If you've ever asked yourself "why" about something related to structural steel design or construction, *Modern Steel Construction's* monthly *Steel Interchange* column is for you!

This month's *Steel Interchange* is compiled from a few of the many frequently asked questions (FAQs) posted at www.aisc.org/faq. Numerical references such as "2.2.6" are references to FAQs in this feature of the AISC web site.

Roughness Limitations

2.2.6. What are the appropriate roughness limitations for thermally cut edges?

Inadvertent notches or gouges of varying magnitude might occur in thermally cut edges, depending upon the cleanliness of the material surface, the adjustment and manipulation of the cutting head, and other factors. When thermally cut edges are prepared for the deposition of weld metal, the 1999 AISC *LRFD Specification* Section M2.2 and AWS D1.1-2002 Section 5.15.1.1 provide acceptance criteria that consider the effect of discontinuities that are generally parallel to the applied stress on the soundness of welded joints. Additionally, correction methods for defects of various magnitudes are stipulated. When thermally cut edges are to remain unwelded, the following surface-condition guidelines are recommended:

1. If subjected to a calculated tensile stress parallel to the edge, edges should, in general, have a surface-roughness value not greater than 1,000 as defined in ASME B46.1.
2. Mechanically guided thermally cut edges not subjected to a calculated tensile stress should have a surface roughness value not greater than 2,000 as defined in ASME B46.1.
3. Hand-guided thermally cut edges not subjected to a calculated tensile stress should have a roughness not greater than 1/16".
4. All thermally cut edges should be free of notches[1] and reasonably free of gouges[2]. Occasional gouges not more than 3/16" deep are permitted.

Gouges greater than 3/16" deep and all notches should be repaired as indicated in 2.2.7.

[1]defined as a V-shaped indentation or hollow

[2]defined as a groove or cavity having a curved shape

Repairing Rough Edges

2.2.7. When surface roughness for thermally cut edged does not meet the limitations in 2.2.6, how is the surface repaired?

Roughness exceeding the criteria in 2.2.6 and notches not more than 3/16" deep should be removed by machining, or grinding and fairing-in at a slope not to exceed 1:2½. The repair of notches or gouges greater than 3/16" deep by welding should be permitted. The following criteria are recommended:

1. Low-hydrogen electrodes not exceeding 5/32" diameter should be used.
2. Other applicable welding requirements of AWS D1.1 should be observed.
3. The repair should be made flush with the adjacent surface with good workmanship.
4. The repair should be inspected to assure soundness.

The discontinuity should be suitably prepared for good welding.

Tolerances

3.5.1. How are tolerances determined if they are not addressed in the applicable standards?

The fabrication and erection tolerances in the AISC *LRFD Specification*, the AISC *Code of Standard Practice*, AWS D1.1, and other existing specifications and codes have evolved over nearly three-quarters of a century. Although these standards generally present a workable format for the fabricator and erector, they tend to address individual members, rather than the role of individual members in the completed structure.

Tolerances for assemblies, such as those on shop-assembled bents, frames, platforms, pairs of girders, etc., are not covered by any code or standard. AWS D1.1-2002 Section 5.23.11.4 states that "... other dimensional tolerances of members not covered by [Section] 5.23 shall be individually determined and mutually agreed upon by the Contractor and the owner with proper regard for erection requirements." This practice is recommended in all cases. The agreed-upon tolerances should account for the erection tolerances specified in the AISC *Code of Standard Practice*.

Odd-Sized Holes

5.1.1. Maximum hole sizes for bolts are specified in the 1999 *LRFD Specification* Table J3.3. What if an actual hole dimension is between two of the values?

AISC *Specification* Table J3.3 is based upon the 2000 *RCSC Specification* Table 3.1 and contains the maximum dimensions of standard, oversized, short-slotted, and long-slotted holes. If an actual dimension exceeds the tabulated maximum, it must be treated as the next larger hole size. For example, a 13/16"-by-1 1/4" slotted hole for a 3/4"-diameter bolt must be treated as a long-slotted hole because it exceeds the maximum short-slotted hole size (13/16" by 1"). Note that the 2000 *RCSC Specification* Section 3(c) allows a 1/32" tolerance on these maximum hole sizes as discussed in 2.4.2 and 2.5.5.

