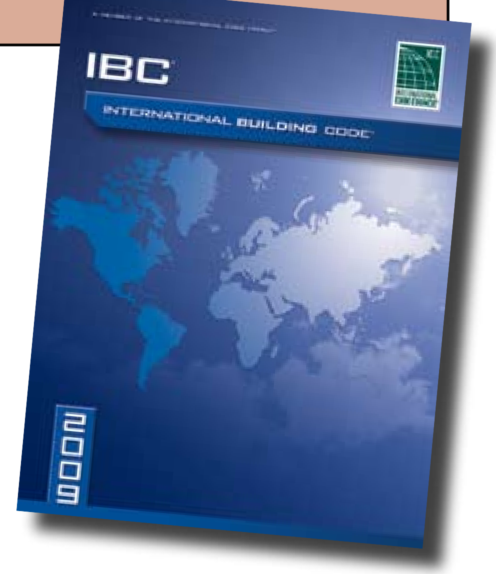
2009 International Building Code® Updates

By Alan Carr, P.E., S.E.

The IBC Structural Code Development Committee considered more than 300 code change proposals to the structural provisions of International Building Code (IBC) in the process of updating from the 2006 edition to the 2009 edition. Nearly 200 of these proposals have been incorporated into the 2009 IBC. These revisions vary in significance from minor editorial clarifications to substantive technical revisions or additional provisions. This article provides a brief overview of the more significant changes to the IBC structural requirements.



Earthquake Load Updates

In the 2009 IBC, the 2005 edition of ASCE 7 remains the primary reference for determining earthquake, snow and wind loads. The referenced standard now includes Supplement No. 2, which revises the earthquake base shear equation for buildings and non-building structures designed under the equivalent lateral force procedure. This reinstates a minimum threshold that had been removed in the 2005 edition of the standard. The supplement can be downloaded from the ASCE/SEI website at no cost.

The requirement in Section 1604.8.2 for concrete and masonry walls to be anchored to the floors and roofs that support them laterally now applies to all wall construction, not just concrete and masonry. Furthermore, the minimum strength level horizontal seismic force of 280 pounds per foot has been replaced with a reference to the minimum design strength in accordance with ASCE 7 Section 11.7.3, *Load Path Connections*. Similarly, new Section 1613.7 provides a modification to Section 11.7.5 of ASCE 7 by making it applicable to all walls rather than just concrete and masonry. In addition, this modification removes the minimum prescribed strength level horizontal seismic force from the ASCE 7 provision. The net effect is that the code now merely refers to the minimum design strength required by ASCE 7 Section 11.7.3 but no longer requires a minimum capacity of 280 pounds per foot.

The 2009 IBC references the 2007 edition of NFPA 13, *Installation of Sprinkler Systems*, for the installation of automatic sprinkler systems. Because this latest edition of NFPA 13 has addressed prior concerns related to seismic supports for sprinkler pipes, Section 1613.6.3 clarifies that systems installed in accordance with NFPA 13 are now deemed to comply with the seismic bracing provisions. The exemptions from seismic bracing requirements allowed by Section 13.6.7, *HVAC Ductwork*, of ASCE 7 is extended, through an IBC modification, to also include ducts that have a component factor, I_p = 1.5 (see Section 1613.6.8).

A minimum seismic separation requirement between adjacent structures contained in the IBC prior to the 2006 edition, as well as in the *Uniform Building Code*® (UBC), allowed engineers to demonstrate compliance with the code. Providing this minimum separation reduces the possibility of impacting an adjacent structure. Since a comparable requirement is not contained in the ASCE 7 seismic provisions, Section 1613.6.7 reinstates this provision under the 2009 IBC.

Wind Load Updates

The outdated legacy Standard SSTD 10 has been replaced by the new ICC– 600 *Standard for Residential Construction in High-Wind Regions*. This standard applies to residential buildings located where the basic wind speed is 100 to 150 miles per hour. It provides prescriptive criteria for exterior walls constructed of concrete, masonry and light-frame wood or cold-formed steel. Criteria for exterior wall assemblies, fenestration and roof assemblies are also included. The recommendations pertaining to lower limits on pressures determined by wind tunnel testing contained in the ASCE 7 *Commentary* have been incorporated directly into the code, so they are now enforceable (see Section 1609.1.1.2). A new section in Chapter 17 will require additional special inspections for wind resistance in high-wind areas based on wind speed and exposure category (Section 1706).

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Alternate All-Heights Method

In response to concerns from design engineers over the complexity of wind load computations under ASCE 7, member organizations of NCSEA composed an alternative method to determining wind loads. The intention is to reduce the effort required in determining wind forces, while providing results equal to, or more conservative than, Method 2 of ASCE 7 Chapter 6. This alternative approach will also be considered by the ASCE 7 Committee and, if accepted, it should appear in the next edition of the standard.

