Saying What You Mean

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Common sense and clear thinking will help you create weld symbols that get you the results you want.

EVERYTHING YOU NEED TO KNOW ABOUT STANDARD SYMBOLS FOR WELDS can be found in the American Welding Society publication *Standard Symbols for Welding, Brazing and Nondestructive Examination* (ANSI/AWS A2.4-98). This standard includes some very detailed weld symbols, because it has to accomodate welding for a wide variety of materials, not just structural steel.

The common symbols used for structural steel and the basic elements of a weld symbol are shown in Table 8-2 of the AISC *Steel Construction Manual*. This table contains most of what you need to properly specify weld symbols for structural steel. However, the table can look like a bowl of alphabet soup and is often misunderstood. But with a working knowledge of the most common types of welds for structural steel, as well as some recommendations from AISC, the floating letters can be rearranged to take on some meaning. (In many cases, an alternative to specifying information in the weld symbol is to specify the required strength of the joint. The issue of when to use a weld symbol and when to use an alternate method will be covered in a future SteelWise article.)

Taking Sides

Weld information below the reference line applies to the side of the joint that the arrow points to (arrow side), while weld information above the reference line applies to the other side of the joint. The "other side" refers to the opposite side of the joint, or a piece in the joint—*not* the other side of the connection. As defined in the AISC *Specification for Structural Steel Buildings*:

Connection: Combination of structural elements and joints used to transmit forces between two or more members.

Joint: Area where two or more ends, surfaces, or edges are attached. Categorized by type of fastener or weld used and method of force transfer.

Figure 1 indicates the arrow side and the other side for several types of joints and includes common misconceptions as well. The joints in each illustration are indicated in red.

TYPically Confusing

The use of the word "typical" or the abbreviation "TYP" is common to save space on drawings. Its use can be very effective—unless it is confusing. This abbreviation can sometimes yield some interesting and unintended results. When using the note, make it clear what the indicated weld is typical for. Write things like "TYP both ends" or "TYP all web stiffeners" to elaborate on what is intended. A few extra words can save many extra dollars. Figure 2 indicates examples of good use of "typical" notes.

Symbology 101

Figure 3 shows the suggested information the structural engineer should include on their drawings, an example of what the shop drawings would indicate, and a sketch of the weld itself for many common types of welds. For help in selecting which type of weld to specify, see AISC *Design Guide 21, Welded Connections—A Primer for Engineers*. Remember, where a symbol is not clear, AWS

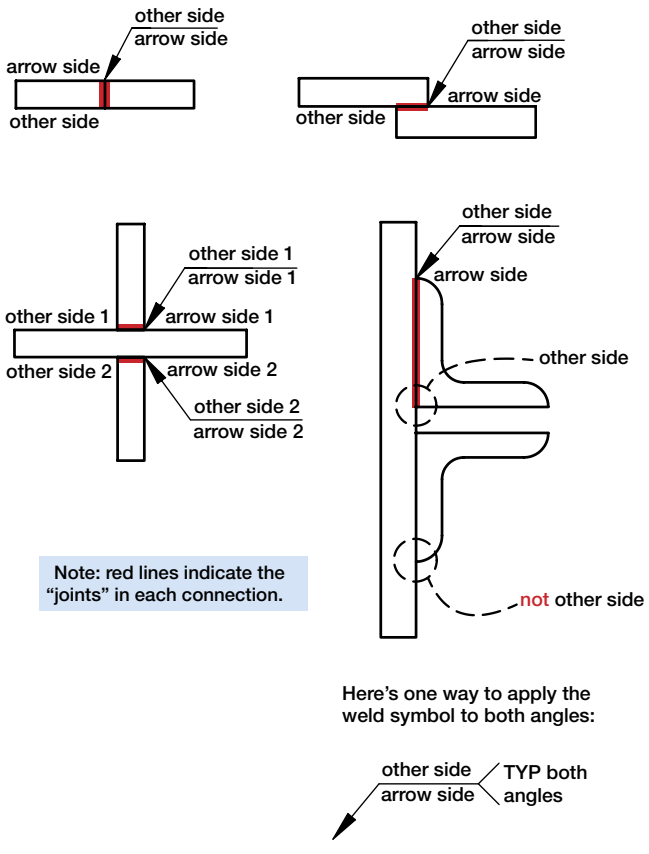


Figure 1. Indicating "sides" in welded joints.

