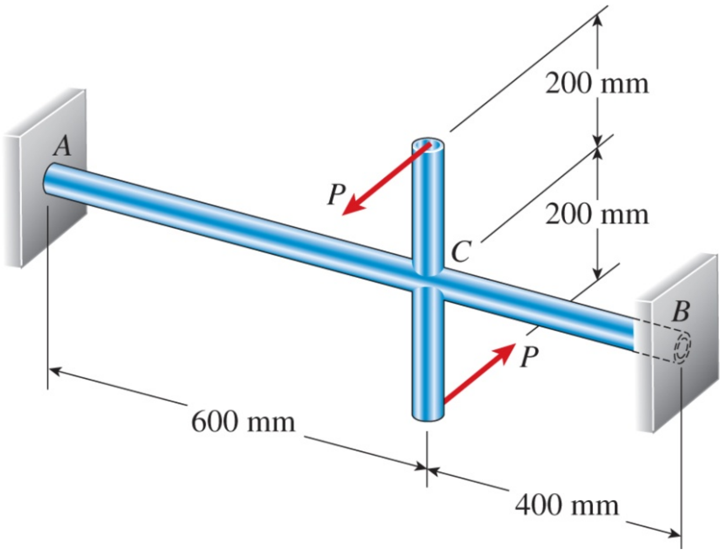
材料力學　作業 10

學號：______________________　　　　姓名：______________________

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.

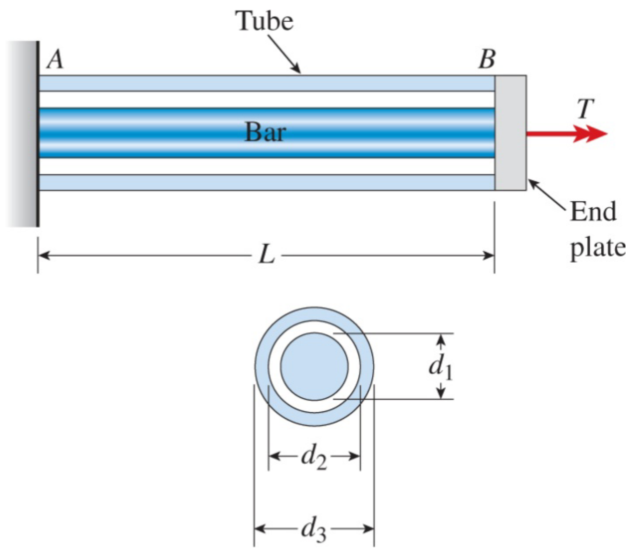


3.8-10 A solid steel bar of diameter $d_1 = 25.0$ mm is enclosed by a steel tube of outer diameter $d_3 = 37.5$ mm and inner diameter $d_2 = 30.0$ mm (see figure). Both bar and tube are held rigidly by a support at end *A* and joined securely to a rigid plate at end *B*. The composite bar, which has a length $L = 550$ mm, is twisted by a torque $T = 400 N \cdot m$ acting on the end plate.

(a) Determine the maximum shear stresses τ_1 and τ_2 in the bar and tube, respectively.

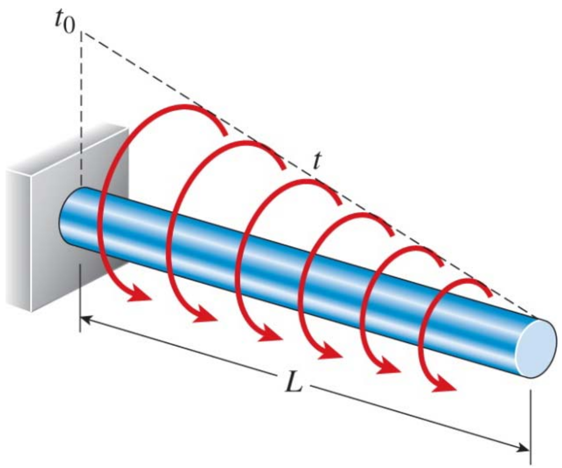
(b) Determine the angle of rotation ϕ (in degrees) of the end plate, assuming that the shear modulus of the steel is $G = 80$ GPa.

(c) Determine the torsional stiffness k_T of the composite bar.



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

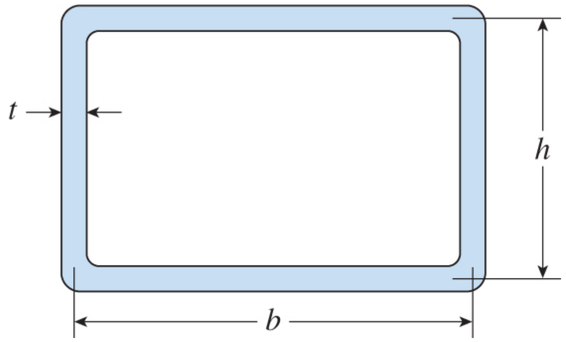
The bar has circular cross sections and length L. It is subjected to a distributed torque of intensity t per unit distance. The intensity varies linearly from $t = 0$ at the free end to a maximum value $t = t_0$ at the support.



3.11-3 A thin-walled aluminum tube of rectangular cross section (see figure) has 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 $T = 90 N \cdot m$.

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



3.11-8 A torque T is applied to a thin-walled tube having a cross section in the shape of a regular hexagon with constant wall thickness t and side length b (see figure). Obtain formulas for the shear stress τ and the rate of twist θ.