While ASCE 7 already includes a simplified wind-load procedure (Method 1), it has numerous restrictions. Similarly the alternative all-heights method has limitations, although it applies to a somewhat broader range of buildings. It is limited to buildings and other structures that have a frequency of at least 1 hertz, which is equivalent to requiring the structure to be rigid (see definition of "rigid buildings and other structures" in Section 6.2 of ASCE 7). The IBC provision also allows any building up to 75 feet in height that has a height-to-least-width ratio of 4 or less to qualify directly without calculating its frequency. Buildings must also be regularly shaped, simple diaphragm buildings with envelopes classified as either enclosed or partially enclosed.

Certain types of structures are not permitted to utilize the alternative all-heights method, and therefore must be analyzed using the ASCE 7 provisions.

These include:

- Open buildings
- Roofs slopes greater than 45 degrees
- Domed, sawtooth, stepped or multi-span gable roofs
- Structures sensitive to dynamic effects
- Structures located where channeling effects or buffeting in the wake of upwind obstructions warrant special consideration

The primary simplification is accomplished by generating a table of net pressure coefficients (C_{net}), combining a number of parameters in a simple and yet conservative manner. Section 1609.6.2 defines the various notations, including C_{net}. Application of this net pressure coefficient is the means by which this method reduces the number of steps required to calculate wind loading. The gust factor, G, is taken as 0.85 for determining the tabulated C_{net} values. This is consistent with the gust factor for rigid structures that is permitted in Section 6.5.8.1 of ASCE 7.

Section 1609.6.3 provides the formula (see Equation 16-34) for calculating the design wind pressures, and it also incorporates the ASCE 7 minimum wind pressure for main wind-force-resisting systems as well as components and cladding. The design wind pressure is the product of the wind stagnation pressure, q_s; velocity pressure exposure coefficient, K_z; net pressure coefficient, C_{net}; importance factor, I; and the topographic factor, K_{zt}.

Table 1609.6.2(1) converts the mapped basic wind speed to wind stagnation pressure at a height of 33 feet for calculating the design wind pressure in Equation 16-34. For the velocity pressure exposure coefficient and the topographic factor, the reader is referred to the corresponding ASCE 7 sections. These are evaluated only at the mean roof height for leeward walls, side walls and roofs (see Section 1609.6.4.2). Table 1609.6.2(2) provides net pressure coefficients for both enclosed and partially enclosed structures [see Section 6.5.9, *Enclosure Classification* in ASCE 7]. The tabulated C_{net} values represent the sum of external and internal pressure coefficients as expressed in the notation definition in Section 1609.6.2.

Structural Integrity

Another significant change to Chapter 16 provides structural integrity requirements for high-rise buildings that are classified as Occupancy Category III or IV in new Section 1614. There is little question that the requirements in building codes and standards, together with structural design and construction practices prevalent in the United States, provide the majority of structures with adequate safety. While the majority of buildings do not appear to have integrity issues, low-rise buildings do not pose the same risk as taller high-rise buildings, which employ more complex structural systems. The code change proponents felt that structural integrity provisions in the code should reflect this relative risk. By limiting these requirements to Occupancy Category III and IV high-rise buildings, they will not impact buildings that are routinely built with no indication of integrity issues.

The provisions are predicated upon integrity requirements contained in the ACI 318 standard for many years. By adapting those ACI 318 requirements to structures of other construction types based on the differing conditions of weight and detailing, these provisions will enhance the overall resistance of structures by establishing minimum requirements for tying together the primary structural elements.

Other Chapter 16 Updates

Decks and balconies will now use the same uniform live load, as the occupancy they serve. This eliminates the previous distinction between deck and balcony loading, in turn rendering the definitions of "deck" and "balcony" moot. Thus these definitions have been deleted as well (Table 1607.1). The code now addresses the condition where the load on a cantilevered portion of a deck span produces uplift at the back-span support. It also explicitly requires consideration of snow load since it is conceivable that snow load may control the design of the deck (see Section 1604.8.3).

The point of application of passenger vehicle loads on vehicle barrier systems in parking garages now includes a second loading condition which reflects bumper heights of currently popular vehicles (Section 1607.7.3). To clarify live load reductions, a K_{LL} factor was added to Table IBC 1607.9.1 for one-way slabs to be consistent with Table 4-2 of ASCE 7. The live-load reduction requirements for one-way slabs have been changed from a general prohibition on live-load reduction to a limit on the tributary area, A_T, for consistency with Section 4.8.5 of ASCE 7 (Section 1607.9.1.1).

