

2012 IBC
CODE AND COMMENTARY
Volume 2

The complete IBC with
commentary after each section



2012 IBC[®]

2012 CODE AND COMMENTARY

Volume 2



2012 International Building Code® Commentary

First Printing: September 2011

ISBN:978-1-60983-063-2 (soft-cover edition)

COPYRIGHT © 2011
by
INTERNATIONAL CODE COUNCIL, INC.

ALL RIGHTS RESERVED. This 2012 *International Building Code® Commentary—Volume II* is a copyrighted work owned by the International Code Council, Inc. Without advance written permission from the copyright owner, no part of this book may be reproduced, distributed or transmitted in any form or by any means, including, without limitation, electronic, optical or mechanical means (by way of example, and not limitation, photocopying, or recording by or in an information storage retrieval system). For information on permission to copy material exceeding fair use, please contact: Publications, 4051 West Flossmoor Road, Country Club Hills, IL 60478-5795. Phone 1-888-ICC-SAFE (422-7233).

Trademarks: “International Code Council,” the “International Code Council” logo and the “International Building Code” are trademarks of the International Code Council, Inc.

PRINTED IN THE U.S.A.

PREFACE

The principal purpose of the Commentary is to provide a basic volume of knowledge and facts relating to building construction as it pertains to the regulations set forth in the 2012 *International Building Code*. The person who is serious about effectively designing, constructing and regulating buildings and structures will find the Commentary to be a reliable data source and reference to almost all components of the built environment

As a follow-up to the International Building Code, we offer a companion document, the *International Building Code Commentary—Volume II*. Volume II covers Chapters 16 through 35 and the appendices of the 2012 *International Building Code*. The basic appeal of the Commentary is thus: it provides in a small package and at reasonable cost thorough coverage of many issues likely to be dealt with when using the *International Building Code* — and then supplements that coverage with historical and technical background. Reference lists, information sources and bibliographies are also included.

Throughout all of this, effort has been made to keep the vast quantity of material accessible and its method of presentation useful. With a comprehensive yet concise summary of each section, the Commentary provides a convenient reference for regulations applicable to the construction of buildings and structures. In the chapters that follow, discussions focus on the full meaning and implications of the code text. Guidelines suggest the most effective method of application, and the consequences of not adhering to the code text. Illustrations are provided to aid understanding; they do not necessarily illustrate the only methods of achieving code compliance.

The format of the Commentary includes the full text of each section, table and figure in the code, followed immediately by the commentary applicable to that text. At the time of printing, the Commentary reflects the most up-to-date text of the 2012 *International Building Code*. As stated in the preface to the *International Building Code*, the content of sections in the code which begin with a letter designation (i.e., Section [P]2903.1) are maintained by another code development committee. Each section's narrative includes a statement of its objective and intent, and usually includes a discussion about why the requirement commands the conditions set forth. Code text and commentary text are easily distinguished from each other. All code text is shown as it appears in the *International Building Code*, and all commentary is indented below the code text and begins with the symbol ❖.

Readers should note that the Commentary is to be used in conjunction with the *International Building Code* and not as a substitute for the code. The Commentary is advisory only; the code official alone possesses the authority and responsibility for interpreting the code.

Comments and recommendations are encouraged, for through your input, we can improve future editions. Please direct your comments to the Codes and Standards Development Department at the Chicago District Office.

The International Code Council would like to extend its thanks to the following individuals for their contributions to the technical content of this commentary:

Chris Marion	Gregory Cahanin
Jeff Tubbs	David Cooper
Rebecca Quinn	Dave Collins
Joann Surmar	Vickie Lovell
James Milke	John Valiulis
Richard Walke	Marcelo Hirschler
Dave Adams	Edward Keith
Zeno Martin	Phillip Samblanet
Jason Thompson	

