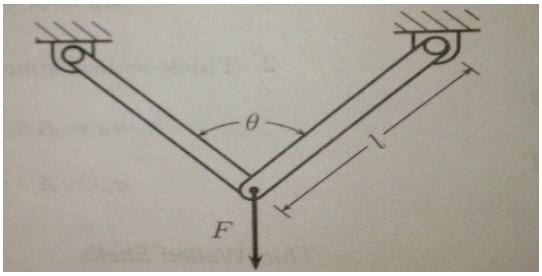
SOM Sheet -3

Q1. Both the bars of the symmetric truss as shown in the figure are made of the same material of the modulus of elasticity E , equal cross-sectional area A and length L.



Determine the vertical deflection of point B on application of load F at this point.

ANS:- $\frac{F_1 l}{2\,cos^2\left(\frac{\theta}{2}\right)AE}$

Q2. A rod of material with $E = 200\times10^3\ MPa$ and α=10^{-3} is mm/mm-°C fixed at both the ends . It is uniformly heated such that the increase in temperature is 30°C. What is the stress developed in the rod?

ANS:- Stress = $-6000\ N/mm^2$

Q3.When the weight of 100N falls on spring of stiffness 1KN/m from a height of 2m. What is the deflection caused in the first fall?

ANS:- x= 0.6324m

Q4.The principal strains at a point in a body under bi-axial state of stress are 1000 $\times10^{-6}$ and -600 $\times10^{-6}$ .What is the maximum shear strain at that point?

ANS:- maximum shear strain=1600 $\times10^{-6}$

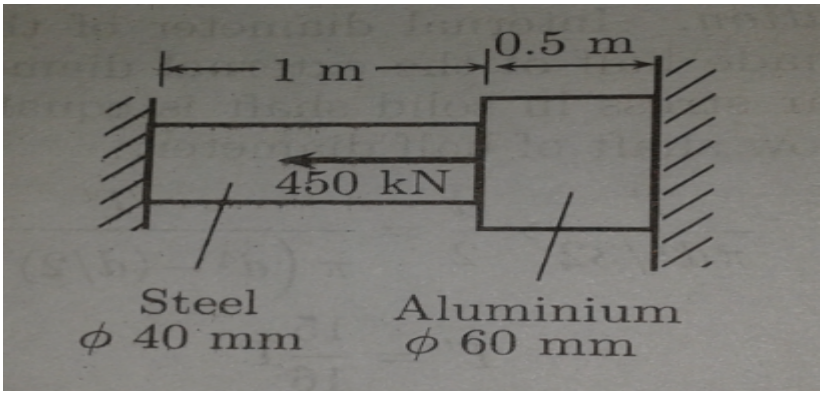
Q5. The Normal stresses at a point are x==80 MPa and y= 20 MPa ;the shear stress at this point is z=40Mpa .What is the maximum principal stress at this point?

ANS:-Maximum principal stress=100MPa

Q6. A solid shaft of diameter 150 mm , length 1200 mm can be subjected to maximum shear stress 80MPa.A hole of 75 mm diameter is now drilled throughout the length of the shaft .Determine the percentage reduction in torque-carrying capacity of the shaft for the same maximum shear stress.

ANS:- Maximum shear stress=6.25%

Q7. A composite bar is made of aluminium and steel portions of lengths 0.5m and 1m ,respectively.A load 450 KN is applied at the junction of the portions as shown in figure.



