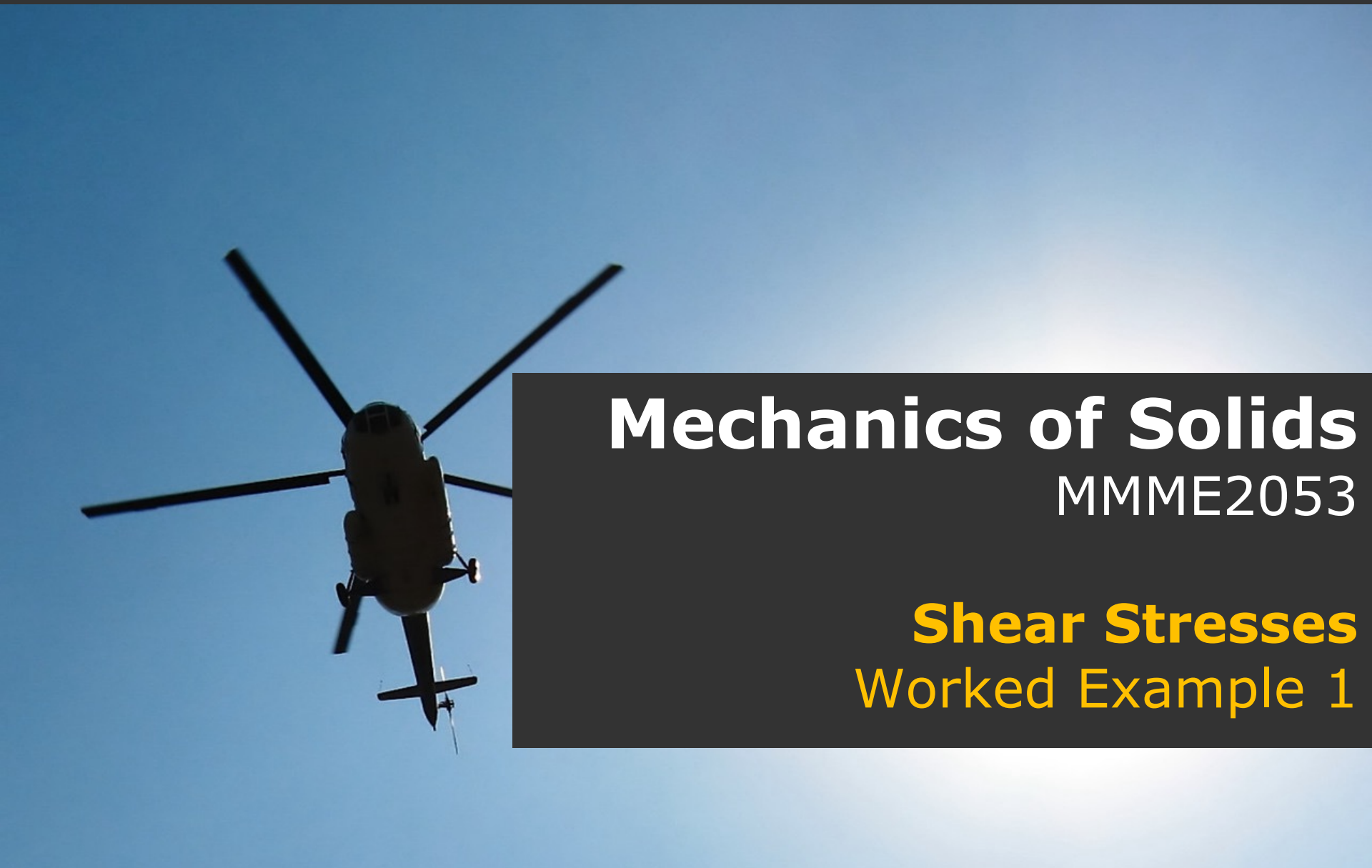

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Mechanics of Solids

MMME2053

Shear Stresses

Worked Example 1

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

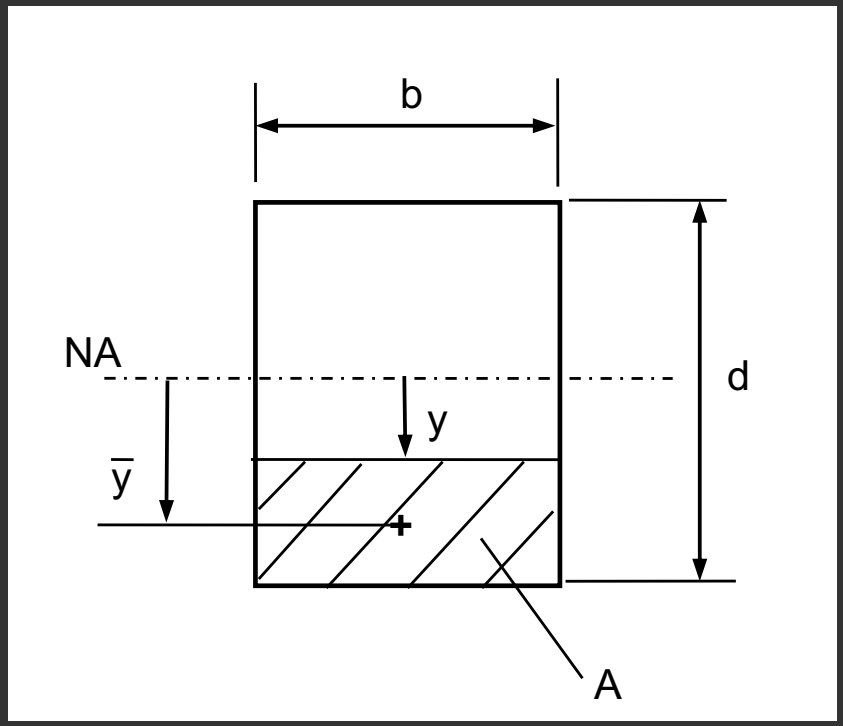
Shear Stress Distribution in a Rectangular Beam (4)

- Numerical example of rectangular beam:

- b = 20 mm
- d = 50 mm
- S = 50 kN

N.A is at d/2

Evaluate points y = 0, -10 and -25mm



Shear Stress Distribution in a Rectangular Beam (5)

- Second moment of area:

$$I = \frac{bd^3}{12} = \frac{20 \times 50^3}{12} = 208333 \text{ mm}^4$$

Shear Stress Distribution in a Rectangular Beam (6)

- At y=0 mm (N.A.)

$$A = \left(\frac{d}{2} - y\right) b = \left(\frac{50}{2}\right) \times 20 = 500 \text{ mm}^2$$

$$\bar{y} = \left(\frac{d}{2} + y\right) \frac{1}{2} = \left(\frac{50}{2}\right) \times \frac{1}{2} = 12.5 \text{ mm}$$

$$\tau = \frac{SA\bar{y}}{Iz} = \frac{50 \times 10^3 \times 500 \times 12.5}{208333 \times 20} = 75 \text{ MPa}$$

