Steel Interchange is an open 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.

The opinions expressed in *Steel Interchange* do not necessarily represent an official position of the American Institute of Steel Construction, Inc. and have not been reviewed. It is recognized that the design of structures is within the scope and expertise of a competent licensed structural engineer, architect or other licensed professional for the application of principles to a particular structure.

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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PRETENSIONING ANCHOR RODS

I have a project where there is a need to pretension the column anchor rods to 110 kips. I am using 1.75" diameter ASTM F 1554 Grade 105 rods. The contractor proposes using a hydraulic torque wrench in lieu of a hydraulic bolt-pretensioning device due to technical, safety, schedule and cost considerations. If we were to allow him to use the hydraulic torquing, what is the necessary torque (ft-lb) required to obtain the 110 kip pretension force? In your opinion at this 110 kip tension, how much of a risk is there for the anchor rod to fail as a result of the combined tension and torsion stresses? If this was a standard slip critical bolted connection and the bolt failed during tensioning it would not be a big deal, a new bolt could easily be inserted, however with a concrete embedded anchor rod it would be an issue if the rod were to fail.

Question sent to AISC's Steel Solutions Center

We have a procedure for pretensioning double-nut anchor rods, that only pretensions the short length between the nuts. I assume you have just a single nut connection since this is for buildings. Then you must have a length of pipe around the anchor rod so there is a substantial free length (10 inches or so) to pretension. These type of anchor rod installations are normally pretensioned with a ram, as you originally required. I know of no specific procedures to pretension them with torque.

However, if you calculate the strain required to hit 110 kips (110/(tensile stress area × E) then multiply this by the unbonded length, that is the "stretch" you want to put on the rod. Then, if the threads are 8 to the inch, every turn will give you $^1/_8$ in. of stretch. If this has coarse threads, the tensile stress area is 1.9 in.^{2}. This assumes that the unbonded length is threaded all the way. If it is only partially threaded, then only the threaded part will stretch. (If the threads are rolled, it may be that only the unthreaded part will stretch). Dangers: the torques involved will be very large, you must be sure you will not twist loose the embedded end of the anchor rod.

Note: If you do not have a long unbonded length, this method will not be reliable as the bonded length will eventually become unbonded and pretension will also be lost soon from creep of the concrete.

Robert J. Dexter
University of Minnesota
Minneapolis

REPAIRING WELDS

What procedures are available to repair a cracked weld between a diaphragm connection plate and the web of a box girder? The crack is over 1 in. long and the web plate length is 60 in.

Question Sent to AISC Steel Solutions Center

This is a difficult question to answer without knowing all of the facts such as the web and stiffener thicknesses. What likely needs to be done as a minimum is to preheat to approximately 250 °F and gouge back into the crack, starting outside the crack area and removing the entire crack into sound weld metal. Grind to bright metal and reweld with the preheat between 250 °F and 300 °F. I would suggest making this repair using the SMAW welding process. Since the repair is not that long I would not use a high-deposition filler metal like FCAW or a low heat input small wire process like GMAW. Hold preheat for up to 30 minutes and slow cool at the rate of 150 °F maximum.

David McQuaid
D. L. McQuaid & Associates, Inc.
Bethel Park, PA

HEIGHT-THICKNESS RATIOS

(from July 2003)

Referring to LRFD Specification Sections F2.2, Appendix F2.2, and Appendix G.3:

For all of the standard rolled W-shapes, is the h/t_w ratio always less than 260? In other words, if a standard rolled shaped is being considered, is it necessary to check for the limit states of web shear yielding or buckling? Also, for all the standard rolled W- shapes utilizing up to 50 ksi specified minimum yield strength, is it always true that:

$$h/t_w \le \frac{418}{\sqrt{F_y}}$$

Stephen Crockett
D. M. Berg Consultants, P.C.

The height-thickness ratio h/t_w is one of the Compact Section Criteria listed in Tables 1-1 to 1-4 of the AISC *Manuals*. For W shapes (Table 1-1), its largest value is 57.5, which occurs for the W30×90 shape. This is less than the limiting beam web slenderness of 59.1 for F_y = 50 ksi. Therefore, all the W-shapes listed in the AISC *Manuals* are capable of the full design shear strength of Specification Equation F2-1 for yield stresses of 50 ksi or less.

Alternatively, the answer to this and many other questions may be found thanks to the AISC Shapes Database CD. Among other things, the CD makes available two files, one in MS Excel format and the other in tab delimited text format. All spreadsheet programs can import at least one of these formats, which makes the AISC Database very useful for widely different operations.

Pierre Dumonteil, P.E. (ret.)

CURVED SHAPES

What are the maximum and minimum curved radii of HSS and W-shapes?

Question Sent to AISC Steel Solutions Center

Limits on radii of curved shapes are essentially a function of the capabilities of the bender. AISC does limit the radius of bend for bent plates to prevent cracking during the bending process. Though similar limits would apply to any bent product, such deformations are not generally achievable in HSS. Guidelines for bending plates are found in Part 10 (Table 10-12) of the 3rd Edition *LRFD Manual*.

Cold bending guidelines for shapes are also found in the 3rd Edition *LRFD Manual* on page 2-39. They are summarized below:

1. The minimum radius for camber induced by cold bending in members up to a nominal depth of 30 inches is between 10 and 14 times the depth of the member. Deeper members may require a larger minimum radius.
2. Cold bending may be used to provide sweep in members to practically any radius desired.
3. A length limit of 40 to 50 feet is practical.

Bending by heat is also a possibility, but it should be noted that this procedure is generally much more expensive than cold bending.

Note that providers for structural shape (including HSS) curving/bending often advertise their services in *Modern Steel Construction*. They would be the best ones to contact for determining minimum and maximum curved radii of shapes.

Keith Mueller, Ph.D.
AISC Steel Solutions Center
Chicago

REFERENCING SPECIFICATIONS

I have a specification section that refers to AISC S335. Can any one tell me if this is a valid number? I have checked the AISC web site and it does not seem to be there.

Question posted at steel-detail@yahoogroups.com

The old AISC numbering system was never intended to allow professionals to reference AISC documents. Instead they were simply inventory record numbers.

Beginning in March 2002, AISC implemented a new publication numbering system. Under this system, every AISC standard and publication may now be referenced by number, rather than its full title and date of issue. This system is very similar to the system used by other standard development organizations.

For example, the *Specification for Structural Steel Buildings—Allowable Stress Design and Plastic Design, June 1, 1989* can now be referenced as AISC 335-89.

Scott Melnick
American Institute of Steel Construction
Chicago

UNANSWERED QUESTIONS

Do you have an answer for these or any other *Steel Interchange* questions? Send it to solutions@aisc.org and receive a surprise gift from the editors of *Modern Steel Construction*.

NEW ASTM STANDARDS AND OLD AISC SPECIFICATIONS

(February 2003)

ASTM A992 wide-flange shapes and F1554 anchor rods are not listed in the 9th edition *ASD Manual* nor in the 1989 *ASD Specification*. Can I use these newer materials in designs involving the ASD, or does the design need to be based on the *LRFD Specification*?

Question Sent to AISC Steel Solutions Center

COMPOSITE FLOOR PENETRATIONS

(February 2003)

Where can I find literature or references regarding the design of composite floors with penetrations?

Question Sent to AISC Steel Solutions Center

BOLTED HANGER-TYPE CONNECTIONS

(January 2003)

The AISC 9th edition *ASD Manual* illustrates procedures for bolted hanger-type connections with a single line of resistance to prying action on each side of the hanging member. If each line of resistance consists of a bolt group, what design and analysis methods should be used?

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