Soils and Foundations

Chapter 18 is reorganized, reformatted and updated to reflect current foundation design and construction practice. Foundations are considered either deep or shallow. The term "geotechnical" is used consistently throughout the chapter in referring to geotechnical investigations and geotechnical reports. The general requirements related to design of all foundations and the specific requirements related to the design of shallow foundations (e.g. footings) are reorganized to appear in a more logical progression of subject matter. Foundation walls, retaining walls and embedded posts and poles are consolidated into a single section. The deep foundation (piles and piers) requirements are reorganized in order to eliminate redundancy, resolve conflicting definitions, and simplify the provisions wherever possible. Deep foundations are further divided into two general categories: driven deep foundations and cast-in-place deep foundations.

Concrete

The majority of changes to the concrete provisions of Chapter 19 coordinate the IBC provisions with the 2008 edition of the ACI 318 standard. New section references in the code correspond to the final published version of ACI 318. Several of the prior IBC modifications to ACI 318 in Section 1908 no longer appear in the 2009 IBC because they have been addressed in the latest edition of the ACI 318 standard. Changes to the definitions related to structural walls coordinate the terminology of ACI 318-08 with ASCE 7-05 (Section 1908.1). Added exceptions to the anchorage ductility requirements of ACI 318 Appendix D apply to 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 (Section 1908.1.9). Continuous special inspection is required for cast-in-place bolts in concrete where allowable loads have been increased for allowable stress design, or where strength design is used and periodic special inspection is required for post installed anchors in hardened concrete (Section 1704.4, Table 1704.4).

Masonry

Substantial portions of Chapter 21 have been replaced with references to the 2008 edition of the *Building Code Requirements and Specification for Masonry Structures*, also known as the Masonry Standards Joint Committee (MSJC) code. In addition to replacing code sections with standard references, modifications were made to coordinate IBC requirements in Chapter 21 with the provisions in the 2008 MSJC code. Seismic design requirements for masonry structures under the IBC directly reference the seismic provisions in the MSJC code. Seismic design coefficients and limitations for autoclaved aerated concrete (AAC) masonry shear wall systems were added in Section 1613.6.4. These extend the use of these structural systems to seismic applications in Seismic Design Category B and C. Some of the prior modifications for allowable stress design and strength design have been removed from the IBC because they have been addressed in the latest edition of the MSJC code.

Steel

The most significant change to Chapter 22 is the updated reference to the latest editions of standards that govern the design of cold-formed steel. New code provisions in Section 2209 reference two new Steel Deck Institute (SDI) standards for design and construction of cold-formed steel floor and roof decks that can be used in lieu of the more formal approach of AISI S100. Additional changes to the IBC cold-formed steel provisions correlate with the latest edition of the corresponding AISI standard. A new standard for cold-formed steel floor and roof framing, AISI S210, appears in Section 2210.5. For cold-formed steel trusses, the code references the latest edition of AISI S214, including Supplement Number 2. New code language for cold-formed steel trusses provides requirements that are similar to those for wood trusses in Chapter 23. Requirements have been added for the design of temporary and permanent bracing for cold-formed steel trusses spanning 60 feet or greater. In addition, cold-formed steel trusses spanning 60 feet or greater require special inspection of the bracing (see Sections 2210.3 and 1704.3.4).

Wood

Specific requirements have been added for design of temporary and permanent bracing for wood trusses spanning 60 feet or greater, and these trusses also require special inspection of the bracing (Sections 2303.4.3 and 1704.6.2). A new table for selecting wood structural panel wall sheathing to resist component and cladding wind loads is added to Section 2304 (Section 2304.6.1, Table 2304.6.1). Changes to the provisions for fasteners in preservative treated and fire-retardant treated wood are intended to reduce confusion between the code requirements and the manufacturer's recommendations (Section 2304.9.5). For preservative-treated wood, corrosion protection guidance is provided for connectors as well as fasteners in exterior connections. Plain carbon-steel nails, timber rivets, wood screws and lag screws used in SBX/DOT and zinc borate preservative-treated wood in an interior, dry environment are permitted (Section 2304.9.5.1). Guidance is also provided for fasteners in fire-retardant-treated wood (see Sections 2304.5.9.3 and 2304.5.9.4).

By far, the most significant change to Chapter 23 is the removal of substantial portions of Section 2305 because the code now references the 2008 edition of the ANSI/AF&PA NDS Supplement *Special Design Provisions for Wind and Seismic* (SDPWS) standard for lateral design of wood structures. In addition, many general design provisions for wood structures in Section 2306 have been removed because they are contained in the AF&PA SDPWS standard. Since the SDPWS is a dual-format standard (ASD/LRFD), a reference to the SDPWS has been added to Section 2307 for load and resistance factor design (LRFD) of wood structures.

Summary

It is just over nine years since *STRUCTURE magazine* featured an article introducing a brand-new building code, the 2000 IBC. Since then, the IBC has been widely adopted and the process of developing codes has continued, sometimes taking unexpected turns. Nine years ago, who would have foreseen structural integrity requirements as a necessity in the building code? As we embark on another cycle of code development, it is perhaps an interesting moment to reflect back on how far we've come, how we got here and ponder what lies ahead.▪

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