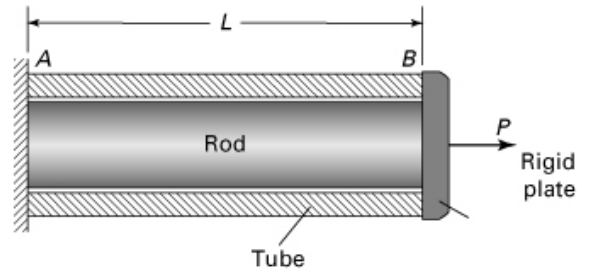
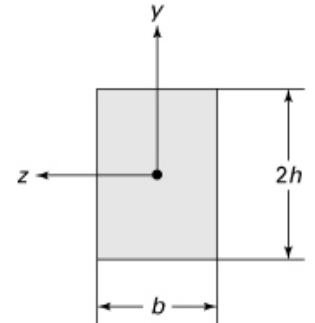


## Homework 14

- 1) The figure depicts a cylindrical rod of cross-sectional area  $A_r$  inserted into a tube of the same length  $L$  and of cross-sectional area  $A_t$ . The left ends of the members are attached to a rigid support and the right ends to a rigid plate. When an axial load  $P$  is applied as shown, determine the deflection at which both components begin to plastically deform and draw the load-deflection diagram of the rod-tube assembly. Given:  $L = 1.2 \text{ m}$ ,  $A_r = 45 \text{ mm}^2$ ,  $A_t = 60 \text{ mm}^2$ ,  $E_r = 200 \text{ GPa}$ ,  $E_t = 100 \text{ GPa}$ ,  $(\sigma_r)_{yp} = 250 \text{ MPa}$ , and  $(\sigma_t)_{yp} = 310 \text{ MPa}$ . Assume: The rod and tube are both made of elastic-perfectly plastic materials, and they have no lateral interactions with each other.



- 2) The figure shows the cross section of a rectangular beam made of mild steel with  $\sigma_{yp} = 240 \text{ MPa}$ . For bending about the  $z$ -axis, find (a) the yield moment; (b) the moment producing a  $e = 20\text{-mm}$ -thick plastic zone at the top and bottom of the beam. Given:  $b = 60 \text{ mm}$  and  $h = 40 \text{ mm}$ .



- 3) A circular shaft of diameter  $d$  and length  $L$  is subjected to a torque of  $T$ , as shown. The shaft is made of 6061-T6 aluminum alloy (see Table D. 1), which is assumed to be elastoplastic. Find (a) the radius of the elastic core  $\rho_0$ ; (b) the angle of twist  $\phi$ . Given:  $d = 50 \text{ mm}$ ,  $L = 1.2 \text{ m}$ , and  $T = 4.5 \text{ kN} \cdot \text{m}$ .

