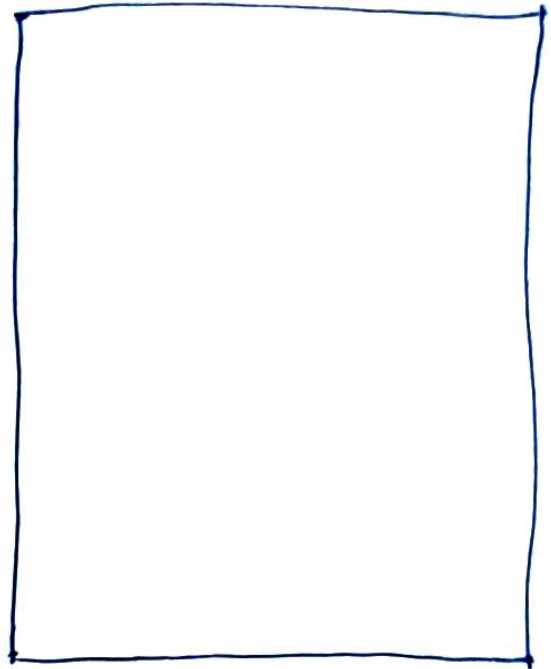
$$\tau = \frac{VQ}{It} = \frac{3 \times 8.75 \times 10^4}{16.28 \times 10^6 \times 100} = 0.346 \text{ MPa}$$

3) To maximise $V_c A'$, maximise A'

$$\therefore Q = y_c' A' = \frac{62.5}{2} \times 100 \times 62.5 = 19.54 \times 10^4 \text{ mm}^3$$

$$\Rightarrow \tau = \frac{VQ}{It} = \frac{3 \times 19.54 \times 10^4}{16.28 \times 10^6 \times 100}$$

$$\tau = 0.36 \text{ MPa}$$



- This shows how the shear stress increases towards the neutral axis.

W L E D

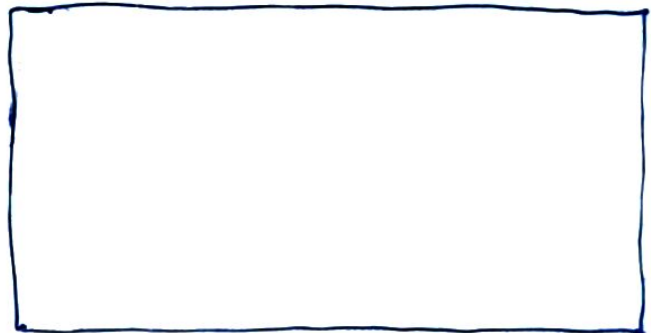
O O R V

Distribution

$$- Q = \int_y^{h/2} y b dy$$

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

$$\rightarrow \tau = \frac{3V}{2bh} - \frac{6Vy^2}{bh^3}$$



This is a parabolic curve.