Welding to Old Steel

We are designing the rehab of several old buildings. In at least two of them, we have structural steel framing that we want to weld to. One was built in about 1901, the other in 1912.

We are in the agonizingly slow process of getting the CM to contract with a testing firm to test the steel for weldability. The CM is not overly concerned because he says that almost any steel is weldable—it's just a matter of picking the right electrode. Sounds too good to be true. Any comments?

Question sent to AISC's Steel Solutions Center

The contractor's statement may be mostly true, but not always if the material in question is steel rather than wrought iron, which was common in structures constructed in the late 1800s and early 1900s. A paper titled "Field Welding to Existing Steel Structures" by David T. Ricker was published in the *Engineering Journal*, first quarter, 1988. This document is an excellent primer on the subject. A copy of the paper can be accessed at **www.aisc.org/epubs** (a free download for AISC members).

The Ricker paper makes applicable comments on the subject as follows:

- The use of low-hydrogen welding electrodes and preheating can improve the weldability of most base metals.
- If it is suspected that the existing material is wrought iron, welding should be avoided if possible.

Ricker also makes suggestions as to possible investigations, which may give a better idea of the weldability, to consider while you are waiting for the testing to be performed.

- Examine the existing steel work to see if welding was used during the original fabrication and erection, or if the structure has been successfully welded onto previously.
- A simple on-site test can be made by welding a lug of weldable steel to the existing member and beating it with a hammer.

There is probably not a sure answer as to whether the material can be welded to successfully. However, the more information you can gather prior to construction, the less surprise can occur.

2000 and IBC 2003 mandate the use of the AISC *Seismic Provisions* for SDC D or higher.

If the code requires you to use the AISC seismic provisions, then you can either choose OCBF or SCBF based on the *R* value you wish to use in the design. Keep in mind that SCBF are expected to withstand significant inelastic deformations and have increased ductility over OCBF due to lesser strength degradation when compression braces buckle. Unlike OCBF, SCBF contains specific provisions for compression slenderness, percentage limits for tension bracing, and width-thickness ratios for stiffened and unstiffened elements. There are additional detailing requirements as well. We generally recommend SCBF for better seismic performance; however, OCBF has significantly fewer detailing requirements and tension-only bracing may be used. Therefore, it may be preferred for industrial-type frames.

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Composite Filled HSS

I am interested in using concrete filled HSS, but I am concerned about load transfer between the steel and concrete. Specification I2.4 addresses concrete encased columns but is silent on concrete filled HSS. Commentary I2.4 states that bond is commonly used on fixed offshore platforms, but no guidelines are available for other structures.

My application is "other structures," and in my application the load is applied to the HSS. Would shear connectors be required to ensure composite action, or can bond be used on other structures? What would be used for shear connectors on HSS, and what are the design criteria? How is bond stress evaluated?

Question sent to AISC's Steel Solutions Center

Based on the section reference stated, it is obvious that you are referring to the 1999 LRFD specification. Section I2.2 of the 2005 AISC *Specification for Structural Steel Buildings* does cover the design of filled composite columns. If you can use it instead, you will be able to take advantage of the latest information available, which includes the information you seek.

Load transfer between the steel and concrete is covered in Section I2.2e of the 2005 specification. Therein, it is stated that "transfer of force from the steel section to the concrete core is required from direct bond interaction, shear connection, or direct bearing. The force transfer mechanism providing the largest nominal strength may be used. These force transfer mechanisms shall not be superimposed."

It probably would not be feasible to get shear connectors on the inside of an HSS; at least at any distance from the end of the member. Therefore, you will probably have to depend on the bond transfer mechanism for filled composite HSS section. The commentary to Section I2.2e of the *Specification*