

SPEAKING IN CODE

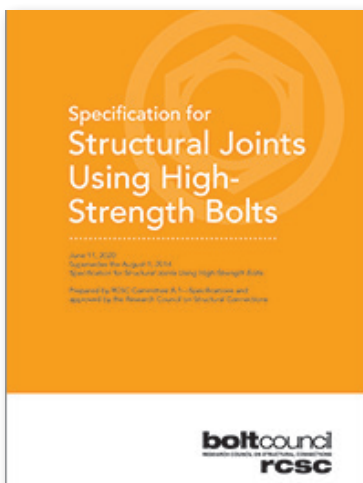
The Low Down on Testing and Special Inspection Topics

May 2021

Inspection of Snug-Tight Bolted Connections

...All the Thrills

Speaking in Code (SIC) previously related the story of BOLTED CONNECTIONS and the epic and grand tale that it is. It is a story that includes *intrigue* (fastener component selection), *drama* (design of the connection), *mystery* (pre-installation verification), *action* (installation), *thrills* (inspection), *horror* (arbitration), *history* (references) and, sometimes, the occasional miracle. THIS episode is about the **THRILL** part of the story and addresses only FIELD INSPECTION OF SNUG-TIGHT BOLTED CONNECTIONS.



Let's start out by recognizing that snug-tight bolted connections must be inspected in accordance with the reference standard (code) published by the Research Council of Structural Connections (RCSC) entitled "*Specification for Structural Joints Using High-Strength Bolts*". The specific editions of RCSC vary throughout the Mid-Atlantic region depending on which jurisdiction the project is located. In Maryland and South Carolina, the **RCSC 2014** edition would be used and in Virginia, North Carolina, West Virginia and Washington D.C., the **RCSC 2009** edition would be the correct edition mandated by the International Building Code (IBC).

RCSC section 9 Inspection and **section 9.1 Snug-Tightened Joints**, specifically, advises the special inspector that "After the connections have been assembled, it shall be visually ensured that the plies of the connected elements have been brought into firm contact and that washers have been used as required in **section 6**." The inspector must determine that all of the bolts in the joint have been tightened sufficiently to prevent the turning of the nuts without the use of a wrench. **Section 9.1** goes on to state that "No further evidence of conformity is required for snug-tightened joints. Where visual inspection indicates that the fastener may not have been sufficiently tightened to prevent the removal of the nut by

hand, the inspector shall physically check for this condition for the fastener.” Wow! This seems like a pretty simple easy-to-do inspection if that is all there is to snug-tight bolted inspection. But...you KNOW there’s more, right?



RCSC stipulates that “it shall be ensured that all fastener components to be used in the work complies with the requirements in **section 2.**” This means that the inspector has got to review the applicable manufacturer certifications (submittals) in order to verify compliance with applicable ASTM standards as well as the code and construction documents. RCSC also requires “that fastener components be protected from dirt and moisture in closed containers at the site of installation.” Only as many fastener components required to be used during the work shift shall be taken from the protected storage. This “protected storage” is mandated with the intent to make certain that all fastener components are maintained as nearly as possible to the **as-manufactured condition** until they are installed in the work. Fastener components that collect rust or dirt **shall not be incorporated into the work** unless requalified as specified in RCSC, **section 7.**

One of the primary duties of the special inspector is to “ensure that all **connected plies** meet the requirements of RCSC **section 3.1** and all bolt holes meet the requirements of **sections 3.3 and 3.4.**” All connected plies that are within the grip of the bolt and any materials that are used under the head or nut shall be steel with faying surfaces that are uncoated, coated or galvanized as defined in **section 3.2.** Compressible materials shall not be placed within the grip of the bolt. The slope of the surfaces of parts in contact with the bolt head and nut shall be equal to or less than 1:20 with respect to a plane that is normal to the bolt axis.

Faying surfaces and surfaces adjacent to the bolt head and nut shall be free of dirt and other foreign material. The faying surfaces of snug-tight joints are permitted to be uncoated, coated with coatings of any formulation or galvanized.

After the connections have been assembled, it shall be visually ensured that the plies of the connected elements have been brought into firm contact and that washers have been used as required in section 6. Washers are not required in snug-tightened joints, **except as required** in RCSC **sections 6.1.1 and 6.1.2.**



6.1.1 Sloping Surfaces: When the outer face of the joint has a slope that is greater than 1:20 with respect to the plane that is normal to the bolt axis, an **ASTM F436** beveled washer shall be used to compensate for the lack of parallelism.



6.1.2 Slotted Hole: When a slotted hole occurs in an outer ply, an ASTM C436 washer or 5/16 inch thick common plate washer shall be used as required to completely cover the hole.

It shall be determined that all of the bolts in the joint have been tightened sufficiently to prevent the turning of the nuts without the use of a wrench. No further evidence of conformity is required for snug-tightened joints. Where visual inspection indicates that the fastener may not have been sufficiently tightened to prevent the removal of the nut by hand, the inspector shall physically check for this condition for the fastener. This is probably a good time to point out the **code rules about the engagement of the nut with the bolt** which requires “that the bolt length used shall be such that the end of the bolt extends beyond or is, at least, flush with the outer face of the nut when properly installed”. (This particular code language can be found in **ANSI-ASME B18.2.6.**)



DEFINITION OF SNUG-TIGHTENED CONDITION

The definition of snug-tight can be a little slippery, at times, and seems to vary from individual to individual and from registered design professional (RDP) to RDP. Regardless of the multitude of random definitions, use the definition provided by RCSC, section 8.1 of the code.

RCSC 2009, section 8.1 definition

Snug-tight is the condition that exists when all of the plies in a connection have been pulled into firm contact by the bolts in the joint and all of the bolts in the joint have been tightened sufficiently to prevent the removal of the nuts without the use of a wrench.

RCSC 2014, section 8.1 definition

The snug-tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the plies into firm contact.



RCSC 2014, section 8.1 Commentary

*The **snug-tightened condition** is typically achieved with a few impacts of an impact wrench application of an electric torque wrench until the wrench begins to slow or the full effort of a worker on an ordinary spud wrench. More than one cycle through the bolt pattern may be required to achieve the snug-tightened joint. The splines on twist-off type tension-control bolts may be twisted off or left in place in snug-tightened joints.*

CONCLUSIONS: You will note the **difference between** the definitions of a “snug-tightened condition” stated in RCSC 2009, section 8.1 and the definition stated in RCSC 2104, section 8.1. It would appear that



the RCSC 2014 definition is **being applied universally** (in the United States) regardless of what edition of the IBC code is used. The modified terminology used in RCSC 2014 does seem to be less subjective in its application (which is a good thing).

The RCSC 2014 definition of “snug-tight condition” is the same verbiage that was previously used in RCSC 2004 and RCSC 2000 and is not as ambiguous as the RCSC 2009 definition; this is probably one of the primary reasons that the RCSC 2014 definition is the one being used on construction projects throughout the United States.

OK, one final thought

The CODE mandates that **every single bolted connection be visually inspected** as stipulated by the American Institute of Steel Construction (AISC 360), in Chapter N - Table N5.6-3.

*Can You
Believe it?*

But Wait, We Have a Lot More to Say!

For a complete picture of the Code and how it relates to Special Inspections, F&R would love to provide a virtual (for the time being) AIA accredited Lunch & Learn presentation to the professionals at your firm.

Troubles Deciphering the Code?

Call the Experts at F&R!

Alan S. Tuck

Director of Code Compliance & Training

T: 540.344.7939

M: 540.798.4440

atuck@fandr.com



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