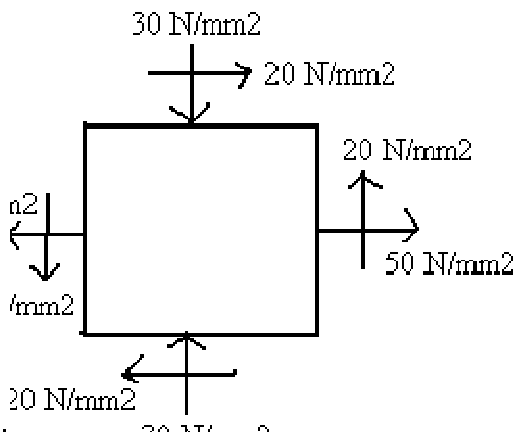
UNIT 1 (Mechanics of Solids)

1. Determine the direction of principal plane, normal stresses and tangential stress of the strained material as shown in figure.



2. The normal stresses acting on two perpendicular planes at a point in a strained material are 70 MN/ m2 tensile, 35 MN/ m2 compressive. In addition, shear stress of 40 N/mm2 act on these planes. Calculate the following:

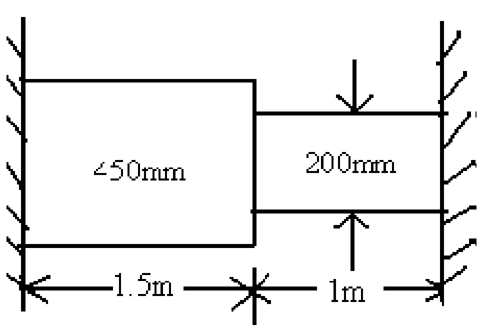
(i).The magnitude of the principle stresses

(ii).The direction of the principal planes

(iii).The magnitude of the maximum shear stress.

3. A steel tube 50mm external diameter 5mm thick encloses centrally a copper bar of 30 mm diameter. The bar and tube are rigidly connected together at the end at a temperature of 30oC. The composite bar is subjected to an axial compressive load of 60kN and the temperature is raised to 150oC. Determine the stresses in the steel tube and copper rod αs = 12x10-6/oC, αcu = 18x10-6/oC, Es = 200 GPa, Ecu = 100 GPa.

4. A bar of non uniform diameter, as shown in figure is rigidly fixed. There is no expansion of the ends and there is no stress in the bar at a temperature of 22oC. If the temperature of the bar be raised to 45oC, find the forces applied by the rigid walls on the bar. MOE and coefficient of thermal expansion for the materials are 200 GN/m2 and 11.7x10-6/oC respectively. Assume no lateral buckling of the bar.



5. A body is subjected to direct stresses in two mutually perpendicular directions accompanied by a simple shear stress. Draw the Mohr's circle of stresses and explain how you will obtain the principal stresses and principal planes.

6. The normal stresses acting on two perpendicular planes at a point in a strained material are 100 MN/ m2 tensile, 45 MN/ m2 compressive. In addition, shear stress of 50 N/mm2 act on these planes. Calculate the following:

(i).The magnitude of the principle stresses

(ii).The direction of the principal planes

(iii).The magnitude of the maximum shear stress.

7. A M.S bar of 50mm square in size and 150mm long is subjected to an axial thrust of 200kN. Half the lateral strain is prevented by the application of uniform external pressure of certain intensity. If E = 200 GPa and Poisson's ratio 0.3. Calculate the change in the length of the bar.

