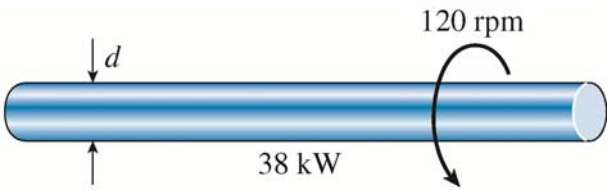
四造二甲材料力學 HW10

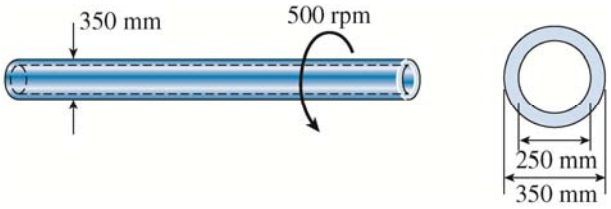
3.7-1 A generator shaft in a small hydroelectric plant turns at 120 rpm and delivers 38 kW (see figure).



(a) If the diameter of the shaft is d = 75 mm, what is the maximum shear stress τ_{max} in the shaft?

(b) If the shear stress is limited to 28 Mpa, what is the minimum permissible diameter d_{min} of the shaft?

3.7-3 The propeller shaft of a large ship has outside diameter 350 mm and inside diameter 250 mm, as shown in the figure. The shaft is rated for a maximum shear stress of 62 MPa.

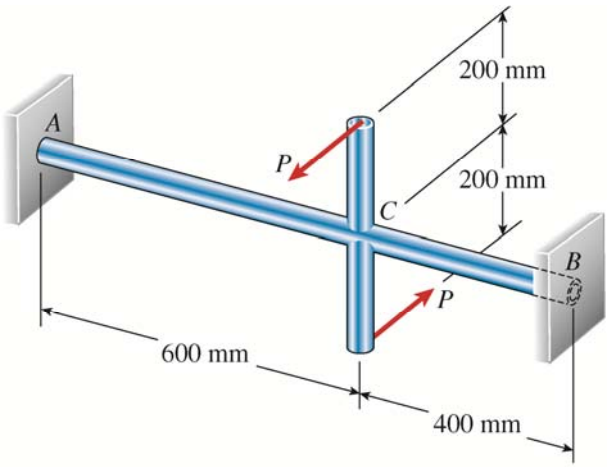


(a) If the shaft is turning at 500 rpm, what is the maximum horsepower that can be transmitted without exceeding the allowable stress?

(b) If the rotational speed of the shaft is doubled but the power requirements remain unchanged, what happens to the shear stress in the shaft?

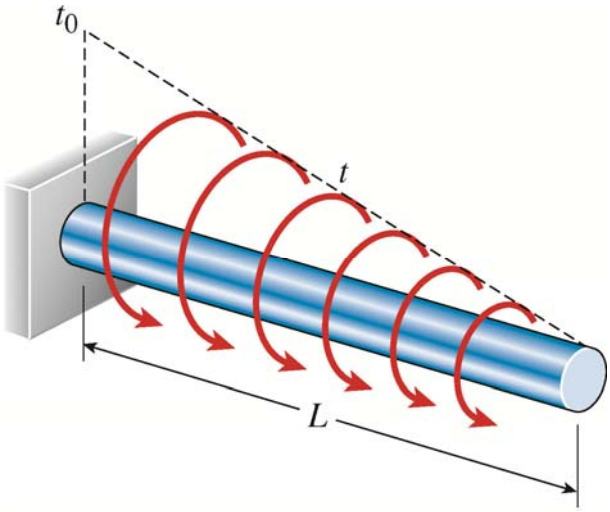
3.8-4 A hollow steel shaft *ACB* of outside diameter 50 mm and inside diameter 40 mm is held against rotation at ends *A* and *B* (see figure). Horizontal forces *P* are applied at the ends of a vertical arm that is welded to the shaft at point *C*.

Determine the allowable value of the forces *P* if the maximum permissible shear stress in the shaft is 45 MPa. (*Hint*: Use Eqs. 3-46a and b of Example 3-9 to obtain the reactive torques.)



3.9-8 Derive a formula for the strain energy U of the cantilever bar shown in the figure.

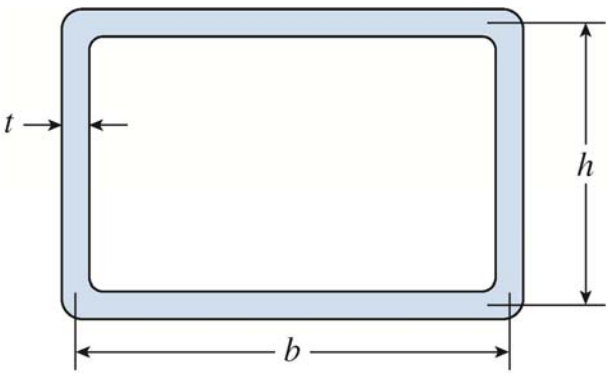
The bar has circular cross sections and length L. It is subjected to a distributed torque of intensity t per unit distance. The intensity varies linearly from $t = 0$ at the free end to a maximum value $t = t_0$ at the support.



3.10-3 A thin-walled aluminum tube of rectangular cross section (see figure) has a centerline dimensions b = 50 mm and h = 20 mm. The wall thickness t is constant and equal to 3 mm.

(a) Determine the shear stress in the tube due to a torque T = 90 N·m.

(b) Determine the angle of twist (in degrees) if the length L of the tube is 0.25 mm and the shear modulus G is 26 GPa.



3.10-6 Calculate the shear stress τ and the angle of twist φ (in degrees) for a steel tube (G = 76 GPa) having the cross section shown in the figure. The tube has length L = 1.5 m and is subjected to a torque T = 10 kN·m.