

Meet The Experts at MSC's Online Chats

Structural Bolting Issues

The following is an edited transcript from the August 7, 2001 on-line chat with Peter Birkemoe from the University of Toronto and Vice Chairman of the Research Council on Structural Connections, and Charlie Carter, AISC's Director of Engineering and Continuing Education who serves on the Executive Committee of the Research Council on Structural Connections. For a list of future chat topics, e-speakers, dates and times, visit www.aisc.org/chat.html.



Peter C. Birkemoe

Q: What are some of the major changes with the 2000 version of the bolt spec?

A: Well, that's a big question. I'd say it's simpler, clearer and improved in the area of inspection and engineers responsibility.

Q: Under what circumstances must erection bolts be removed after a connection has been field welded?

A: I see nothing wrong with leaving erection bolts in, because inspectors are often concerned by empty holes.

Q: I have recently been ordering structural steel with a hot-dipped galvanized coating. The erector has asked to have the bolt holes increased from 1/16" greater to 1/8" greater than the bolt. The fabricator has indicated that this is the standard procedure. All information I've read does not discuss this issue. The RCSC states that a hole 3/16" greater is an oversize hole. Is there any publication, paper, etc. that addresses this subject?

A: Enlarging the holes is not standard procedure but rather

something that has to be approved by the SER. The hole becomes an oversized hole after modification, and the change would have to be considered. Increasing the hole size for galvanized construction is not permitted in the RCSC or AISC spec. That said, it's also not prohibited explicitly, hence the mistaken belief that it is "standard practice." Tom Langhill of the American Galvanizers Association wrote on this subject in the "Steel Interchange" in Modern Steel Construction. You can find it in the "Online Library" at www.aisc.org. I believe he said a good galvanizer will blow the zinc out of the holes during galvanizing and that the "fill" of the hole is not significant.

Q: I have a question about using A325 TC bolts. I know pre-installation verification is required. Is this the same as rotational capacity testing, RCT? Is the terminology interchangeable? We can usually purchase the RCT reports from the manufacturer; do we still have to do the pre-installation verification? I'm confused.

A: Rotational capacity is quite a different requirement from verification and really doesn't apply to the verification procedure. Pre-installation verification is a feature that emphasizes the need to verify that the bolts are working prior to use on the steelwork.

The attempt in the new spec is to treat all installation methods and fastener assemblies equally.

Q: Why does the RCSC Spec not allow reuse of A490 bolts, but it does allow it for A325? Does the process of fully tension create a problem in the threading of A490s?

A: Reuse of A490 bolts is not permitted because, although they are stronger, they are also less ductile, and the first installation exhausts most of that ductility. There is some good backup on this in the Guide to Design Criteria for Bolted and Riveted Joints by Kulak, Fisher and Struik.

Q: I know it is a different test, but do TC bolts require RC testing by the fabricator/erector in addition to the pre-verification testing?

A: Nothing in the RCSC specification requires rotational testing. Highway specs do, and ASTM A325 does. Just to clarify, the pre-installation verification is to be done by the installer to ensure that the assembly works together. The manufacturer's testing just verifies their manufacture of the individual components individually. A325 only requires RC testing for galvanized bolts. However, highway specs may require it for black bolts as well. The rotational capacity test is meant to verify that a number of things

happen. Lubrication is adequate, stripping doesn't occur, a reserve of rotational capacity is available especially for turn of nut installation.

Q • Is anyone aware of any new research on using two lines of bolts in a shear tab connection?

A • Shear tabs are a funny animal. The Manual procedure is based upon the Astaneh research, which is limited to one vertical row of bolts. If you do something that doesn't meet those limitations (incorporated into the AISC Manual), you are "on your own." And I don't think there is much research available. But with good engineering judgment and a viable design philosophy, I don't think you'll be too far out on a limb.

Q • Is there anything that can be done during the design phase to prevent "banging bolts" syndrome [slip critical joints]?

A • Well, it shouldn't be blamed on the bolts, but it is the result of the loud report one gets from joints that were not expected to slip. Note: if the steelwork is primed or painted, the problem is not there; in my experience, only bare steel with blast, rusted or bare mill scale surfaces will exhibit the sharp sound as the slip commences.

Q • Do you mean if the faying surfaces are primed, "bolts" never "bang"?

A • Unless the primer exhibits the same dry friction that steel on steel exhibits, I'd say yes. I've never seen a primer slip with a loud report. Some washes might do that, but I doubt it. I've never seen such a primer. Specifying SC joints requires surface prep for all faying surfaces, which costs money. The "banging" is the result of the holes slipping into bearing on the bolts. The holes in most joints are in bearing before the bolts are tightened, and therefore would not result in bang-

ing bolts unless the direction of the loading is changed.

Q • I would assume snug-tight would reduce "banging bolts" as well, as slip would create bearing before occupancy.

A • Yes, snug tight would work, although it's the one case when "too snug" is bad. Snug doesn't have a defined upper limit, but rather a practical one.

Q • Does anyone have any experience with DTIs, like the squirting one? Seems like a good idea to me.

A • ASTM F959 DTIs are one of the approved methods for pre-tensioned installation. The squirting ones may not conform exactly to the F959. If not, they'd be manufacturer certified. When DTIs are confirmed as performing properly with pre-installation verification as required in the RCSC Specification, they're as good a method as any.

Q • The anchor bolt has been installed such that the top of the bolt is even with the top of the nut, and the contractor has already welded it. I didn't have any input on the materials or the current situation and was asked to see if I could help out with it.

A • You probably got ASTM A449 or A193 grade B7 material, because ASTM A325 applies only to high-strength bolts (defines the head, threading and configuration in a way that is usually not suitable for the length of an anchor rod). Be careful; welding of these heat-treated materials can damage the heat treatment.

Q • Are there any benefits for a bolted-flange moment connection in having the bolts pre-tensioned? Can you get away without pre-tensioning in this case?

A • Are you talking about an end-plate detail with the bolts in tension or a flange plate detail with the bolts in shear?

Q • Flange plates in shear.

A • Without pretension you only sacrifice predictable slip behavior.

Q • The RCSC spec has a provision that faying surfaces that are galvanized should have be hot-dipped per ASTM A123. What about cold galvanization using a zinc-based primer instead of the hot-dipped process?

A • The difference would largely be the slip values and if they were required. For other coatings, the tests would have to be done as specified in Appendix A of the RCSC Spec. These sorts of tests have been done for zinc based primers and paints and many other coatings, but since the coatings are not considered generic, the use of the results for other than the one specific material is not permitted.

Q • FEMA 353 paragraph 6.3.4 requires bolting inspectors to demonstrate competency through the written examination, but it does not appear to provide any guidance regarding the examination. Are there any canned exams "on the market," or do engineers have to dream up their own? Any suggestions?

A • FEMA 353 is a set of recommendations, not requirements. Also, it was written with a view of what should be in the future, not necessarily what is right now. Of course, since they wrote that recommendation, AISC, RCSC and AWS have started creating a certified structural steel inspector training program that will include bolting aspects. It is in the works.