product focus

WELDING DONE WELL

A brief introduction to stud welding.

BY DUKE PERRY

STUD WELDING meets a broad variety of fabrication and construction requirements—and is particularly useful with composite beams and girders in buildings and composite girders in bridges.

Compared to other composite anchorage methods, it can be faster, easier and stronger, and can involve a lower installed cost. But how does it work? Following is a brief description of the process and equipment necessary for a successful stud welding job.

Components

Let's start with stud welding equipment, which is composed of a few key pieces:

1) A power source to generate the welding energy.
2) The weld tool (gun) that is used to automatically strike the welding arc and hold the fastener during the welding process.
3) The stud and the ceramic arc shield (ferrule) themselves.
4) Accessories that are suited to the particular welding application.
5) While none of these components appear complex, like any system they require the proper set-up, use and maintenance to ensure proper welding and maximum job uptime. (For example, cables that run between the power source and the weld tool. The cables can become a critical component if they are undersized or if a user attempts to put too much cable onto a power supply that cannot handle the cable load.)

Duke Perry (dukeperry@imageindustries.com) is a general manager with Bluearc Stud Welding (www.bluearcstudwelding.com).

Shear studs on embedded plates.

Setup

Critical in the stud welding process is equipment setup. In fact, improper setup causes 90% of all issues with successful stud welding.

First, one must have the proper accessories. These are the components for the stud weld gun that accommodate the particular stud being welded. This includes a chuck to hold the stud and legs and feet to hold the ferrule.

Once the proper accessories are selected, there are three critical adjustments that must be made. The first is the lift. Lift is how far the gun "lifts" the weld stud off of the work piece; this is similar to striking an arc with a stick welder. This lift distance controls the arc length of the welding arc, and the arc length correlates directly with the weld voltage and has a direct impact on the amount of weld energy poured into a weld.

The second adjustment is determining the proper plunge depth. The stud will protrude beyond the ferrule a given distance. This distance is referred to as "plunge" and is the distance that the tool will try to plunge the stud into the molten weld puddle.

Third is ferrule alignment. The ferrule must be centered on the stud being welded. Proper centering prevents improper lift and/or improper plunge, which can cause a bad weld.

Shear stud thru deck and typical stud gun.

Process

The stud welding process is similar to the stick welding process in that the electrode is melted using a constant-current power source. However, unlike stick welding, stud welding is automated and does not demand the same level of welding skill.

Here's how it works: The operator loads a stud and a ceramic shield into the welding tool; the ceramic shield serves to contain the molten pool of steel during the welding process. The stud, like the stick, is the electrode in this welding process.

The stick process is a continuous process; therefore, the stick is entirely covered with flux to support this continuous welding process. Stud welding is a single-shot process, so it only contains a single ball of flux loaded by the manufacturer into the weld end of the stud.

The operator places the stud tip against the work piece and presses the gun downward compressing the plunge spring. This moves the stud rearward and the result is that both the stud and the ferrule are flush with the work surface.

The operator then presses the trigger. The power supply then activates the internal mechanism in the gun to create the lifting action initiating an arc. Once the arc is established, the power supply provides the necessary weld current to sufficiently melt the stud and the base material. The power supply maintains this arc for the appropriate duration (typically less than one second) and then plunges the stud into the molten pool of steel created by the arc. The ceramic shield (ferrule) molds the molten pool of steel until the steel cools, and then the ceramic shield is broken and discarded. This automatic process means that the welding of fasteners is extremely fast.

Once the ferrule is discarded, the result is a full cross-sectional weld. Although it is permissible as an alternative to weld shear studs with a fillet weld around the perimeter of the stud, the welding described here is usually more practical.

Fasteners

Because the weld produced by the stud welding process offers high structural integrity, excellent productivity and other benefits, many different styles of fasteners have been designed to tackle different demanding applications. Here are some of the most common:

Shear stud. The shear stud is probably the most commonly used stud in construction by volume. This headed stud is well-known and is widely used in composite beam construction. The headed stud is also commonly used in embed plates for concrete core walls, concrete tilt-up wall construction or in earth retaining wall applications.

Deformed bar anchor. Deformed bar anchors (DBAs) are used to provide anchorage with surrounding concrete. Unlike conventional deformed bar (rebar) DBAs are weldable using the stud weld process. This means anchorage can be welded quickly and reliably into a wide variety of spaces and surfaces.

Threaded studs. Threaded studs also have their place in construction and fabrication and have been used in window retention, drop ceilings, wire way routings and many other applications. ■

Shear stud welding accessories.

A bridge girder with $^7/_8$ shear studs.