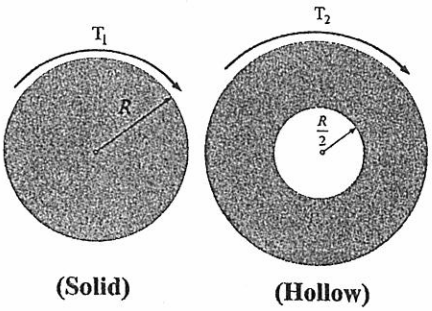
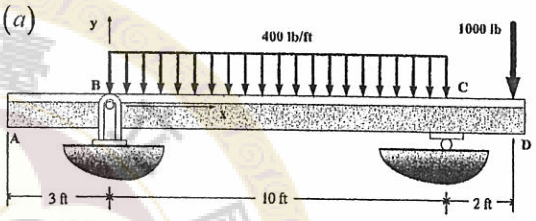
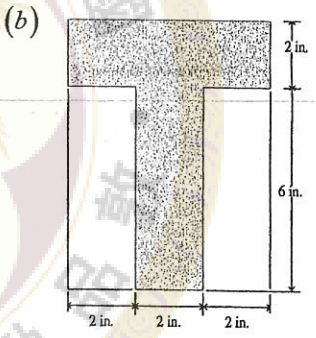
1. Two circular shafts (made by the same material with the allowable shear stress τ_m) are used to transmit a torque as shown in Fig. 1. If these two shafts have the same cross-sectional area, determine (i) which one can transmit more torque? (10%) (ii) $T_1 / T_2 = ?$ (the ratio of T_1 and T_2) (10%)



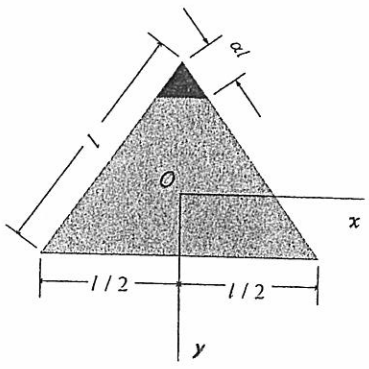
2. A simple T-beam shown in Fig. 2(a) has the cross section in Fig. 2(b). (i) Find the reactions at the two supports B & C. (6%) (ii) Draw the shear-force and bending-moment diagrams for the beam. (8%) (iii) Find the maximum tensile and compressive flexural stresses in the beam. (8%) (iv) Find the horizontal shearing stress distribution along the y-axis at the location of x=5 ft (5 ft right of pt. B). (8%)





3. Answer the following questions. (i) Give the reasons for the symmetry of stress and of strain. (6%) (ii) Why the shearing stress vanishes on the plane, on which the maximum tensile stress acts? Why the normal stress is not required to be zero on the plane, on which the maximum shearing stress acts? (6%) (iii) What are the plane stress and the plane strain? (6%) (iv) Using Mohr's circle to explain why the normal stress of a steel bar must be nonnegative when the two ends of the bar are subjected to an axial tensile load? (7%)

4. (i) In order to obtain the strongest cross section in bending, please find the ratio α defining the small area that should be removed from a cross section in the form of an equilateral triangle, as shown in Fig. 4. (18%) (ii) By what percent in the section modulus increased when this area is removed? (7%)



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