CHAPTER

16

Part 1 STRUCTURAL DESIGN

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This chapter explains and provides background on the development of the structural design requirements of Chapter 16 of the 2009 International Building Code (IBC). As was the case with the 2006 edition of the IBC, large portions of Chapter 16 provisions related to the determination of snow, wind, and seismic loads are included only by reference to ASCE 7-05 Standard Minimum Design Loads for Buildings and Other Structures1 in order to eliminate the possibility of error and confusion arising from the IBC's past practice of adopting and transcribing the provisions related to snow, wind, and seismic loads from ASCE 7. This practice often required designers and building officials to refer to both the building code and the ASCE 7 standard simultaneously. Further, there was a risk that when transcription into the building code was made, inadvertent errors and omissions might take place. Thus, to ensure that the design requirements of the building code are succinctly and unambiguously specified, a coalition of the Structural Engineering Institute (SEI) of ASCE and the National Council of Structural Engineers Associations (NCSEA) developed a proposal whereby all technical specifications relating to snow, wind, and seismic loading are incorporated through reference to the 2005 edition of the ASCE 7 standard. This results in substantial reduction in material actually contained in the 2006 and 2009 IBC. Portions that are still left in the IBC relate to the local geologic, terrain, or other environmental conditions that many building officials will wish to specify when adopting the model code by local ordinance. In addition, the 2009 IBC includes a new simplified wind design provision that is not found in ASCE 7-05 or in the 2006 IBC. Many of the seismic provisions of the IBC are derived from two major sources: ASCE 7-05[1] and the 2003 NEHRP *Provisions*.[2] The seismic design provisions of ASCE 7-05 are in fact adopted from those of the 2003 NEHRP *Provisions*. Fortunately, both of these documents come with detailed commentaries. Portions of these commentaries have at times been paraphrased in an attempt to make this handbook reasonably self-contained. In many instances, fairly detailed background to certain provisions has been provided in appendices, so as not to interfere with the flow of the handbook.

Numerical examples have been included where they serve to illustrate the design requirements.

Section 1601 *General*

Chapter 16, Structural Design, governs the structural design of IBC-regulated buildings, nonbuilding structures, and portions thereof. A building is defined in Section 202 as any structure used or intended for supporting or sheltering any use or occupancy.

Chapter 16 provides requirements for minimum structural loads as well as criteria or methods of load application to be used in the design of buildings and other structures. The various types of structural loads specified by Chapter 16 are either gravity loads or lateral loads. Gravity loads specifically addressed are dead loads, live loads, snow loads, and rain loads. Lateral loads specifically dealt with are those due to wind, earthquakes, soil pressure, or flood. Loading conditions, such as uniformly distributed and concentrated live loads, impact loads, and most important, the design load combinations are also regulated by the provisions of Chapter 16. Section 1601 presents the scope of Chapter 16. Section 1602 defines terms that are commonly used in the structural design requirements. Section 1603 specifies the minimum information that must be provided on the construction documents. Section 1604 gives general design requirements and specifically addresses strength criteria, serviceability criteria, including deflection limitations, structural analysis, occupancy categories, and load tests. Section 1605 addresses the vital topic of design load combinations. Strength design load combinations as well as allowable stress design load

combinations are given. Section 1606 specifies design dead loads. Section 1607 specifies the minimum uniformly distributed live loads and minimum concentrated live loads for various types of occupancies. This section also permits a reduction of design live loads under certain conditions. Section 1608 specifies the design snow loads, largely by reference to Chapter 7 of ASCE 7-05. Section 1609 contains structural design requirements for wind loads, largely by reference to Chapter 6 of ASCE 7-05. Sections 1610, 1611 and 1612 treat soil lateral loads, rain loads and flood loads, respectively. The rain load provisions of Section 1611 are by reference to Chapter 8 of ASCE 7-05. Section 1613 is devoted to the seismic design of buildings and other structures and references Chapters 11 through 23 (excluding Chapter 14) and Appendix 11B of ASCE 7-05. Section 1614 is new in the 2009 edition of the code and includes provisions to ensure a minimum level of structural integrity.

Section 1602 *Definitions*

The IBC defines general structural terms that are used in Chapter 16 in Section 1602.

Although some notations are given in Section 1602, symbols and notations are typically defined throughout the IBC following the equation(s) in which they are used. The ICC Structural Subcommittee thought this to be more user-friendly than requiring the reader to refer back to the beginning of a chapter every time an equation appears.

Note that the 2009 IBC no longer makes a distinction between a "Balcony" and a "Deck," and their definitions no longer appear in this section. The definitions were listed because the 2006 IBC Table 1607.1 required different live loads for balconies and for decks. Different loading conditions for a balcony cantilevering from a structure and a deck that is supported on at least two opposing sides were first included in two of the three legacy building codes about a decade ago. This eventually made its way into the IBC as well as ASCE 7-05. Live load on a deck was to be determined simply from the occupancy of the building, whereas additional minimum values were specified for the live load on a balcony. However, after closer scrutiny, it was felt that there is no justification for specifying different live loads based on different support conditions, especially when there is no historical evidence that the structural performance of decks is superior to that of balconies. As a result, the live load on both balconies and decks is now to be determined from the occupancy without any specified minimum value.

Section 1603 *Construction Documents*

This section details the items to be shown on construction documents.

Construction documents are a part of the submittal documents required by Section 107 and are defined in Section 202. Note that the loads are not required to be on the construction drawings, but must be included within the construction documents in such a way that the design loads are clear for all parts of the structure. Of course, the indicated loads are required to be equal to or greater than the loads required by the code. The information required to be included in the construction documents is useful to the building official in performing plan review and field inspection. It is also typically found to be useful if additions or alterations are made to a structure at a later date. Each of the items indicated in Section 1603.1.4 is an important parameter in the determination of the wind resistance that is required in the structural system of the building.

The exception to Section 1603.1 simplifies the structural design information required for buildings constructed to the conventional light-frame construction provisions of Section 2308. A registered design professional is not required for such buildings. However, many of the requirements of Sections 1603.1.1 through 1603.1.9 clearly would require the services of such a professional in order to provide the specified design data. The requirements in the