TABLE OF CONTENTS

CHAPTER 16	STRUCTURAL DESIGN.....	16-1 – 16-90
CHAPTER 17	SPECIAL INSPECTIONS AND TESTS	17-1 – 17-30
CHAPTER 18	SOILS AND FOUNDATIONS.....	18-1 – 18-80
CHAPTER 19	CONCRETE	19-1 – 19-30
CHAPTER 20	ALUMINUM	20-1 – 20-2
CHAPTER 21	MASONRY	21-1 – 21-46
CHAPTER 22	STEEL	22-1 – 22-10
CHAPTER 23	WOOD	23-1 – 23-118
CHAPTER 24	GLASS AND GLAZING	24-1 – 24-28
CHAPTER 25	GYPSUM BOARD AND PLASTER.....	25-1 – 25-24
CHAPTER 26	PLASTIC	26-1 – 26-28
CHAPTER 27	ELECTRICAL.....	27-1 – 27-4
CHAPTER 28	MECHANICAL SYSTEMS.....	28-1 – 28-2
CHAPTER 29	PLUMBING SYSTEMS.....	29-1 – 29-18
CHAPTER 30	ELEVATORS AND CONVEYING SYSTEMS.....	30-1 – 30-24
CHAPTER 31	SPECIAL CONSTRUCTION	31-1 – 31-20
CHAPTER 32	ENCROACHMENTS INTO THE PUBLIC RIGHT-OF-WAY	32-1 – 32-6
CHAPTER 33	SAFEGUARDS DURING CONSTRUCTION.....	33-1 – 33-8
CHAPTER 34	EXISTING STRUCTURES	34-1 – 34-58
CHAPTER 35	REFERENCED STANDARDS	35-1 – 35-26
APPENDIX A	EMPLOYEE QUALIFICATIONS	A-1 – A-2
APPENDIX B	BOARD OF APPEALS.....	B-1 – B-4
APPENDIX C	GROUP U — AGRICULTURAL BUILDINGS	C-1 – C-4

TABLE OF CONTENTS

APPENDIX D FIRE DISTRICTS..... D-1 – D-8

APPENDIX E SUPPLEMENTARY ACCESSIBILITY REQUIREMENTS..... E-1 – E-12

APPENDIX F RODENTPROOFINGF-1 – F-2

APPENDIX G FLOOD-RESISTANT CONSTRUCTION..... G-1 – G-16

APPENDIX H SIGNS..... H-1 – H-10

APPENDIX I PATIO COVERS.....I-1 – I-2

APPENDIX J GRADING J-1 – J-8

APPENDIX K ADMINISTRATIVE PROVISIONS..... K-1 – K-4

APPENDIX L EARTHQUAKE RECORDING INSTRUMENTATION..... L-1 – L-2

APPENDIX M TSUNAMI-GENERATED FLOOD HAZARD M-1 – M-4

INDEX INDEX-1 – INDEX-38

Chapter 16: Structural Design

General Comments

This chapter contains the commentary for the following structural topics: definitions of structural terms, construction document requirements, load combinations, dead loads, live loads, snow loads, wind loads, soil lateral loads, rain loads, flood loads and earthquake loads. This chapter provides minimum design requirements so that all buildings and structures are proportioned to resist the loads and forces that are likely to be encountered. The loads specified herein have been established through research and service performance of buildings and structures. The application of these loads and adherence to the serviceability criteria will enhance the protection of life and property. The earthquake loads, wind loads and snow loads in this chapter are based on the 2010 edition of ASCE 7. The earthquake criteria and

ASCE 7 load requirements are based on the National Earthquake Hazards Reduction Program's (NEHRP) *Recommended Provisions for Seismic Regulations for New Buildings and other Structures* (FEMA 450). The NEHRP provisions were prepared by the Building Seismic Safety Council (BSSC) for the Federal Emergency Management Agency (FEMA).

Purpose

The purpose of this chapter is to prescribe minimum structural loading requirements for use in the design and construction of buildings and structures with the intent to minimize hazard to life and improve the occupancy capability of essential facilities after a design level event or occurrence.

SECTION 1601 GENERAL

1601.1 Scope. The provisions of this chapter shall govern the structural design of buildings, structures and portions thereof regulated by this code.

❖ While a significant portion of Chapter 16 is dedicated to the determination of minimum design loads, it also includes other important criteria that impact the design of structures, such as the permitted design methodologies, as well as the combinations of design loads used to establish the required minimum strength of structural members. Unless stated otherwise, the criteria found in this chapter are applicable to all buildings and structures. See Chapter 34 for application of these requirements to alterations, additions or repairs to existing structures.

SECTION 1602 DEFINITIONS AND NOTATIONS

1602.1 Definitions. The following terms are defined in Chapter 2:

❖ Definitions facilitate the understanding of code provisions and minimize potential confusion. To that end, this section lists definitions of terms associated with structural design. Note that these definitions are found in Chapter 2. The use and application of defined terms, as well as undefined terms, are set forth in Section 201.

ALLOWABLE STRESS DESIGN.

DEAD LOADS.

DESIGN STRENGTH.

DIAPHRAGM.

Diaphragm, blocked.

Diaphragm boundary.

Diaphragm chord.

Diaphragm flexible.

Diaphragm, rigid.

DURATION OF LOAD.

