CLOSURE

Specifying Bolt Length for High-Strength Bolts

Paper by CHARLES J. CARTER
(2nd Quarter, 1996)

Closure by Charles J. Carter

Mr. Flucker correctly points out that the statement quoted in his discussion is worded in an unclear manner. However, contrary to his indicated interpretation, it was the author's intent that the thickness of ASTM F959 direct tension indicators be added to the thickness of the connected plies when determining the grip.

The author acknowledges that the failure to do so would not alter the selected bolt length increment in most cases. However, there are a few critical cases in which the accumulation of manufacturing tolerances in the bolt-washer-nut assembly could be such that the point of the installed bolt would not be at least flush with the face of the nut as required in RCSC Specification Section 2(b). One such case is illustrated in the following example, which is taken from the critical bolt length selection case described previously in the subject paper.

For a ¾-in. diameter bolt with one $^5/_{32}$-in.-thick washer and a ⅞-in. grip, the minimum possible bolt length would be

$$\frac{7}{8} + \frac{5}{32} + 1 = 2^1/_{32}\text{-in.}$$

where

1 inch = value from RCSC Specification Table C2

The author neglected this potential $^1/_{32}$-in. underrun, which would only occur if the bolt, washer, and nut were simultaneously produced to their respective maximum tolerances. It should be noted, however, that bolt-washer-nut assembly tolerances commonly approach this accumulation because the minus tolerance on bolt length is one order of magnitude greater than the plus tolerances on nut and washer thickness. Therefore, a bolt produced at or near its minimum length has a great influence on the tolerance of the assembly.

Next, consider the same example, except with an ASTM F959 DTI under the bolt head. With a compressed DTI thickness from ASTM F959 of 0.126 in. the minimum possible bolt length would be

$$0.126 + \frac{7}{8} + \frac{5}{32} + 1 = 2^5/_{32}\text{-in.}$$

This represents a potential $^5/_{32}$-in. underrun and the author would recommend that a 2¼-in. bolt length be selected. Accordingly, the author included the aforementioned statement intending that DTI thickness be added to the thickness of the connected plies when determining the grip for use in the Table provided, which would otherwise indicate the universal suitability of a 2-in. bolt length.

In his discussion, Mr. Flucker states that the stick-through in the case of Figure 2 would still be at least $^3/_{32}$-in. This is correct only if the 1-in. RCSC allowance is replaced with the $^{47}/_{64}$-in. theoretical thickness of a ¾-in. diameter ASTM A563 nut. It should be noted that doing so neither allows for the effects of tolerances (i.e., on bolt-length, nut-thickness, and washer-thickness) nor follows the established RCSC bolt length selection procedure.

In summary, the failure to include DTI thickness as a part of the calculated grip would not alter the selected bolt length increment in most cases. The author, however, respectfully disagrees with Mr. Flucker's categorical statement above.

Charles J. Carter is director of manuals, American Institute of Steel Construction, Inc., Chicago, IL.