From the column load tables for $KL = 1.0(26) = 26$ ft, a W14 × 132 has an allowable strength of 702 kips.

ANSWER Use a W14 × 132.

EXAMPLE 4.7

Select the lightest W-shape that can resist a service dead load of 62.5 kips and a service live load of 125 kips. The effective length is 24 feet. Use ASTM A992 steel.

SOLUTION The appropriate strategy here is to find the lightest shape for each nominal depth in the column load tables and then choose the lightest overall.

LRFD SOLUTION The factored load is

$$P_u = 1.2D + 1.6L = 1.2(62.5) + 1.6(125) = 275 \text{ kips}$$

From the column load tables, the choices are as follows:

W8: There are no W8s with $\phi_c P_n \geq 275$ kips.

W10: W10 × 54, $\phi_c P_n = 282$ kips

W12: W12 × 58, $\phi_c P_n = 292$ kips

W14: W14 × 61, $\phi_c P_n = 293$ kips

Note that the strength is not proportional to the weight (which is a function of the cross-sectional area).

ANSWER Use a W10 × 54.

ASD SOLUTION The total applied load is

$$P_a = D + L = 62.5 + 125 = 188 \text{ kips}$$

From the column load tables, the choices are as follows:

W8: There are no W8s with $P_n/\Omega_c \geq 188$ kips.

W10: W10 × 54, $\dfrac{P_n}{\Omega_c} = 188$ kips

$$\text{W12:} \quad \text{W12} \times 58, \quad \frac{P_n}{\Omega_c} = 194 \text{ kips}$$

$$\text{W14:} \quad \text{W14} \times 61, \quad \frac{P_n}{\Omega_c} = 195 \text{ kips}$$

Note that the strength is not proportional to the weight (which is a function of the cross-sectional area).

ANSWER Use a W10 × 54.

For shapes not in the column load tables, a trial-and-error approach must be used. The general procedure is to assume a shape and then compute its strength. If the strength is too small (unsafe) or too large (uneconomical), another trial must be made. A systematic approach to making the trial selection is as follows:

1. Assume a value for the critical buckling stress F_{cr}. Examination of AISC Equations E3-2 and E3-3 shows that the theoretically maximum value of F_{cr} is the yield stress F_y.
2. Determine the required area. For LRFD,

$$\phi_c F_{cr} A_g \geq P_u$$

$$A_g \geq \frac{P_u}{\phi_c F_{cr}}$$

For ASD,

$$0.6F_{cr} \geq \frac{P_a}{A_g}$$

$$A_g \geq \frac{P_a}{0.6F_{cr}}$$

3. Select a shape that satisfies the area requirement.
4. Compute F_{cr} and the strength for the trial shape.
5. Revise if necessary. If the available strength is very close to the required value, the next tabulated size can be tried. Otherwise, repeat the entire procedure, using the value of F_{cr} found for the current trial shape as a value for Step 1.
6. Check local stability (check the width-to-thickness ratios). Revise if necessary.