DISCUSSIONS

A Summary of Changes and Derivation of LRFD Bolt Design Provisions

Paper by CHARLES J. CARTER, RAYMOND H. R. TIDE, and JOSEPH A. YURA
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Discussion by Joseph Biren, P.E.

In the subject paper, the authors present two alternative methods for the determination of strength when a bolt is subjected to combined shear and tension: the elliptical interaction approach that has historically been used by the Research Council on Structural Connections (RCSC) and the three-straight-line approach that has historically been used by AISC. The RCSC elliptical solution (Equation 5 in the subject paper) represents a simple formulation that provides for a straight-forward calculation. As such it is not clear why a three-straight-line approximation is needed. Additionally, Equation 5 is a transparent presentation of the assumed interaction concept and constraints and, as such, would greatly assist practicing engineers. Perhaps AISC should simply adopt the RCSC elliptical solution directly.

Also, there is a typesetting error in Equation 4 in the term to the right of the equals sign. The proper form is as follows:

$$f_t \le \sqrt{(\phi F_{nt})^2 - \left(\frac{\phi F_{nt}}{\phi F_{nv}}\right)^2 f_v^2} = \phi \sqrt{F_{nt}^2 - \left(\frac{F_{nt}}{\phi F_{nv}}\right)^2 f_v^2}$$

Discussion by Pierre Dumonteil, P.E.

It is certain that the errors discovered by the authors in the existing bolt design strength formulae must be corrected. However, the writer, for one, does not agree with the point of view that (1) stresses, as in Table 3, are more convenient and, therefore, should be specified rather than bolt strengths, as in equation 5 or on Figure 3, and (2) a straight-line approximation is more practical than the RCSC elliptical solution.

The writer's disagreement is based on the following reasons:

(a) It is easier to look up the basic bolt design strengths for tension and shear given in the appropriate tables of the AISC *Manual of Steel Construction, Volume II—Connections* than it is to calculate stresses.

(b) The elliptical solution amounts to nothing more than calculating the side of a right-angled triangle (which is truly what it is), and its simple form is easy to remember.

(c) It provides excellent agreement with the test data.

(d) In limit states design philosophy, member and component strengths or resistances are to be preferred unless the use of stresses cannot be avoided. This is not the case here.

Statements (a) and (b) are best verified with a spreadsheet: compare the instructions required to follow the stress approach step by step, with the bolt load method using Equation 5 in the subject paper.

The writer strongly recommends that the elliptical solution should be adopted in the exact form of Equation 5, without modification.

Joseph Biren, P.E., is principal of the structural engineering firm of Joseph Biren located in Westfield, NJ.

Pierre Dumonteil, P.E., is structural engineer, Krupps Robins, Greenwood Village, CO.