UNIT:V ***Mr.Nurul Hassan***

SIMPLE STRESS & STRAIN

Q.1 A steel bar 2.4m long and 30mm square is elongated by a load of 500N.If Poisson ratio is 0.25, find the increase in volume .Given $E=0.2\times10^6$ N/mm^2

Q.2. The piston of a steam engine is 300mm in diameter and the piston rod is of 50mm diameter. The steam pressure is 1N/mm^2. Find the stress in the piston rod and elongation in a length of 800mm. Take E=200GPa.

Q.3. Three bars of equal length and having cross-sectional areas in the ratio 1:2:4 are all subjected to equal load. Compare their strain energy.

Q.4. A metallic rectangular rod 1.5m long and 40mm wide and 25mm thick is subjected to an axial tensile load of 120KN. The elongation of the rod is 0.9mm. Calculate the stress, strain and modulus of elasticity.

Q.5. One meter long steel rod of rectangular section 80mm x 40mm is subjected to an axial tensile load of 200 KN. Find the strain energy and maximum stress produced in it when the load is applied gradually. Take $E=2x10^5$ N/mm^2.

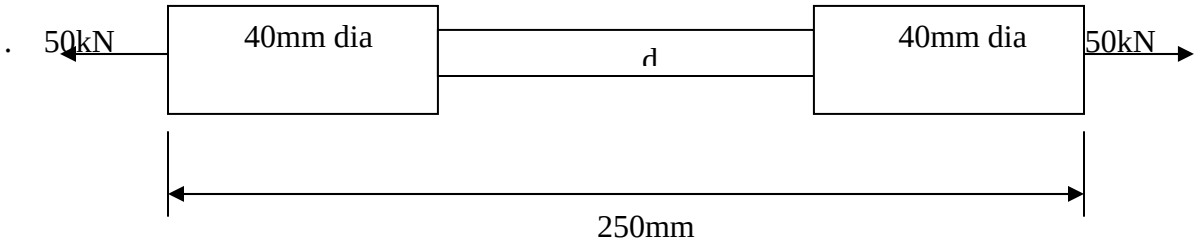
Q.6. A circular rod of 100mm diameter and 500mm long is subjected to a tensile force of 1000KN. Determine the modulus of rigidity, bulk modulus and change in volume if poison's ratio is 0.3 and $E=2x10^5$ N/mm^2.

Q.7.The piston of a steam engine is 300mm in diameter and the piston rod is of 50mm diameter. The steam pressure is 1 N/mm^2.Find the stress in the piston rod and elongation in a length of 800mm.Take:E=200GPa. (Ans: stress=35N/ mm^2 ,elongation=.14mm)

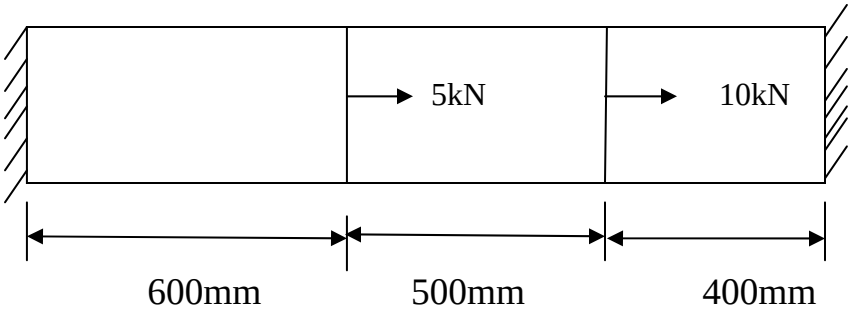
Q.8.A bar of 25mm diameter is subjected to a pull of 60kN.The measured extension over a gauge length of 250mm is 0.15mm and change in diameter is 0.004mm. Calculate the modulus of elasticity, modulus of rigidity and Poisson's ratio.

Q.9.A steel rod of diameter 50mm and 2.5m long is subjected to a pull of 100kN. To what length the rod should be bored centrally so that the total extension will increase by 15% under the same pull, the bore being 25mm diameter? Take E=200GN/m^2 (Ans: x=1.2m)

Q.10.The bar shown in Fig is subjected to a tensile load of 50kN. Find the diameter of the middle portion if the stress is limited to 130MN/ m^2. Find also the length of the middle portion if the total elongation of the bar is 0.15mm .Take E=200GN/m^2 (d=22.1mm, L=222mm)

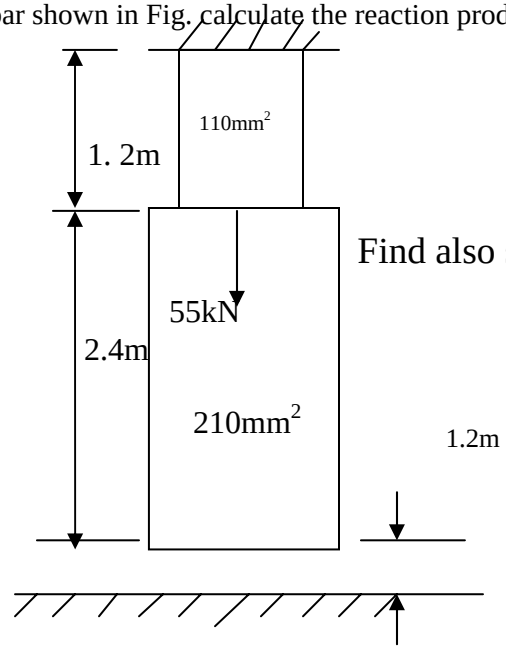


Q.11.



