Weld Backing Materials

Alternate Backing Materials for Use in Structural Steel Welds

By Thomas Schlafly

Weld backing is an important component in providing support during the weld process. However, there are certain instances where leaving backing bars in place are not acceptable. To accommodate these occasions, structural engineers should understand the weld process, the need for weld backing, and alternative materials that can facilitate the removal of the backing. The following is a short overview, and includes recommendations for alternative backing materials.

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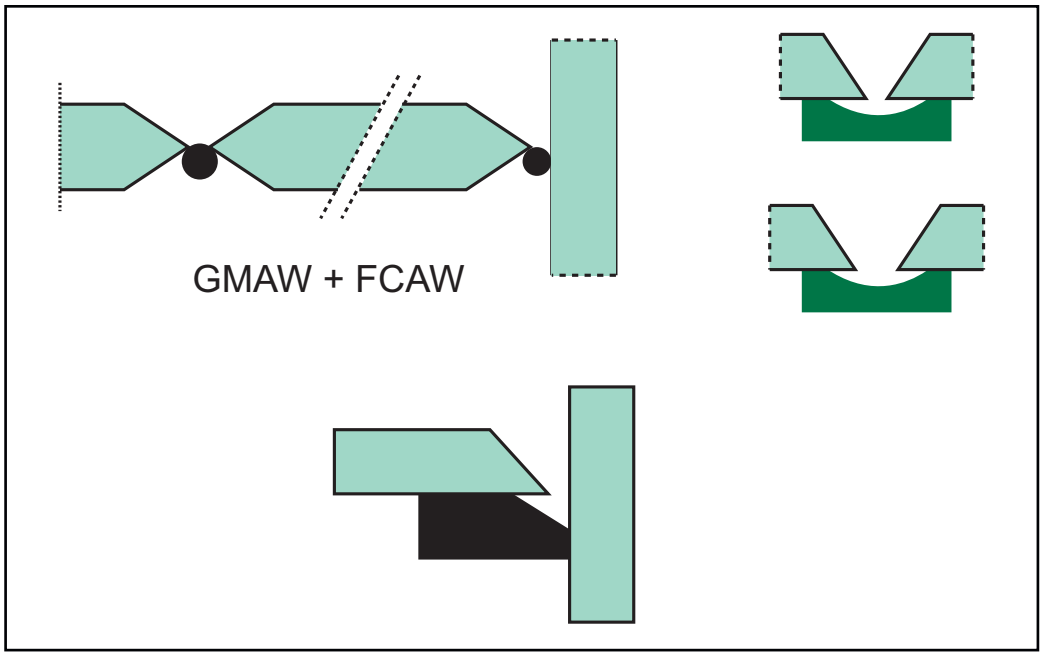
Fillet welds and partial joint penetration welds are made on base metals, and the root is left in the as-welded condition. Complete joint penetration welds are deposited through the full thickness of the base metal. In order to accomplish this, the welder can prepare and weld the joint on part of the thickness and then turn it over and prepare and weld the remainder of the joint from the other side, or he can weld the whole joint from one side. When he welds from one side, the molten root pass usually needs to be supported. The one case the code recognizes the need for the root pass to be deposited without backing or backgouging is in direct welded tubular joints. These provisions are in the code because there is no way to remove the backing that is commonly not permitted to be left in pipe or tubular structures, and in the case of direct welded T, Y and K joints there is no way to install backing. Welding without backing is not prequalified in other joints because it is difficult, requires good fitup and a welder qualified to perform that kind of work.

In non-tubular joints, support of molten weld metal is provided by backing. Backing is usually in the form of a back up bar. In the structural steel industry this bar is usually steel and it is left in place. There are occasions where leaving the backing bar in place is undesirable. An example of where leaving the backing bar in place is not acceptable is the bottom flange joint in seismically loaded beam to column moment connections; the back up bar has to be removed according to AISC *Seismic Provisions* and AWS D1.8. Removal of steel backing is normally accomplished by air carbon arc gouging the bar from the back of the joint and restoring the surface by rewelding. This does provide an opportunity to visually inspect the root to see that the weld metal has fused to both sides of the joint. Since the single sided joint was selected in the first place, it is common that the welded connection cannot be positioned and the backing removal and rewelding is performed 'out of position'. That makes the work slow, tedious and it requires a welder qualified for out of position welding.



Typical joint details using ceramic backing

An alternative to installing and removing steel backing is to use a material that will not fuse to the weld metal. AWS D1.1 permits the use of copper, flux, glass tape, ceramic, iron powder, or similar materials (ref AWS D1.1 sect 5.10). Various products are available and have been used for specific applications for many years.

> *"…code requires that joints using nonferrous backing be qualified by test."*

In the steel pole industry, some longitudinal seam welds are made using submerged arc welding against granular flux supported on a flexible fixture such as a fire hose that is expanded under the joint to place the flux against the back of the joint. The copper shoes used in electroslag welds are considered a form of backing. In a similar fashion, copper can be used under arc welds. Some shipyards and pipe welders use a product consisting of ceramic tiles held in place with an adhesive tape. The tiles are about 1 inch square and ⅜-inch thick and provided on an adhesive strip 18 to 24 inches long. They are available in a variety of shapes; rounds for general use, grooved to produce reinforcement under butt welds or chamfered for fillet type reinforcement on the back side of T joints.

Nonferrous backing has not been common in the structural steel industry for a variety of reasons. Welding against ceramic backing requires training and skills. The welder has to learn to control the arc differently than with steel backing. With steel backing, the weld metal is to fuse to the backing bar so the arc is directed to the front of the puddle. With nonferrous backing, the arc has to stay in the puddle or the electrical continuity will be interrupted and weld quality will suffer. Weld processes produce varying amounts of slag. Slag can be trapped between the weld and the backing, leaving a poor back surface profile. Some weld processes run hotter than others, and materials such as copper can melt in the heat of some hotter processes. That is why the shoes on electroslag welds are water cooled and reusable. The typical joint geometry may need to be changed. Grooves that are too wide generate passes that can be too heavy to support, while those that are too narrow will not fill the reinforcement cavity to leave an acceptable surface. As with other welding consumables, backing should be kept dry to prevent hydrogen pickup in the weld. Weld fixtures like the pole makers use require development, and are not practical for use in typical structural steel applications. Due to the variation that may be required to achieve good welds, the D1.1 code requires that joints using nonferrous backing be qualified by test. When the nonferrous backing is removed, the back side must be inspected and in many cases will require grinding or gouging and rewelding, though less than required to remove steel backing.

Certainly the best solution for the treatment of backing materials is to leave it in place. When that is not possible, the use of nonferrous backing is an alternative that may be worthy of consideration by the contractor.

As a final caution, engineers need to be aware that backing and weld tabs are not the same. Removal of backing is more difficult and expensive than removal of tabs and the reasons to remove them are different. A requirement to remove one will not achieve removal of the other.▪

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