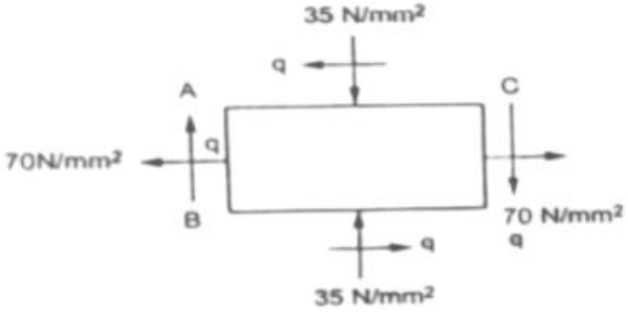
19ASB201 Aero Mechanics of Solids

IAE 3 QUESTION BANK

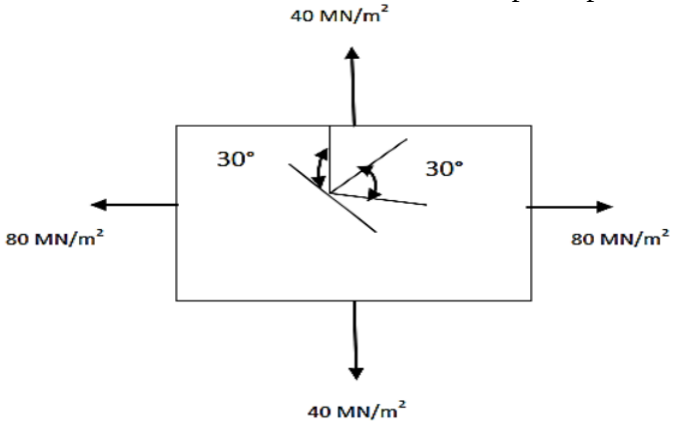
1. Write polar moment of inertia and establish the equations for a solid and hollow circular shaft. Also write the governing equation for torsion of circular shaft?
2. A solid shaft of 180 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45 N/mm2.
3. What are the stresses induced in thin cylindrical shell subjected to internal pressure?
4. List out the type of stress induced in a structural member subjected to torsional loading.
5. Define Mohr's circle in the context of plane stress analysis.
6. What is spring index (C)?
7. Write the stresses induced in thin cylindrical shell subjected to internal pressure?
8. Recall the stiffness and spring index of a helical spring.
9. Define principal stresses and principal planes.
10. Compare cylindrical shell and spherical shell subjected to internal pressure.

11. A solid shaft is to transmit 400kW at 100rpm if the shear stress is not exceeded 90N/mm2. Find the diameter of the shaft. If this shaft were to be replaced by hollow shaft of same material and length with an internal diameter of 0.7 times the external diameter, what percentage saving in weight is possible.
12. A closely coiled helical spring of round wire 100mm in diameter having 11 complete turns with a mean diameter of 120mm is subjected to an axial load of 300N. Determine i) The deflection of the spring ii) Maximum shear stress in the wire iii) Stiffness of the spring. Take C = 8x104 N/mm2
13. The principal stresses at a point across two perpendicular planes are 80 MN/m^2(tensile) and 35 MN/m^2 (tensile). Find the normal, tangential stresses and the resultant stress and its obliquity on a plane at 20° with the major principal plane.
14. Two planes AB and AC which are right angles carry shear stress of intensity 17.5 N/mm^2 while these planes also carry a tensile stress of 70 N/mm^2 and a compressive stress of 35 N/mm^2 respectively. Determine the principal planes and the principal stresses. Also determine the maximum s gear stress and planes on which it acts.



15. How is Mohr's circle used to determine principal stresses and maximum shear stress in a material under plane stress conditions?

16. Two shafts of the same material and of same lengths are subjected to the same torque, if the first shaft is of a solid circular section and the second shaft is of hollow circular section, whose internal diameter is 2/3 of the outside diameter and the maximum shear stress developed in each shaft is the same, compare the weights of the shafts.
17. A hollow shaft is to transmit 300 kW at 80 rpm. If the shear stress is not to exceed 70 MN/m^2 and internal diameter is 0.5 of the external diameter. Find the external and internal diameters assuming that maximum torque is 1.6 times the mean.
18. Calculate the maximum external diameter of the shaft satisfying these conditions. Hollow shaft of diameter ratio 3/8 is required to transmit 600 kW at 120 rpm. The shear stress is not to exceed 65 MPa and the angle of twist in a length of 3 meters is not to exceed 1.4 degrees. Assume Rigidity modulus (or shear modulus) as 84 GPa.
19. The principal stresses in the wall of a container are 40 MN/m2 and 80 MN/m2. Determine the normal, shear and resultant stresses in magnitude and direction in a plane, the normal of which makes an angle of 30° with the direction of maximum principal stress.



20. Discuss the differences between plane stress and plane strain and how Mohr's circle applies to each condition.

21. A regulator block of material is subjected to a tensile stress of 110 N/mm2 on one plane and a tensile stress of 47/Nmm2 on the plane at right angles to the former. Each of the above stresses is accompanied by a shear stress of 63 N/mm2 and that associated with the former tensile stress tends to rotate the block anticlockwise. Find: (i) The direction and magnitude of each of the principal stress (ii) Magnitude of the greatest shear stress.

22. The stiffness of a closely coiled helical spring is 1.5N/mm of compression under a maximum load of 60N. The maximum shearing stress produced in the wire of the spring is 125 N/mm^2. The solid length of the spring (when the coils are touching) is given as 5cm. Find (i) Diameter of wire (ii)Mean diameter of the coils and (iii) Number of coils required. Take C = 4.5x104 N/mm^2