

Anchor Provisions Undergo Significant Changes in the 2012 International Building Code

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Since its introduction in 2000, the International Building Code® (IBC) has been the preferred model code for states, municipalities and other jurisdictions throughout the U.S.

The publication of the 2012 IBC represents another milestone in the I-Code legacy. Notable improvements in the 2012 IBC include significant changes to the provisions for anchors in concrete by way of reference in Section 1912 to ACI 318-11, Building Code Requirements for Structural Concrete, and a new ACI standard, ACI 355.4-11. Taken together, these documents provide the basis for the qualification and design of adhesive anchors.

At present the most widely recognized requirements for qualification and design of adhesive anchor systems are given in AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements, an Acceptance Criteria published by ICC Evaluation Service (ICC-ES). This document establishes requirements that permit post-installed adhesive anchors in concrete elements to be recognized in ICC-ES Evaluation Service Reports (ESRs). Prior to publication of the 2012 IBC, procedures for establishing the design strength of adhesive anchors used to create connections between structural concrete and attachments have not existed in the code. Past editions of ACI 318 have

specifically excluded adhesive anchors from the scope of Appendix D – Anchoring to Concrete. Accordingly, the basis for the development of AC308 in 2005 was to allow recognition of adhesive anchors in concrete as an alternative to cast-in-place anchors and post-installed expansion and undercut anchors under the provisions of IBC Section 1912, Anchorage to Concrete – Strength Design.

Even with the publication of the new ACI provisions, it will be necessary to retain acceptance criteria for adhesive anchors in order to address the specific documentation and quality control requirements associated with ICC-ES procedures and to accommodate required revisions or enhancements to the standards as they now exist.

The new standard ACI 355.4-11, Qualification of Post-Installed Adhesive Anchors in Concrete, provides test requirements and assessment procedures that are coordinated with the new design



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provisions for adhesive anchors in ACI 318-11 Appendix D. While the provisions of the new ACI 355.4-11 standard are largely consistent with those of AC308, notable differences exist. Some of the more significant variances include:

- ACI 355.4-11 does not address the use of torque-controlled adhesive anchors, a relatively new addition to the post-installed anchor world. Since AC308 currently provides testing and qualification provisions for these types of adhesive anchors, the revised AC308 will retain those provisions to evaluate torque-controlled adhesive anchors as alternatives to conventional adhesive anchors in the code.
- The use of adhesive anchors overhead to support sustained tension loads has long been an area of concern. Testing for



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sustained tension loads is mandatory under both AC308 and ACI 355.4-11, and while ICC-ES had previously strengthened the provisions of AC308 related to both sustained tension loading and overhead installation, ACI 355.4-11 and ACI 318-11 add further conservatism to the sustained load/overhead installation condition by

- a. adding specific visual assessment criteria for the testing of overhead installations;
 - b. requiring a special label on products limited to vertically downward installation only, i.e., if testing and assessment to address sensitivity to installation direction (horizontal and overhead) has not been conducted or if the product is not suitable for this installation direction as established by test;
 - c. requiring that anchors be tested for sustained loading at a minimum temperature of 110°F (43°C); and
 - d. requiring that all adhesive anchor installations in the horizontal or upwardly inclined position for anchors that are intended to resist sustained tension must be performed by a certified adhesive anchor installer under continuous special inspection.
- Adhesive anchor performance can be influenced if the anchor is installed in water-saturated concrete. Tests for this condition are optional in AC308, but have been made mandatory under ACI 355.4-11.
 - Freezing conditions during service life of the anchor can also have a negative effect on the anchor performance. The freezing and thawing test is conducted to verify the anchor's response to a sustained tension load when subjected to 50 temperature cycles ranging between room temperature and sub-freezing temperatures. While AC308 permits this test to be omitted, e.g., for systems to be used only for indoor applications in climate-controlled environments, freeze-thaw testing is mandatory under ACI 355.4-11.
 - ACI 318-11 Appendix D provides default bond stress values for design that may be used in the event that a specific adhesive anchor system has not yet been selected. ACI 355.4-11 adopts these default bond stresses as minimum acceptable bond stresses for qualification of adhesive anchor systems; that

is, any adhesive anchor system qualified for use under ACI 355.4-11 must be able to provide bond stresses equivalent to or better than the default values provided in the code.

- Tests for the effects of regional variations in concrete on bond strength, already provided in AC308, now include tests in concrete using fly ash as a cement-replacement to assess whether the adhesive anchor system behavior is sensitive in any way to this common concrete additive.

With some exceptions, the design provisions for adhesive anchors in ACI 318-11 Appendix D are also quite similar to those currently included in AC308. Differences include:

- Omission of the increase factor for groups, $\psi_{g,Na}$ in ACI 318-11 Appendix D. This term, which is always equal to or greater than unity, was omitted for simplicity but may still be used at the discretion of the designer.
- Revision of the equation used to determine the critical edge distance and spacing values corresponding to bond failure.
- Revision of the factor on bond strength for the supplemental check on sustained tension loads from 0.75 to 0.55.
- Inclusion of adhesive anchors in lightweight concrete with default strength reduction values. This is not currently included in the scope of AC308.

As noted earlier, ICC-ES will develop acceptance criteria referring to ACI 355.4-11 for qualification requirements and to ACI 318-11 Appendix D for design of adhesive anchors, thus eliminating any duplication of requirements for testing or conflicts in design provisions, and enabling applicants to obtain Evaluation Service Reports for adhesive anchors that comply with the 2012 IBC.

We encourage applicants interested in obtaining Evaluation Service Reports for adhesive anchor systems, showing compliance with the 2012 IBC, to contact Andra Hoermann-Gast at ahoermann-gast@icc-es.org for further information.



This article is intended to provide information about the 2012 IBC significant changes to the provisions for anchors in concrete. It should not be construed as an endorsement or procedural recommendation by ICC-ES®.