3.6-2 Use A992 ($F_y = 50$ ksi (345 MPa); $F_u = 65$ ksi (450 MPa)) steel and select the lightest American Standard Channel for a tension member that will safely support a service dead load of 130 kips (578 kN) and a service live load of 65 kips (289 kN). The member is 20 feet (6,000 mm) long, and it is connected through the web with two lines of 1-inch-diameter (M24) bolts. The length of the connection is 6 inches (150 mm).

* USE AMERICAN STANDARD CHANNEL SECTION

$d_{HOLES} = 1\text{in} + 3/16\text{in} = 1\ 3/16\ \text{in.}$ $\quad L = 20\text{ft}(12\text{in/ft}) = 240\text{in.}$

LRFD LC#1 $1.4D = 1.4(130\text{k}) = 182^{\text{k}}$

#2 $1.2D + 1.6L = 1.2(130\text{k}) + 1.6(65\text{k}) = \underline{260^{\text{k}}}$

$$\text{REQ } A_g = \frac{260^{\text{k}}}{0.9F_y} = \frac{260^{\text{k}}}{0.9(50\text{ksi})} = 5.7778\text{in}^2$$

$$\text{REQ. } A_e = \frac{260^{\text{k}}}{0.75F_u} = \frac{260^{\text{k}}}{0.75(65\text{ksi})} = 5.3333\text{in}^2$$

$$\text{REQ } r_{min} = \frac{L}{300} = \frac{240\text{in}}{300} = 0.800\text{in}$$

3.16-21

* LOOKING AT TABLE 1-5 (1-38/39)

FIND A SECTION THAT GIVES REQ A_g & GETS CLOSE TO r_{min} (THIS REQUIREMENT IS A RECOMENDATION & DOES NOT EFFECT TENSILE STRENGTH)

→ TRY C12 x 20.7 $A_g = 6.08 in^2 > REQ\ A_g$ ✓

$r_{min} = 0.797 in \sim REQ.\ r_{min}$

$t_{WEB} = 0.282 in \quad \bar{x} = 0.698$

$$A_n = A_g - A_{HOLE} = 6.08 in^2 - 2(0.282 in)(13/16 in) = 5.4103 in^2$$

$$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.698 in}{6 in} = 0.8837$$

$$A_e = UA_n = 0.8837(5.4103 in^2) = 4.7809 in^2$$

$A_e < REQ.\ A_e$ N. G.

TRY C12 x 25 $A_g = 7.34 in^2 > REQ.\ A_e$ ✓

$r_{min} = 0.779 in < 0.8 in$ OK?

$t_{WEB} = 0.387 in. \quad \bar{x} = 0.674 in$

$$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.674 in}{6 in} = 0.8877$$

$$A_e = UA_n = (0.8877)\left[7.34\text{in}^2 - 2(1\tfrac{3}{16}\text{in})(0.387\text{in})\right]$$

$$= 5.6998\text{in}^2 > \text{REQ } A_e \quad \underline{\text{O.K.}}$$

USE C12×25

b) ASD DESIGN LC#2 $D+L = 130^k + 65^k = 195^k$

$$\text{REQ. } A_g = \frac{195^k}{0.6F_y} = \frac{195^k}{0.6(50\text{ksi})} = 6.50\text{in}^2$$

$$\text{REQ. } A_e = \frac{195^k}{0.5F_u} = \frac{195^k}{0.5(65\text{ksi})} = 6.00\text{in}^2$$

$$\text{REQ } r_{min} = \frac{240\text{in}}{300} = 0.80\text{in}$$

$\Rightarrow$ TRY C12×25 $A_g = 7.34\text{in}^2 > \text{REQ } A_g$

$r_{min} = 0.779 < \text{REQ } r_{min}$ ok?

$t_{WEB} = 0.387\text{in}$ $\bar{x} = 0.674\text{in}$

$$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.674\text{in}}{6\text{in}} = 0.8877$$

3.6-21

$A_e = U A_n = (0.8877)\left[7.34\,in^2 - 2(1\tfrac{3}{16}in)(0.367in)\right]$

$= 5.6998\,in^2 < REQ\,A_e$ N.G.

↳ TRY C12×30 $A_g = 8.81\,in^2 > REQ\,A_g$

$r_{min} = 0.762in < 0.8in$ OK?

$t_{WEB} = 0.510in$ $\bar{x} = 0.674in.$

$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.674in}{6in} = 0.8877$

$A_e = U A_n = (0.8877)\left[8.81in^2 - 2(1\tfrac{3}{16}in)(0.510in)\right]$

$= 7.5988\,in^2 > REQ\,A_e$ ✓ O.K.

USE C12×30