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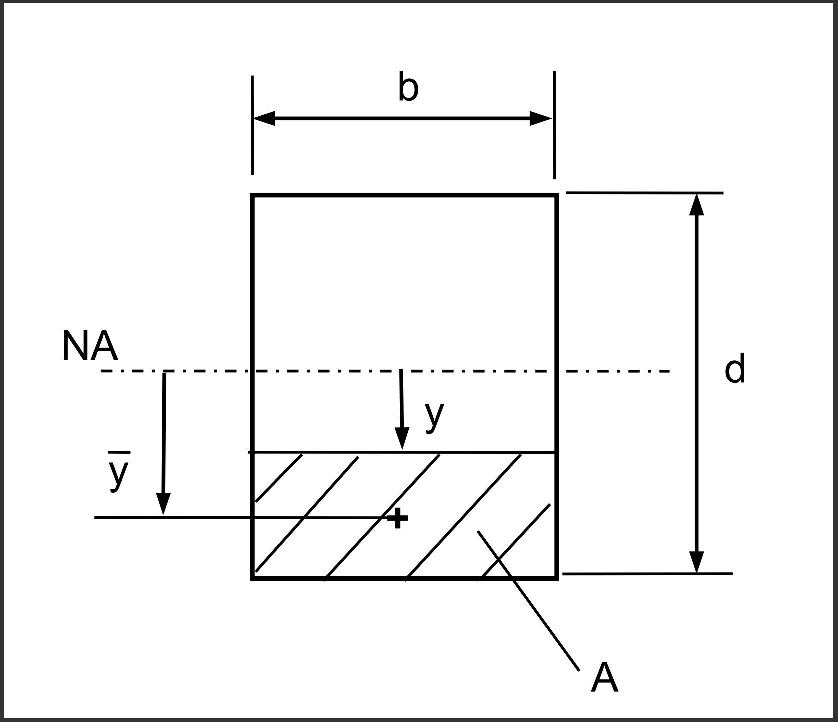
Mechanics of Solids

MMME2053

Shear Stresses

Lecture 3

Shear Stress Distribution in a Rectangular Beam (1)



$$A = \left(\frac{d}{2} - y\right) b$$

$$\bar{y} = \left(\frac{d}{2} + y\right) \frac{1}{2}$$

Shear Stress Distribution in a Rectangular Beam (2)

- Substituting into [3] gives:

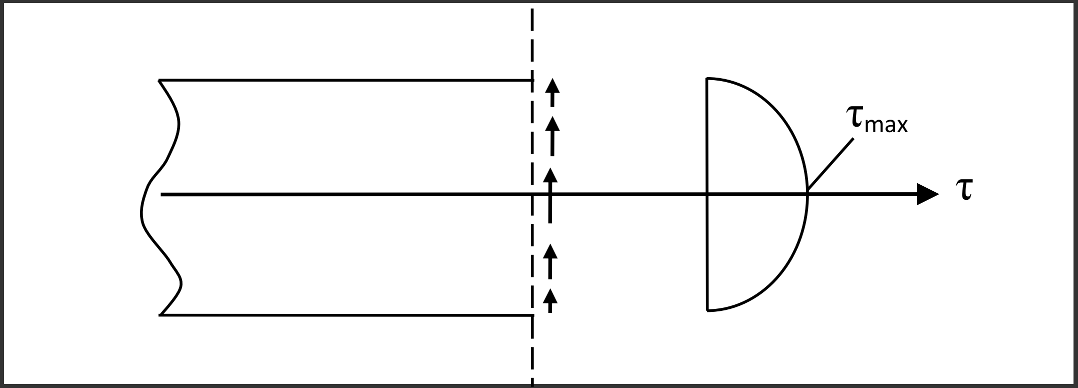
$$\tau = \frac{S}{\left(\frac{bd^3}{12}\right)b}\left(\frac{d}{2} - y\right) b \left(\frac{d}{2} + y\right)\frac{1}{2}$$

$$\tau = \frac{6S}{bd^3}\left(\frac{d}{2}\right)^2 - y^2$$

Shear Stress Distribution in a Rectangular Beam (3)

- Which gives a parabolic distribution (varies with y^2). At the top and bottom of the section, $\tau = 0$.
- At the neutral axis ($y = 0$):

$$\tau = \frac{6S}{bd^3}\frac{d^2}{4} = 1.5\frac{S}{bd}$$



Important Points

- The general formulae for shear stresses in beams in both integral and discrete forms are:

$$\tau = \frac{S}{Iz}\int_A y dA \qquad \tau = \frac{SA\bar{y}}{Iz}$$

Where S is the shear force on the section, I is the second moment of area, $\bar{y}$ is the position from the N.A. at which you wish to determine the shear stress, z is the thickness of the section at that location, A is the area outside that location, and y is the distance to the centroid of that area.

Important Points

- For rectangular cross sections, the distribution of shear stresses through the depth of the section is parabolic (varies with y^2)

- At the free surfaces, the shear stress is 0

Learning Summary

1. Appreciate that in addition to longitudinal bending stresses, beams also carry transverse shear stresses arising from the vertical shear loads acting within the beam (knowledge)
2. Be able to derive a general formula, in both integral and discrete form, for evaluating the shear stress distribution through a cross-section (comprehension);
3. Determine the shear stress distribution through the thickness in a rectangular, circular and I-section beam (application);