Problems of Practices
Of
Mechanics of Solids
7- Concept of Shear Stresses in Beams

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1. A horizontal beam of square cross-section is so placed that the loading in the transverse plane is along one of its diagonals of length d. If the shear force at a section of the beam is S, draw the shear stress distribution diagram for the section and indicate the position and magnitude of the maximum shear stress on it.

2. An I-beam has flanges 10 cm wide and 1 cm thick, and the web 12 cm high and 1 cm thick. At a section of this beam acts a bending moment of 1000 kg-m and a shear force of 10,000 kg. Find the normal and shear stresses at the following points on the vertical centre line:
   (i) Top of flange.
   (ii) In web at the function with flange.
   (iii) At the neutral axis.

3. A beam has a cross-section in the form of an isosceles triangle of base b and height h. Derive an expression for the magnitude of the maximum horizontal shearing stress under a vertical shear force V. What will be the location of the plane of this stress?
   If the beam has b = 10 cm, and h = 30 cm find the magnitude of maximum shear stress, and the shear stress at neutral axis when V = 10,000 Kgf.

4. The section of a beam is square of 10 cm side with one diagonal vertical. It is subjected to a transverse shear force of magnitude F. Determine the problem of the layer at which the transverse shear stress is maximum.

5. A beam is of square section with diagonals 60 mm long, vertical and horizontal, as shown in Fig. 2. Shear force at a particular section is 5 kN. What is the shear stress at layer AB as shown?

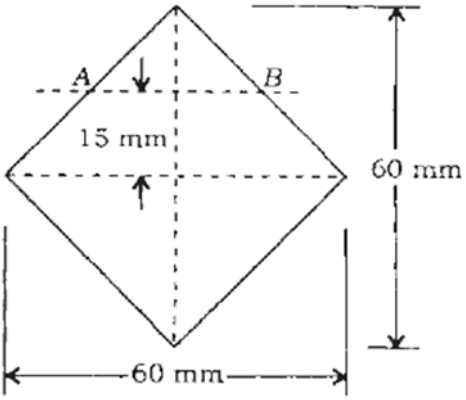

Fig. 2

6. An I-beam with the following dimensions is subjected to a shearing force of 20 kN.
Flange: breadth = 50 mm, thickness = 5.5 mm
Web: depth = 109 mm, thickness = 3.5 mm
Area of cross-section = 9.4×10^4 mm^2
M.I. = $I_{xx} = 220 \times 10^4$ mm^4.
Calculate the value of the transverse shear stress at the neutral axis x-x and at the top of the web.

7. A circular punch, 20 mm in diameter, is used to punch a hole through a steel plate 10 mm thick. If the force necessary to drive the punch is 250 kN, determine the maximum shearing stress developed in the plate.