

Post-Installed Anchor Approvals for ACI 318 Appendix D

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ACI 318-02, *Building Code Requirements for Structural Concrete*, Appendix D “Anchoring to Concrete” contains design provisions for both cast-in-place and post-installed anchors. Section D.2.3 of Appendix D permits post-installed anchors that meet the requirements of ACI 355.2-01 *Evaluating the Performance of Post-Installed Mechanical Anchors in Concrete* to be used with the Appendix D design provisions. The recently issued ACI 318-05 Appendix D requires that post-installed anchors meet the requirements of ACI 355.2-04, *Qualification of Post-Installed Mechanical Anchors in Concrete*.

Questions have been raised regarding how ACI 318 Appendix D and ACI 355.2 interact with the International Building Code (IBC), promulgated by the International Code Council (ICC), and the evaluation reports issued by the ICC Evaluation Service (ICC-ES).

Qualification of Post-Installed Anchors

First, it is important to understand the content and relationships among the pertinent documents. In the development of ACI 318-99, Appendix D was completed for both cast-in-place and post-installed mechanical anchors but was not included in ACI 318-99 since ACI Committee 355, Anchorage to Concrete, had not completed ACI 355.2 (ACI 355.2 was first issued in 2000 as a provisional standard, and in 2001 as a standard). Therefore, a proposal was presented and adopted into the 2000 IBC to add *Section 1913, Anchorage to Concrete — Strength Design* that contained the design provisions of Appendix D but only for cast-in-place anchors. Cities and other governmental jurisdictions began adopting the 2000 IBC, which provided a design method for cast-in-place anchors, but not for post-installed mechanical anchors.

In late 2001, it was recognized that there was a need to provide for the use of post-installed mechanical anchors under the strength design provisions of the 2000 IBC, rather than wait for ACI 318-02 (with its reference to ACI 355.2-01) and the subsequent adoption of the 2003 IBC. Under Section 104.11 of the IBC, the use of alternative materials and products can be allowed when properly justified. ICC-ES provides this service to building officials in the issuance of Evaluation Service Reports (ICC ESR's) that evaluate and provide data for products considered alternatives to code permitted materials and products. Post-installed mechanical anchors can be considered alternatives to the code-permitted cast-in-place anchors.

A proposed acceptance criterion was considered by the ICBO-ES Evaluation Committee that used ACI 355.2-01 as the basic test program and added ICBO-ES specific requirements, including quality control requirements among others. This *Acceptance Criteria for Mechanical Anchors in Concrete Elements AC193* was adopted by ICBO-ES in April 2002.

On February 1, 2003, ICC-ES came into existence by the consolidation of the four code evaluation service agencies: the National Evaluation Service, Inc.; the BOCAI Evaluation Services; the ICBO Evaluation Service, Inc.; and the SBCCI Public Service Testing and

Evaluation Services, Inc. ICC ES continued the use of the ICBO ES acceptance criteria as legacy criteria, as well as adopting new and revised criteria for use with the requirements of the IBC and IRC. AC 193 became acceptance criteria for use with and referencing the 2000 IBC.

Meanwhile, it was recognized in ACI 355 and subsequently in ACI 318 that revisions were required in both Appendix D and ACI 355.2 with regard to the potential for edge splitting if most torque-controlled (wedge and similar types) anchors as well as displacement-controlled (drop-in type) anchors were to be covered by Appendix D. Revisions were developed, balloted, and approved by both ACI 318 and ACI 355 to provide for the design and product qualification of post-installed anchors that have a potential to cause edge splitting. ACI 318-05 and ACI 355.2-04 contain these revisions. ACI Committee 355 also began balloting several other desired changes to ACI 355.2. Many of these changes were subsequently adopted into ACI 355.2-04, which is referenced in ACI 318-05, and will subsequently be adopted by reference in the 2006 IBC. These changes were incorporated into AC193 in 2003 and 2004. The latest version of AC193 is dated October 2005.

In summary, cast-in-place anchors are covered in both the 2000 (*Section 1913*) and 2003 IBC (by reference to ACI 318-02). Post-

installed mechanical anchors are not covered in the 2000 IBC, but are included in the 2003 IBC through reference to ACI 318-02 Appendix D, Anchorage to Concrete. However, due to a problem with edge splitting described above, most post-installed mechanical anchors could not be qualified for use under *Appendix D*. The problem was solved in ACI 318-05 by adding the provisions in *Sections*

D.5.2.7 and D.8.6. But to allow post-installed mechanical anchors to be qualified and used for both the 2000 and 2003 IBC, ICC-ES developed acceptance criteria qualification procedures (AC193) that included the corrections found in ACI 318-05 *Sections D.5.2.7 and D.8.6*. The June 2004 issue of AC193 and later versions contain this correction in Section 9.3.2 of Annex A. Therefore, post-installed mechanical anchors receiving an ESR under AC193 from ICC-ES are qualified for use with the 2003 IBC (that references ACI 318-02) and the 2000 IBC (using *Appendix D of ACI 318-02*) provided that Annex A, Section 9.3.2 of AC 193, is considered for design with close edge distances. Section 9.3.2 of AC 193 Annex A must be considered when the edge distance from the center of an undercut anchor is less than 2.5 times the embedment length and when it is less than 4.0 times the embedment length for post-installed torque-controlled and displacement-controlled mechanical anchors. ■

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