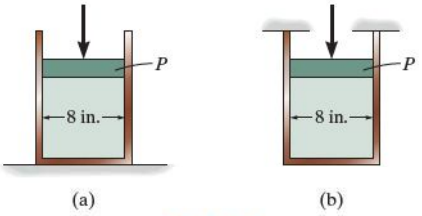
PROBLEMS

8–1. A spherical gas tank has an inner radius of $r = 1.5$ m. If it is subjected to an internal pressure of $p = 300$ kPa, determine its required thickness if the maximum normal stress is not to exceed 12 MPa.

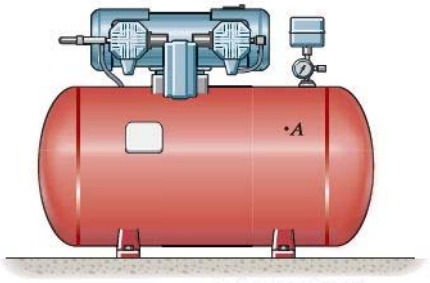
8–2. A pressurized spherical tank is to be made of 0.5-in.-thick steel. If it is subjected to an internal pressure of $p = 200$ psi, determine its outer radius if the maximum normal stress is not to exceed 15 ksi.

8–3. The thin-walled cylinder can be supported in one of two ways as shown. Determine the state of stress in the wall of the cylinder for both cases if the piston P causes the internal pressure to be 65 psi. The wall has a thickness of 0.25 in. and the inner diameter of the cylinder is 8 in.



Prob. 8–3

***8–4.** The tank of the air compressor is subjected to an internal pressure of 90 psi. If the internal diameter of the tank is 22 in., and the wall thickness is 0.25 in., determine the stress components acting at point A. Draw a volume element of the material at this point, and show the results on the element.

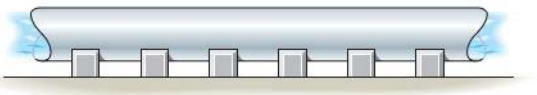


Prob. 8–4

8–5. The open-ended pipe has a wall thickness of 2 mm and an internal diameter of 40 mm. Calculate the pressure that ice exerted on the interior wall of the pipe to cause it to burst in the manner shown. The maximum stress that the material can support at freezing temperatures is $\sigma_{max} = 360$ MPa. Show the stress acting on a small element of material just before the pipe fails.

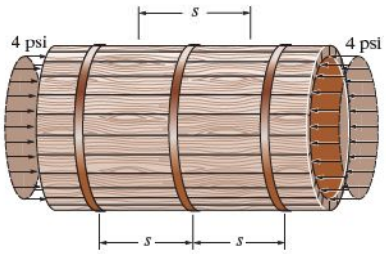
Prob. 8–5

8–6. The open-ended polyvinyl chloride pipe has an inner diameter of 4 in. and thickness of 0.2 in. If it carries flowing water at 60 psi pressure, determine the state of stress in the walls of the pipe.



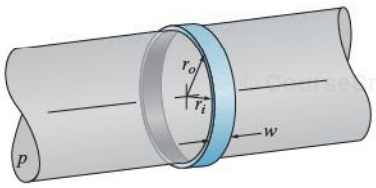
Prob. 8–6

8–11. A wood pipe having an inner diameter of 3 ft is bound together using steel hoops having a cross-sectional area of 0.2 in^2. If the allowable stress for the hoops is $\sigma_{allow} = 12$ ksi, determine their maximum spacing s along the section of pipe so that the pipe can resist an internal gauge pressure of 4 psi. Assume each hoop supports the pressure loading acting along the length s of the pipe.



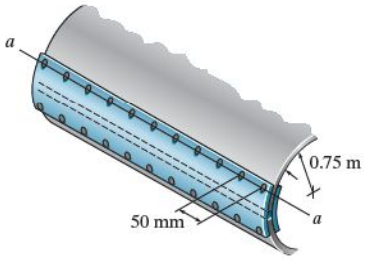
Prob. 8–11

8–13. The ring, having the dimensions shown, is placed over a flexible membrane which is pumped up with a pressure p. Determine the change in the internal radius of the ring after this pressure is applied. The modulus of elasticity for the ring is E.



