The concrete chapter of the 2012 International Building Code®, Chapter 19, references ACI 318-11 Building Code Requirements for Structural Concrete, the standard for concrete design and construction. The chapter continues to include a small number of modifications to ACI 318. These modifications are based on ACI 318-08, which was the referenced standard for concrete in the 2009 IBC. This makes the modifications in the 2012 IBC inconsistent with the 2011 edition of the ACI 318 standard.

The purpose of this article is to identify three significant proposed changes approved in the 2012 Code Development Cycle which resolve the inconsistency in the 2012 IBC. These approved changes address requirements for concrete wall piers and anchors in concrete. The code changes are S203-12, S340-12 and S215-12. These changes are being brought to the attention of designers and adopting agencies in an effort to correlate the provisions of the 2012 IBC with those of ACI 318-11. Jurisdictions that have not adopted the 2012 IBC can make the following amendments in their adopting ordinance, and those that have adopted the 2012 IBC can approve the changes under Section 104.11 of the IBC, “Alternative materials, design and methods of construction and equipment.” Consistent with the formatting of Section 1905 in the IBC, the text in italics indicates provisions that differ from ACI 318-11 but are necessary to coordinate the provisions.
S203-12: Concrete wall piers

Code change S203-12 was submitted by the American Concrete Institute (ACI), the standard developer responsible for ACI 318, to coordinate the IBC wall pier provisions with Chapter 21 of ACI 318-11. The final action on this code change was Approved as Submitted. The resulting IBC text is as follows:

1905.1.1 ACI 318, Section 2.2

WALL PIER. The definition for this term is deleted without substitution or revision.

1905.1.3 ACI 318, Section 21.4. Modify ACI 318, Section 21.4, by adding new Section 21.4.3 and renumbering existing Sections 21.4.3 and 21.4.4 to become 21.4.4 and 21.4.5, respectively.

21.4.3 – Connections that are designed to yield shall be capable of maintaining 80 percent of their design strength at the deformation induced by the design displacement, or shall use Type 2 mechanical splices.

21.4.4 – Elements of the connection that are not designed to yield shall develop at least 1.5 $S_y$.

21.4.5 – In structures assigned to SDC D, E, or F, wall piers shall be designed in accordance with 21.9 or 21.13 in ACI 318.

1905.1.4 ACI 318, Section 21.9. This section is deleted without substitution or revision.

S340-12: Concrete anchors

Code change S340-12 was submitted by the author to coordinate the IBC anchor provisions with Appendix D of ACI 318-11. The final action on this code change was Approved as Modified. The resulting IBC text is as follows:

1905.1.9 ACI 318, Section D.3.3. Modify ACI 318 Sections D.3.3.4.2, D.3.3.4.3(d) and D.3.3.5.2 to read as follows:

D.3.3.4.2 – Where the tensile component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor tensile force associated with the same load combination, anchors and their attachments shall be designed in accordance with D.3.3.4.3. The anchor design tensile strength shall be determined in accordance with D.3.3.4.4.

Exception:

1. Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy Section D.3.3.4.3(d).

D.3.3.4.3(d) – The anchor or group of anchors shall be designed for the maximum tension obtained from design load combinations that include $E$, with $E$ increased by $\Omega_{w}$. 

This illustrates the definition of a Wall Pier in ACI 318-11
The anchor design tensile strength shall be calculated from D.3.3.4.4.

D.3.3.5.2 – Where the shear component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor shear force associated with the same load combination, anchors and their attachments shall be designed in accordance with D.3.3.5.3. The anchor design shear strength for resisting earthquake forces shall be determined in accordance with D.6.

Exceptions:

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or non-bearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane shear strength in accordance with D.6.2 and D.6.3 need not be computed, and D3.3.5.3 shall be deemed to be satisfied provided all of the following are met:
   1.1. The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.
   1.2. The maximum anchor nominal diameter is 5/8 inches (16 mm).
   1.3. Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).
   1.4. Anchor bolts are located a minimum of 13/4 inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.
   1.5. Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.
   1.6. The sill plate is 2-inch or 3-inch nominal thickness.

2. For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or non-bearing walls of light-frame construction to foundations or foundation stem walls, the in-plane shear strength in accordance with D.6.2 and D.6.3 need not be computed and D3.3.5.3 shall be deemed to be satisfied provided all of the following are met:
   2.1. The maximum anchor nominal diameter is 5/8 inches (16 mm).
   2.2. Anchors are embedded into concrete a minimum of 7 inches (178 mm).
   2.3. Anchors are located a minimum of 13/4 inches (45 mm) from the edge of the concrete parallel to the length of the track.
   2.4. Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.
   2.5. The track is 33 to 68 mil designation thickness.

Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.

3. In light-frame construction, bearing or non-bearing walls, shear strength of concrete anchors less than or equal to 1 inch [25 mm] in diameter attaching a sill plate or track to foundation or foundation stem wall need not satisfy D.3.3.5.3(a) through (c) when the design strength of the anchors is determined in accordance with D.6.2.1(c).

1905.1.10 ACI 318, Section D.4.2.2: This section is deleted without substitution or revision.
S215–12: Concrete anchors

Code change S215–12 was submitted by ACI, to coordinate the IBC anchor requirements with Appendix D of ACI 318–11. The final action on this code change was Approved as Submitted. The resulting IBC text is as follows:

In addition to the revisions to Table 1705.3, this code change included the addition of new Section 1901.3 (subsequent sections renumbered) and the deletion of current Section 1909 as follows:

1901.3 Anchoring to concrete. Anchoring to concrete shall be in accordance with ACI 318 as amended in Section 1905, and applies to cast-in (headed bolts, headed studs, and hooked J- or L-bolts) anchors and post-installed expansion (torque-controlled and displacement-controlled), undercut, and adhesive anchors.

1909 Anchorage to concrete—strength design. This section is deleted without substitution or revision.
This article points out that the concrete chapter of the 2012 IBC is inconsistent with its referenced standard, ACI 318-11. Further, it provides critical information regarding concrete wall piers and anchors, and corrective action to correlate the provisions based on code changes approved in the 2012 cycle.

The administrative update process through which ACI 318-11 was adopted into the 2012 IBC was apparently meant for standards not modified by the IBC. When applied to standards modified by the IBC, it obviously can render the modifications inconsistent with the updated referenced standard. It is probably time for ICC to reconsider whether they want to continue to allow the administrative update of standards modified by the IBC. Standard Development Organizations also need to consider whether such an administrative update is in the interest of the user community.

ICC Technical Staff Response:
Dr. Ghosh has correctly noted an inconsistency in the concrete-related provisions in the 2012 IBC versus that of the referenced standard, ACI 318-11. He further correctly notes that a process which allows for revisions to a reference standard via the IBC while at the same time the standard’s developer is updating the standard is not a tenable situation. ICC will be looking for a solution to this problem. The code changes noted in this article can be downloaded from the ICC website.