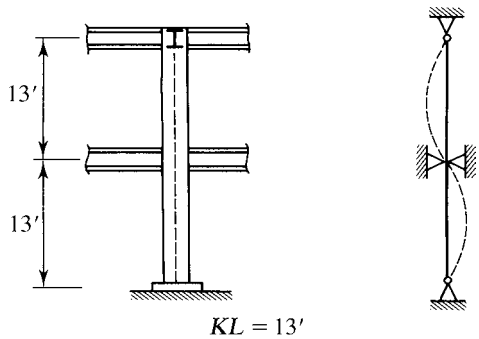
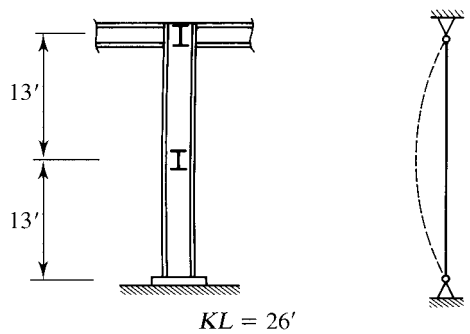
FIGURE 4.10



(a) Minor Axis Buckling



(b) Major Axis Buckling

pin-connected at the top. For the same reasons, the connection to the support at the bottom may also be treated as a pin connection. Generally speaking, a rigid, or fixed, condition is very difficult to achieve, and unless some special provisions are made, ordinary connections will usually closely approximate a hinge or pin connection. At midheight, the column is braced, but only in one direction.

Again, the connection prevents translation, but no restraint against rotation is furnished. This brace prevents translation perpendicular to the weak axis of the cross section but provides no restraint perpendicular to the strong axis. As shown schematically in Figure 4.10, if the member were to buckle about the major axis, the effective length would be 26 feet, whereas buckling about the minor axis would have to be in the second buckling mode, corresponding to an effective length of 13 feet. Because its strength decreases with increasing KL/r, a column will buckle in the direction corresponding to the largest slenderness ratio, so K_xL/r_x must be compared with K_yL/r_y. In Figure 4.10, the ratio $26(12)/r_x$ must be compared with $13(12)/r_y$ (where r_x and r_y are in inches), and the larger ratio would be used for the determination of the axial compressive strength.

EXAMPLE 4.9

A W12 × 58, 24 feet long, is pinned at both ends and braced in the weak direction at the third points, as shown in Figure 4.11. A992 steel is used. Determine the available compressive strength.

SOLUTION

$$\frac{K_x L}{r_x} = \frac{24(12)}{5.28} = 54.55$$

$$\frac{K_y L}{r_y} = \frac{8(12)}{2.51} = 38.25$$

$K_x L/r_x$, the larger value, controls.

LRFD SOLUTION

From Table 4-22 from Part 4 of the *Manual* and with $KL/r = 54.55$,

$$\phi_c F_{cr} = 36.24 \text{ ksi}$$

$$\phi_c P_n = \phi_c F_{cr} A_g = 36.24(17.0) = 616 \text{ kips}$$

ANSWER Design strength = 616 kips.

ASD SOLUTION

From Table 4-22 with $KL/r = 54.55$,

$$\frac{F_{cr}}{\Omega_c} = 24.09 \text{ ksi}$$

$$\frac{P_n}{\Omega_c} = \frac{F_{cr}}{\Omega_c} A_g = 24.09(17.0) = 410 \text{ kips}$$

ANSWER Allowable strength = 410 kips.

FIGURE 4.11