Using a shear lag factor $U$ of 0.80, the actual effective net area is computed as follows:

$$A_n = A_g - A_{\text{holes}} = 4.93 - 2\left(\frac{3}{4} + \frac{1}{8}\right)\left(\frac{5}{8}\right) = 3.836 \text{ in.}^2$$

$$A_e = A_n U = 3.836(0.80) = 3.069 \text{ in.}^2$$

and the allowable strength based on rupture of the net section is

$$\frac{P_n}{\Omega_t} = \frac{F_u A_e}{\Omega_t} = \frac{58(3.069)}{2.00} = 89.0 \text{ kips} < 105 \text{ kips} \qquad \text{(N.G.)}$$

This shape did not work because the ratio of actual effective net area $A_e$ to gross area $A_g$ is not equal to 0.75. The ratio is closer to

$$\frac{3.069}{4.93} = 0.6225$$

This corresponds to a required $P_n/\Omega_t$ (based on rupture), for purposes of using Table 5-2, of

$$\frac{0.75}{0.6225}(105) = 127 \text{ kips}$$

Using this as a guide, try L6 × 4 × ⅝, with $P_n/\Omega_t = 126$ kips based on yielding of the gross section and $P_n/\Omega_t = 128$ kips based on rupture of the net section. From the dimensions and properties tables in Part 1 of the *Manual,* $r_{\min} = 0.859$ in.

$$A_n = A_g - A_{\text{holes}} = 5.86 - 2\left(\frac{3}{4} + \frac{1}{8}\right)\left(\frac{5}{8}\right) = 4.766 \text{ in.}^2$$

$$A_e = A_n U = 4.766(0.80) = 3.81 \text{ in.}^2$$

$$\frac{P_n}{\Omega_t} = \frac{F_u A_e}{\Omega_t} = \frac{58(3.81)}{2.00} = 111 \text{ kips} > 105 \text{ kips} \qquad \text{(OK)}$$

**ANSWER** Use an L6 × 4 × ⅝, connected through the 6-inch leg.

Note that if the effective net area must be computed, the tables do not save much effort. In addition, you must still refer to the dimensions and properties tables to find the radius of gyration. The tables for design do, however, provide all other information in a compact form, and the search may go more quickely.

When structural shapes or plates are connected to form a built-up shape, they must be connected not only at the ends of the member but also at intervals along its length. A continuous connection is not required. This type of connection is called *stitching,* and the fasteners used are termed *stitch bolts*. The usual practice is to locate the points of stitching so that $L/r$ for any component part does not exceed $L/r$ for the built-up member. The user note in AISC D4 recommends that built-up shapes whose component parts are separated by intermittent fillers be connected at intervals such that the maximum $L/r$ for any component does not exceed 300. Built-up shapes consisting of plates or a combination of plates and shapes are addressed in AISC Section J3.5 of Chapter J ("Design of Connections"). In general, the spacing of fasteners or welds should not exceed 24 times the thickness of the thinner plate, or 12 inches. If the member is of "weathering" steel subject to atmospheric corrosion, the maximum spacing is 14 times the thickness of the thinner part, or 7 inches.

## 3.7 THREADED RODS AND CABLES

When slenderness is not a consideration, rods with circular cross sections and cables are often used as tension members. The distinction between the two is that rods are solid and cables are made from individual strands wound together in ropelike fashion. Rods and cables are frequently used in suspended roof systems and as hangers or suspension members in bridges. Rods are also used in bracing systems; in some cases, they are pretensioned to prevent them from going slack when external loads are removed. Figure 3.26 illustrates typical rod and cable connection methods.

When the end of a rod is to be threaded, an upset end is sometimes used. This is an enlargement of the end in which the threads are to be cut. Threads reduce the cross-sectional area, and upsetting the end produces a larger gross area to start with. Standard upset ends with threads will actually have more net area in the threaded portion than in the unthreaded part. Upset ends are relatively expensive, however, and in most cases unnecessary.

**FIGURE 3.26**