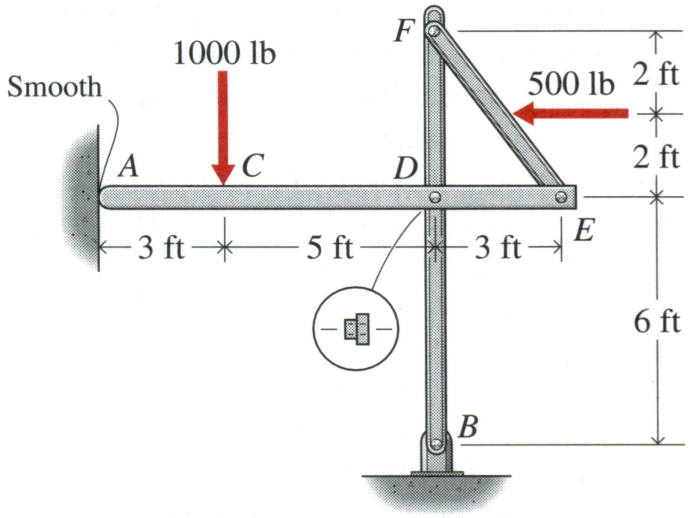
IDE 110 – Mechanics of Materials
May 9, 2006

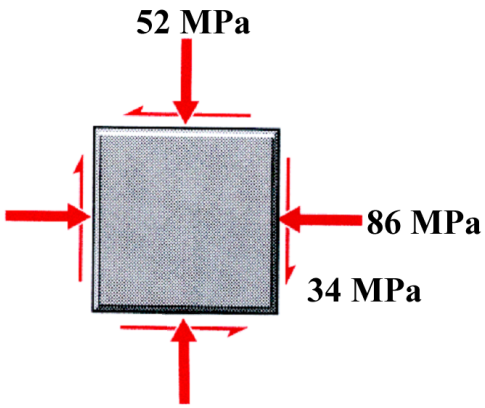
Student _____

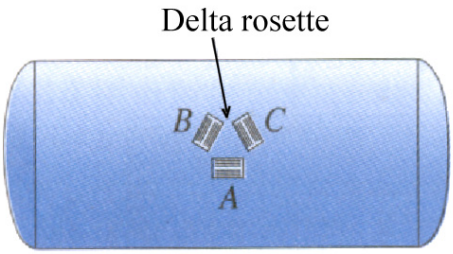
1. For the pin-connected structure shown, determine the minimum diameter for the pin at joint D if the average shear stress in the pin is limited to 7,500 psi. Note: The pin is in single shear.



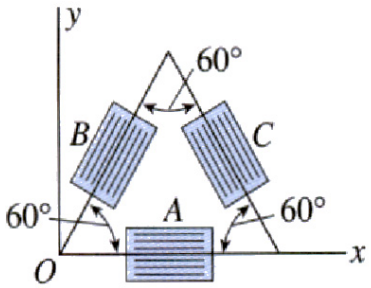
PRINT CLEARLY
Include proper units
Box-in your answers

2. The stresses shown act at a point on the free surface of a stressed body.
   (a) Determine the principal stresses and the maximum in-plane shearing stress and show these stresses on a properly labeled and oriented sketch (i.e., a single wedge element or two square elements).
   (b) Determine the absolute maximum shear stress. (No sketch required…just the magnitude.)

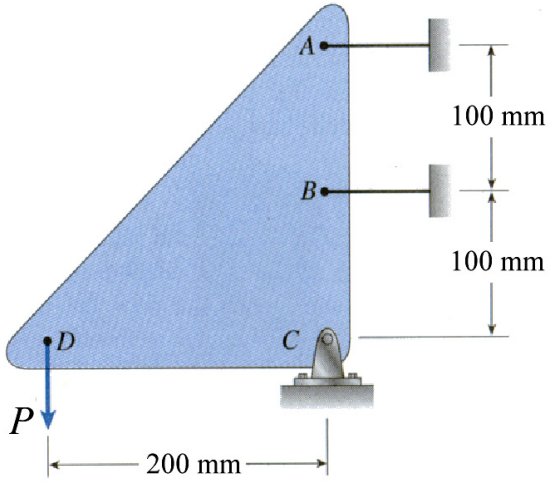




3. A 60° strain rosette is mounted on the outside of a cylindrical pressure vessel as shown in the figure. The recorded strains are ε_a = 80με and $\varepsilon_b = \varepsilon_c$ = 275με. If the vessel has an *r/t* ratio (i.e., inside radius to wall thickness ratio) of 25, find the pressure *p* in the tank. Assume that the modulus of elasticity is *E* = 200 GPa and Poisson's ratio is ν = 0.30.



4. The rigid plate shown in the figure pivots at point *C* and is held by two horizontal rods at points *A* and *B*. Each rod has a cross sectional area of 474 mm^2 and a modulus of elasticity of *E* = 1,140 MPa. The horizontal rods are both the same length. If a vertical load of *P* = 2.2 kN is applied at point D as shown, find the tension force in Rod *A*.



