

Anchor Bolt Tolerances

ASCC Position Statement #14

The American Institute of Steel Construction (AISC) Structural Steel Educational Council, *Steel TIPS* (Technical Information and Product Services), Dec. 1993, states: "The installation of anchor bolts is not an easy task under the best of conditions. If the contractor has a firm, level, dry, and uncongested job site, then the steel erector will probably find properly installed anchor bolts. But we all know most sites are not in the above listed condition. So misplaced anchor bolts may be expected."

Even though misplaced anchor bolts may be expected, the tolerances for anchor bolt position on a project are often in dispute. The dispute arises from differing tolerances for anchor bolt placement given by the concrete industry in ACI 117-90, "Standard Specifications for Tolerances for Concrete Construction and Materials," and by the steel industry in the AISC "Code of Standard Practice for Steel Buildings and Bridges," 2000. Division 3 specifications for the concrete contractor typically reference ACI 117 while Division 5 specifications for the steel erector reference the AISC Code of Standard Practice.

ACI 117-90, Section 2.3, *Placement of embedded items*, allows a tolerance on vertical, lateral, and level alignment of ± 1 in. AISC, Section 7.5, *Installation of Anchor Rods, Foundation Bolts and Other Embedded Items*, states that the variation in dimension between the centers of any two anchor rods within an anchor rod group shall be equal to or less than 1/8 in. Clearly, these two requirements are not compatible. The ACI 117 tolerance is too lenient for anchor bolts, and the AISC tolerance is too tight, although it makes erection more convenient for the steel installer. Because both tolerances are specified in the contract documents, arguments are inevitable.

To allow for misplaced bolts, holes in base plates are oversized. The AISC *Manual of Steel Construction* recommends the following oversized hole diameters for each bolt diameter:

3/4 in. bolt—1-5/16 in. hole; **7/8 in. bolt**—1-9/16 in. hole; **1 in. bolt**—1-13/16 in. hole; **1-1/4 in. bolt**—2-1/16 in. hole; **1-1/2 in. bolt**—2-5/16 in. hole; **1-3/4 in. bolt**—2-3/4 in. hole; **2 in. bolt**—3-1/4 in. hole; and **2-1/2 in. bolt**—3-3/4 in. hole.

AISC, *Steel Design Guide Series 1, Column Base Plates*, suggests that using oversized holes

meeting these criteria may still not accommodate field variations in anchor bolt placement and suggests adding 1/4 in. to the hole diameter listed. The guide recommends using a heavy plate washer over the holes. The AISC Structural Steel Educational Council cites the following example: "If bolts are misplaced up to 1/2 inch, the oversized base plate holes normally allow the base plate and column to be placed near or on the column line. If the bolts are misplaced by more than 1/2 inch, then corrective work is required."

Based on AISC oversize holes, the Structural Steel Educational Council recommendations, and concrete contractor anchor-bolt placement techniques, ASCC concrete contractors recommend the following tolerance for each bolt location:

- 3/4- and 7/8-in.-diameter bolts: $\pm 1/4$ in.;
- 1-, 1-1/4-, and 1-1/2-in.-diameter bolts: $\pm 3/8$ in.; and
- 1-3/4, 2-, and 2-1/2-in.-diameter bolts: $\pm 1/2$ in.

ASCC concrete contractors will work with specifiers, general contractors, and construction managers to resolve tolerance conflicts between Division 3 and Division 5. If you have any questions, contact your ASCC concrete contractor or the ASCC Technical Hotline at (800) 331-0668.

Update: ACI 117-10 now includes the following tolerances for anchor bolts in concrete:

2.3.4 Anchor bolts in concrete

2.3.4.1 Top of anchor bolt from specified elevation

Vertical deviation $\pm 1/2$ in.

2.3.4.2 Centerline of individual anchor bolts from specified location

Horizontal deviation

for 3/4 in. and 7/8 in. bolts $\pm 1/4$ in.

for 1 in., 1-1/4 in., and 1-1/2 in. bolts $\pm 3/8$ in.

for 1-3/4 in., 2 in., and 2-1/2 in. bolts $\pm 1/2$ in.

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