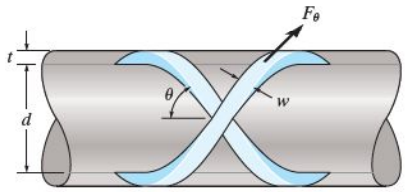
Prob. 8–13

***8–12.** A boiler is constructed of 8-mm thick steel plates that are fastened together at their ends using a butt joint consisting of two 8-mm cover plates and rivets having a diameter of 10 mm and spaced 50 mm apart as shown. If the steam pressure in the boiler is 1.35 MPa, determine (a) the circumferential stress in the boiler's plate apart from the seam, (b) the circumferential stress in the outer cover plate along the rivet line a–a, and (c) the shear stress in the rivets.



Prob. 8–12

8–14. A closed-ended pressure vessel is fabricated by cross-winding glass filaments over a mandrel, so that the wall thickness t of the vessel is composed entirely of filament and an epoxy binder as shown in the figure. Consider a segment of the vessel of width w and wrapped at an angle θ. If the vessel is subjected to an internal pressure p, show that the force in the segment is $F_\theta = \sigma_0 wt$, where σ_0 is the stress in the filaments. Also, show that the stresses in the hoop and longitudinal directions are $\sigma_h = \sigma_0 \sin^2\theta$ and $\sigma_l = \sigma_0 \cos^2\theta$, respectively. At what angle θ (optimum winding angle) would the filaments have to be wound so that the hoop and longitudinal stresses are equivalent?

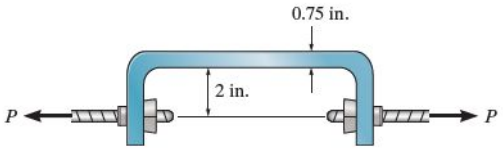


Prob. 8–14

PROBLEMS

8–15. The steel bracket is used to connect the ends of two cables. If the allowable normal stress for the steel is $\sigma_{allow} = 24$ ksi, determine the largest tensile force P that can be applied to the cables. The bracket has a thickness of 0.5 in. and a width of 0.75 in.

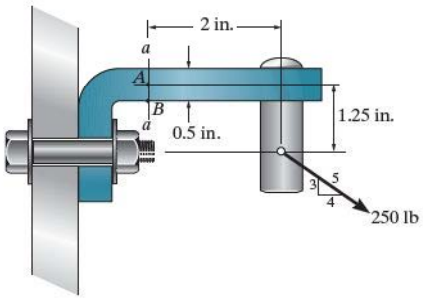
***8–16.** The steel bracket is used to connect the ends of two cables. If the applied force $P = 500$ lb, determine the maximum normal stress in the bracket. The bracket has a thickness of 0.5 in. and a width of 0.75 in.



Probs. 8–15/16

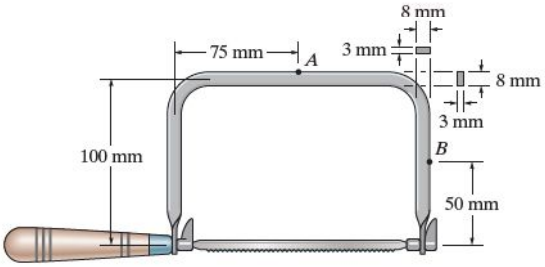
8–17. The joint is subjected to a force of 250 lb as shown. Sketch the normal-stress distribution acting over section a–a if the member has a rectangular cross section of width 0.5 in. and thickness 0.75 in.

8–18. The joint is subjected to a force of 250 lb as shown. Determine the state of stress at points A and B, and sketch the results on differential elements located at these points. The member has a rectangular cross-sectional area of width 0.5 in. and thickness 0.75 in.



Probs. 8–17/18

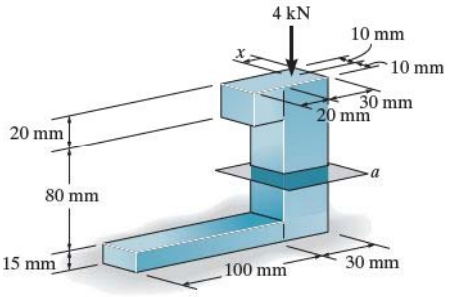
8–19. The coping saw has an adjustable blade that is tightened with a tension of 40 N. Determine the state of stress in the frame at points A and B.