Paint on Faying Surfaces

6.7.1. When is paint permitted on the faying surfaces of bolted connections?

In snug-tight and pretensioned bearing connections, paint is permitted unconditionally on the faying surfaces. In slip-critical connections, however, if paint is present, it must be a qualified paint. A qualified paint is one that has been tested in accordance with the 2000 *RCSC Specification* Appendix A and offers a defined slip-coefficient. Other paints that do not offer a defined slip-coefficient are not permitted on the faying surfaces of slip-critical connections, even when due to inadvertent over-spray.

Paint Under Nuts and Bolt Heads

6.7.2. Both the AISC and RCSC specifications require that paint on the faying surfaces of slip-critical connections be qualified (providing a minimum slip coefficient) or that such surfaces remain unpainted. Does this requirement apply to the surfaces under the bolt head and nut?

No. In a slip-critical connection, the faying surfaces are those that resist relative movement (or slip) of the plies. This occurs on the contact surfaces between the plies, not those surfaces under the bolt head or nut.

Fillet Weld Size Limitations

8.3.6. Why is a fillet-weld size generally limited to 1/16" less than the material thickness when placed along the edge of a connected part?

As explained in the 1999 AISC *LRFD Specification* Commentary Section J2.2b, "For plates of ¼" (6 mm) or more in thickness, it is necessary that the inspector be able to identify the edge of the plate to position the weld gage." Note that this requirement is qualified in AISC *LRFD Specification* Section J2.2b: the weld toe is permitted to be less than 1/16" away from the edge of the base metal, provided the weld size is clearly verifiable. Additionally, the weld size can match the thickness of the plate edge for plates that are less than ¼" thick.

Weld Symbols

8.3.7. Is the weld-all-around symbol acceptable when a fillet weld must be continued out-of-plane?

No. Use of the weld-all-around symbol at conditions that would require the weld to be continued out-of-plane calls for a condition that is specifically prohibited in the 1999 AISC *LRFD Specification* Section J2.2b and AWS D1.1:2002 Section 2.8.3.5. Instead, when an out-of-plane transition occurs, the welds must be interrupted at the corner common to both welds.

When to Paint

10.1.1. When must structural steel be painted?

As stated in the 1999 AISC *LRFD Specification* Section M3.1, "Shop paint is not required unless specified by the contract documents." Therefore, fabricated structural steel is left unpainted unless painting requirements are outlined in the contract documents.

In building structures, steel need not be primed or painted if it will be enclosed by building finish, coated with a contact-type fireproofing, or in contact with concrete. When enclosed, the steel is trapped in a controlled environment and the products required for corrosion are quickly exhausted. As indicated in the 1999 AISC *LRFD Specification* Commentary Section M3, "The surface condition of steel framing disclosed by the demolition of long-standing buildings has been found to be unchanged from the time of its erection, except at isolated spots where leakage may have occurred. Even in the presence of leakage, the shop [primer] coat is of minor influence (Bigos, Smith, Ball, and Foehl, 1954)[1]." A similar situation exists when steel is fireproofed or in contact with concrete; in fact, paint is best omitted when steel is to be fireproofed because primer decreases its adhesion.

In exterior exposed applications, steel must be protected from corrosion by painting or other means. Likewise, steel must be protected from corrosion in special applications such as the corrosive environment of a paper-processing plant or a structure with oceanfront exposure.

[1]Bigos, J., G.W. Smith, E.F. Ball, and P.J. Foehl, 1954, "Shop Paint and Painting Practice," *Proceedings of the 1954 AISC National Engineering Conference*, AISC, Chicago, IL.

Selecting Paint Systems

10.1.2. When a paint system is required, how should it be selected?

When paint is required, SSPC emphasizes the importance of the development of a total paint system. Among the primary considerations for this design decision by the owner, architect, or engineer are:

1. The end use of the member.
2. A realistic estimate of time and severity of exposure of each coat of paint.
3. An economic evaluation of the initial cost as compared to future maintenance cost.
4. A practical determination of the division between shop and field work and responsibilities.

Steel Interchange is a forum for *Modern Steel Construction* readers to exchange useful and practical professional ideas and information on all phases of steel building and bridge construction. Opinions and suggestions are welcome on any subject covered in this magazine.

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If you have a question or problem that your fellow readers might help you to solve, please forward it to us. At the same time, feel free to respond to any of the questions that you have read here. Contact *Steel Interchange* via AISC's Steel Solutions Center:

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