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!

Calibrated Wrench Pretensioning

AISC's Steel Solutions Center recently received several questions related to calibrated wrench pretensioning:

Define the term *calibrated wrench pretensioning method*. What constitutes such a method?

This is one of the four methods for bolt pretensioning provided in the RCSC specification. The full description of this method is given in Section 8.2.2 of the 2005 RCSC specification (www.boltcouncil.org).

Is it a torque-controlled method of installation?

Yes, but since torque can vary by as much as ± 40% in terms of predicting bolt pretension (due to variations in the friction on the surfaces in contact), a tension calibrator is mandated to calibrate the torque to the bolt pretension. This is why the method is called the calibrated wrench pretensioning method.

If an installation torque is not determined as defined in (3) of the commentary to Section 7.1, does the pretensioning method qualify as a calibrated wrench?

No. Section 8.2.2 on calibrated wrench pretensioning invokes Section 7, which requires that a tension calibrator be used to establish the calibrated torque that corresponds to the correct pretension for the bolts being installed.

If anything other than a torque-to-pretension relationship is used, does the pretensioning method qualify as a calibrated wrench? Define what constitutes a calibrated wrench.

Again, refer to Section 8.2.2 for specific requirements. We're not sure what you mean by a relationship and "anything other than." If it is an equation or table for a torque value, this is specifically disallowed in the RCSC specification. There is too much variation in frictional condition of the various surfaces in contact to permit use of an uncalibrated equation-based or tabulated value. Thus, a calibrated wrench is the only one for which the torque-tension relationship is calibrated.

What are the specific items that allow any impact wrench to be calibrated?

The specific item as identified in the RCSC specification Section 7 is a tension calibrator. If the impact wrench has a torque cutoff device, the setting of this device is what is calibrated in the tension calibrator. That is, the cutoff setting must be calibrated to the torque corresponding to the pretension required. If the impact wrench does not have a cutoff device, but does have a torque indicator, the calibration procedure is used to determine the calibrated torque that must be applied, and the indicator is then used to confirm that torque is reached during the installation process.

If the impact wrench does not have either of these devices, it is still possible to calibrate the wrench based upon the rotation from snug-tight required to induce the proper pretension. However, anyone trying to calibrate a wrench in this manner should realize that they will find it easier and more direct to instead apply the turn-of-nut method in RCSC specification Section 8.2.1.

Does the impact wrench have to have a torque dial? Must the impact wrench have an auto-stop feature?

As stated above, the wrench must have some feature that can be used to determine the calibration torque.

How can a torque-to-pretension relationship be ensured if an impact wrench cannot be calibrated with torque being the main variable?

If installation is being done using some indicator other than torque as a calibration, this is not the calibrated wrench method. Often, an installer is actually calibrating the amount of turns to produce the right pretension. But again, this is really the turn-of-nut method, which should be performed following the rules for turn-of-nut pretensioning in Section 8.2.1. If your contractor is calibrating something other than torque, you can probably help them by asking if they are really doing the turn-of-nut method.

Is the intent of the RCSC, though not explicitly stated, that an impact wrench needs to be directly (not indirectly) torque-controlled to be calibrated?

We cannot speak on behalf of RCSC or their intentions. However, it is AISC's intent that the calibrated wrench method is based upon a torque value that is calibrated to the proper pretension.

Sergio Zoruba, Ph.D., P.E.
American Institute of Steel Construction

Weld Interactions

When using LRFD, is there a specific interaction relationship between loads applied to a weld both parallel and perpendicular to the weld at the same time? Can the full calculated capacity be taken in each direction, or must the loads be combined?

Question sent to AISC's Steel Solutions Center

A question of the components of load angle on a weld is independent of the design approach taken, LRFD or ASD. If simultaneous forces occur in different directions with respect to the weld axis, these must be combined to determine the critical stress on the weld. Note that the strength for a linear weld group loaded in-plane through the center of gravity is determined by Equation (J2-4) of the 2005 *Specification for Structural Steel Buildings* (a free download at www.aisc.org/2005spec). Equation (J2-5) can be used to determine the capacity when the resultant is at an angle to the weld longitudinal axis.

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Cantilevered Beam Stability Bracing

Why does Appendix 6.3.1 of the 2005 AISC specification mandate that bracing be attached near the top (tension) flange of cantilevered members?

Question sent to AISC's Steel Solutions Center

Compression flange bracing at the cantilevered beam end does little in terms of preventing lateral-torsional buckling (LTB). Many textbooks state that LTB requires both rotation (i.e. twisting) and lateral translation of the cross-section in order to manifest itself. The center of twist in this particular case is a point outside and directly below the compression flange. Hence, the top tension flange will need to laterally translate much more than the compression flange at the cantilevered end during buckling, which is why bracing the tension flange is crucial at the ends of cantilevered beams.

Sergio Zoruba, Ph.D., P.E.
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Cleaning Steel for Fireproofing

I have structural steel that will receive spray-applied fireproofing. To what specification should the steel be cleaned, if at all?

Question sent to AISC's Steel Solutions Center

Typically there is no special surface preparation requirement for unpainted steel that will receive sprayed-applied fireproofing. Unpainted steel has excellent adhesion for spray-applied fireproofing, even in the presence of rust that is not loose or flaking. Adhesion concerns may come into play if there is a primer or paint coating, which may affect that adhesion. Section IX of AISC's *Design Guide 19: Fire Resistance of Structural Steel Framing* (**www.aisc.org/epubs**), provides discussion on the topic of cohesion/adhesion determination.

For further information on requirements for surface preparation, please refer to Section 6.5.2 of the AISC *Code of Standard Practice for Steel Buildings and Bridges* (a free download at **www.aisc.org/code**) and FAQ 10.4.1 on the AISC web site at **www.aisc.org/faq**.

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Seismic Brace-to-Gusset Plate Offset

Figure C-I-13.2 of the 2005 AISC *Seismic Provisions* shows the brace end offset from the gusset bend line. This is recommended for SCBF. Would the same apply to OCBF or is there a different detail?

Question sent to AISC's Steel Solutions Center

The 2*t* offset will provide a means for ductile performance of the connections, which is why it is commonly used to meet the SCBF requirements. The 2*t* can be used as part of the detailing in OCBF connections, but providing that inelastic rotation capability is not required for OCBFs due to the lower system *R* factor.

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Contract Addenda

We are working on a waste water treatment plant. The structural drawings show pipe supports that are fabricated from structural shapes. They also show a detail referencing the mechanical drawings.

The original bid set of drawings called for this material to be mild steel, but there was an addendum issued during the bid process. I reviewed the addendum for architectural and structural references, drawing numbers, or specification sections and found nothing referencing the pipe supports. This information was sent to our detailers and they also reviewed the addendum for architectural and structural references and found nothing. An addendum to the mechanical drawings referenced changes to this material. The material was revised from mild steel to stainless steel.

Is it common practice for the fabricator to check all drawings and spec sections of the addendum for work related to architectural and structural steel?

Question sent to AISC's Steel Solutions Center

We can only speak to common practice of the structural steel building projects that are covered in the COSP (a free download at **www.aisc.org/code**). Section 3.2 indicates that requirements are to be shown on the structural design drawings. This actual experience illustrates exactly why the COSP reads as it does. Many people claim it is fine to put structural information on drawings other than the structural documents, but this is a practical example of why this is not a good idea.

When the material changed to stainless steel, it probably could have been considered as having moved from Section 2.1 of the COSP to Section 2.2.

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Steel Interchange is a 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.

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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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