Shear Stress Distribution in a Rectangular Beam (7)

- At y=-10 mm

$$A = \left(\frac{d}{2} - y\right) b = \left(\frac{50}{2} - (-10)\right) \times 20 = 700 \text{ mm}^2$$

$$\bar{y} = \left(\frac{d}{2} + y\right) \frac{1}{2} = \left(\frac{50}{2} + (-10)\right) \times \frac{1}{2} = 7.5 \text{ mm}$$

$$\tau = \frac{SA\bar{y}}{Iz} = \frac{50 \times 10^3 \times 700 \times 7.5}{208333 \times 20} = 63 \text{ MPa}$$

Shear Stress Distribution in a Rectangular Beam (8)

- At y=-25 mm (top surface)

$$A = \left(\frac{d}{2} - y\right) b = \left(\frac{50}{2} - (-25)\right) \times 20 = 1000 \text{ mm}^2$$

$$\bar{y} = \left(\frac{d}{2} + y\right) \frac{1}{2} = \left(\frac{50}{2} + (-25)\right) \times \frac{1}{2} = 0 \text{ mm}$$

$$\tau = \frac{SA\bar{y}}{Iz} = \frac{50 \times 10^3 \times 1000 \times 0}{208333 \times 20} = 0 \text{ MPa}$$

Shear Stress Distribution in a Rectangular Beam (9)