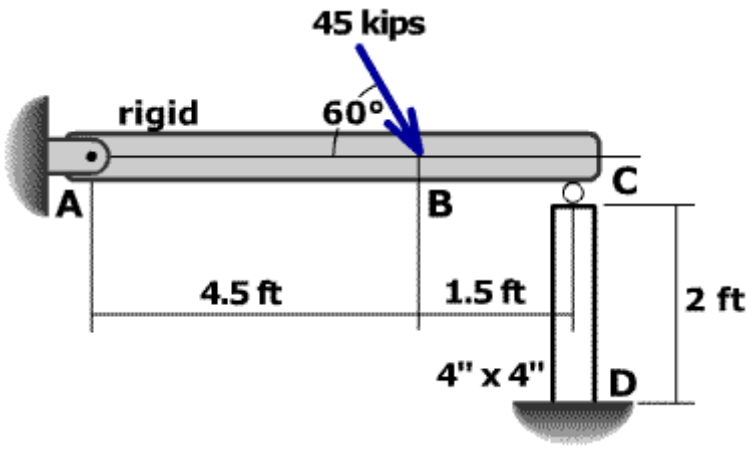
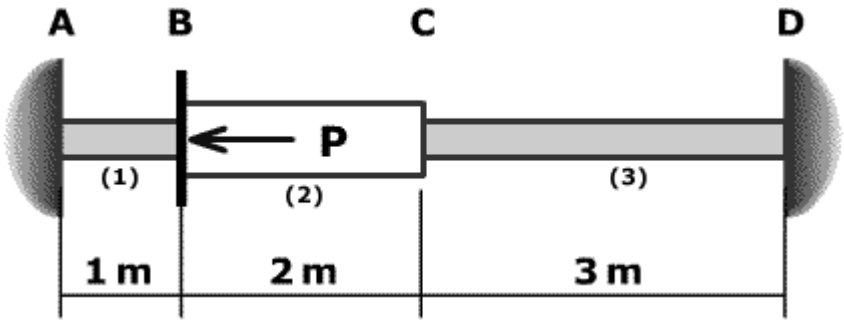
1. A rigid bar ABC is supported by a pin in double shear at A and a post at C.
   - Determine the average shear stress in the 3/4-inch diameter pin at A.
   - Determine the factor of safety for the post if the post fails at a normal stress of 2.5 ksi.



2. The assembly ABCD shown in the sketch is attached to rigid walls at A and D. When the assembly is initially attached to the supports, it is stress free.

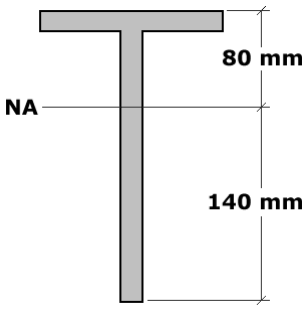
   A concentrated force **P** is applied to the flange at B. For bars (1) and (3), assume the cross-sectional area of each bar is A and the elastic modulus is E. For bar (2), assume the cross-sectional area is 2A and the elastic modulus is 2E.

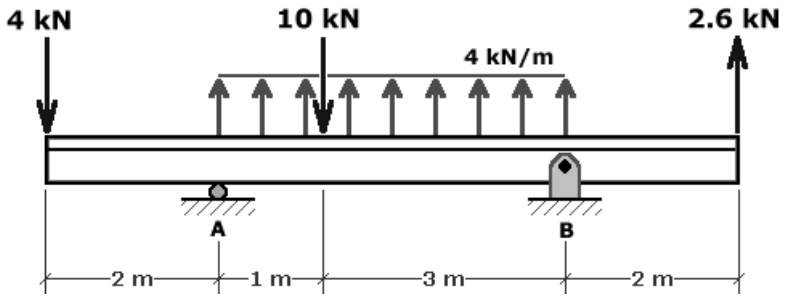
   Determine the axial force in bars (1), (2), and (3), and express your answers in terms of the concentrated force **P**.



3. A hollow shaft of aluminum alloy (G = 28 GPa) is to transmit 1200 kW at 1800 rpm. The shearing stress is not to exceed 100 MPa, and the angle of twist is not to exceed 0.20 rad in a 3 m length of the shaft. Determine the minimum permissible outside diameter if the inside diameter is to be three-fourths of the outside diameter.

