Building Code Basics: Residential
Based on the 2012 International Residential Code®
Building Code Basics: Residential
Based on the 2012 International Residential Code®

International Code Council
Stephen A. Van Note, CBO
Notice to the Reader
Publisher does not warrant or guarantee any of the products described herein or perform any independent analysis in connection with any of the product information contained herein. Publisher does not assume, and expressly disclaims, any obligation to obtain and include information other than that provided to it by the manufacturer. The reader is expressly warned to consider and adopt all safety precautions that might be indicated by the activities described herein and to avoid all potential hazards. By following the instructions contained herein, the reader willingly assumes all risks in connection with such instructions. The publisher makes no representations or warranties of any kind, including but not limited to, the warranties of fitness for particular purpose or merchantability, nor are any such representations implied with respect to the material set forth herein, and the publisher takes no responsibility with respect to such material. The publisher shall not be liable for any special, consequential, or exemplary damages resulting, in whole or part, from the readers’ use of, or reliance upon, this material.

ALL RIGHTS RESERVED. No part of this work covered by the copyright herein may be reproduced, transmitted, stored, or used in any form or by any means, graphic, electronic, or mechanical, including but not limited to photocopying, recording, scanning, digitizing, taping, Web distribution, information networks, or information storage and retrieval systems, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without the prior written permission of the publisher.
PART I: CODE ADMINISTRATION AND ENFORCEMENT 1

Chapter 1: Introduction to Building Codes 2
  Code Development ....................................... 3
  The Building Codes: Scope and Limitations .............. 3
    International Building Code (IBC) ..................... 4
    International Mechanical Code (IMC) .................. 4
    International Fuel Gas Code (IFGC) .................... 4
    International Plumbing Code (IPC) ..................... 5
    International Fire Code (IFC) .......................... 5
    International Property Maintenance Code (IPMC) ....... 5
    International Existing Building Code (IEBC) .......... 5
  International Residential Code (IRC) .................... 6
    Dwellings and townhouses ................................ 6
    Manufactured homes ..................................... 8
    Accessory buildings and structures ..................... 9
    Existing structures ..................................... 10

Chapter 2: Legal Aspects, Permits, and Inspections 11
  Code Adoption ........................................... 12
    Adoption of the IRC .................................... 12
    Amending the IRC ....................................... 13
    Appendices ............................................. 13
    Local and state laws .................................... 14
  Authority ............................................... 14
    Authority and duties of the building official .......... 14
    Interpretations ......................................... 15
    Alternative methods and materials and evaluation service reports ........................................... 15
  Permits ................................................ 17
    Permit application .................................... 17
    Plans and specifications ................................ 17
    Fees ................................................... 17
    Permit issuance ....................................... 19
  Inspections ............................................. 20
    Required inspections .................................. 22
    Other inspections ..................................... 22
    Certificate of occupancy ................................ 23
  Board of Appeals ....................................... 25
# PART II: SITE DEVELOPMENT

## Chapter 3: Site Preparation ........................................ 28

- **Location on Property** ........................................ 29
  - Fire separation distance ..................................... 29
  - Separation distance from lot line .......................... 29
  - Location of foundations adjacent to slopes .............. 31
- **Site Preparation** .................................................. 32
  - General requirements ......................................... 33
  - Soil properties ................................................. 33
  - Fill ............................................................... 35
- **Storm Drainage** ................................................... 35
- **Flood Hazard Areas** .............................................. 38

# PART III: STRUCTURAL

## Chapter 4: Structural Design Criteria .......................... 40

- **Prescriptive and Performance** ............................... 41
- **Basic Loads (Live and Dead)** ................................. 42
  - Live loads ....................................................... 42
  - Dead loads ...................................................... 44
  - Deflection ....................................................... 44
- **Wind, Snow, Seismic, and Flood Loads** .................... 46
  - Wind .............................................................. 46
  - Exposure category ............................................ 46
  - Hurricanes ...................................................... 48
  - Tornadoes ....................................................... 49
  - Storm shelters ................................................ 50
  - Snow ............................................................. 50
  - Earthquake ..................................................... 51
  - Floods ........................................................... 53