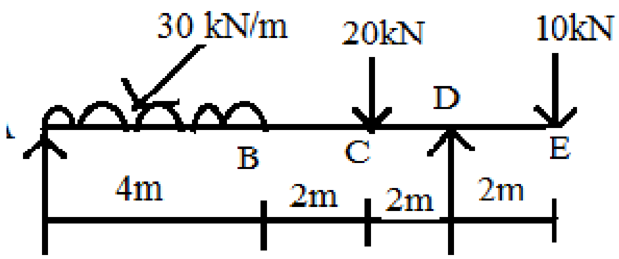
8. An element in a stressed material has tensile stress of 500 N/mm2 and compressive stress of 350 N/mm2 acting on two mutually perpendicular planes and equal shear stresses of 100 N/mm2 on these planes. Find the principal stresses and its planes. Find the plane of maximum shear stress and its plane.

9. A member ABCD is subjected to point loads P1, P2, P3 and P4 as shown in fig. Calculate the force P2 necessary for equilibrium if P1=4500kg, P3=45,000kg and P4=13,000kg. Determine the total elongation of the member, assuming E to be 2.10X106 kg/cm2.

10. A solid circular bar of diameter 20mm when subjected to an axial tensile load of 40 KN, the reduction in diameter of the rod was observed as 6.4x10 – 3 mm. The bulk modulus of the material of the bar is 67 GPa. Determine the following. a) Young modulus, b) Poisson's ratio, c) Modulus of rigidity, d) Change in length per meter and e) Change in volume of the bar per meter length.

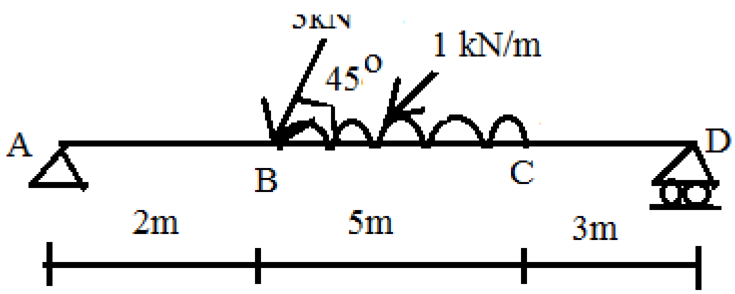
UNIT-2

1. For the loaded beam shown in Fig determine (i) The reaction at each support (ii) The bending moment under the loads and hence the maximum bending moment. Also draw the shear force and bending moment diagrams.



Fig

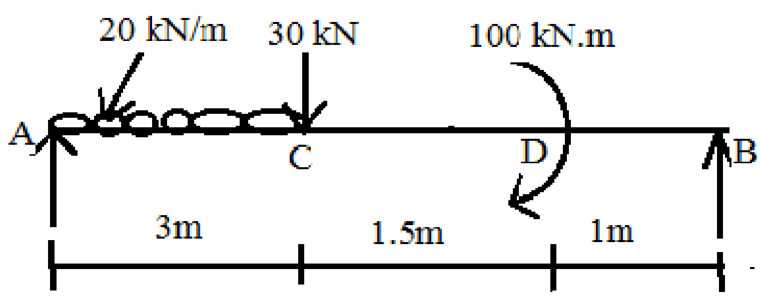
2. Draw the shear force and bending moment diagram for the beam shown in Fig. Indicate maximum positive bending moment and its location.



Fig

3. A beam 6m long and simply supported at each end has a uniformly distributed load of 800 N/m extending from the left end to a point 2 m away. There is also a clockwise couple of 1500 Nm. applied at the centre of the beam AB. Draw the shear force and bending moment diagrams for the beam and find the maximum bending moment.

4. Draw shear force and bending moment diagram for the beam shown in Fig.



5. A cantilever of length 4m carries a of 3KN/m run over the whole length and two point loads of 4KN and 2.5KN are place 1m and 2m respectively from the fixed end. Draw the shear force and BM diagram.

6. A T – section of a beam has the following dimensions width of the flange 100mm, overall depth 80mm, thickness of the web 10mm, thickness of flange 10mm. Determine the maximum bending stress in the beam, when the bending moment of 200 Nm is acting one of the section.

