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! Send your questions or comments to solutions@aisc.org.

HSS Steel Availability

What yield strengths are typically available for HSS2×2×¼ and HSS3×3×¼?

HSS is generally supplied to the fabricator through a local service center from an inventory of common sizes. The two sizes you list are quite common and most likely available in your region. For additional information please try the Steel Availability link at www.aisc.org/availability, a handy resource to find manufacturers of various shapes commonly used in structural steel applications. Generally speaking, sizes with multiple manufacturers are carried by steel service centers. Should you require more information on availability, use the "Contact Information for Steel Service Centers" to find a contact in your area.

Kurt Gustafson, S.E., P.E.

Installation Torque

What is the normal torque for ASTM A325 and A490 bolts used in non-slip-critical connections?

There are three types of joints: snug-tightened, pretensioned, and slip-critical. There is no "normal torque" defined for any of these cases. Rather, it is the level of installed pretension that matters.

In the first case—snug-tightened—the installation requirements are only that the connection be brought into firm contact with the full effort of an ironworker using an ordinary spud wrench. Where snug-tightened installation is permitted, the actual level of pretension that results does not matter.

In the second case—pretensioned—the AISC and RCSC *Specifications* define a required pretension that must be installed in the bolts, rather than a torque. There is no recognized uncalibrated torque/tension relationship for bolt installations, as this can be quite variable dependent on the condition of the bolts. That is why pretensioned bolt installations must be performed using one of the four permitted methods: turn-of-nut pretensioning, calibrated wrench pretensioning, TC bolt pretensioning, or DTI washer pretensioning. All of these methods require a preinstallation verification process. The calibrated wrench method is torque-based, but must be explicitly calibrated in order to define the torque-tension relationships for the particular application. See the RCSC *Specification* (a free download at www.boltcouncil.org) for details.

In the third case—slip-critical—installation is performed the same way as for pretensioned joints. The only differences are in the additional requirements, such as for design and faying surface preparation.

Kurt Gustafson, S.E., P.E.

Axial Strength of Channels

The AISC *Manual* tables for columns do not include channels. How does one determine the axial strength of such shapes?

The axial strength of channels with webs that are not slender can be computed using the AISC *Specification*, Chapter E. Specifically, consider flexural buckling per Section E3 and flexural-torsional buckling per Section E4 (Equation E4-5). If the web is slender for compression (see Table B4.1, Case 14), see Section E7.

Brad Davis, Ph.D., S.E.

Thermal Cutting

If an oxy-acetylene torch is used to flame cut the edge of a new steel beam or plate, what impact does that have on the steel? Is the strength of the steel affected? Is the edge distance or bolt hole spacing affected by this process?

Flame cutting is a common practice in steel fabrication and erection, and the effects of this heat input are not significant in statically loaded structures. In cyclically loaded structures, there are cases when the AISC *Specification* requires that flame-cut surfaces must be ground smooth. Note that the surface finish of thermally cut surfaces, and particularly bolt holes, must comply with the requirements of Sections M2.2 and M2.5 of the 2005 AISC *Specification* [available for free at www.aisc.org/2005spec] for the above to be true.

Amanuel Gebremeskel, P.E.

Mill Cut or Square Cut?

What is the difference between mill cut and square cut?

The term mill cut generally implies that compressive loads will be transferred in bearing between the parts. Since this is rarely required for beams, the more general term square cut is used.

The Commentary to Section J7 of the AISC *Specification* states, "As used throughout the *Specification*, the terms "milled surface," "milled" and "milling" are intended to include surfaces that have been accurately sawed or finished to a true plane by any suitable means."

Kurt Gustafson, S.E., P.E.

Puddle Welds

We have a project where we have asked the structural engineer of record to change a ⅝-in. puddle welded connection to a connection using powder-driven fasteners. He has indicated it is acceptable to use powder-driven fasteners as long as they meet or exceed the uplift resistance of the assembly when using welds. Can such fasteners provide the uplift resistance of a ⅝-in. puddle weld?

I presume that you are referring to puddle welds (arc spot welds) on sheet steel products. This subject is not covered in the AISC *Specification*, but you can find the method to calculate the uplift capacity of puddle welds in AWS D1.3, S*tructural Welding Code—Sheet Steel*. This capacity will be based on the thickness and specified tensile strength of the sheet steel, and the resultant average diameter of the arc spot weld. With that information, the powder-driven fastener product manufacturer should be able to advise you which of their products will provide for the needed strength.

