

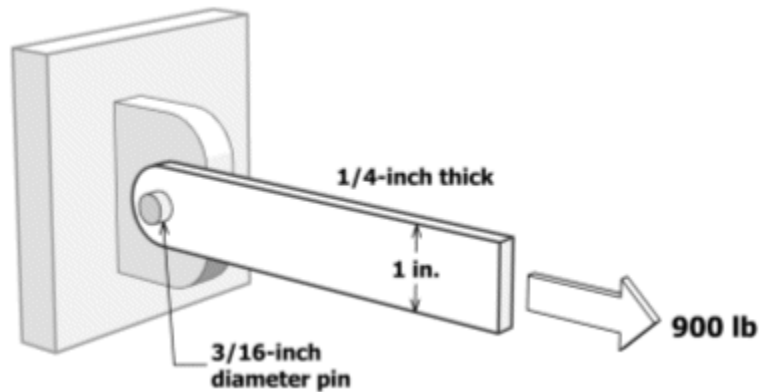
# **IDE 110 - Mechanics of Materials - Summer 2006**

Exam 4 – Combined Loading, Beam Deflection, and Semester Review

Name:

Section: A

1. A tension member is loaded with 900 pounds and connected in single shear with a 3/16-inch diameter pin as shown. The member is one inch wide and 1/4-inch thick. Determine:
  - a. the maximum normal stress in the member.
  - b. the bearing stress between the member and the pin.
  - c. the shear stress in the pin.



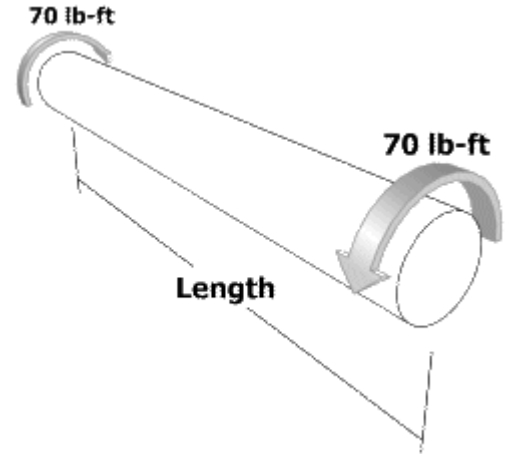
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2. A torsion bar is to be designed for an automotive application. In order to properly tune the suspension, the angle of twist of the bar should be precisely  $15^\circ$  when a torque of 70 lb-ft is applied. In order to prevent fatigue failure, the maximum allowable torsional shearing stress in the bar is 20 ksi when the 70 lb-ft torque is applied. Assume  $G = 11,200$  ksi. Determine:
- the required length  $L$ .
  - the required diameter  $d$  of the solid torsion bar.



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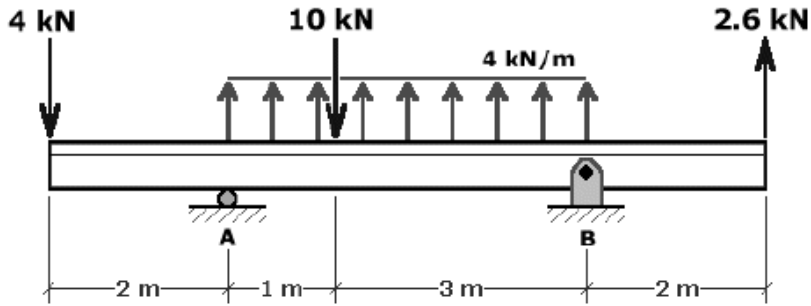
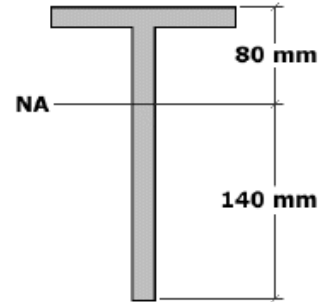
3. A mechanical component is subjected to plane stress. At a particular point in the component, a stress element has a normal stress of 68.5 MPa (compression) in the  $x$  direction, a normal stress of 10 MPa (compression) in the  $y$  direction, and a shearing stress of -10 MPa. Determine:
  - a. the principal stresses and show them on an appropriate sketch.
  - b. the maximum in-plane shear stress and average normal stresses and show them on an appropriate sketch.

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4. A tee-shaped steel cross section is used for the beam shown below. The moment of inertia for the tee shape is  $I = 24 \times 10^6 \text{ mm}^4$  and the dimensions to the centroid of the shape are shown on the sketch at the right. Determine the maximum tensile and compressive stresses acting at any point in the tee shape throughout the entire span of the beam.



