3.6-1

(a) $P_u = 1.2D + 1.6L = 1.2(28) + 1.6(84) = 168$ kips

$$\text{Required } A_g = \frac{P_u}{0.9F_y} = \frac{168}{0.9(36)} = 5.19 \text{ in.}^2$$

$$\text{Required } A_e = \frac{P_u}{0.75F_u} = \frac{168}{0.75(58)} = 3.86 \text{ in.}^2$$

$$\text{Required } r_{\min} = \frac{L}{300} = \frac{18 \times 12}{300} = 0.72 \text{ in.}$$

Try L5 × 3½ ×¾

$A_g = 5.81 \text{ in.}^2 > 5.19 \text{ in.}^2$ (OK)

$r_{\min} = r_z = 0.744 \text{ in.} > 0.72 \text{ in.}$ (OK)

$A_n = 5.81 - 0.75(1.125) = 4.966 \text{ in.}^2$

$A_e = A_n U = 4.966(0.80) = 3.97 \text{ in.}^2 > 3.86 \text{ in.}^2$ (OK)

Use an L5 × 3½ × ¾

3.6-5

$$\text{Required } A_g = \frac{P_u}{0.9F_y} = \frac{180}{0.9(36)} = 5.56 \text{ in.}^2$$

$$\text{Required } A_e = \frac{P_u}{0.75F_u} = \frac{180}{0.75(58)} = 4.14 \text{ in.}^2$$

$$\text{Required } r_{\min} = \frac{L}{300} = \frac{15 \times 12}{300} = 0.6 \text{ in.}$$

Try C10 × 20

$A_g = 5.87 \text{ in.}^2 > 5.56 \text{ in.}^2$ (OK)

$r_{\min} = r_y = 0.690 \text{ in.} > 0.6 \text{ in.}$ (OK)

$A_n = 5.87 - 0.379(1.0)(2) = 5.112 \text{ in.}^2$

$A_e = A_n U = 5.112(0.85) = 4.35 \text{ in.}^2 > 4.15 \text{ in.}^2$ (OK)

Use a C10 × 20

3.6-6

From Part 1 of the *Manual*, all W10 shapes have a flange thickness ≤ 1.25 in. Therefore, from Table 2-3 in Part 2 of the *Manual*, $F_y = 50$ ksi and $F_u = 70$ ksi.

$$P_u = 1.2D + 1.6L = 1.2(175) + 1.6(175) = 490.0 \text{ kips}$$

$$\text{Required } A_g = \frac{P_u}{0.9F_y} = \frac{490}{0.9(50)} = 10.9 \text{ in.}^2$$

$$\text{Required } A_e = \frac{P_u}{0.75F_u} = \frac{490}{0.75(70)} = 9.33 \text{ in.}^2$$

$$\text{Required } r_{\min} = \frac{L}{300} = \frac{30 \times 12}{300} = 1.2 \text{ in.}$$

Try W10 × 49

$A_g = 14.4 \text{ in.}^2 > 10.9 \text{ in.}^2$ (OK)

$r_{\min} = r_y = 2.54 \text{ in.} > 1.2 \text{ in.}$ (OK)

$A_n = 14.4 - 0.560(1.25 + 0.125)(4) = 11.32 \text{ in.}^2$

$\frac{b_f}{d} = \frac{10.0}{10.0} > \frac{2}{3}$ $\Rightarrow$ From AISC Table D3.1, Case 7, $U = 0.90$

$A_e = A_n U = 11.32(0.90) = 10.2 \text{ in.}^2 > 9.33 \text{ in.}^2$ (OK)

Use a W10 × 49