Local Buckling of Flanges

Equivalent Column (See p. 38 of L. G. Steel Manual)

$$\frac{2 \cdot 1.0 - 1.0}{6 \cdot 1.0} \cdot 2.0 = 0.33\text{in.}$$

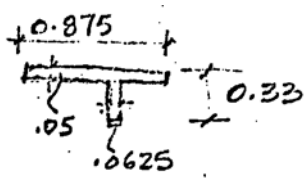

Figure 1: Distance of centroid to equivalent column to top tier.

Centroid Calculations

$$\begin{aligned} 0.875 + (0.33 - 0.05) &= 1.055 \\ 0.875 \times \frac{0.05}{2} &= 0.022 \\ .0625 \times 0.19 &= 0.0119 \end{aligned}$$

$$\frac{0.022 + 0.0119}{1.055} = .0322$$

$$A = (.815 \times .05) + (.0625 \times .28) = .0612$$

$$y_0 = .0322 - .025 = .007$$

$$\begin{aligned} D &= \frac{2^3}{3EI} + \frac{2^2(.875)}{2EI} \\ &= \frac{8}{3EI} + \frac{3.5}{2EI} \\ &= \frac{26.5}{6EI} = \frac{44.1}{EI} \end{aligned}$$

$$E = 10 \times 10^6$$

$$I = \frac{1}{12} \cdot (0.0625)^3 = 20.3 \times 10^{-6}$$

$$D = \frac{44.1}{10 \cdot 20.3} = .217$$

$$\beta = D^{-1} = 4.61$$

$$T_0 = \frac{2}{2 + (2.4 \cdot y_0)} = \frac{2}{2.02} = 0.99$$

$$\begin{aligned} P_{cr} &= T_0\sqrt{4\beta EI} \\ &= 0.99\sqrt{4 \cdot 4.61 \cdot 10 \cdot 20.3} \\ &= 60.4 \text{ lbs.} \end{aligned}$$

$$\sigma_{cr} = P_{cr}/A = 60.4/.0612 = 986 \text{ psi}$$

$$M = P\cos\alpha\frac{L'}{L}(L - L')$$

Leaning Ladder: For L = 180", L' = 132", $\cos\alpha = 0.34$,

$$M = P \cdot 0.34 \cdot \frac{132}{180} \cdot 48 = 12.0 \cdot P$$

$$\begin{aligned} \sigma &= \frac{P}{A}\sin\alpha + \frac{12PC}{I} \\ &= P(\frac{0.94}{0.414} + \frac{12 \cdot 1}{0.229}) \\ &= 7.52 \cdot P \end{aligned}$$

$$P = \frac{\sigma_{cr}}{7.52} = 132 \text{ lbs., placed 11' up the ladder}$$