Week 6 - Sheer Stress and Sheer Beams

Sheer Stress

##EJFU##

- If two opposite forces act parllel, 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.

- $M = \tau A l$
  $= \tau b d l$

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

$$\boxed{\tau = \tau'}$$

Shear Strain

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

##DI40##

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

Examples ##POPH##

A) τ @ P B) τ_{max}

a) $V = 3\,kN$

$$I = \frac{bd^3}{12} = \frac{1}{12} \times 100 \times 125^3$$

$$= 16.28 \times 10^6\ mm^4$$

$$Q = \bar{y}_c A = \left(12.5 + \tfrac{1}{2}(50)\right) \times 50 \times 100$$

$$= 18.75 \times 10^4\ mm^3$$

$$\tau = \frac{VQ}{It} = \frac{3 \times 18.75 \times 10^4}{16.28 \times 10^6 \times 100} = 0.346\,MPa$$

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

$$\therefore Q = y_c' A' = \frac{62.5}{2} \times 100 \times 62.5 = 19.53 \times 10^4\,mm^3$$

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

$$\underline{\tau = 0.36\,MPa}$$

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

##W4ED##

##oORV##

<u>Distribution</u>

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

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

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

This is a parabolic curve.