Prob. 8–19

***8–20.** Determine the maximum and minimum normal stress in the bracket at section a when the load is applied at $x = 0$.

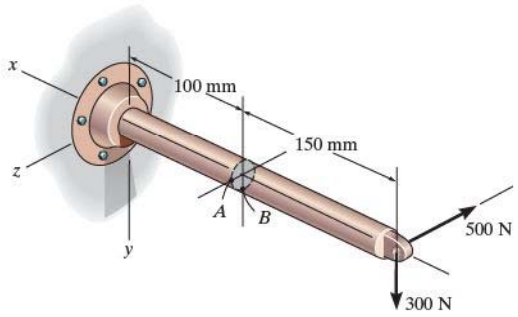
8–21. Determine the maximum and minimum normal stress in the bracket at section a when the load is applied at $x = 50$ mm.



Probs. 8–20/21

8–45. The bar has a diameter of 40 mm. If it is subjected to the two force components at its end as shown, determine the state of stress at point *A* and show the results on a differential volume element located at this point.

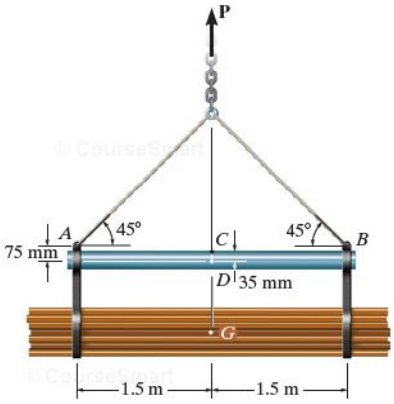
8–46. Solve Prob. 8–45 for point *B*.



Probs. 8–45/46

8–47. The strongback *AB* consists of a pipe that is used to lift the bundle of rods having a total mass of 3 Mg and center of mass at *G*. If the pipe has an outer diameter of 70 mm and a wall thickness of 10 mm, determine the state of stress acting at point *C*. Show the results on a differential volume element located at this point. Neglect the weight of the pipe.

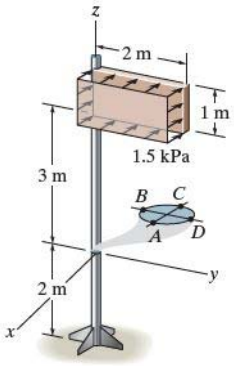
***8–48.** The strongback *AB* consists of a pipe that is used to lift the bundle of rods having a total mass of 3 Mg and center of mass at *G*. If the pipe has an outer diameter of 70 mm and a wall thickness of 10 mm, determine the state of stress acting at point *D*. Show the results on a differential volume element located at this point. Neglect the weight of the pipe.



Probs. 8–47/48

8–49. The sign is subjected to the uniform wind loading. Determine the stress components at points *A* and *B* on the 100-mm-diameter supporting post. Show the results on a volume element located at each of these points.

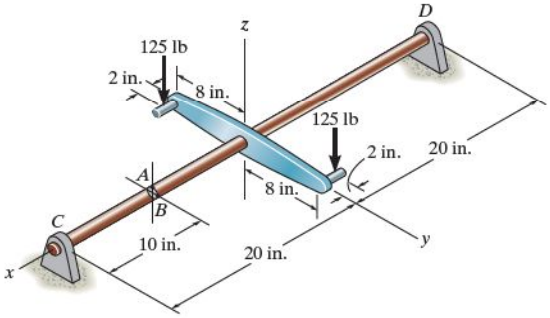
8–50. The sign is subjected to the uniform wind loading. Determine the stress components at points *C* and *D* on the 100-mm-diameter supporting post. Show the results on a volume element located at each of these points.



Probs. 8–49/50

8–51. The $\frac{3}{4}$-in.-diameter shaft is subjected to the loading shown. Determine the stress components at point *A*. Sketch the results on a volume element located at this point. The journal bearing at *C* can exert only force components $\mathbf{C}_y$ and $\mathbf{C}_z$ on the shaft, and the thrust bearing at *D* can exert force components $\mathbf{D}_x$, $\mathbf{D}_y$, and $\mathbf{D}_z$ on the shaft.

***8–52.** Solve Prob. 8–51 for the stress components at point *B*.



Probs. 8–51/52