7. Two wooden planks 50mm x 150mm in section is used to form a Tee section as shown in fig. if a bending moment of 3400 Nm is applied with respect to the neutral axis. Find the extreme fibre stresses and the total tensile force.

8. A flitched beam consists of two timber joist 100mm wide and 240mm deep with a steel plate 180mm deep and 10mm thick placed symmetrically between the timber joists and well clamped. Determine

i) The maximum fibre stress when the maximum fibre stress in wood is 80 kg/cm2.

ii) The combined moment of resistance if the modular ratio is 18.

9. A rectangular beam of width 100 mm and depth 200 mm is simply supported over a span of 6 m and carries a central concentrated load of 20 kN. Determine the maximum bending and shear stress in the beam and indicate where in the beam they occur. Plot the distribution of the stresses across the depth at any cross section.

10. A rolled steel joist of section has the following dimension.

Flange width = 250 mm; Flange thickness = 25 mm

Overall depth = 800 mm; Web thickness = 12 mm

Calculate the safe 'UDL' per meter length of beam, if the beam, if the effective span is 8m and the maximum stress in steel is 100 N/mm2.

UNIT -3

1. i) Derive the torsion equation for a circular shaft of diameter'd' subjected to torque 'T'.

ii) Find the torque that can be transmitted by a thin tube 6 cm mean diameter and wall thickness 1 mm. the permissible shear stress is 6000 N/cm2.

2. A close coiled helical spring is made of a round wire having 'n' turns and the mean coil radius R is 5 times the wire diameter. Show that the stiffness of the spring = 2.05 R/n. If the above spring is to support a load of 1.2kN with 120mm compression. Calculate mean radius of the coil and number of turns assuming G = 8200 N/mm2 and permissible shear stress, λ allowable = 250 N/mm2.

3. A steel shaft ABCD having a total length of 2400mm is contributed by three different sections as follows. The portion AB is hollow having outside and inside diameters 80mm and 50mm respectively, BC is solid and 80mm diameter. CD is also solid and 70mm in diameter. If the angle of twist is same for each section, determine the length of each portion and the total angle of twist. Maximum permissible shear stress is 50 MPa and shear modulus 0.82x105 MPa.

4. It is required to design a close coiled helical spring which shall deflect 1mm under and axial load of 100N at a shear stress of 90 MPa. The spring is to be made of round wire having shear modulus of 0.8x105 MPa. The mean diameter of the coil is to times that at the coil wire. Find the diameter and length of the wire.

5. A solid circular shaft transmits 75kW power at 200rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed one degree in 2m length of shaft and shear stress is not exceed 50 N/mm2. Assume the modulus of rigidity of the material of the shaft as 100 kN/mm2.

6. A shaft has to transmit 110 kW at 160rpm. If the shear stress is not to exceed 65N/mm2 and the twist in a length of 3.5m must not exceed 1o, find a suitable diameter. Take C = 8x104 N/mm4.

7. A leaf spring 750mm long is required to carry a central load of 8kN. If the central deflection is not to exceed 20mm and the bending stress is not to be greater than 200N/mm2. Determine the thickness, width and number of plates. Assume the width of the plates is 12 times, their thickness and modulus of elasticity of the springs material as 200kN/mm2.

8. A closely coiled helical spring made out of a 10mm diameter steel bar has 12 complete coils, each of mean diameter of 100mm. Calculate the stress induced in the section of rod, the deflection under the pull and the amount of energy stored in the spring during the extension. It is subjected to an axial pull of 200N. Modulus of rigidity is 0.84x105 N/mm2.

9. A close coiled helical spring has a stiffness of 5N/mm. its length when fully compressed with adjacent coils touching each other is 40 cm. the modulus of rigidity of the material of the spring is 0.8x10N/mm2. Determine the wire diameter and mean coil diameter if their ratio is 1/10. What is the corresponding maximum shear stress in the spring?

