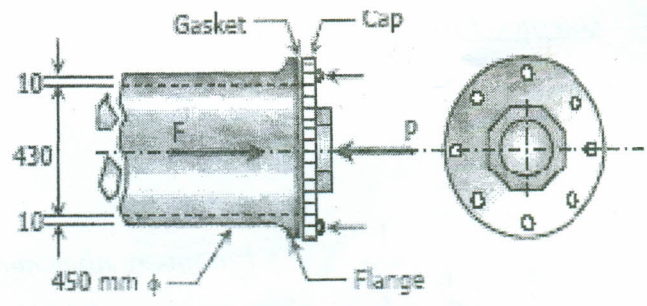


Question One: (15 Marks)

A pipe carrying steam at 3.5 MPa has an outside diameter of 450 mm and a wall thickness of 10 mm. A gasket is inserted between the flange at one end of the pipe and a flat plate used to cap the end. How many 40-mm-diameter bolts must be used to hold the cap on if the allowable stress in the bolts is 80 MPa, of which 55 MPa is the initial stress? What circumferential stress is developed in the pipe?

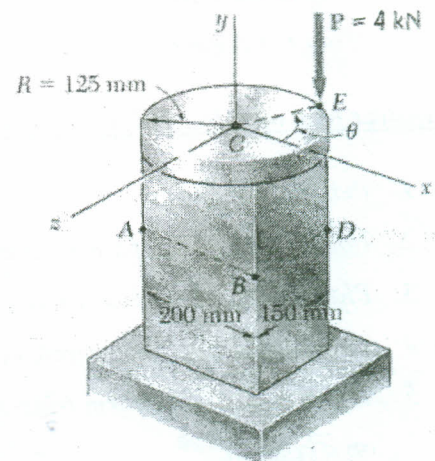


Question Two: (15 Marks)

A 1.5 m long tubular steel shaft of 38 mm outer diameter d_1 and 30 mm inner diameter d_2 is to transmit 100 KW between a turbine and a generator. Determine the minimum frequency at which the shaft can rotate, knowing that $G = 77.2$ GPa, that the allowable shearing stress is 60 MPa, and the angle of twist must not exceed 3°

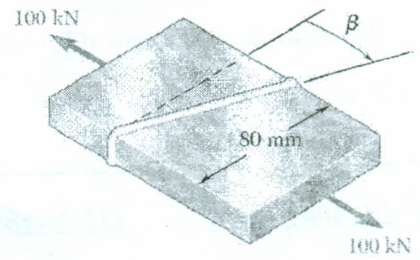
Question Three: (25 Marks)

A rigid circular plate of 125 mm radius is attached to a solid 150×200 rectangular post, with the center of the plate directly above the center of the post. If 4 KN force P is applied at E with $\theta = 30^\circ$, determine the stress at point A and the stress at point B .

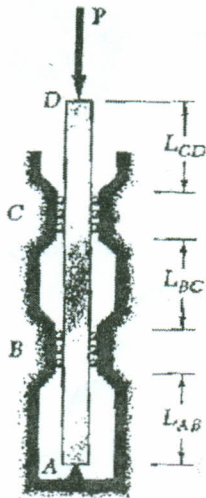


Question Four: (15 Marks)

Two steel plates of uniform cross section 10×80 mm are welded together as shown. Knowing that centric 100-kN forces are applied to the welded plates and that the in-plane shearing stress parallel to the weld is 30 MPa, determine (a) the angle β , (b) the corresponding normal stress perpendicular to the weld. (Using Mohr's circle)



Question Five: (12 Marks)



A 1 in square Aluminum strut is maintained in the position shown by a pin support at A and by sets of rollers at B and C that prevent rotation of the strut in the plane of the figure. Knowing that $L_{AB} = 3$ ft, and $L_{BC} = 4$ ft, and $L_{CD} = 1$ ft, determine the allowable load P using factor of safety with respect to buckling 3.2. Consider only buckling in the plane of the figure and use $E = 10.4 \times 10^6$ psi

Question Six: (18 Marks)

Please try to answer the following questions:

1. What is the difference between a brittle material and a ductile material?
2. What is the difference between strong material and tough material?
3. What is necking?

Answer true or false. If false give the correct explanation:

1. Principal planes are always orthogonal.
2. For a given state of stress at a point, the principal stresses depend on the material.
3. Planes of maximum shear stress are always 90° to principal planes.
4. Two points on Mohr's circle can represent the same plane.
5. The addition of uniform transversely distributed forces decreases the critical buckling load on a column.
6. Increasing the slenderness ratio increases the critical buckling load.