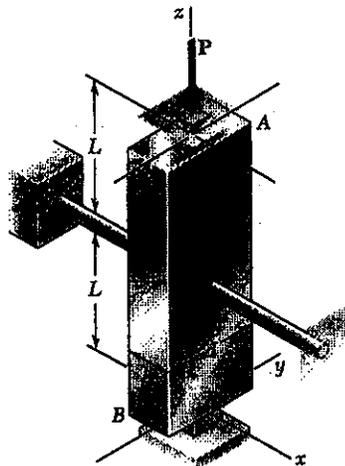


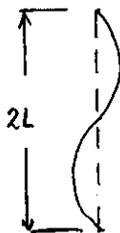
PROBLEM 10.25

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.



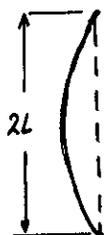
$$I = \frac{1}{12} db^3$$

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

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

$$= 0.21406 \text{ in}^4$$

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

$db^3 = d(\frac{1}{8}d^3) = \frac{1}{8}d^4 = 0.21406 \text{ in}^4, \quad d = 1.144 \text{ in.}$
 $b = \frac{1}{2}d = 0.572 \text{ in.}$