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steel interchange

Weld Designation

What do the "U" and "a" indicate in the prequalified weld type B-U4a?

The U indicates that the weld can be used with material of unlimited thickness, as opposed to an L, which would indicate that the weld is only appropriate within a range of thicknesses. AWS D1.1 states: "The lower case letters—e.g., a, b, c, etc.—are used to differentiate between joints that would otherwise have the same joint designation." In this case there are two prequalified butt welds (B) using a single-bevel groove (4) with no limitation on thickness (U) listed in AWS D1.1. One of the listed welds uses backing (a) and the other does not (b). The "a" in your designation, "B-U4a", indicates that backing is used.

Larry S. Muir, P.E.

Mixed Hole Sizes in Slip-Critical Connections

We have designed slip-critical connections with standard holes. When the structure was erected, a few of the bolts could not be installed due to mislocated holes. Can we make the mislocated holes oversized and leave the others as standard holes? Does the strength of the connection need to be reduced due to the oversized holes?

There is nothing in the RCSC or AISC *Specifications* that discusses the mixing of standard and oversized holes in a slip-critical connection, so you will have to rely on your own judgment. I will provide some comments that might assist you in this process.

It is not uncommon to see slip-critical connections with oversized holes that contain a couple of standard holes to help maintain the intended geometry during erection, so the mixing of hole types is relatively common. In such cases, the entire group is designed using oversized holes, while also incorporating a couple of standard holes; this leads to a more conservative design strength. Your situation is also not uncommon, since things do not always fit the way we would like in the field. Some engineers would tend to design the entire group using the values for oversized holes, although this is likely not necessary. Though the strength provided in the *Specification* is less for connections with oversized holes, there is no loss of pretension or slip resistance due to the oversized holes. The lower nominal load is due to a higher factor of safety (reliability) to account for the consequences of slip. This is discussed in the Commentary to Section J3.8.

Since most of the holes in your connection are standard holes, the amount of slip that could occur prior to the bolts going into bearing would likely be small, and the higher factor of safety against slip likely is not warranted.

Carlo Lini, P.E.

DTIs Used For Preinstallation Verification

Can tension indicator washers be used in lieu of a Skidmore Wilhelm tension calibrator to perform pre-installation verification?

The answer to your question is yes, unless you are tensioning the bolts using turn-of-nut installation. This is covered in the commentary to Section 7.1 in the 2009 RCSC *Specification* (a free download at **www.boltcouncil.org**), which states:

Direct tension indicators (DTIs) may be used as tension calibrators, except in the case of turn-of-nut installation. This method is especially useful for, but not restricted to, bolts that are too short to fit into a hydraulic tension calibrator. The DTIs to be used for verification testing must first have the average gap determined for the specific level of pretension required by Table 7.1, measured to the nearest 0.001 in. This is termed the "calibrated gap." Such measurements should be made for each lot of DTIs being used for verification testing, termed the "verification lot"…This technique cannot be used for the turn-of-nut method because the deformation of the DTI consumes a portion of the turns provided. For turn-of-nut pre-installation verification of bolts too short to fit into a hydraulic calibration device, installing the fastener assembly in a solid plate with the proper size hole and applying the required turns is adequate. No verification is required for achieved pretension to meet Table 7.1.

Carlo Lini, P.E.

Square-Cut Sloping Beams

There are large wide-flange beams that slope with the roof pitch of ¼ in. per foot. In some instances they connect to girders and in other instances they connect to HSS columns. Can the beams be cut square leaving a varying distance from the end of the beam to the face of the support?

Especially for heavy shapes, cutting the member square is easier than making a bevel cut. The decision on whether to bevel-cut the beam or to bevel the connection material is usually based on economics. As the bevel increases, the eccentricity on the connection increases, potentially adding to the connection cost and overriding any benefit of square-cutting the beam. In your case, the bevel adds only about ¾ in. to the usual setback; therefore, standard shear end connections likely can be used for the strength calculations. In this case, square-cutting the beam will be preferred by most fabricators, and this is acceptable from an engineering standpoint.

Bo Dowswell, P.E., Ph.D.

Special Inspection Waivers for Erectors

We are an erector. Once AISC Certified, do we become self-inspecting as erectors?