4. A tee-shaped steel cross section is used for the beam shown below. The moment of inertia for the tee shape is $I = 24 \times 10^6$ mm^4 and the dimensions to the centroid of the shape are shown on the sketch at the right.
   - Draw the complete shear force and bending moment diagrams for the beam. (16 points)
   - Determine the maximum tensile bending stress acting at any point in the tee shape throughout the entire span of the beam. (9 points)





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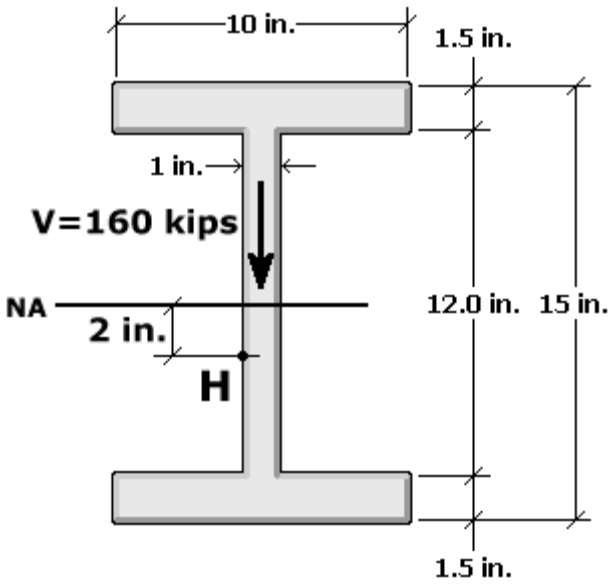
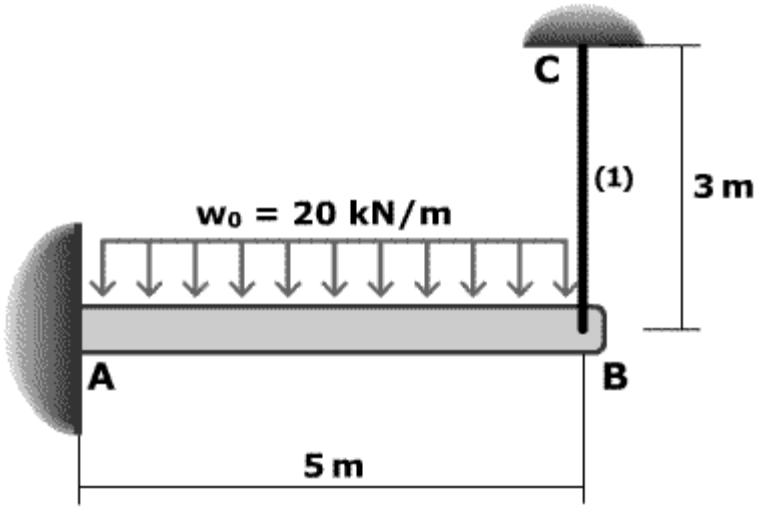
5. The doubly-symmetric wide-flange shape shown carries a downward transverse shear force of V = 160 kips. Compute the transverse shear stress τ at point H located 2 inches below the centroidal axis for the wide-flange shape.



6. A mechanical component is subjected to plane stress. At a particular point in the component, a stress element has a normal stress of 68.5 MPa (C) in the x direction, a normal stress of 10 MPa (C) in the y direction, and a shearing stress of -10 MPa.
   - Determine the principal stresses and show them on an appropriate sketch.
   - Determine the shear stress and normal stress on planes of maximum in-plane shear stress and show them on an appropriate sketch.
   - If the maximum allowable shearing stress is 32 MPa, is the component safe?

7. A cantilever steel beam AB (E = 200 GPa, I = 100×10^6 mm^4) is supported at B by a 3-m steel rod (E = 200 GPa, A = 300 mm^2). The rod is stress-free before the distributed load is applied to the beam. For the 20 kN/m uniformly distributed load shown, compute the deflection of point B.



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8. The component shown is rigidly attached to a foundation. A 5 kN concentrated force is applied at the top surface of the component in the direction shown on the sketch. Determine the stresses acting on the surface element at A.