

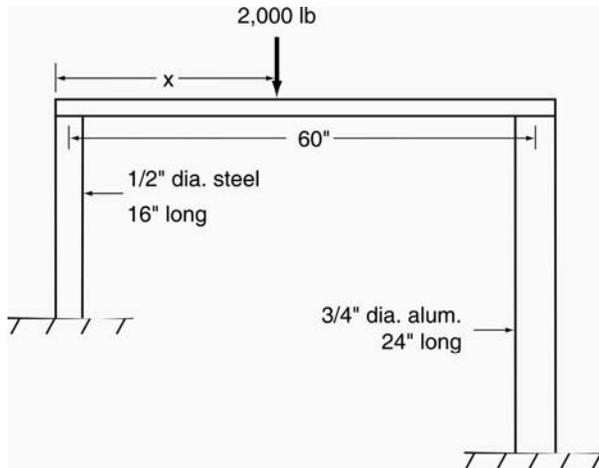
330:148 (g) Machine Design
Class work 2: Stress and Deformation (Ch 3)

August 27, 2007

1. A mild steel bar of 12 mm diameter is subjected to an axial load of 50 kN in tension. Find the magnitude of induced stress. If the length of the bar is 1 m and the modulus of elasticity of the material of the bar is 2×10^5 MPa, find the elongation of the bar. If Poisson's ratio for the material of the bar is 0.3, find the change in the diameter of the bar. (442.09 MPa, 2.2105 mm, 7.96×10^{-3} mm)

2. Four round rods, 48 inches long, support the weight of an overhead space heater from the ceiling that weighs 2,400 lb. If these rods are made of AISI cold-drawn 1020 steel, how large should they be? Select a factor of safety (Choose 6) you think is appropriate for your design. How much are these rods going to stretch under this load? (5/16 in; 0.0125 in)

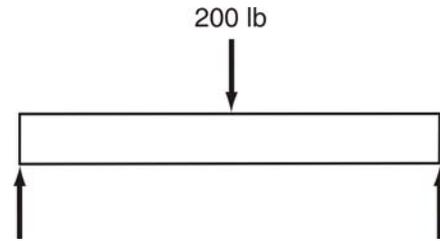
3. If the horizontal beam below is to remain horizontal after the load is applied, where (value of x) should the load be applied? Assume horizontal beam is rigid and no column action occurs. Assume $E_{\text{steel}} = 30 \times 10^6$ psi; $E_{\text{al}} = 10 \times 10^6$ psi. (20 in)



4. a. A simply supported aluminum beam as shown in Fig. is 30 inches long and carries no weight. Calculate the stress and deflection for its own weight. Assume a density of 0.07 lb/in^3 . (0.0008859 in)



b. A force of 200 pounds is now applied to the center. Calculate the stress and deflection from this load. Ignore the weight of the beam. (0.135 in)



5. For a 2×8 inch rectangular cross section of wooden floor beams, the deflection under a given load must be reduced by one-half. Leaving the width same, by what amount should the height be increased? Assume load is in center and beams are simply supported. (Hint: Use formulae given in Appendix 2 and 3 for beams). (10.079 in)

6. A 38-inch long torsion bar is made from a 0.25-inch diameter C1050 steel bar, as rolled. What is the maximum twisting angle in degrees to which the bar can be subjected before failure. (1.18956 radians; 68.157°)

7. A steel rod 25 mm diameter and 800 mm length is subjected to an axial compressive force of 175 kN. Find the induced stress and axial and lateral deformation of rod. Poisson's ratio is 0.25. The modulus of elasticity of the material of the bar is 2×10^5 MPa. [356.50987 MPa, 1.426 mm, 0.0108 mm]

8. A bar of steel of square cross section with side of square 20 mm is subjected to a load of 50 kN along the axis, causing tension. What is the magnitude of induced stress? What will be the magnitude of stress? What will be the magnitude of stress if the load increases to 250 kN? [125 MPa, 625 MPa]

9. A tension bar is subjected to an axial pull of 30 kN. The bar is hollow with inner diameter 0.6 times the outer diameter. Find the diameter of the material if the yield stress is 330 MPa and factor of safety of 3. [25 mm]

10. A link with a rectangular cross section is subjected to a tensile load of 40 kN. The link is 475 mm long and the width is equal to twice the thickness. Maximum permissible elongation is 0.125 mm. Find the width and thickness of the link if the yield stress is 330 MPa and factor of safety of 4. The modulus of elasticity of the material of the bar is 2×10^5 MPa. [20 mm \times 40 mm]