Find stresses in all three parts of the bar if cross-sectional area of bar is 1000mm^2

Q.12.For the bar shown in Fig. calculate the reaction produced by the lower support on the bar. E=200GN/m^2



Find also stresses in the bars.

BENDING STRESS:

1.A wooden beam of rectangular section is subjected to a bending moment of 5kNm.If the depth of the section is to be twice the breadth and stress in the wood is not to exceed 60N/m^2, find the dimension of the cross-section of the beam (Ants'=0.6786m)

2.A rectangular beam with depth 150mm and width 100mm is subjected to a maximum bending moment of 300 kNm, find the maximum stress in the beam. (Ans:80kN/cm^2)

3.A rectangular beam of 200mm in width and 400mm in depth is simply supported over a span of 4m and carried a udl of 10K=kN/m. determine the maximum bending stress in the beam. (Ans:3750 kN/ m^2)

4.A rectangular beam of cross-section(300*200) mm^2 is simply supported over a span of 5m.What uniformly distributed load the beam may carry

(i)when the height is 300mm (ii) when the height is 200mm.

The bending stress is not to exceed 130N/ mm^2

5.A beam made of C.I. having a circular section of 50mm external diameter and 25mm internal diameter is supported at two points 4m apart. The beam carries a concentrated load of 100N at the centre. Find the maximum bending stress in the beam? (Ans:8.69N/mm^2)

6.A hollow circular bar having outside diameter twice the inside diameter is used as a beam subjected to a bending moment of 50kNm.Determine the inside diameter of the bar if allowable bending stress is limited to 100MN/ m^2 (Ans:d=88.12mm)

7. Find the dimension of the strongest rectangular beam that can be cut from a log of 250mm diameter.(Ans:b=144mm, d=204mm)

8. Three beams have the same length, same stress and same bending moment. The cross-sections of the beams are a square, a rectangle with depth twice the width and a circle. Determine the ratios of weight of circular and rectangular beams with respect to that of square beam.

9.For a given stress compare the moment of resistance of a beam of square section when placed (i) with two sides horizontal and(ii) with its diagonal horizontal. (Ans:1.414)

10.A water mains 500mm external diameter and 25mm thick is full of water and is freely supported for 20m span. Determine the maximum bending stress induced in the pipe metal if the weight of water and that of pipe is taken in to account. The specific weight of water and steel as 10kN/ $m^3$and 75kN/m^3 (Ans=52.014N/ mm^2

11.A cantilever with a constant breadth of 100mm has a span of 2.5m.It carries a uniformly distributed load of 20kN/m. Determine the depth of the section at the middle of the length of the cantilever and also at the fixed end if the stress remains the same throughout and is equal to 120 MN/ m^2

12.A simply supported beam 1m long and 20mm*20mm in cross-section fails when a central load of 600N is applied to it. What intensity of UDL would cause failure of a cantilever beam 2m long and 400mmwide * 80mm deep made of same material.

13.Deterrmine the longest span of a simply supported beam carry a UDL of 6kN/m without exceeding a bending stress of 120MN/ m^2 .The depth and moment of inertia of the symmetrical I-section are 20cm and 2640cm^4 respectively

14.. A simply supported beam 200mm wide and 250mm deep carries a UDL of intensity 800N/mm over its entire span of 4m find maximum stress developed in the beam.

15. For I section given flange = 250mm wide and 25mm thick, web = 15mm thick, over all depth = 600mm. The beam has span of 10m and carries a UDL of intensity 50KN/m for the entire span. Find the stress produced due to bending.

TORSION

Q.1. Compare the strength between hollow and a solid circular shaft for same material, same length and same weight.

Q.2. The diameter of a shaft is 20cm. Find the safe maximum torque which can be transmitted by the shaft, if the permissible shear stress in the shaft material is 4000N/cm^2 and permissible angle of twist is 0.2^o per meter length. Take G= 8x10^6 N/cm^2. if the shaft rotates at 320rpm what maximum power can be transmitted by the shaft

Q.3.If the maximum torque transmitted by a solid shaft exceeds the mean by 30% in each revolution, find a suitable shaft diameter to transmit 75 kW power at 200rpm.Take allowable shear stress as 70 N/ mm^2 (Ans:69.7mm)

Q.4.What external and internal diameter is required for a hollow shaft to transmit 50kW of power at 300rpm if the shear stress is limited to 100MN/ m^2.Take outside diameter to be twice of inside diameter.

Q.5.Calculate the diameter of a circular shaft to transmit 75 kW at 200rpm.Allowable shear stress is restricted to 50MN/ m^2 and twist 1^o in 2 m shaft length .Take G=400GPa

Q.6.Compare the weight of a solid and hollow shaft of same material, same length, same torque and same stress. The internal diameter of hollow shaft is 2/3 of its outer diameter.

Q.7.A hollow shaft of 3m length is subjected to a torque such that the maximum shear stress produced is 75MPa.The external and internal diameters of the shaft are 150mm and 100mm respectively. Find the shear stress at the inside surface.Take:G=75MPa

Q.8.A solid circular shaft is required to transmit 200kW power at 100rpm.Determine the diameter of the shaft if permissible shear stress is 60 N/mm^2.calculate the energy stored per meter length of the shaft. Take:G=100kN/mm^2

Q.9.A solid circular shaft is to transmit power 160kW at 180rpm.What will be the suitable diameter of this shaft if the permissible stress in the shaft material should not exceed 2MPa and twist per meter length should not exceed 2^o.Take:G=200GPa

Theoretical Questions:

Q.1.