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.

Direction of Bend

Where can I find information on bending of plates with respect to the direction of the rolling?

Table 10-12 in the 13th Edition AISC *Steel Construction Manual* and Appendix X4 of ASTM A6, which is similar, provide information on cold bending of plates, including suggested inside radii for cold bending. The suggested radii differ depending on the orientation of the bend with respect to the direction of the rolling. As stated therein, it is preferable that the bend line is perpendicular to the direction of final rolling. Otherwise, a more generous radius is suggested.

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

Moment Connections

In AISC Design Guide No. 13, the author chose to neglect story shear in all 13 design examples. Is it *always* conservative to neglect story shear? The author does not address this in the Guide, yet the effects are not included in the examples.

It is always conservative to neglect the effects of story shear. Considering story shear will always reduce the shear on the column panel zone, since the reactions to the moments will always act opposite the moments themselves.

In practice, I commonly neglect story shear on my first pass. If doublers were required, I would go back and consider the story shear in an attempt to eliminate the doublers. Doublers can represent a tremendous increase in fabrication cost, so it is always best to attempt to eliminate them whenever possible.

Larry S. Muir, P.E.

ASTM A449 Threaded Rods

The project specifications call out ASTM A449 threaded rods with nuts on each end for connecting two members. The plans specify to pretension these rods as opposed to just snug-tight. The RCSC *Specification* defines specific tensioning and inspection requirements for ASTM A325 and A490 bolts. Are there any codes or written recommendations on what is considered pretensioned on ASTM A449 rods (i.e., pretension load) and also for inspection requirements?

Yes. When a pretensioned installation is required, Section J3.1 of the 2005 AISC *Specification* discusses the use of ASTM A449 threaded rods, indicating that "Installation shall comply with all applicable requirements of the RCSC *Specification* with modifications as required for the increased diameter and/or length to provide the design pretension."

Amanuel Gebremeskel, P.E.

CJP Weld for HSS

Is it possible to get a prequalified CJP groove weld on an HSS without a backing bar?

It is possible to make a CJP groove weld from one side without backing; see AWS D1.1:2008 Section 4.26. This is a prequalified joint, but it requires additional welder qualifications that may not be possessed by many welders working on building projects. Welders that do a lot of tube fabrication, such as for offshore structures, may likely posses the required qualifications. There will probably be a premium paid if this type of welding is required on the project.

To avoid the extra expense, what we often did was cut a thick steel plate to the profile of the inside of the HSS, and used this as backing. We would tap a hole in the plate to accept a threaded rod (or otherwise form some attachment) and then provide a slot in one wall of the HSS. The rod attached to the backing plate could be used to adjust the plate so that it fit tightly against the support to complete the weld. Cutting to the inside profile of the HSS also produced a backing that fit well at the radius corners, something that is otherwise difficult.

Larry S. Muir, P.E.

W/D Ratios

Where are *W/D* values for W-shape beams published? I don't know where to look for these, but was told that AISC could provide them.

AISC Design Guide No. 19, *Fire Resistance of Structural Steel Framing*, includes a listing of *W/D* ratios for hot-rolled shapes. AISC design guides are available as free downloads for AISC members at **www.aisc.org/epubs**, or can be purchased by others.

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

Elevated Temperature Service

Where can I find properties of steel at high temperature?

Appendix 4 of the 2005 AISC *Specification* (a free download at **www.aisc.org/2005spec**) includes Table A-4.2.1, Properties of Steel at Elevated Temperatures. Part 2 of the 13th Edition AISC *Steel Construction Manual* also includes a discussion on elevated temperature service.

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

Lifting Plate

Can Part 15 of the 13th Edition *Manual*, covering bracket plates, be used as a procedure for the design of lifting plates? Instead of the load applied downward, the load is applied upward.

Bracket plates are typically used to support a reaction from gravity loading, placing the bracket in compression. A lifting lug is typically used to support a force in tension. You may want to look at Chapter D of the AISC *Specification*, which may be more applicable to the lifting plate application. Also, there is a good article in the AISC *Engineering Journal* on this topic by David T. Ricker, "Design and Construction of Lifting Beams," from the 4th quarter 1991 issue. This article is available as a free download for AISC members at **www.aisc.org/epubs**, or can be purchased by others.

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

steel interchange

Weak-Axis Flexure of Plates

Section F6 of the 2005 AISC *Specification* does not mention plates bending about the weak axis. Can we use the same F6 equations for weak-axis bending of plates, or do we revert back to the 0.75F_y? Also, on the Basic Design Values card, the weak axis bending says to use 0.9F_yS_y for ASD applications. Where does the 0.9 come from, and do we apply the 1.67 ASD omega factor to that?

Flexure of rectangular bars (plates) is covered in Section F11 of the AISC *Specification*, but this gives the same basic limit state equation for yielding, as covered in Section F6, which is the only flexural check needed for plates bent about the minor axis.

The 0.9F_yS_y for the ASD weak-axis bending on the Basic Design Values card reflects using the shape factor (Z_y/S_y) of 1.5, and then dividing by the omega (1.67). Thus the omega is already included. For the LRFD, 1.35F_yS_y represents using the same shape factor (1.5) and multiplying it by the phi factor (0.9).

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

Camber Measurement

We have a project with cambered beams. The contractor is requiring a survey of the camber after erection as a measure of compliance with the specified camber. The AISC *Code of Standard Practice* indicates that this is not a correct procedure. What is the proper procedure for measuring camber?

The AISC *Code of Standard Practice* (a free download at **www.aisc.org/code**) stipulates that camber must be measured in the shop in the unstressed condition. This means laying the beam on its side in the shop, such that gravity does not affect the measurement, and measuring for compliance within camber tolerances.

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

Non-Destructive Testing of CJP Welds

Is there an industry standard defining the amount of NDT that should be done on full-penetration welds of moment connections?

There are requirements for non-destructive testing (NDT) of welds for high-seismic applications defined in Appendix Q of the 2005 AISC *Seismic Provisions*. However, there is no industry standard that defines required NDT of welds in non-high-seismic applications; that is left to the discretion of the responsible design professional for the project. However, the AISC Committee on Specifications is currently considering a proposal for a chapter in the AISC *Specification* similar to Appendix Q, but reduced in scope to that appropriate for non-high-seismic applications.

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

Eccentrically Loaded Weld Groups

The table values for the eccentrically loaded weld groups published in the 13th Edition AISC *Steel Construction Manual* result in much greater strength than the comparable table published in the 9th edition ASD *Manual*. What is the reason for this increase?

One factor for the differences between the coefficient values published in the current *Manual* versus those coefficients published in the 9th edition *Manual* is that the tables in the current *Manual* do not include the omega factor for ASD design, or the phi factor for LRFD design. The 9th edition ASD *Manual*, which reflected only the ASD load approach, incorporated the safety factor in the tabularized values.

Additionally, there also is a major difference in strength because the current *Manual* takes advantage of the increase permitted for the component of the force that is at an angle to the axis of the weld. This permitted increase is covered in Section J2.4 of the 2005 AISC *Specification*, but was not included in the 1989 ASD *Manual* table values.

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

Thickness Limitation for Single-Plate Shear Connection

Why is there a thickness limitation of $t \leq d_b/2 + 1/16$" for single-plate shear connections?

The limitation is intended to ensure that the bolts can "plow" through the material without fracturing. This plowing is used as one mechanism to accommodate the simple beam end rotation that is required at simply supported beam ends. Essentially, it is a connection ductility requirement.

Larry S. Muir, P.E.

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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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