## Chapter 5: Foundations .............................................. 56

- **Materials** .......................................................... 57
  - Concrete ......................................................... 57
- **Footings** .......................................................... 58
  - Depth, bearing, and slope .................................... 58
  - Sizing concrete footings ...................................... 60
    - Reinforcing for footings .................................. 64
    - Foundation anchorage ..................................... 65
- **Masonry and Concrete Foundation Walls** .................. 69
  - Wall height and thickness .................................... 69
  - Seismic requirements ......................................... 72
  - Height above finished grade .................................. 73
- **Moisture Protection** ............................................ 74
  - Foundation drainage .......................................... 74
  - Dampproofing and waterproofing ............................. 74
- **Underfloor Space** .............................................. 75
Chapter 6: Framing .................................................. 76
  Grade Marks ..................................................... 77
  Engineered Wood Products .................................. 78
  Trusses .......................................................... 78
  Wood Treatment .............................................. 80
  Cutting, Boring, and Notching ............................. 80
  Fireblocking ................................................... 84
  Draftstopping ................................................ 84
  Floors .......................................................... 85
    Beams and girders ......................................... 87
    Joists ....................................................... 87
    Deck attachment .......................................... 89
  Walls .......................................................... 89
    Studs and plates ......................................... 92
    Headers ..................................................... 92
    Single member headers .................................. 94
    Wall bracing ............................................. 97
  Ceiling and Roof ........................................... 99
    Ceiling joist ............................................. 99
    Rafters ..................................................... 99
    Roof uplift connections ................................ 103
    Attic ventilation and access ......................... 104

PART IV: FINISHES AND WEATHER PROTECTION  105

Chapter 7: Interior and Exterior Finishes and Weather Protection 106
  Interior Finishes ........................................... 107
    Gypsum board ............................................. 107
    Backing for ceramic tile and other
      nonabsorbent finishes ................................ 107
  Exterior Wall Coverings ................................ 107
    Water and moisture management ...................... 108
    Flashing ................................................... 109
    Masonry and stone veneer .............................. 110
      Support .................................................. 110
      Veneer anchoring ...................................... 112
    Siding ..................................................... 112
    Exterior insulation finish system (EIFS) ............ 112
    Windows ................................................... 112
  Roof Covering .............................................. 114
    Underlayment and ice barrier ........................ 116
    Flashing .................................................. 118
    Asphalt shingles ......................................... 119
    Wood shingles and wood shakes ...................... 119
    Reroofing ................................................ 122
PART V: HEALTH AND SAFETY

Chapter 8: Home Safety ........................................124
  Room Areas ..................................................125
  Ceiling Height ..............................................125
  Means of Egress ............................................125
  Doors and landings .........................................127
  Stairs ................................................................127
  Winders ..........................................................127
  Spiral stairways ..............................................127
  Stair landings ..................................................128
  Handrails .......................................................129
  Protection from Falls ........................................130
  Guards ...........................................................130
  Window-sill height ..........................................137
  Emergency Escape and Rescue Openings ...............138
  Window wells ..................................................141
  Safety Glass ....................................................141

Chapter 9: Fire Safety ..........................................147
  Smoke Alarms ................................................148
    Smoke alarms in existing dwellings ...............149
  Fire Sprinkler Systems .....................................149
  Fire-Resistance-Rated Construction ..................151
    Exterior walls ..............................................151
    Two-family dwellings ..................................151
    Townhouses ...............................................153
    Fire-resistance-rated assemblies ...................155
    Penetrations of fire-resistance-rated assemblies ..157
  Dwelling Separation from Garage .....................157
  Fire Protection of Floors ................................160
  Foam Plastic .................................................161

Chapter 10: Healthy Living Environment ..................164
  Natural and Artificial Light ...............................165
    Stairway illumination ..................................165
  Natural and Mechanical Ventilation .................165
  Carbon Monoxide Alarms .................................167
  Heating and Cooling ......................................168
  Sanitation .....................................................168
    Toilet and bathing facilities .........................169
    Cooking and cleaning facilities ......................170

Chapter 11: Chimneys and Fireplaces ....................171
  Exterior Air Supply ........................................172
  Masonry Chimneys and Fireplaces ....................172
    Footings ....................................................173
    Seismic requirements ..................................173
    Masonry fireplace details ............................174
Hearth and hearth extension ........................................... 175
Clearance to combustibles and fireblocking ......................... 175
Chimney dimensions and lining ...................................... 178
Chimney termination .................................................... 178