10. A circular shaft of 1000mm diameter and 2m length is subjected to a twisting moment which creates a shear stress of 20N/mm2 at 30mm from the axis of the shaft. Calculate the angle of twist and the strain energy stored in the shaft. Take G=8x104 N/m

UNIT-4

1.A thin cylindrical shell 1000 mm long, 200 mm in external diameter, thickness of metal 10 mm is filled with a fluid at atmosphere pressure. If an additional 25 cm3 of the fluids at atmospheric find the pressure exerted by the fluid on the wall. Take E = 2 x 105 N/mm2 and Poisson's ratio = 0.3. Find also the hoop stress induced.

2. A cylindrical shell 3m long which is closed the ends has an internal diameter of 1m a wall thickness of 15mm. Calculate the Circumferential and longitudinal stresses induced and also changes in the dimensions of the shell, if it is subjected to an internal pressure of 1.5 N/mm2. Take E = 2 x 105 N/mm2 and 1/m = 0.3.

3. (i) Show that in thin cylinder subjected to internal fluid pressure, the hoop stress is twice the longitudinal stress.
(ii) Derive an expression for the change in volume of a thin cylindrical shell subjected to internal fluid pressure.
4. A cast iron thin cylindrical pipe of internal diameter 200 mm and 15mm thick is closely wounded by single layer steel wire of 2mm diameter under a tension of 50 N/mm2. Find the stresses set up in the pipe when the pipe is empty. Also find the stresses set up in the pipe and steel wire, when water is admitted in the pipe under a pressure of 5 N/mm2. Take E for as C.I and steel respectively 1 x 105 N/mm2 and 2x 105 N/mm2. Poisson's ratio = 0.3.

5. A copper cylinder, 90 cm long, 40 cm external diameter and wall thickness 6mm had its both ends closed by rigid blank flames. It is initially full of oil at atmospheric pressure calculate the additional volume of all which must be pumped into it in order to rise the oil pressure to 5 N/mm2 above atmospheric pressure. For copper assume E = 1.0 x 106 N/mm2 and Poisson's ratio = 1/3. Take bulk modulus of oil is 2.6 x 108 N/mm2.

6.In a hydraulic press, the cylinder has an internal diameter of 30cm. The cylinder has to withstand an internal pressure of 10 MPa without the material being stressed beyond 20 MPa. Determine the thickness of the metal.

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8.. A solid circular bar of diameter 20mm when subjected to an axial tensile load of 40 KN, the reduction in diameter of the rod was observed as 6.4x10 – 3 mm. The bulk modulus of the material of the bar is 67 GPa. Determine the following. a) Young modulus, b) Poisson's ratio, c) Modulus of rigidity, d) Change in length per meter and e) Change in volume of the bar per meter length.

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(ii) Derive an expression for the change in volume of a thin cylindrical shell subjected to internal fluid pressure

10.Distinguish between thin walled cylinder and thick walled cylinder.

UNIT-5

1.How would you find the bending stress in unsymmetrical sections?

2. What do you understand by the assumption, plane section remain plane even after the application of load?

3. Draw the bending stress distribution for a symmetrical I section.

4.A simple beam of span 10m carries a udl of 3kN/m. The section of the beam is a T having a flange of 125x125mm and web 25x175mm. For the critical section obtain the shear stress at the neutral axis and at the junction of flange and the web. Also draw the shear stress distribution across the section.

5.What do you understand by neutral axis & moment of resistance? How do you locate Neutral axis?

6. (a).The plane of load should contain of load should contain one of the principal axes of inertia, so that the neutral axis is perpendicular to the plane of load –true or false.
(b).In the theory of simple bending neutral axis is the centroidal axis perpendicular the plane of load – true or false.

7.How would you find the bending stress in unsymmetrical sections?

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10.A beam of channel section 120x60mm has a uniform thickness of 15mm. Draw the shear stress distribution for a vertical section where the shear force is 50kN. Find the ratio between the maximum and mean shear stress.