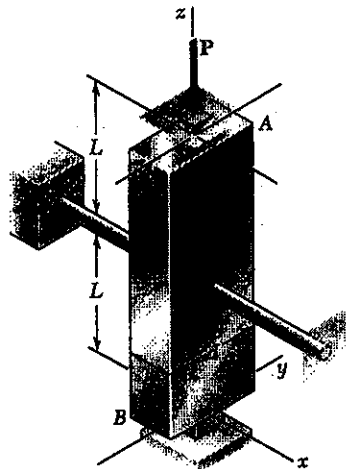


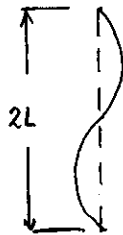
**PROBLEM 10.25**

**10.25** Column  $ABC$  has a uniform rectangular cross section and is braced in the  $xz$  plane at its midpoint  $C$ . (a) Determine the ratio  $b/d$  for which the factor of safety is the same with respect to buckling in the  $xz$  and  $yz$  planes. (b) Using the ratio found in part a, design the cross section of the column so that the factor of safety will be 2.7 when  $P = 1.2$  kips,  $L = 24$  in., and  $E = 10.6 \times 10^6$  psi.



**SOLUTION**

Buckling in  $xz$ -plane:  $L_e = L = 24$  in.

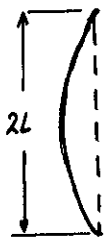


$$I = \frac{1}{12} db^3$$

$$P = \frac{P_{cr}}{F.S.} = \frac{\pi^2 EI}{2.8 L_e^2} = \frac{\pi^2 E db^3}{12(F.S.) L_e^2}$$

$$db^3 = \frac{12 P (F.S.) L_e^2}{\pi^2 E} = \frac{(12)(1.2 \times 10^3)(2.7)(24)^2}{\pi^2 (10.6 \times 10^6)} = 0.21406 \text{ in}^4$$

Buckling in  $yz$ -plane:  $L_e = 2L = (2)(24) = 48$  in  $I = \frac{1}{12} bd^3$



$$P = \frac{P_{cr}}{F.S.} = \frac{\pi^2 EI}{2.8 L_e^2} = \frac{\pi^2 E bd^3}{12(F.S.) L_e^2}$$

$$bd^3 = \frac{12 P (F.S.) L_e^2}{\pi^2 E} = \frac{(12)(1.2 \times 10^3)(2.7)(48)^2}{\pi^2 (10.6 \times 10^6)} = 0.85625 \text{ in}^4$$

$$(a) \quad \frac{db^3}{bd^3} = \frac{b^2}{d^2} = \frac{0.21406}{0.85625} = \frac{1}{4} \quad \frac{b}{d} = \frac{1}{2}$$

$$db^3 = d\left(\frac{1}{8}d^3\right) = \frac{1}{8}d^4 = 0.21406 \text{ in}^4, \quad d = 1.144 \text{ in.}$$

$$b = \frac{1}{2}d = 0.572 \text{ in.}$$