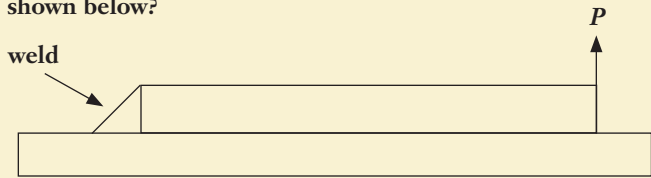


IF YOU'VE EVER ASKED YOURSELF "WHY?" about something related to structural steel design or construction, *Modern Steel Construction's* monthly Steel Interchange column is for you! Send your questions or comments to solutions@aisc.org.

Fillet Weld Design

How should I design the fillet weld for the load condition shown below?



AISC does not have provisions for this case because it is recommended to avoid loading a fillet weld in this manner. The reasoning is stated on page 36 of AISC *Steel Design Guide No. 21, Welded Connections—A Primer for Engineers*, “Because fillet welds do not fuse the cross-section of the joint, there will always be an unfused plane under the root of the fillet, or in the case of double-sided fillets, between the two (unless the fillet is applied on top of a groove weld). Single-sided fillet welded joints should be checked to ensure that the rotation about the root of the joint cannot occur, regardless of the loading condition.”

Design Guide 21 is available as a free download for AISC members, and for purchase by non-members, at www.aisc.org/dg.

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

Design of Bracing Connections

Is the variation of the Uniform Force Method found in the 14th Edition AISC *Steel Construction Manual* section titled “Analysis of Existing Diagonal Bracing Connections” applicable to new construction?

Yes, you can use the method under “Analysis of Existing Diagonal Bracing Connections” for new construction. The connection will distribute loads in the most efficient way possible and does not know whether it is being analyzed as part of an existing or new structure.

Larry S. Muir, P.E.

Shear Lag

Reinforcement may be required due to shear lag in heavily loaded HSS tension member connections. Does AISC have a published approach for the design of reinforcement for square HSS at slotted HSS-to-gusset connections?

Example 3.10 in the AISC *Seismic Design Manual* shows the procedure for a pipe brace, and the procedure for a square HSS would be similar. The required strength used in this example is specific to a brace in a special concentrically braced frame. For $R=3$ seismic applications, actual loads can be used rather than the expected strength of the brace.

Bill Thornton, P.E., Ph.D.

Galvanized Anchor Rods

Can an ASTM F1554 Grade 105 anchor rod be hot dip galvanized?

Yes. F1554-07a Section 7, Protective Coatings, allows galvanizing and defines the requirements for galvanizing, which apply to all grades of F1554 anchor rods.

Erin Criste, LEED GA

Welding to Historic Steels

I would like to make some welded modifications to an existing steel structure that was constructed with ASTM A7 steel. Is welding to A7 steel acceptable?

Possibly, and the answer for your case can be determined with guidance given in AISC *Design Guide 21*, which states:

“The weldability of A7 must be evaluated on a case-by-case basis. The ASTM A7 specification was in effect for 67 years, and mill practices varied over the years. However, in 1957, the 11th edition of *The Procedure Handbook of Arc Welding* stated: ‘Although specifications are not intended to control carbon content, experiences with the material, as it has been delivered, indicate that the carbon content is within the readily weldable range.’ Thus, while not certain, by the late 1950s, the general experience with the material being delivered by that time was that the weldability was good.”

In a more general discussion of historical structures *Design Guide 21* states, “It is helpful and highly desirable to obtain a representative chemistry from steels of unknown or questionable weldability. If the composition meets the limits of a current steel grade with good weldability, it likely will have welding characteristics similar to the modern steel. Steels enriched in carbon and hardening alloys typically will require more preheat to be successfully welded. Higher levels of sulfur or phosphorous will signify an increased sensitivity to hot cracking.”

“Even though a representative chemistry from the steel is desirable, it still is only an indirect indication of the weldability of the steel. Accordingly, it is advisable to run simple tests on the existing member to ensure that it is weldable. For example, a single-sided fillet weld can be used to join the end of a long, flat bar to an existing member. After the weld has cooled, attempt to break the flat bar from the existing member by applying force that puts the weld face into tension. When the steel has poor weldability, the weld will easily break away, cracking in the heat-affected zone as an indication of poor weldability.”