**Manufactured Chimneys and Fireplaces** ............................ 180

---

**PART VI: BUILDING UTILITIES** 181

**Chapter 12: Mechanical and Fuel-Gas** .......................... 182

**Appliances** ............................................................... 183
- Appliance installation and location ................................ 183
- Clearances .................................................................. 184
- Location limitations ................................................... 184
- Appliances in garages ................................................ 184
- Protection from impact .............................................. 184
- Exterior installation ................................................... 185
- Access to appliances .................................................. 185
- Appliances in attics .................................................... 186
- Condensate .................................................................. 187

**Exhaust Systems** .......................................................... 189
- Clothes dryer exhaust systems .................................... 189
- Whole-house mechanical ventilation system ................. 190
- Kitchen range hoods .................................................. 190
- Bathrooms and toilet rooms with mechanical ventilation .... 190

**Duct Systems** ............................................................... 191

**Return Air** ................................................................. 192

**Combustion Air** ............................................................ 192
- Calculating the net free area of vents or grilles ............... 193
- Combustion air from inside the building ....................... 193
- Combustion air from outdoors ..................................... 194
  - Outdoor combustion air obtained through two openings or ducts 194
  - Outdoor combustion air obtained through single opening or duct ........................................... 195

**Vents** ........................................................................... 196
- Vent installation .......................................................... 196
- Gas vent roof termination ......................................... 196
- Direct-vent appliance vent termination ....................... 198

**Fuel-Gas Piping** ............................................................ 199
- Pipe sizing ............................................................... 199
- Piping materials ....................................................... 200
- Piping system prohibited locations ............................ 200
- Other installation requirements .................................. 200
- Appliance connections .............................................. 200
- Shutoff valve ......................................................... 200
- Sediment trap .......................................................... 202
- Piping support ....................................................... 202
## Chapter 13: Plumbing

### Piping
- Protection from damage ........................................ 204
- Piping support ......................................................... 204
- Testing of piping systems ......................................... 205

### Water System
- Water service .......................................................... 205
- Water supply system design criteria .......................... 206
- Valves ........................................................................ 206
- Dwelling unit fire sprinkler systems ......................... 206
- Water supply protection ............................................. 207

### Sanitary Drainage
- Connections and fittings .......................................... 207
- Cleanouts .................................................................. 208
- Minimum slope for horizontal drainage piping ........... 208
- Drain pipe sizing ......................................................... 210
- Gray water .................................................................. 211

### Venting Systems
- Vent connections and grades ..................................... 212
- Fixture vents ............................................................... 212
- Wet venting ............................................................... 213
- Island fixture venting ............................................... 213
- Vent pipe sizing ......................................................... 213
- Vent termination ......................................................... 214
- Air admittance valves ................................................. 215

### Plumbing Fixtures
- Laundry standpipes .................................................... 215
- Dishwashers .............................................................. 216
- Protection against scalding ........................................ 217
- Showers ..................................................................... 217
- Whirlpool bathtubs .................................................... 217

### Fixture Traps
- .................................................................................. 218

### Water Heaters
- .................................................................................. 218

## Chapter 14: Electrical

### Electrical Services
- Equipment location .................................................... 221
- Electrical service size and rating .............................. 222
- Service conductor size ................................................ 222

### Grounding
- Grounding electrode system ...................................... 223
- Bonding ....................................................................... 224
- Bonding for other systems ........................................ 226

### Branch Circuits
- Branch circuit ratings and conductor size .................. 226
- Conductor sizing ......................................................... 226
Overcurrent protection required ........................................ 227
Location of overcurrent devices ........................................ 227
Required branch circuits .............................................. 228

Wire and Terminal Identification ........................................ 228
Grounded (neutral) conductors and terminals ...................... 228
Grounding conductors .................................................. 228
Ungrounded (hot) conductors ........................................... 229

Wiring Methods ............................................................ 229
Type NM cable ................................................................ 229
Underground installation requirements .............................. 231
Boxes ........................................................................... 231
Grounding ...................................................................... 232

