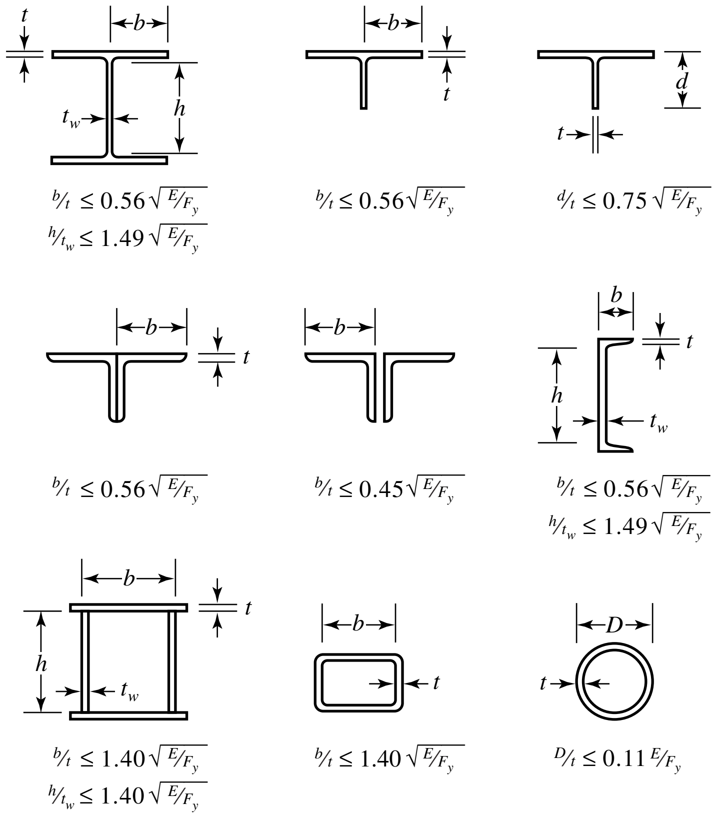
FIGURE 4.9



EXAMPLE 4.3

Investigate the column of Example 4.2 for local stability.

SOLUTION For a W14 × 74, $b_f = 10.1$ in., $t_f = 0.785$ in., and

$$\frac{b_f}{2t_f} = \frac{10.1}{2(0.785)} = 6.43$$

$$0.56\sqrt{\frac{E}{F_y}} = 0.56\sqrt{\frac{29{,}000}{50}} = 13.5 > 6.43 \qquad \text{(OK)}$$

$$\frac{h}{t_w} = \frac{d - 2k_{des}}{t_w} = \frac{14.2 - 2(1.38)}{0.450} = 25.4$$

where k_{des} is the *design* value of k. (Different manufacturers will produce this shape with different values of k. The *design* value is the smallest of these values. The *detailing* value is the largest.)

$$1.49\sqrt{\frac{E}{F_y}} = 1.49\sqrt{\frac{29{,}000}{50}} = 35.9 > 25.4 \qquad \text{(OK)}$$

ANSWER Local instability is not a problem.

In Example 4.3, the width-to-thickness ratios $b_f/2t_f$ and h/t_w were computed. This is not necessary, however, because these ratios are tabulated in the dimensions and properties table. In addition, shapes that are slender for compression are indicated with a footnote (footnote c).

It is permissible to use a cross-sectional shape that does not satisfy the width-to-thickness ratio requirements, but such a member may not be permitted to carry as large a load as one that does satisfy the requirements. In other words, the strength could be reduced because of local buckling. The overall procedure for making this investigation is as follows.

- If the width-to-thickness ratio λ is greater than λ_r, use the provisions of AISC E7 and compute a reduction factor Q.
- Compute KL/r and F_e as usual.
- If $\dfrac{KL}{r} \le 4.71\sqrt{\dfrac{E}{QF_y}}$ or $\dfrac{QF_y}{F_e} \le 2.25$,

$$F_{cr} = Q\left(0.658^{\frac{QF_y}{F_e}}\right)F_y \qquad \text{(AISC Equation E7-2)}$$

- If $\dfrac{KL}{r} > 4.71\sqrt{\dfrac{E}{QF_y}}$ or $\dfrac{QF_y}{F_e} > 2.25$,

$$F_{cr} = 0.877F_e \qquad \text{(AISC Equation E7-3)}$$

- The nominal strength is $P_n = F_{cr}A_g$ (AISC Equation E7-1)

The reduction factor Q is the product of two factors—Q_s for unstiffened elements and Q_a for stiffened elements. If the shape has no slender unstiffened elements, $Q_s = 1.0$. If the shape has no slender stiffened elements, $Q_a = 1.0$.

Many of the shapes commonly used as columns are not slender, and the reduction will not be needed. This includes most (but not all) W-shapes. However, a large number of hollow structural shapes (HSS), double angles, and tees have slender elements.