“If it does not break, the bar is pried in the opposite direction, putting the weld root into tension. The weld will naturally break, and typically does so in the throat. Fracture in this manner indicates better weldability.”

The electrode to be used will depend on the strength of the steel and the process used. Table 3.1 of AWS D1.1, though it does not contain A7 steel, can provide some guidance. The preheat requirements will depend on the thicknesses involved. Again AWS D1.1 can be consulted for guidance.

Larry S. Muir, P.E.

steel interchange

Single-Angle Shear Strength

AISC 360-05 Section G4, Single Angles, states, “The nominal shear strength of a single angle leg shall be determined using Equation G2-1 with $C_v=1.0$, ..., and $k_v=1.2$.” If $C_v=1.0$, what is k_v used for?

The variable k_v is only used to compute C_v , so it isn't actually needed in Section G4. The 2010 AISC Specification (www.aisc.org/2010spec) seems to agree—AISC 360-10 Section G4, simply says to use $k_v=1.2$ and Equation G2-1.

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

Beam Bracing

Does AISC have requirements regarding the required strength of beam lateral braces? I have not been able to find any information on this in the 9th Edition AISC Manual of Steel Construction.

You can find the information you seek in Appendix 6.3 of the 2005 or 2010 AISC Specification. The 2005 AISC Specification is included in the 13th Edition AISC Steel Construction Manual. The 2010 AISC Specification is included in the 14th Edition AISC Steel Construction Manual and available as a free download at www.aisc.org/2010spec. There are two types of braces for beams: lateral braces and torsional braces. These are both described in Appendix 6.3. In both cases, there is a required brace stiffness and a required brace strength.

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

Preinstallation Verification Testing

RCSC Specification Section 7 requires the use of a tension calibrator for preinstallation verification testing. Who is to provide the tension calibrator on a project when job site preinstallation verification testing is required?

In the RCSC Specification (available as a free download at www.boltcouncil.org) Sections 7 and 8 cover the requirements for preinstallation verification testing. The RCSC Specification does not specify who is responsible for the testing. Section 7.1(2) does state that the testing is used to “confirm... the proper use by the bolting crew of the pretensioning method to be used.” Thus, it would be expected that the bolting crew is present for the testing.

The 2010 AISC Specification (available for free download at www.aisc.org/2010spec) has a new chapter (Chapter N) on QA/QC requirements. Section N6 and its associated commentary make bolting tasks explicitly clear and there is a part in the erector's work that needs a tension calibrator if the bolts are to be pretensioned. The erector either must have a tension calibrator or have permission to use a tension calibrator provided by the owner, inspector or another if there are pretensioned field bolts.

Charles J. Carter, S.E., P.E., Ph.D.

Composite Beam Design

Can composite beams in negative flexure be designed to include any contribution of the concrete slab to the strength of the composite section?

When the composite section undergoes negative bending, the resistance of the composite section can be considered in the calculation of the available flexural strength. The 2010 AISC Specification addresses this in Section I3.2b. The concrete slab is assumed to be cracked and does not contribute to the nominal resistance. However, if the steel beam is compact, adequately braced and anchors are provided for shear transfer in the negative moment region, properly developed longitudinal reinforcement can be considered. The commentary to Section I3.2b provides additional discussion of the theory that forms the basis of this procedure.

Erin Criste, LEED GA

Proper Nut Orientation

I have seen nuts for structural fasteners that have a flat face on one side while the other side has chamfered corners. Common sense would indicate that the flat surface of the nut would face the washer. Is there a specified orientation for the nut?

The dimensions of the nut are governed by ANSI B18.2.2. This information is summarized in the 14th Edition AISC Manual Table 7-14. The nuts can be manufactured with chamfered corners on both sides or with chamfers on only one side. To my knowledge there is no reference that designates a “correct” orientation of the nut relative to the washer or the plies in the bolt grip. The nut can be installed in either position.

Larry S. Muir, P.E.

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