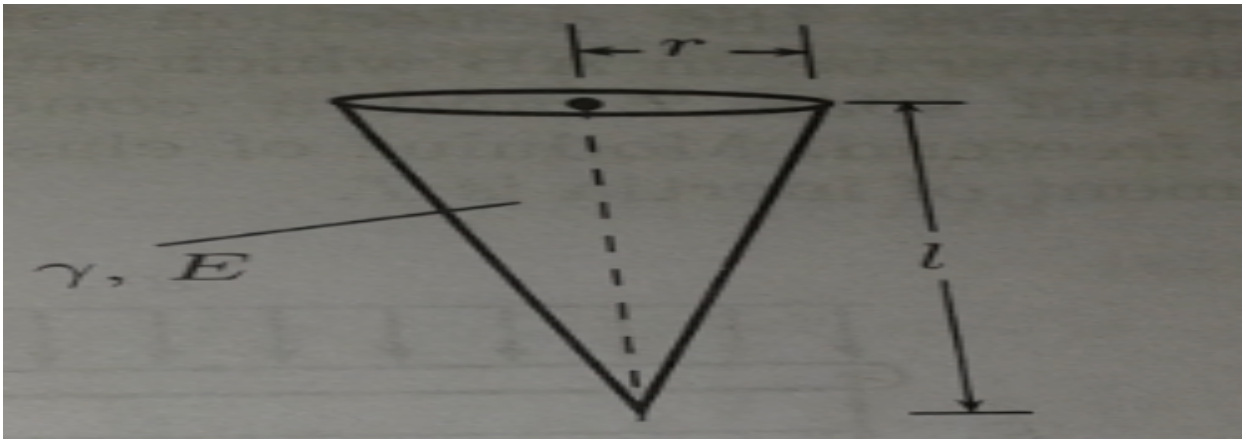
The modulus of elasticity of steel and aluminium are 210 GPa and 70GPa ,respectively.Determine the loads shared by the aluminium and steel portions .Also determine the stresses developed in both the portions.

ANS:-204.62MPa

Q8. A high strength steel band saw, 20 mm wide and 0.8 mm thick,runs over a pulley 600mm in diameter.The modulus of elasticity of the saw material is 200 GPa.Determine the maximum flexural stress developed in the saw due to bending in the pulley.Also calculate the minimum radius of pulley which can be used without exceeding a flexural stress of 400MPa.

ANS:-200 mm

Q.9.A cone of height L and diameter d is made of a material having weight density x=pg and modulus of elasticity E.



Determine how far its end ids displaced due to gravity when it is suspended in the vertical position keeping its base on the upper side.

ANS:- $\frac{\gamma l^2}{6E}$

Q10. In an axial tensile test on 15mm diameter bar of gauge length 200mm, the load at proportionality limit is 25KN and corresponding changes in length and diameter are 0.25mm and 0.0065mm , respectively.Calculate the modulus of elasticity and poisson's ratio of the material.

ANS:- -113GPa, 0.3467

Q11.A thin rectangular steel plate $100mm \times 50mm$ undergoes deformation of 0.05 mm and 0.01 mm in longitudinal and lateral directions .The modulus of elasticity of steel is 200 GPa and Poission's ratio is 0.3.Calculate the stresses in the longitudinal and lateral directions.

ANS:- 123.08MPa, 76.92MPa

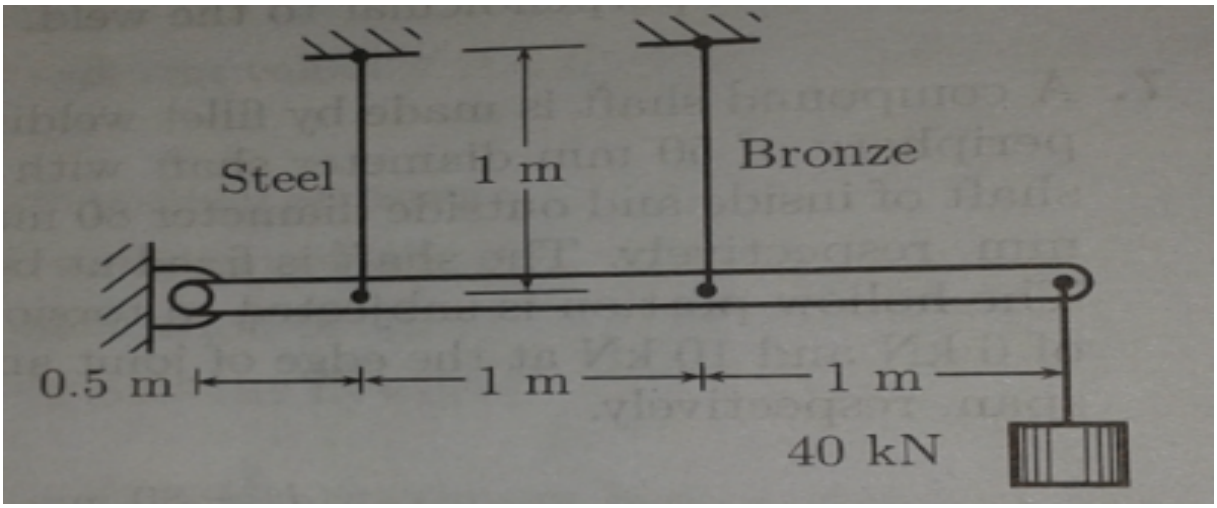
Q12.A steel bar $50mm \times 50mm \times 300mm$ is under a compressive load of 100KN in longitudinal direction .The lateral strains are prevented by constraints .The apparent of modulus of elasticity is 200 GPa and Poission's ratio is 0.3 .Calculate the change in the volume of the bar.

