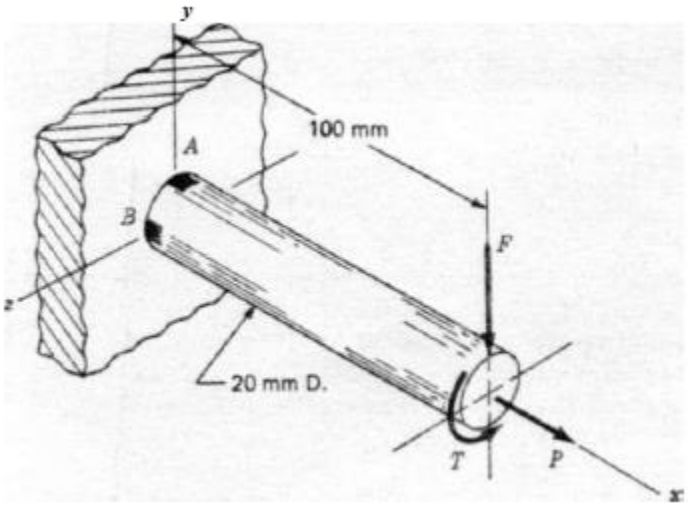
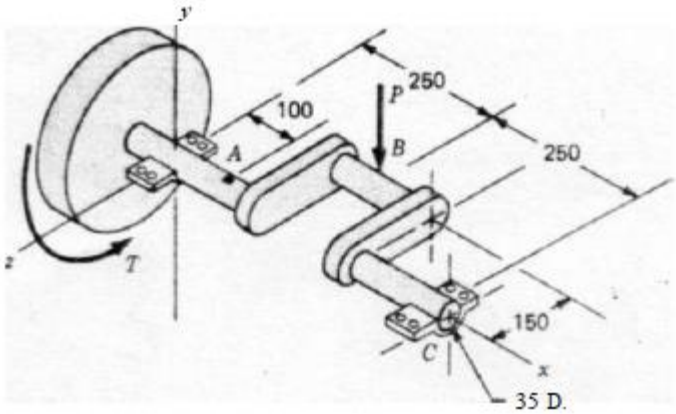
SAMPLE PROBLEMS ABOUT CHAPTER I-II-III

1) The stresses are to be computed at two points on the cantilever shown in the figure. These are the stress element which is shown at A on top of the bar and parallel to the xz plane and the one at B that is on the front side of the bar and parallel to the xy plane. The forces are F= 0.55 kN, P = 8 kN, and T= 30 N.m. Draw both stress elements, label the axes and the stress components using proper magnitudes and directions.



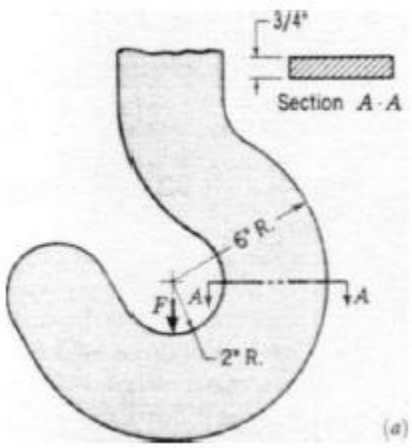
2- The figure shows the crankshaft and flywheel of a one-cylinder air compressor. In use, a part of the energy stored in the flywheel is used to produce a portion of the piston force P. In this problem you are to assume that the entire piston force P results from the torque of 600 N.m delivered to the crankshaft by the flywheel. A stress element is to be located on the top surface of the crankshaft at A, 100 mm from the left bearing. The sides of the element are parallel to the xz axes.

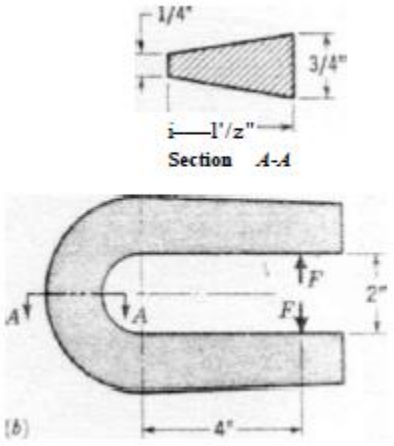


(a) Compute the stress components that act at A.
(b) Find the principal stresses and their directions for the element at A.
(c) Make a sketch of the principal stress element and orient it correctly with reference to the x and z axes. Label completely.
(d) Sketch another stress element correctly oriented to show the maximum shear stress and the corresponding normal stresses. Label this element too.

3- Plot the distribution of stresses across section A-A of the crane hook shown in the figure. The load is F = 5 kip.

4- Find the stress at the inner and outer surfaces at section A-A of the frame shown in the figure if F = 500 lb.





Problem 3 Problem 4

5- A light pressure cylinder is made of an aluminum alloy. This cylinder has a 3.5–in OD, a 0.065-in wall thickness, and material properties E=10.3 Mpsi and ν = 0.334. If the internal pressure is 1860 psi, what are the principal normal strains on an element on the circumference?

6- A magnesium tube is 5 in in OD and has a wall thickness of 1/2 in. The tubing is used as a pressure vessel to hold a fluid at an internal pressure of 4 kpsi. Calculate the radial- and tangential-stress components and the three principal normal strains at the outer and inner radii.

7- A cylinder is 300 mm OD by 200 mm ID and is subjected to an external pressure of 140 MPa. The longitudinal stress is zero. What is the maximum shear stress and at what radius does it occur?

8- A cylinder is 25 mm ID by 50 mm OD and is subjected to an internal pressure of 150 MPa. Find the tangential stress at the inner and outer surfaces.

9- Based on the use of UNS C27000 hard yellow brass rod as the material, find factors of safety for each of the three static-failure theories for the following stress states:

(a) σ_x = 70 MPa, σ_y = 70 MPa

(b) σ_x = 70 MPa, τ_{xy} = 35 MPa (CW)

(c) σ_x = -10 MPa, σ_y = - 60 MPa, τ_{xy} = 35 MPa (CCW)

(d) σ_x = 50 MPa, σ_y = 20 MPa, τ_{xy} = 40 MPa (CW)

10- A thin-walled pressure vessel is made of UNS A93003-H14 aluminum alloy tubing. The vessel has an OD of 60 mm and a wall thickness of 1.50 mm. What internal pressure would cause the material to yield?

11 - Tests on a particular melt of ASTM No 20 cast iron gave S_{ut} = 150 MPa and S_{uc} = 600 MPa. Find the factor of safety for each of the three failure theories tor brittle materials for the following stress states:

(a) σ_x = 50 MPa, τ_{xy} = 30 MPa (CW)

(b) σ_x = -80 MPa, σ_y = -40 MPa. τ_{xy} = 20 MPa (CCW)

(c) σ_x = 40 MPa, σ_y = 30 MPa, τ_{xy} = 10 MPa (CCW)

(d) σ_x = 30 MPa, σ_y = -60 MPa, τ_{xy} = 30 MPa (CW)