The available strengths given in the column load tables are based on the effective length with respect to the $y$-axis. A procedure for using the tables with $K_xL$, however, can be developed by examining how the tabular values were obtained. Starting with a value of $KL$, the strength was obtained by a procedure similar to the following:

- $KL$ was divided by $r_y$ to obtain $KL/r_y$.
- $F_{cr}$ was computed.
- The available strengths, $\phi_c P_n$ for LRFD and $P_n/\Omega_c$ for ASD, were computed.

Thus the tabulated strengths are based on the values of $KL$ being equal to $K_yL$. If the capacity with respect to $x$-axis buckling is desired, the table can be entered with

$$KL = \frac{K_xL}{r_x/r_y}$$

and the tabulated load will be based on

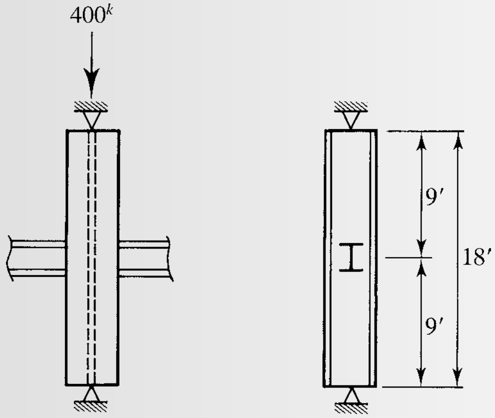
$$\frac{KL}{r_y} = \frac{K_xL/(r_x/r_y)}{r_y} = \frac{K_xL}{r_x}$$

The ratio $r_x/r_y$ is given in the column load tables for each shape listed.

## EXAMPLE 4.10

The compression member shown in Figure 4.12 is pinned at both ends and supported in the weak direction at midheight. A service load of 400 kips, with equal parts of dead and live load, must be supported. Use $F_y$ = 50 ksi and select the lightest W-shape.

**FIGURE 4.12**



**LRFD SOLUTION**

Factored load $= P_u = 1.2(200) + 1.6(200) = 560$ kips

Assume that the weak direction controls and enter the column load tables with $KL = 9$ feet. Beginning with the smallest shapes, the first one found that will work is a W8 × 58 with a design strength of 634 kips.

Check the strong axis:

$$\frac{K_x L}{r_x/r_y} = \frac{18}{1.74} = 10.34 \text{ ft} > 9 \text{ ft}$$

$\therefore K_x L$ controls for this shape.

Enter the tables with $KL = 10.34$ feet. A W8 × 58 has an interpolated strength of

$$\phi_c P_n = 596 \text{ kips} > 560 \text{ kips} \quad \text{(OK)}$$

Next, investigate the W10 shapes. Try a W10 × 49 with a design strength of 568 kips.

Check the strong axis:

$$\frac{K_x L}{r_x/r_y} = \frac{18}{1.71} = 10.53 \text{ ft} > 9 \text{ ft}$$

$\therefore K_x L$ controls for this shape.

Enter the tables with $KL = 10.53$ feet. A W10 × 54 is the lightest W10, with an interpolated design strength of 594 kips.

Continue the search and investigate a W12 × 53 ($\phi_c P_n = 611$ kips for $KL = 9$ ft):

$$\frac{K_x L}{r_x/r_y} = \frac{18}{2.11} = 8.53 \text{ ft} < 9 \text{ ft}$$

$\therefore K_y L$ controls for this shape, and $\phi_c P_n = 611$ kips.

Determine the lightest W14. The lightest one with a possibility of working is a W14 × 61. It is heavier than the lightest one found so far, so it will not be considered.

**ANSWER**

Use a W12 × 53.

**ASD SOLUTION**

The required load capacity is $P = 400$ kips. Assume that the weak direction controls and enter the column load tables with $KL = 9$ feet. Beginning with the smallest shapes, the first one found that will work is a W8 × 58 with an allowable strength of 422 kips.

Check the strong axis:

$$\frac{K_x L}{r_x/r_y} = \frac{18}{1.74} = 10.34 \text{ ft} > 9 \text{ ft}$$

$\therefore K_x L$ controls for this shape.