From AISC B4.1(b) and the discussion in Part 1 of the *Manual,* the unreduced length of the 8-inch side between the corner radii can be taken as

$$b = 8 - 3t = 8 - 3(0.116) = 7.652 \text{ in.}$$

where the corner radius is taken as 1.5 times the design thickness.

The total loss in area is therefore

$$2(b - b_e)t = 2(7.652 - 4.784)(0.116) = 0.6654 \text{ in.}^2$$

and the reduced area is

$$A_e = 2.70 - 0.6654 = 2.035 \text{ in.}^2$$

The reduction factor is

$$Q_a = \frac{A_e}{A_g} = \frac{2.035}{2.70} = 0.7537$$

$$Q = Q_s Q_a = 1.0(0.7537) = 0.7537$$

Compute the local buckling strength:

$$4.71\sqrt{\frac{E}{QF_y}} = 4.71\sqrt{\frac{29{,}000}{0.7537(46)}} = 136.2$$

$$\frac{KL}{r} = 105.3 < 136.2 \qquad \therefore \text{ Use AISC Equation E7-2}$$

$$F_{cr} = Q\left(0.658^{\frac{QF_y}{F_e}}\right)F_y = 0.7537\left(0.658^{\frac{0.7537(46)}{25.81}}\right)46 = 19.76 \text{ ksi}$$

$$P_n = F_{cr}A_g = 19.76(2.70) = 53.35 \text{ kips}$$

Since this is less than the flexural buckling strength of 58.91 kips, local buckling controls.

LRFD SOLUTION

Design strength $= \phi_c P_n = 0.90(53.35) = 48.0$ kips

ASD SOLUTION

$$\text{Allowable strength} = \frac{P_n}{\Omega} = \frac{53.35}{1.67} = 32.0 \text{ kips}$$

(Allowable stress $= 0.6F_{cr} = 0.6(19.76) = 11.9$ ksi)

ALTERNATIVE SOLUTION WITH *f* DETERMINED BY ITERATION

As an initial trial value, use

$f = F_{cr} = 19.76$ ksi (the value obtained above after using an initial value of $f = F_y$)

$$b_e = 1.92(0.116)\sqrt{\frac{29{,}000}{19.76}}\left[1 - \frac{0.38}{(66.0)}\sqrt{\frac{29{,}000}{19.76}}\right] = 6.65 \text{ in.}$$

The total loss in area is

$$2(b - b_e)t = 2(7.652 - 6.65)(0.116) = 0.2325 \text{ in.}^2$$

and the reduced area is

$$A_e = 2.70 - 0.2325 = 2.468 \text{ in.}^2$$

The reduction factor is

$$Q_a = \frac{A_e}{A_g} = \frac{2.468}{2.70} = 0.9141$$

$$Q = Q_s Q_a = 1.0(0.9141) = 0.9141$$

Compute the local buckling strength.

$$4.71\sqrt{\frac{E}{QF_y}} = 4.71\sqrt{\frac{29{,}000}{0.9141(46)}} = 123.7$$

$$\frac{KL}{r} = 105.3 < 123.7 \qquad \therefore \text{ Use AISC Equation E7-2}$$

$$F_{cr} = Q\left(0.658^{\frac{QF_y}{F_e}}\right)F_y$$

$$= 0.9141\left(0.658^{\frac{0.9141(46)}{25.81}}\right)46 = 21.26 \text{ ksi} \quad 19.76 \text{ ksi (the assumed value)}$$

Try $f = 21.26$ ksi:

$$b_e = 1.92(0.116)\sqrt{\frac{29{,}000}{21.26}}\left[1 - \frac{0.38}{(66.0)}\sqrt{\frac{29{,}000}{21.26}}\right] = 6.477 \text{ in.}$$

The total loss in area is

$$2(b - b_e)t = 2(7.652 - 6.477)(0.116) = 0.2726 \text{ in.}^2$$

and the reduced area is

$$A_e = 2.70 - 0.2726 = 2.427 \text{ in.}^2$$