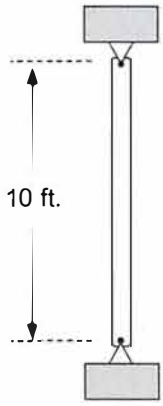


**Classroom Problem 4.4-2:** A HSS 10 x 5 x 1/4 of A500 Grade C steel ( $F_y = 50 \text{ ksi}$  and  $F_u = 62 \text{ ksi}$ ) has a length of 10 ft., and the ends are pinned. Compute the flexural buckling strength.



FROM TABLE 1-11 (1-90)  $\left[ \begin{array}{l} A = 6.63 \text{ in}^2 \quad r_y = 2.1 \text{ in} \quad r_x = 3.6 \text{ in} \\ b/t = 18.5 \quad h/t = 39.9 \quad t_w = 0.233 \text{ in} \end{array} \right.$

$$\frac{L_c}{r_{min}} = \frac{10 \text{ ft} (12 \text{ in/ft})}{2.1 \text{ in}} = 57.14 < 200 \quad \underline{\text{o.k.}}$$

$$4.71 \sqrt{\frac{E}{F_y}} = 113.43$$

$$\frac{L_c}{r} < 4.71 \sqrt{\frac{E}{F_y}} \Rightarrow \text{AISC EQ E3-2}$$

$$F_e = \frac{\pi^2 E}{(L/r)^2} = \frac{\pi^2 (29,000 \text{ ksi})}{(57.14)^2} = 87.66 \text{ ksi}$$

$$F_n = (0.658^{F_y/F_e}) F_y = (0.658^{50/87.66}) 50 \text{ ksi} = 39.38 \text{ ksi}$$

$$P_n = F_n A_g = 39.38 \text{ ksi} (6.63 \text{ in}^2) = \underline{261.1 \text{ k}}$$

CHECK WIDTH-TO-THICKNESS RATIO

$$\lambda = \frac{h}{t} = 39.9 \quad \lambda = \frac{b}{t} = 18.5$$

$$\lambda_r = 1.40 \sqrt{\frac{29,000 \text{ ksi}}{50 \text{ ksi}}} = 33.72$$

$\lambda = \frac{h}{t} > 1.40 \sqrt{\frac{E}{F_y}}$   $\therefore$  LARGER DIMENSION IS SLENDER  
 COMPUTE LOCAL BUCKLING STRENGTH

FROM TABLE B4.1a CASE 6

UPPER LIMIT  $\lambda_r = 1.40 \sqrt{E/F_y}$

$$\lambda = \lambda_r \sqrt{\frac{F_y}{F_n}} = 33.72 \sqrt{\frac{50 \text{ ksi}}{39.38 \text{ ksi}}} = 38.00 \quad \frac{h}{t} = 39.9 > \lambda_r \sqrt{\frac{E}{F_n}}$$

USE E7-3

$$h_e = h \left( 1 - c_1 \sqrt{\frac{F_{el}}{F_n}} \right) \sqrt{\frac{F_{el}}{F_n}}$$

TABLE E7.1  
 $c_1 = 0.20$   
 $c_2 = 1.38$

$$F_{el} = \left( c_2 \frac{\lambda_r}{\lambda} \right)^2 F_y = \left( 1.38 \frac{33.72}{39.9} \right)^2 50 \text{ ksi} = 68.01 \text{ ksi}$$

$$h = H - 3t = 10 \text{ in} - 3(0.233 \text{ in}) = 9.30 \text{ in}$$

$$h_e = 9.30 \text{ in} \left[ 1 - 0.20 \sqrt{\frac{68.01}{39.38}} \right] \sqrt{\frac{68.01}{39.38}} = 9.01 \text{ in}$$

$$A_e = A_g - \sum (h - h_e)t = 6.63 \text{ in}^2 - 2 \left( 9.30 \text{ in} - 9.01 \text{ in} \right) 0.233 \text{ in}$$

↙ TWO 10 IN SIDES

$$= 6.49 \text{ in}^2$$

$$P_n = F_n A_e = 39.38 \text{ ksi} (6.49 \text{ in}^2) = \underline{255.75 \text{ k}}$$

$$\phi P_n = 0.90 (255.75 \text{ k}) = \underline{\underline{230.2 \text{ k}}}$$