The decision to waive third-party inspection, or Special Inspection, is the responsibility of the building official (authority having jurisdiction). As an erector, you are always responsible for the QC inspections outlined in Chapter N of the AISC *Specification*. The waiver of Special Inspection at the fabrication shop has become commonplace over the years, while the concept of waiver of Special Inspection at the job site is quite new (2010).

The bottom line is that Special Inspection will be required unless the building official decides otherwise. The IBC does provide the mechanism that the Building Official can use to waive Special Inspection for an approved contractor in Chapter 17, Section 1704.2.5.2.

Keith Landwehr

Special Inspections and Small Projects

The 2012 IBC has recently been adopted by our local government, and inspections in accordance with Chapter N of the AISC *Specification* are now required. I am currently working on a small renovation project that did not even require the design of a lateral force resisting system. The inspections required by Chapter N seem excessive for this small project. Must all of these inspections always be performed?

IBC generally requires special inspections through reference to AISC Chapter N. However, there are at least a couple of provisions that would allow the authority having jurisdiction to waive the requirements. Waivers are often granted for approved contractors in accordance with IBC Chapter 17, Section 1704.2.5.2 (AISC Certified contractors, for example). There are also provisions in IBC that do not require special inspections for "work of a minor nature." Chapter N states that the QA shall be performed "when required by the authority having jurisdiction (AHJ), applicable building code (ABC), purchaser, owner, or engineer of record (EOR)." It does not independently mandate inspections.

Larry S. Muir, P.E.

Comparing AISC 360 Chapter J and Appendix 3 Requirements

I have four rods, threaded on one end, supporting a stair platform. The unthreaded end of the rod is welded to the upper support and the other end passes through an HSS, and a nut is installed. The AISC *Specification* seems to provide conflicting requirements related to the design of these rods. Table J3.2 provides a nominal tensile strength of $0.75F_u$. However, Tables A-3.1 of Appendix 3 states that the threshold stress is limited to 7 ksi. Appendix 3 also bases the stress calculation on net tensile area while Chapter J neglects the reduction in area due to the threads. When I design the rods for my 5.3-kip load using these provisions of Chapter J and Appendix 3, I get very different results. It seems that Appendix 3 would always govern, so why must the Chapter J checks be performed?

First, both Chapter J and Appendix 3 account for the reduction in area due to the threads. However, they take different approaches. Equation J3-1 refers to Table J3.2 for the nominal tensile strength. Table J3.2 provides a nominal strength of $0.75F_u$. The 0.75 coefficient accounts for the reduction in area due to the threads. This is explained in the Commentary, which states: "The factor of 0.75 included in this equation accounts for the approximate ratio of the effective tension area of the threaded portion of the bolt to the area of the shank of the bolt for common sizes."

Table J3.2 also states that the threaded rods shall conform to Section A3.5, which states: "Threads on anchor rods and threaded rods shall conform to the Unified Standard Series of ASME B18.2.6 and shall have Class 2A tolerances." When used with the designated threads and the applicable safety factors, the 0.75 assumption provides an adequate estimate of the net tensile area, though the actual ratio of net tension area to nominal area will vary somewhat with diameter. Appendix 3 uses a more precise calculation of the net tension area.

It also has to be recognized that Chapter J and Appendix 3 are quite different requirements and apply to different conditions. The strength calculated using Chapter J should be compared to the total load on the hanger. The strength calculated using Appendix 3 only applies to the portion of the load causing fatigue. So, first you must determine if fatigue must be considered for your condition. If it must, then the net tensile stress area should be calculated as shown in Equation A-3-9. However, the 7 ksi is not compared to the total load, but rather only to the stress range. For example, the dead load of stair platform will contribute to the total load but will not contribute to the stress range. Only cyclic loads will contribute to the stress range.

Larry S. Muir, P.E.

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Larry Muir is director of technical assistance and Carlo Lini is staff engineer–technical assistance, both with AISC. Bo Dowswell and Keith Landwehr are consultants to AISC.

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:

1 E Wacker Dr., Ste. 700, Chicago, IL 60601
tel: 866.ASK.AISC • fax: 312.803.4709
solutions@aisc.org