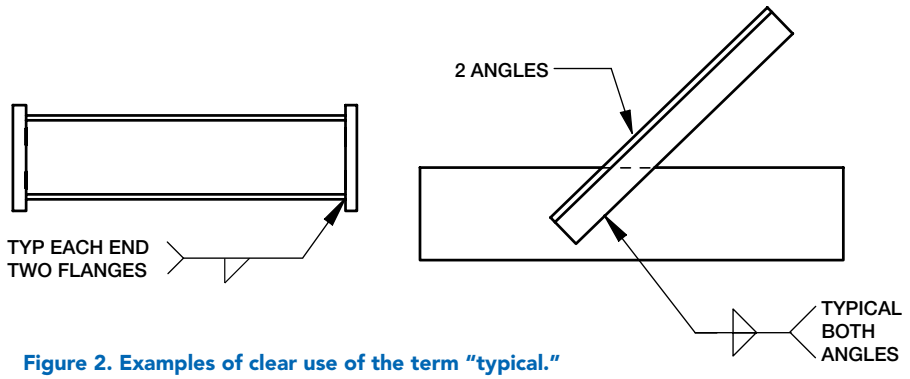


Figure 2. Examples of clear use of the term "typical."

says a sketch of the required weld should be shown. Common weld types include:

Complete joint penetration groove weld (CJP). The engineer need only specify "CJP" in the tail of the weld symbol when such a weld is required, as shown in Figure 3. The contractor can choose whether the weld should be a single- or double-sided weld, as well as whether a V, bevel, U, or another option is appropriate. The detail shown in Figure 3 is just one example of the joint preparation that is allowed for a CJP.

Partial joint penetration groove weld (PJP). The engineer must specify the effective throat *E* and the filler metal strength. Based on the welding process that will be used and other factors, the contractor can determine the required depth of joint preparation *S* that will achieve the required *E* dimension. The contractor can also determine whether the PJP will consist of bevel grooves, V groves, or other preparations. The engineer may want to specify whether the joint should be single- or double-sided. See the *Design Guide 21* for a discussion on single sided PJP welds.

Fillet weld. The engineer can specify the length and size of a fillet weld, and may want to specify if the joint should be single- or double-sided. See the *Design Guide 21* for a discussion on single-sided fillet welds.

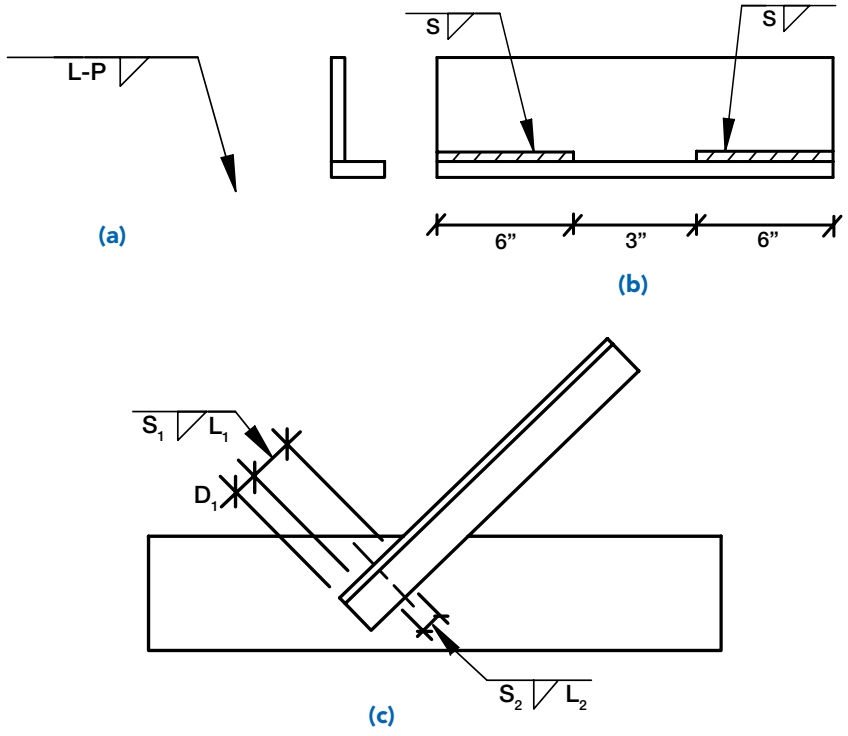


Figure 4. Locating and dimensioning welds.