ESSENTIAL FACILITIES.

FABRIC PARTITION.

FACTORED LOAD.

HELIPAD.

ICE-SENSITIVE STRUCTURE.

IMPACT LOAD.

LIMIT STATE.

LIVE LOAD.

LIVE LOAD (ROOF).

LOAD AND RESISTANCE FACTOR DESIGN (LRFD).

LOAD EFFECTS.

LOAD FACTOR.

LOADS.

NOMINAL LOADS.

OTHER STRUCTURES.

PANEL (PART OF A STRUCTURE).

RESISTANCE FACTOR.

RISK CATEGORY.

STRENGTH, NOMINAL.

STRENGTH, REQUIRED.

STRENGTH DESIGN.

SUSCEPTIBLE BAY.

VEHICLE BARRIER.

NOTATIONS.

D = Dead load.

D_i = Weight of ice in accordance with Chapter 10 of ASCE 7.

E = Combined effect of horizontal and vertical earthquake induced forces as defined in Section 12.4.2 of ASCE 7.

F = Load due to fluids with well-defined pressures and maximum heights.

F_a = Flood load in accordance with Chapter 5 of ASCE 7.

H = Load due to lateral earth pressures, ground water pressure or pressure of bulk materials.

L = Roof live load greater than 20 psf (0.96 kN/m²) and floor live load.

L_r = Roof live load of 20 psf (0.96 kN/m²) or less.

R = Rain load.

S = Snow load.

T = Self-straining load.

V_{asd} = Nominal design wind speed (3-second gust), miles per hour (mph) (km/hr) where applicable.

V_{ult} = Ultimate design wind speeds (3-second gust), miles per hour (mph) (km/hr) determined from Figures 1609A, 1609B, or 1609C or ASCE 7.

W = Load due to wind pressure.

W_i = Wind-on-ice in accordance with Chapter 10 of ASCE 7.

❖ These notations are used to refer to specific nominal loads that are determined in this chapter for use in the load combinations in Section 1605:

- D is the nominal dead load determined in Section 1606. Also see the definition of “Dead load.”
- D_i is the weight of ice. See the ASCE 7 provisions referenced in Section 1614.
- Earthquake load effect, E , in Section 12.4.2 of ASCE 7 includes the effects of the horizontal load, E_h , as well as a vertical component, E_v . E_h is the product of the redundancy factor, ρ , and Q_E , the effects of horizontal earthquake forces. E_v accounts for vertical acceleration due to earthquake ground motion, taken as $0.2S_{DS}D$.

Note that its magnitude is not intended to represent a total vertical response, since that is not likely to coincide with the maximum horizontal response. It is essentially a portion of the dead load, D , that is added in “additive” load combinations or subtracted in “counteractive” load combinations. The term S_{DS} , design spectral response acceleration at short periods, is explained in the commentary to Section 1613.3.4.

For example, when this expression is used in the alternative allowable stress design load combinations of Section 1605.3.2 that include earthquake load effects the resulting combinations are as follows:

Equation 16-21

$$D + L + S + E/1.4 = (1 + 0.143S_{DS})D + L + S + \rho Q_E/1.4$$

Equation 16-22

$$0.9D + E/1.4 = (0.9 - 0.143S_{DS})D + \rho Q_E/1.4$$

Earthquake design criteria is provided in Section 1613, which, in turn, references the relevant ASCE 7 provisions for computation of the earthquake load effects. While these loads are necessary for establishing the required strength, the computed forces approximate the expected deformations under the design earthquake ground motions and are not applied to a structure in an actual earthquake.

- F refers to the nominal load due to fluids having “well defined pressures and maximum heights.” Unlike most other nominal loads, there is no code section governing the determination of fluid loads. Also note that F includes a vertical component (fluid weight), as well as a horizontal component (lateral pressure).
- F_a is used to refer to the flood load that is determined under Chapter 5 of ASCE 7. Note that F_a is not explicitly included under other loads listed for the alternative ASD combination in Section 1605.3.2.
- H is used to refer to the nominal load resulting from lateral soil pressure, lateral pressure of ground water or the lateral pressure of bulk materials. Section 1610 specifies minimum requirements for lateral soil loads. Note that there are not specific provisions for the determination of load resulting from the lateral pressure of bulk materials.
- L in the nominal live load determined in accordance with Section 1607 (also see the definition of “Live load”). In addition to floor live loads, it includes roof live loads that exceed the limit on L_r . L_r represents nominal roof live loads up to 20 psf (0.96 N/m²).
- R is the nominal rain load determined in accordance with Section 1611.