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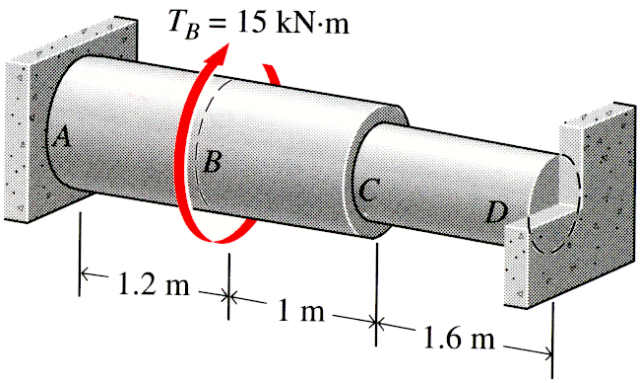
5. The 100-mm diameter segment ABC of the shaft is securely connected to the 60-mm diameter segment CD, and the ends of the shaft are fixed to rigid walls. The moduli of rigidity are G = 40 GPa for ABC and G = 80 GPa for CD. When torque T_B = 15 kN-m is applied as shown, determine the maximum shearing stresses τ_{AB}, τ_{BC} and τ_{CD} for the three regions of the shaft.



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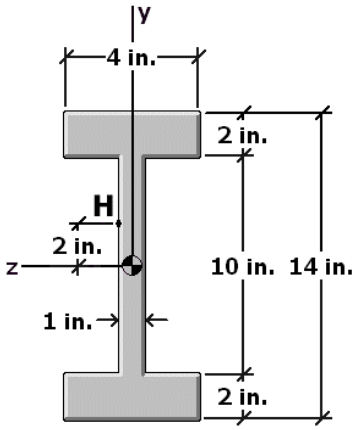
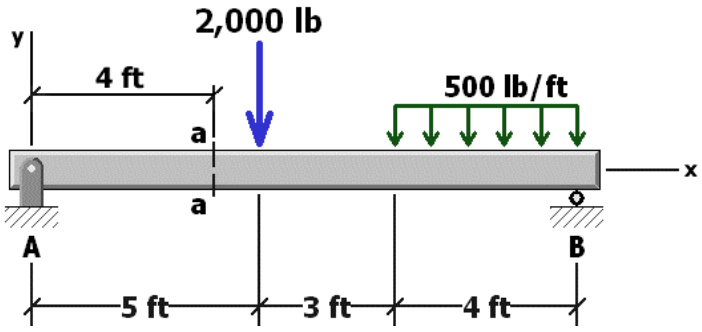


Beam cross section

6. A simply supported beam is loaded as shown.
   (a) Determine the shear force *V* and bending moment *M* acting at section a-a, which is located 4 ft from pin support *A*.
   (b) At section a-a, determine the bending stress σ_x and the transverse shear stress τ_{xy} at point *H*, which is located 2 in. above the z centroidal axis.
   (c) Show σ_x and τ_{xy} on a stress element for point *H*.



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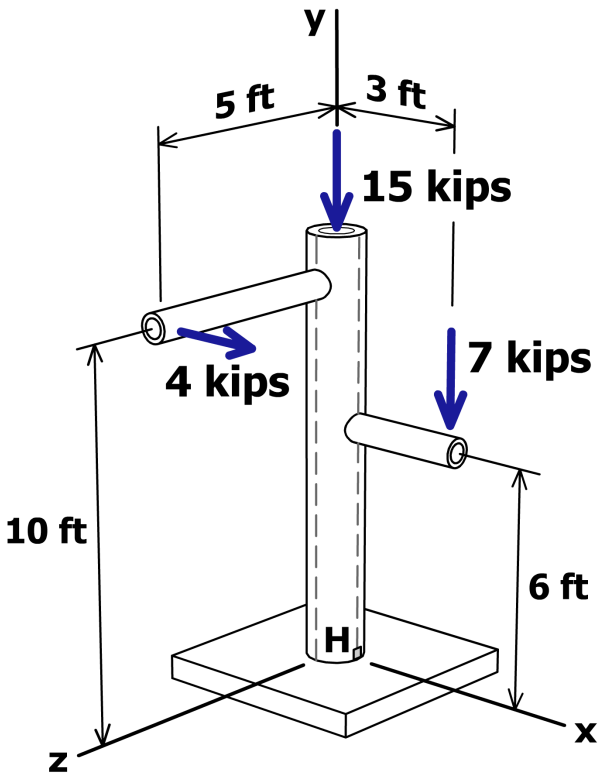

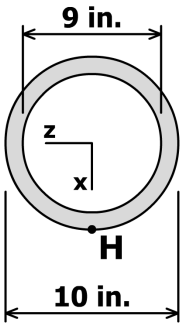

pipe cross section

7. The vertical structural member consists of a steel pipe with an outside diameter of 10 in. and an inside diameter of 9 in. For the loads shown, determine the normal and shear stresses acting at point *H*, which is located on the x axis at the lower end of the vertical member. Show the stresses at *H* on a stress element.

Student _____

8. A steel (E = 29 × 10^6 psi and I = 120 in^4) beam is loaded and supported as shown. Additional support is provided at B by a 6 × 6-in. timber (E = 1.5 × 10^6 psi) post BD. Determine the load carried by the post if it is unstressed before the 530 lb/ft uniform load is applied to the beam.