Kurt Gustafson, S.E., P.E.

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Anchor Rods

For base plate anchor rod design, why is ASTM F1554 the preferred specification? Is ASTM A449 suitable? What is the reference for torque values of base plate anchor rods?

Both ASTM F1554 and ASTM A449 are permitted for use as anchor rods in the AISC *Specification*. ASTM F1554 is preferred because it is an anchor-rod product specification. ASTM A449, like all the other common grades that have been used for anchor rods, is a material specification only with no specific requirements given for when it is used as in an anchor rod application.

Table 2-5 in the 13th edition AISC *Steel Construction Manual* shows ASTM F1554 Grade 36 as the usual grade for the general case. If you are specifically going to use a high-strength anchor rod, ASTM F1554 remains the preferred type, and has two options: Grades 55 and 105.

Regarding torque, we have two comments. First, torque is not useful in installation of fasteners in buildings, unless it is calibrated. Rather, it is the level of pretension that we specify. Second, pretensioning of anchor rods is not a requirement in the AISC *Specification*, and it is not required in usual applications. If there is a case in which pretensioned anchor rods are required, the effects of creep in the concrete and bond relaxation along the length of the rods would have to be addressed. You also will need to specify a pretensioning method, as the bolt pretensioning methods we have are for short fasteners, not long rods.

Amanuel Gebremeskel, P.E.

Increase Fillet Weld Size for Gap?

On braced-frame connections we specify a weld size from a slotted HSS to a gusset plate. The HSS are generally slotted about ⅛ in. larger than the thickness of the gusset plate, so theoretically $1/16$ in. of weld is lost on each side. Do I need to show the increased weld size on the design drawings?

Clause 5.22 of AWS D1.1 requires the welder to increase the leg size by the gap dimension when the gap is greater than $1/16$ in. up to a maximum allowed gap of $3/16$ in. (with some exceptions on the maximum gap).

You should not increase the weld size shown on your design documents, since this will result in the weld size being increased twice. It is good practice, however, in obvious cases such as the slotted HSS connection you describe, to include a note in the tail of the weld symbol that states that the welder is to increase weld size to account for the gap. This precaution should be unnecessary, since as I stated it is covered in AWS, but it always made me feel better to include it.

Larry S. Muir, P.E.

Delayed Steel Erection

A delivery on a job has been delayed by eight months. Because the steel is to be fireproofed, it is not painted and has rusted. The owner has expressed concerns about the steel and the effects of the rust. Would this affect the steel as far as strength?

If there is a loss of section caused by rusting, the strength of the member could be compromised. However, except for extremely corrosive environments, deterioration due to rusting is a very long-term process, and I would be surprised if this is a factor for an eight-month exposure.

The effect of the rust on the bonding of the fireproofing might be more of a consideration. FAQ 11.1.1 on the website at www.aisc.org/faq addresses the subject of surface preparation for application of fireproofing. If the rust bloom is tightly adherent, it may not affect the adhesion. I suggest that you should check with the fireproofing applicator to review the conditions for suitability of their product application.

Kurt Gustafson, S.E., P.E.

Prequalified Weld Details

In Table 8-2, the prequalified weld for a single-bevel corner joint groove weld(4), on pages 8-43 and 8-44 of the 13th edition AISC *Steel Construction Manual*, one diagram shows the bevel in the horizontal plate and no bevel in the vertical plate. Wouldn't this be a problem of lamellar tearing? If not, why isn't it? Are there some load conditions in which this geometry would be acceptable?

The figures on the right in both the TC-U4a and the TC-U4b show the bevel on the part that is perpendicular to the 'face' of the weld. This is the preferred detail to reduce the potential for lamellar tearing. That being said, the details on the left are not prohibited. They will work in many cases and are useful in many applications.

A brief discussion of lamellar tearing is in the commentary to Clause 2 of the AWS D1.1 *Code*. AISC alumnus Bill Milek wrote this information, and did a good job of listing variables that affect potential for lamellar tearing. The figures on the right are the first choice, but not the only choice.

Tom Schlafly

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Steel Interchange is a forum 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.

If you have a question or problem that your fellow readers might help you 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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