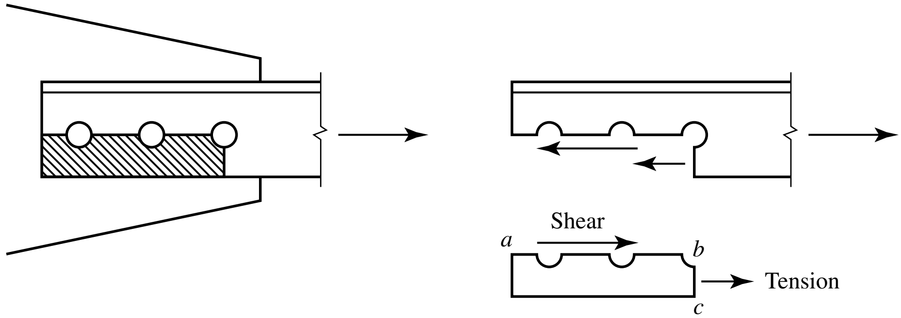
FIGURE 3.21

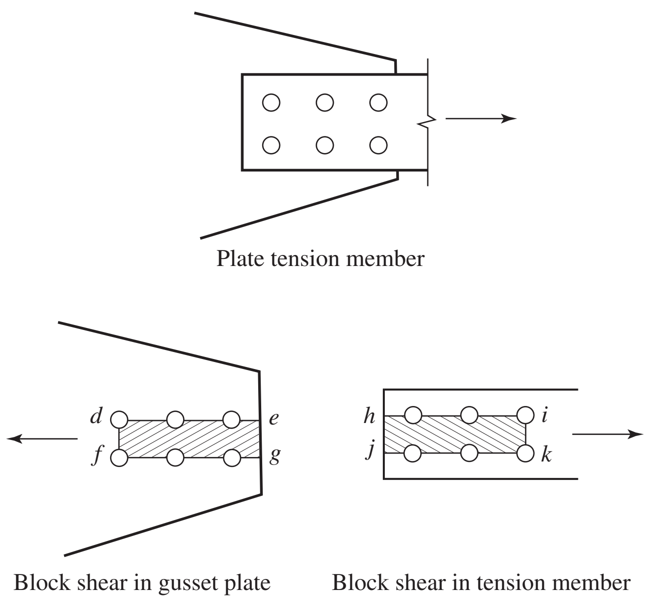


For the case illustrated, the shaded block would tend to fail by shear along the longitudinal section *ab* and by tension on the transverse section *bc*.

For certain arrangements of bolts, block shear can also occur in gusset plates. Figure 3.22 shows a plate tension member connected to a gusset plate. In this connection, block shear could occur in both the gusset plate and the tension member. For the gusset plate, tension failure would be along the transverse section *df,* and shear failure would occur on two longitudinal surfaces, *de* and *fg*. Block shear failure in the plate tension member would be tension on *ik* and shear on both *hi* and *jk.* This topic is not covered explicitly in AISC Chapter D ("Design of Members for Tension"), but the introductory user note directs you to Chapter J ("Design of Connections"), Section J4.3, "Block Shear Strength."

The model used in the AISC Specification assumes that failure occurs by rupture (fracture) on the shear area and rupture on the tension area. Both surfaces contribute to the total strength, and the resistance to block shear will be the sum of the strengths of the two surfaces. The shear rupture stress is taken as 60% of the tensile ultimate

FIGURE 3.22



stress, so the nominal strength in shear is $0.6F_uA_{nv}$ and the nominal strength in tension is F_uA_{nt},

where

A_{nv} = net area along the shear surface or surfaces
A_{nt} = net area along the tension surface

This gives a nominal strength of

$$R_n = 0.6F_uA_{nv} + F_uA_{nt} \tag{3.3}$$

The AISC Specification uses Equation 3.3 for angles and gusset plates, but for certain types of coped beam connections (to be covered in Chapter 5), the second term is reduced to account for nonuniform tensile stress. The tensile stress is nonuniform when some rotation of the block is required for failure to occur. For these cases,

$$R_n = 0.6F_uA_{nv} + 0.5F_uA_{nt} \tag{3.4}$$

The AISC Specification limits the $0.6F_uA_{nv}$ term to $0.6F_yA_{gv}$, where

$0.6F_y$ = shear yield stress
A_{gv} = gross area along the shear surface or surfaces

and gives one equation to cover all cases as follows:

$$R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt} \leq 0.6F_yA_{gv} + U_{bs}F_uA_{nt} \qquad \text{(AISC Equation J4-5)}$$

where U_{bs} = 1.0 when the tension stress is uniform (angles, gusset plates, and most coped beams) and U_{bs} = 0.5 when the tension stress is nonuniform. A nonuniform case is illustrated in the Commentary to the Specification.

For LRFD, the resistance factor ϕ is 0.75, and for ASD, the safety factor Ω is 2.00. Recall that these are the factors used for the fracture—or rupture—limit state, and block shear is a rupture limit state.

Although AISC Equation J4-5 is expressed in terms of bolted connections, block shear can also occur in welded connections, especially in gusset plates.

EXAMPLE 3.10

Compute the block shear strength of the tension member shown in Figure 3.23. The holes are for ⅞-inch-diameter bolts, and A36 steel is used.

a. Use LRFD.
b. Use ASD.

FIGURE 3.23