ANS:-111.43 mm^3

Q13. A weight of 100N is dropped onto the flanged attached to a 20 mm diameter rod of length 2m.The tensile strength of the material is 150MPa and modulus of elasticity is 200 GPa .Calculate the maximum height from where the weight can be dropped.Also calculate the maximum extension in the rod.

ANS:-175.96mm,2.54mm.

Q14. A horizontal rigid bar of negligible mass and length 2.5 m is hinged at A and supported by two rods made of bronze and steel , each 1m long ,as shown in figure . A load of 40KN is also supported at its free end .The cross-sectional areas of the steel and bronze rods are 500 mm^2 and 200mm^2, respectively .Moduli of elasticity of their material are 180 GPa and 80GPa ,respectively .Calculate the stresses in the steel and bronze rod.



ANS:-205.06 MPa,153.85 MPa.

Q15. A steel rod 5m long is secured between two walls ,the Cross -sectional area of the rod is 600mm^2.The load is rod is zero at 25 ℃.The rod is cooled to -10 ℃.Coefficient of thermal expansion is 12 =μm/m ℃. And modulus of elasticity is 180 G Pa . Calculate the stress in the rod if the walls are rigid. Calculate the stress in the rod if walls spring together a total distance of 0.2mm with drop in temperature .

ANS:-93.6MPa,57.6MPa.

Q16.A steel tube of inner diameter 100 mm and wall thickness 5mm is subjected to a torsional moment of 1000Nm.Determine the principal stresses on the outer surface of the tube.Also calculate the orientation of the principal plane on the outer surface of tube.

ANS:-24.81MPa,45 Degree

Q17.A solid phosphor bronze shaft 60 mm in diameter is rotating at 800 rpm and transmitting power under torsion only . An electrical resistance strain gauge mounted on the surface of the shaft gives strain reading as 3.98×10^{-4}. The modulus of elasticity for phosphor bronze is 105 GPa and poission ratio is 0.3.Estimate the maximum shear stress in the shaft and maximum power that can be transmitted by shaft .

ANS:-32.15MPa,114.22KW

Q18. A timber beam 150 mm wide and 200 mm deep carries a uniformly distributed load over a span of 4m and is simply supported. The permissible stresses are 30N/mm^2 longitudinally. Determine the load carrying capacity of the timber.Calculate the maximum load if permissible shear stress in transverse direction is 3N/=mm^2.

ANS:-15KN/m,30KN/m

Q19. A solid shaft is to transmit 300KW at 120 rpm .The shear stress is not to exceed 100 MPa .It is desired to reduce the weight of the shaft by replacing it by a hollow shaft with diameter ratio of 0.6 keeping other parameters same .Determine the diameter of solid shaft and percentage saving of the material by using hollow shaft.

ANS:-0.10m,29.79%