Note that all fillet welds are assumed to be continuous unless noted otherwise.

Flare bevel groove weld or flare V groove weld. This connection is typically found in cases where rectangular HSS sections are used, but can also apply to round bars. The engineer can specify the effective throat and filler metal strength. Geometry can get complicated in these welds, so there is extra incentive to specify the required strength in this case. The dimensions *S* extend to the tangent point of the radius to the other connected part. *S* would be the radius of a round bar of the outside radius of the wall in an HSS section. (See the illustration in Figure 3.) Therefore, *S* is determined by the geometry of the connected parts and is beyond the control of the engineer and contractor.

Location, Location, Location

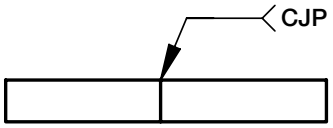
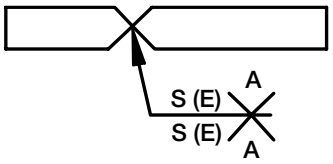
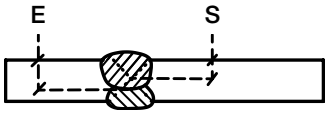
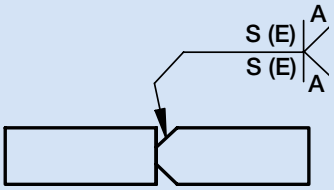
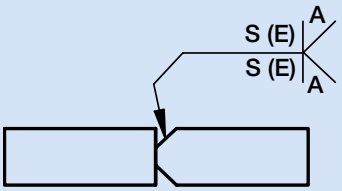
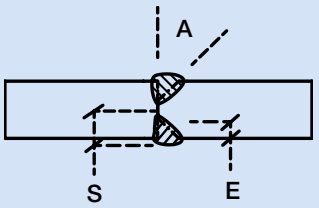
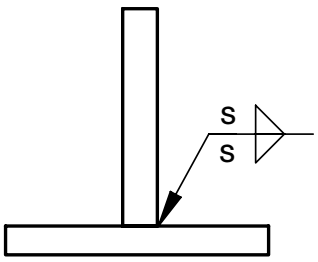
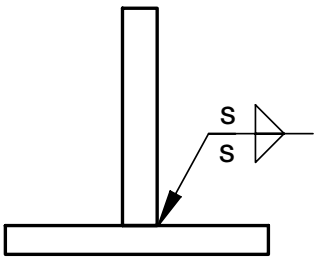
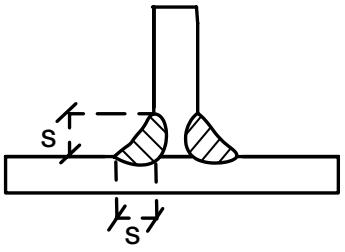
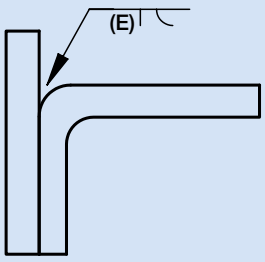
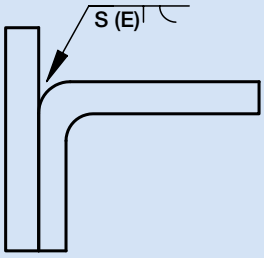
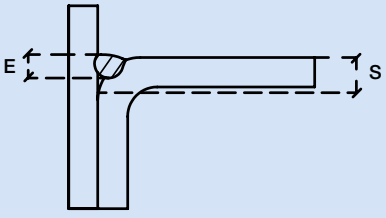
There are several ways to indicate the length, pitch (spacing), and location of welds. The length and pitch can easily be indicated to the right of the basic weld symbol as shown in Figure 4a, where *L* = length and *P* = pitch. This method does not indicate the location of the weld. If the weld needs to be in a certain location, this location can be indicated on a detail as in Figures 4b and 4c. Figure 4b uses hatching and dimensions to indicate where the weld should be located. Figure 4c indicates that the weld should start a distance of D_1 from the end of the angle, but indicates the length in the weld symbol.

