

## PROPER SPECIFICATION OF JOINT TYPE

### Selection of Weld Type

The most common weld types are fillet and groove welds. Fillet welds are normally more economical than groove welds and generally should be used in applications for which groove welds are not required. Additionally, fillet welds around the inside of holes or slots require less weld metal than plug or slot welds of the same size, even though the diameters of holes and widths of slots for fillet welds must be larger to accommodate the necessary tilt of the electrode.

Partial joint penetration (PJP) groove welds are more economical than complete joint penetration (CJP) groove welds. When groove welds are required, bevel and V groove welds, which can be flame-cut, are usually more economical than J and U groove welds, which must be air-arc gouged or planed. Also, double-bevel, double-V, double-J, and double-U welds are typically more economical than welds of the same type with single-sided preparation because they use less weld metal, particularly as the thickness of the connection element(s) being welded increases. The symmetry also results in less rotational distortion strain. However, in thinner connection elements, the savings in weld-metal volume may not offset the additional cost of double edge preparation, weld-root cleaning and repositioning. As a general rule of thumb, double-sided joint preparation is normally less expensive than single-sided preparation above 1-in. thickness.

### Weld Symbols

For guidance on the proper use of weld symbols, refer to Table 8-2. More extensive information on weld symbols may be found in AWS A2.4 *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

### Available Strength

The available strength of a welded joint is determined in accordance with AISC Specification Section J2.4 and Table J2.5. The calculation of the available strength of a longitudinally loaded fillet weld can be simplified from that given in AISC Specification Table J2.5. For a fillet weld less than or equal to 100 times the weld size in length, the available strength,  $\phi R_n$  or  $R_n/\Omega$ , may be calculated as follows:

$$R_n = 0.6F_{EXX} \times \frac{\sqrt{2}}{2} \times \frac{D}{16} \times l$$

$$\phi = 0.75 \qquad \Omega = 2.00$$

where

$l$  = length, in.

$D$  = weld size in sixteenths of an inch

for  $F_{EXX} = 70$  ksi:

LRFD	ASD
$\phi R_n = 1.392DI$	$R_n/\Omega = 0.928DI$

When the fillet weld is not longitudinally loaded, the provisions in AISC Specification Section J2.4a may be used to take advantage of the increased strength due to load angle. The maximum strength increase will be for a transversely loaded fillet weld, which is 50 percent stronger than the same fillet weld longitudinally loaded.

### *Effect of Load Angle*

When designing fillet welds, the increased strength due to loading angle may be accounted for by multiplying the available strength of the weld by the following expression:

$$(1.0 + 0.50\sin^{1.5}\theta)$$

where

$\theta$  = Loading angle

For transversely loaded welds,  $\theta = 90^\circ$ . This accounts for a 50 percent increase in weld strength over a longitudinally loaded weld. However, this increased weld strength is accompanied by a decrease in ductility. For a single line weld, the decreased ductility is inconsequential for most applications. However, for weld groups composed of welds loaded at various angles, this change in ductility means that the designer must consider load-deformation compatibility.

## **CONCENTRICALLY LOADED WELD GROUPS**

The load-deformation curves shown in Figure 8-5 highlight the need for consideration of deformation compatibility, since the transversely loaded weld will fracture before the longitudinally loaded weld obtains its full strength.

A simplified procedure for determining the available strength of concentrically loaded fillet weld groups is presented in Table 8-1. In lieu of using this procedure, it is permitted to sum the capacities of individual weld elements, neglecting load-deformation compatibility, when no increase in strength due to the loading angle is assumed.

## **ECCENTRICALLY LOADED WELD GROUPS**

### **Eccentricity in the Plane of the Faying Surface**

Eccentricity in the plane of the faying surface produces additional shear. The welds must be designed to resist the combined effect of the direct shear,  $P_u$  or  $P_a$ , and the additional shear from the induced moment,  $P_ue$  or  $P_ae$ . Two methods of analysis for this type of eccentricity are the instantaneous center of rotation method and the elastic method.

The instantaneous center of rotation method is more accurate, but generally requires the use of tabulated values or an iterative solution. The elastic method is simplified, but may be excessively conservative because it neglects the ductility of the weld group and the potential for load redistribution.