ESO 202A/204: Mechanics of Solids (2016-17 II Semester)
Assignment No. – 8

8.1 A cantilever beam of span 4 m is subjected to a uniformly distributed load of 20 kN/m. Determine the maximum bending stresses in the beam for the following sections:

a) Square section with 200 mm side
b) Hollow box section with outer and inner dimensions as 200 × 400 mm and 140 × 340 mm respectively

8.2 A simply supported beam is to carry a uniformly distributed load of 20 kN/m. The cross-section is as shown in Fig. 8.2. Find the largest possible span of the beam such that the maximum bending stress is 140 MPa.

8.3 A bookshelf is made out of 5 mm glass plate. For long time service, ordinary glass plate cannot safely be stressed to more than 10 MPa in tension. If the supports are located in the optimum position, estimate the average weight of books (uniformly distributed) per unit length, which can be placed along the shelf (Fig. 8.3).

8.4 The flange of a T-section, as shown in Fig. 8.4, is of aluminium and the web is of steel. If this composite beam is subjected to bending moment of 100 kN-m, sketch the bending stress distribution along the depth of the beam. Given E_{Al} = 70 GPa, E_S = 210 GPa.

8.5 In an attempt to make a beam which combines light weight with large stiffness, 6.25 mm steel plates are riveted to the top and bottom of an aluminum alloy I beam for which $I_{zz} = 23.70 \times 10^6$ mm^4. By what ratio is the stiffness $k = M/(d\phi/ds)$ of the I-beam increased by the addition of plates? In the composite beam what is the ratio of the maximum bending stress in the aluminum to that in the steel (Fig 8.5)? Given E_{Al} = 70 GPa, E_S = 200 GPa.

8.6 A uniform, rectangular beam is in equilibrium under the action of two equal and opposite forces, P, applied on the end faces and parallel to the x axis (Fig 8.6). The line of action of these forces passes through the point $y = h/4$, $z = b/4$.

a) Determine the stress σ_x at the corner C.
b) Determine the region (in y – z plane) within which the line of action of P must lie in order to avoid tensile stress along x direction at all the points on the beam cross section.

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Fig. 8.2

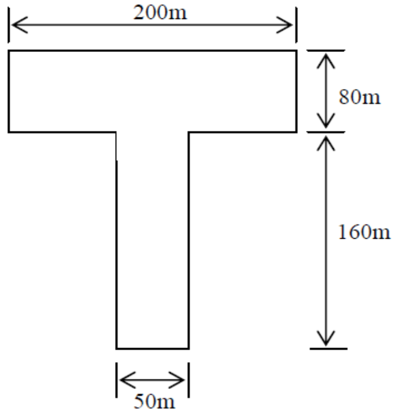

Fig. 8.4

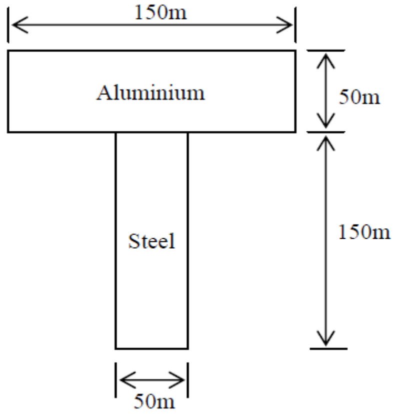

Fig. 8.3

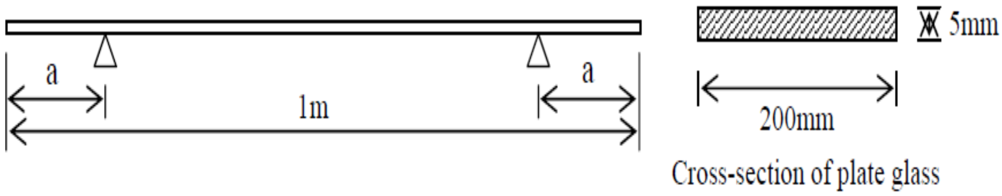

Fig. 8.5

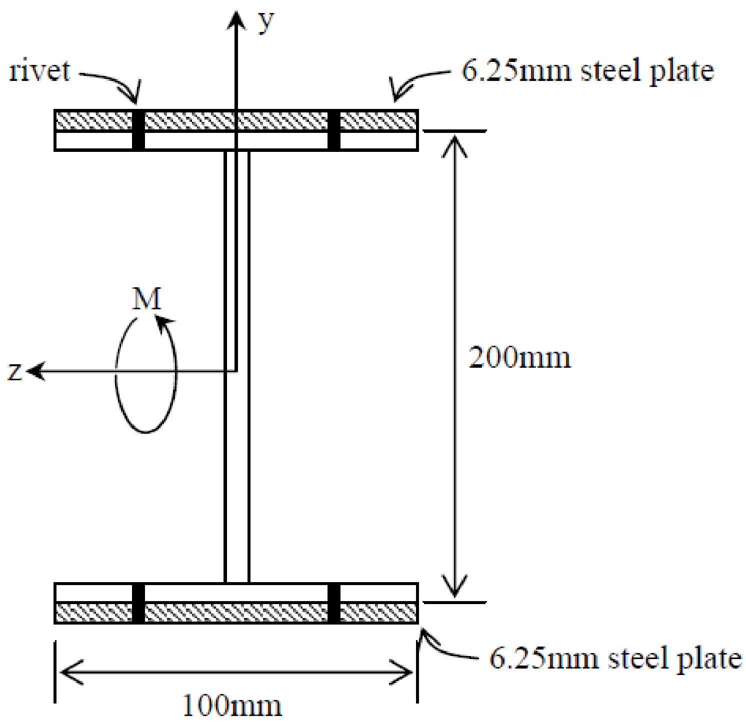

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Fig. 8.6