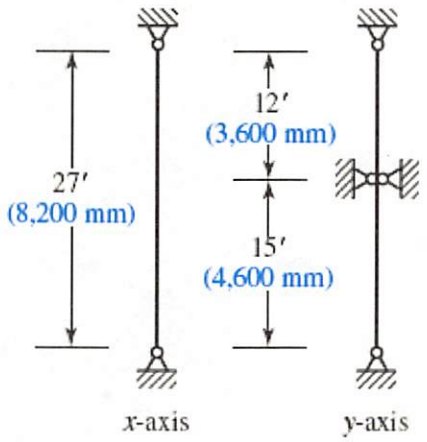
4.7-7 Select the best rectangular (not square) HSS for a column to support a service dead load of **33 kips (145 kN)** and a service live load of **82 kips (365 kN)** . The member is **27 feet (8,200 mm)** long and is pinned at the ends. It is supported in the weak direction at a point **12 feet (3,600 mm)** from the top. Use $F_y = 46$ **ksi (345 MPa)** .

a. Use LRFD.

b. Use ASD.

$K_x = 1.0 \quad L_x = 27\,ft$

$K_y = 1.0 \quad L_y = 15\,ft$



a) LRFD

$P_u = 1.2D + 1.6L$

$= 1.2(33^k) + 1.6(82^k) = 170.8^k$

GUESS FROM TABLE 4.3 USING $F_y = 50\,ksi$ $L_c = 15\,ft$

HSS 10 x 8 x 3/16 $\quad \phi_c P_n = 184^k$

$r_x = 3.88\,in \quad r_y = 3.28\,in \quad A_g = 6.06\,in^2 \quad t = 0.174\,in$

$\frac{L_{cx}}{r_x} = \frac{27\,ft(12\,in/ft)}{3.88\,in} = 83.51$ * LARGER VALUE CONTROLS

$\frac{L_{cy}}{r_y} = \frac{15\,ft(12\,in/ft)}{3.28\,in} = 54.88$

$4.71\sqrt{E/F_y} = 4.71\sqrt{\frac{29{,}000\,ksi}{46\,ksi}} = 118.26$

$\frac{L_{cx}}{r_x} < 4.71\sqrt{E/F_y} \Rightarrow$ USE EQ. E3-2

4.7-7

$$F_e = \frac{\pi^2 E}{(L_{cx}/r_x)} = \frac{\pi^2(29{,}000\,ksi)}{(83.51)^2} = 41.04\,ksi$$

$$F_n = F_y\left(0.658^{F_y/F_e}\right) = 46\,ksi\left(0.658^{46/41.04}\right) = 28.78\,ksi$$

$$P_n = F_n A_g = 28.78\,ksi\,(6.06\,in^2) = 174.5\,k$$

$$\phi_c P_n = 0.9(174.5k) = 157.05^k < P_u \quad \text{N.G.}$$

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* TRY HSS 10 x 8 x 1/4 $\phi_c P_n = 283^k$ ($F_y = 50\,ksi$)

$r_x = 3.85\,in$ $r_y = 3.25\,in$ $A_g = 8.03\,in^2$ $t = 0.233\,IN$

$$\frac{L_{cx}}{r_x} = \frac{27ft\,(12\,in/ft)}{3.85\,in} = 84.16$$ * LARGER VALUE CONTROLS

$$\frac{L_{cy}}{r_y} = \frac{15ft\,(12\,in/ft)}{3.25\,in} = 55.38$$

$$\frac{L_{cx}}{r_x} < 4.71\sqrt{E/F_y} \Longrightarrow \text{USE EQ E3-2}$$

$$F_e = \frac{\pi^2 E}{(L_{cx}/r_x)} = \frac{\pi^2(29{,}000\,ksi)}{(84.16)^2} = 40.41\,ksi$$

$$F_n = F_y\left(0.658^{F_y/F_e}\right) = 46\,ksi\left(0.658^{46/40.41}\right) = 28.57\,ksi$$

$$P_n = F_n A_g = 28.57\,ksi\,(8.03\,in^2) = 229.39k$$

$$\phi_c P_n = 0.9(229.39^k) = 206.45 > P_u \quad \underline{\text{O.K.}}$$

CHECK WIDTH-THICKNESS RATIOS $t = 0.233in$

FROM TABLE 1-11 (1-90) $b/t = 31.3$ $h/t = 39.9$

FROM TABLE B4.1a

$$b/t < 1.40\sqrt{E/F_y} = 1.40\sqrt{\frac{29{,}000ksi}{46ksi}} = 35.15$$

$h/t > 1.40\sqrt{E/F_y}$ ELEMENT IS SLENDER

$$\frac{h}{t} = \frac{10in - 3(0.233in)}{0.233in} = 39.92$$

$$\lambda_r\sqrt{\frac{F_y}{F_{cr}}} = 35.15\sqrt{\frac{46ksi}{28.57ksi}} = 44.62$$

SINCE $h/t < \lambda\sqrt{\frac{F_y}{F_{cr}}}$ $b_e = b \Rightarrow A_e = A_g$

$$\Rightarrow P_n = F_n A_g = 229.39^k$$

$$\phi_c P_n = 206.45^k > P_u = 170^k \quad \text{O.K.}$$

USE HSS $10 \times 8 \times 1/4$

4.7-7 USE HSS 10x8x1/4

b) ASD $P_u = D + L = 33^k + 82^k = 115^k$

TRY HSS 10 x 8 x 1/4

P_n FROM PART a $\Rightarrow 229.39^k$

$$\frac{P_n}{\Omega_c} = \frac{229.39^k}{1.67} = 137.36 > P_u = 115^k \quad \text{o.k.}$$

USE HSS 10 x 8 x 1/4