Mixed Message

A common notation on design drawings is "E70XX." While most people would accept that note as requiring the use of electrodes classified to a 70 ksi tensile strength, we've heard from a few folks that interpreted it as restricting the process to SMAW because of the format of the electrode designation. Also, there are occasions where the use of 60 or 80 ksi filler metal is desirable, and the E70 notation prevents the use of these electrodes.

AISC Table J2.5 and AWS Table 2.3 tell the user what strength level to use relative to the base metal, and AWS Table 3.1 tells the user what filler metals meet those requirements. An engineer only needs to tell a user what electrode strength to use where the engineer has determined the size of a weld. Otherwise, AISC and AWS direct the contractor to weld with filler metals complying with AWS A5 specifica-

Figure 3. Common Weld Symbols

Weld Type	Structural Drawings Show:	Shop Drawings Show:	Weld Produced:
CJP*	 Geometry is left to the contractor.	 S = preparation depth E = effective throat A = preparation angle	
PJP	 Geometry is left to the contractor.	 S = preparation depth E = effective throat A = preparation angle The break in the weld symbol means the arrow points to the piece to be prepared.	
Fillet**		 S = weld leg	
Flare-Bevel**		 S = distance from outside of HSS to tangent at plate E = effective throat	

* If joint or connection has a required strength defined by the SER, sizes are not necessary on structural drawings.
** See Figure 4 for specifying weld length and location.

tions, as they provide enough guidance to select appropriate fillers for each joint.

Skewed perspective

AWS D1.1 states that T joints under 80 degrees or over 100 degrees are considered skewed T Joints. The details on the bottom of page 8-36 of the AISC *Manual* (or Fig 3.11 of AWS D1.1) are considered prequalified for T joints. If the engineer sizes the weld, AWS D1.1 Section 2.2.4 says the leg size is shown for fillet welds for joints between 80 and 100 degrees. For welds in skewed T joints under 80 degrees or over 100 degrees, the effective throat is shown. AWS D1.1 section 2.4 states, "When the angle between the fusion faces is such that the identification of the weld type and, hence, proper weld symbol is in question, the detail of the desired joint and weld configuration shall be shown on the drawing with all necessary dimensions." Confusion occurs because at some point (angle) the weld for the skewed joint would change from a fillet to groove weld—and what is that angle? Instead of running the risk of being unclear, draw and dimension the joint. See Figure 5 for the suggested method of communicating the requirements. In the figure, D_1, D_2 and D_3 represent leg dimensions.

Technically Perfect

You've looked at all the references and devised the perfect weld symbol to put on your drawings. Now, stop and think about this: Someone has to be able to interpret that symbol in order to create the weld you have in mind.

Chances are that if you had to scratch your head to come up with the "perfect" symbol, someone down the line will be scratching their head trying to figure out what all that "perfect" symbolism means. And maybe that someone will make an assumption rather than asking for clarification. So, take away this last piece of advice: when in doubt, make a sketch of your intent in the tail of the weld symbol arrow. Pictures are harder to misinterpret. MSC

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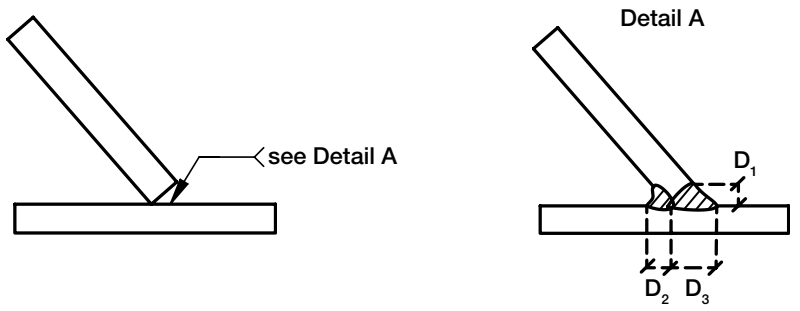

Figure 5. How to clarify a weld for a skewed T joint.