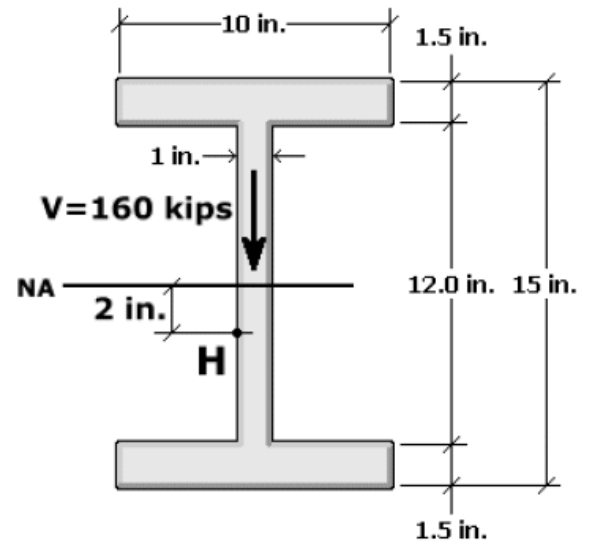
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5. The wide-flange shape shown carries a downward transverse shear force of  $V = 160$  kips. Determine the transverse shear stress  $\tau$  at point  $H$  located 2 inches below the centroidal axis for the wide-flange shape.

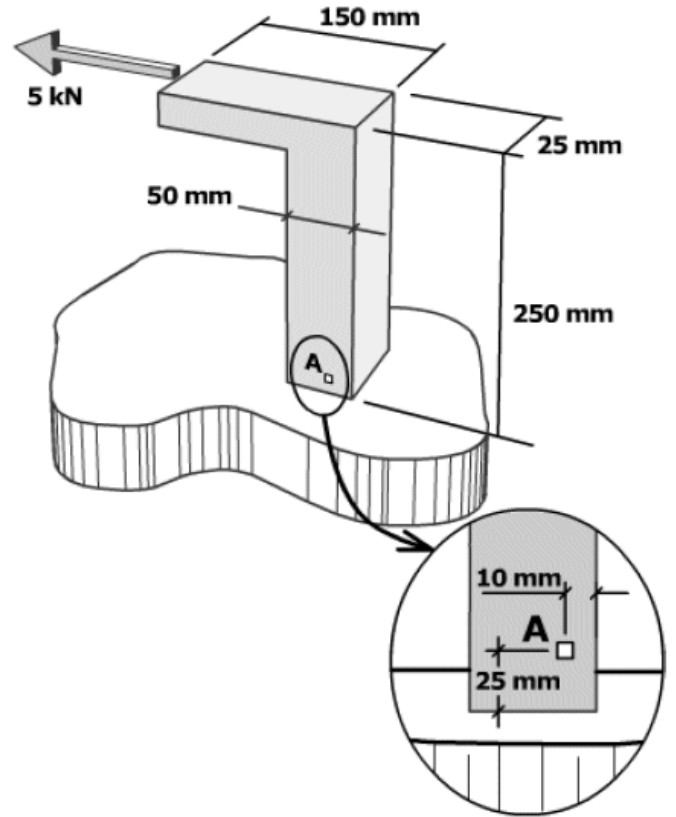


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6. The component shown is rigidly attached to a foundation. A 5 kN concentrated force is applied at the top surface of the component in the direction shown on the sketch. Determine the stresses acting on the surface element at *A* and draw them on the box below.



Write legibly – box answers  
Include proper units

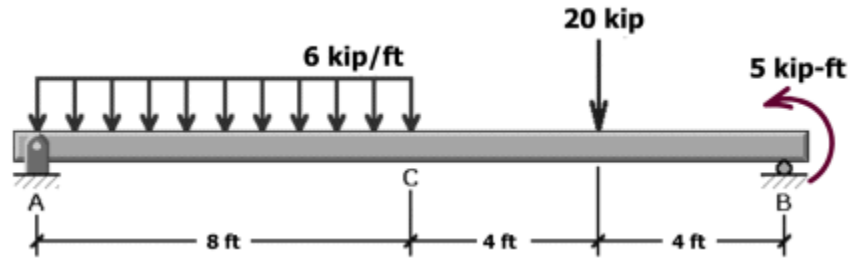
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7. Determine the deflection at the midspan  $C$  of the simply supported beam. Assume  $E = 29 \times 10^6$  psi and  $I = 82.8$  in<sup>4</sup>.



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8. Determine the support reaction at  $B$  for the simply supported beam with the loading shown. Assume  $EI = 720 \times 10^6 \text{ lb-in}^2$  for all portions of the beam.

