If you've ever asked yourself "Why?" about something related to structural steel design or construction, *Modern Steel*'s monthly Steel Interchange is for you! Send your questions or comments to **solutions@aisc.org**.

steel interchange

Note: All AISC publications referenced in the questions and/or answers are the current edition (unless specifically noted otherwise) and can be found at ***www.aisc.org/specifications****.*

Weld All Around?

The current details on a project show an all-around fillet weld symbol at wide-flange-column-to-base-plate connections. A December 2006 Steel Interchange item indicated that this is not a good practice. Is the guidance provided in 2006 still applicable?

Yes. As stated in that article (which can be found in the Archives section of **www.modernsteel.com**): "We recommend welding on the flat surfaces only. The small amount of weld across the toes of the flanges and in the areas of the fillet radii add very little strength and are very costly. Yet welding around the corners and across the toes of the flanges is difficult and may result in rapid melting at the corners and a resulting gouge during welding. The repair implications outweigh any benefits of welding all around. Further discussion of the subject can be found on page 4 of AISC Design Guide 1: *Base Plate and Anchor Rod Design*." (You can access Design Guide 1 at **www.aisc.org/dg**.)

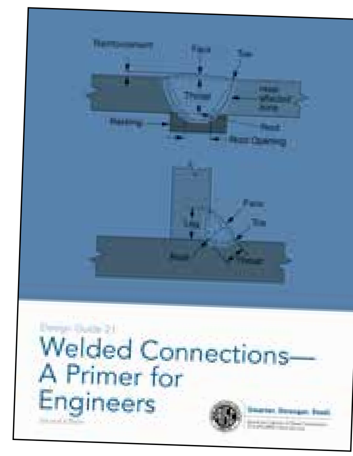
Larry S. Muir, PE

Specifying Weld Metal

I am a structural engineer. My company's standard specification requires the use of AWS A5.1 or A5.5. I have received a request from the fabricator to allow AWS A5.20. Should I permit this request?

We cannot arbitrate or make engineering decisions. Ultimately, you must use your own engineering judgment, knowledge and experience to decide what is appropriate for your project. However, I will provide some information that may help you make an informed decision.

AWS A5.1, A5.5 and A5.20 are all approved for use in Section A3.5 of the *Specification*. The commentary to this section states: "Engineers do not, in general, specify the exact filler metal to be employed on a particular structure. Rather, the decision as to which welding process and which filler metal is to be utilized is usually left with the fabricator or erector. Codes restrict the usage of certain filler materials or impose qualification testing to prove the suitability of the specific electrode, so as to make certain that the proper filler metals are used." Note too that Clause 3.3 in AWS D1.1 addresses base metal/filler metal combinations and may help you decide if the substitution is acceptable.



AISC Design Guide 21: *Welded Connections—A Primer for Engineers* (a free download for members at **www.aisc.org/dg**) provides a good discussion of the various consumables allowed by AWS. (Design Guide 21, which was recently updated, also happens to be the focus of this month's SteelWise on page 17.) The main differences between these are the welding processes that adhere to these specifications. AWS A5.1 and A5.5 electrodes are used in the shield metal arc welding (SMAW) process, whereas A5.20 is used in the flux cored arc welding (FCAW) process. SMAW is not widely used for the primary shop fabrication or field erection of buildings due to its lower productivity. However, it is easier to use due to the portability of the equipment. FCAW is semi-automatic and has economic advantages. By specifying the consumable, you are also restricting the welding process that can be used, which is unusual and likely unnecessary and could increase fabrication costs.

Jonathan Tavarez

Filling of Weld Access and Erection Holes

Is there a requirement in the AISC *Code of Standard Practice for Steel Buildings and Bridges* (ANSI/AISC 303) or the AISC *Specification for Structural Steel Buildings* (ANSI/AISC 360) to fill weld access and erection holes in steel that is visible in public areas, even when the steel has not been designated as architecturally exposed structural steel (AESS)?

No. Unless there are project-specific requirements to do so, filling open holes is only required for steel designated as AESS Category 4. (For more on the various AESS categories, see "Maximum Exposure" in the November 2017 issue, available at **www.modernsteel.com**.)

The *Code* addresses AESS separately in Section 10. AESS 4 is defined as "showcase elements with special surface and edge treatment beyond fabrication." The commentary states: "Showcase elements in AESS 4 are those for which the designer intends that the form is the only feature showing in an element. All welds are ground and filled, edges are ground square and true. All surfaces are filled and sanded to a smoothness that doesn't catch on a cloth or glove. Tolerances of fabricated forms are more stringent—generally half of standard tolerance. AESS 4 involves the use of a mock-up and acceptance is based upon the approved conditions of the mock-up." The requirement is in Section 10.6– Erection of the *Code* states: "The erector shall plan and execute all operations in such a manner that allows the architectural appearance of the structure to be maintained… (g) For Category AESS 4, open holes shall be filled with weld metal or body filler and smoothed by grinding or filling to the standards applicable to the shop fabrication of the materials."

It should also be noted that weld access holes often serve a structural purpose beyond simply providing access for welding, and therefore any potential filling of weld access holes should be "nonstructural" (body filler, not weld metal) and should be coordinated with the engineer of record (EOR).

Larry S. Muir, PE

Beam End Reactions Based on Uniform Design Loads

The AISC *Steel Construction Manual* states: "The full force envelope should be given for each simple shear connection. Because of the potential for overestimation and underestimation inherent in approximate methods, actual beam end reactions should be indicated on the design drawings. The most effective method to communicate this information is to place a numeric value at each end of each span in the framing plans. In the past, beam end reactions were sometimes specified as a percentage of the uniform load tabulated in Part 3. This practice can result in either over- or under-specification of connection reactions and should not be used. The inappropriateness of this practice is illustrated…" Does this prohibit specifying beam end reactions as a percentage of the uniform load tabulated in Part 3?

No. The *Manual* provides guidance, not requirements. The *Code* requires "the owner's designated representative for design" to provide "data concerning the loads, including shears, moments, axial forces and transfer forces that are to be resisted by the individual members and their connections, sufficient to allow the selection, completion or design of the connection details while preparing the approval documents." This does not require the engineer to provide actual, economical or even appropriate loads. It requires only that the information be "sufficient to allow the selection, completion or design of the connection details."

The language in the *Manual* reflects the consensus of the AISC Committee on Manuals. AISC has long held and expressed the idea that specifying actual loads is the best means of ensuring a safe and economical structure. The Committee feels it is inappropriate to provide loads as a percentage of the tabulated uniform load. This does not mean it is prohibited—e.g., one may encounter inappropriate behavior in life, but such behavior often doesn't rise to the level of being a crime. Therefore, it is not always prohibited, though it may be discouraged and is generally frowned upon. Engineers are likewise given the latitude to make choices that may be less than appropriate; such choices should be frowned upon and discouraged by those of us who know better.

One of the historical reasons for specifying reactions as a percentage of the tabulated uniform load was that it was simpler than providing the actual loads. However, today most structural design is done using analysis and design software. Many of these programs will generate at least some loading information automatically. In many cases, the reported loads can even be factored up somewhat to account for potential increases in loads as the use of the structure evolves.

Larry S. Muir, PE

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STEEL SOLUTIONS CENTER

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The complete collection of Steel Interchange questions and answers is available online at **www.modernsteel.com**.