Power Distribution .......................................................... 232
Receptacle outlet locations ................................................ 232
Lighting outlets ................................................................ 235
Ground-fault circuit interrupter (GFCI) protection .............. 235
Arc-fault circuit interrupter (AFCI) protection ................. 235

Receptacles and Luminaires ............................................. 236
Receptacles ................................................................. 236
Tamper resistant receptacles ........................................... 236
Luminaires ................................................................... 237
Recessed luminaire installation and clearance ................... 237
Bathtub and shower areas .............................................. 237
Luminaires in clothes closets ......................................... 237

PART VII: ENERGY CONSERVATION .................................. 241

Chapter 15: Energy Efficiency ........................................ 242

Building Insulation ......................................................... 243
Insulation identification and verification ............................ 243
Insulation requirements .................................................. 244
Slab-on-grade floors ..................................................... 245
Crawl space walls ......................................................... 246

Windows and Doors ...................................................... 247

Air Leakage ................................................................. 248
Sealing ........................................................................ 248
Recessed luminaires ...................................................... 249
Testing ....................................................................... 250

Systems ....................................................................... 250
Duct insulation and sealing ........................................... 250
Piping insulation ........................................................... 250
Lighting .................................................................... 251

Energy Certificate ......................................................... 251
PART VIII: PROTECTION FROM OTHER HAZARDS

Chapter 16: Other Hazards of the Built Environment ........................................... 254
Termite Protection ................................................................. 255
Termite control methods ......................................................... 255
Foam plastic protection ......................................................... 256
Swimming Pools and Hot Tubs .................................................. 256
Barriers ........................................................................... 256
Entrapment protection ......................................................... 258
Radon Control .............................................................. 259
Lead ................................................................. 260
Asbestos ........................................ 262
Glossary .......................................................... 263
Index ................................................................. 267
Constitution of residential buildings routinely consists of conventional practices, those tried-and-true methods that have performed well over the years and have long been recognized by the building code. With the introduction of new technology, materials, and methods, improved understanding of safe and healthy living environments, and innovation in dwelling designs, residential construction and the codes that regulate it have become increasingly complex. Such complexity is necessary to afford flexibility in design and construction. Reference publications intending to explain the provisions regulating residential construction may overwhelm the reader with a broad range of topics and alternatives, may provide superficial coverage of all requirements, or may focus on the details of a limited number of provisions.

Building Code Basics: Residential—Based on the 2012 International Residential Code® was specifically developed to address the need for an illustrated text explaining the basics of the residential code—those provisions essential to understanding the application of the code to the most commonly encountered building practices. The text is presented and organized in a user-friendly manner with an emphasis on technical accuracy and clear non-code language. The content is directed to readers with a basic understanding of conventional dwelling construction but a less than complete knowledge of the International Residential Code® (IRC).

Anyone involved in the design, construction, or inspection of residential buildings will benefit from this book. Beginning and experienced inspectors, contractors, home builders, architects, designers, home inspectors, and students of construction technology or related fields will gain a fundamental understanding and practical application of the frequently used provisions of the 2012 edition of the IRC.

The content of Building Code Basics: Residential is organized to correspond to the order of construction, beginning with sitework and foundations through completion of a safe, healthy, and energy-efficient dwelling. Mechanical, fuel-gas, plumbing, and electrical provisions are placed in separate chapters. The advantage of this format to the reader is that it pulls related information together from various sections of the IRC into one convenient location of the text and provides a familiar frame of reference to those with any construction experience. The book explains the difference between “prescriptive” and “performance” requirements. Prescriptive structural design requirements to resist the forces of wind, earthquake, and snow are described and illustrated in an easy-to-understand way. Structural topics include conventional footings and foundations (including the fundamentals of soil capacity), conventional wood floor, wall and roof framing, engineered wood products, and seismic reinforcing of masonry chimneys. Fire- and life-safety concerns are addressed with topics including means of egress, emergency escape, stairways, fall protection, smoke alarms, fire sprinklers, and fire-resistant construction. Building Code Basics: Residential also covers
the minimum interior environmental conditions for a healthy living environment, weather protection, and energy conservation measures. Correct and reasonable application of the code provisions is enhanced by a basic understanding of the code development process, the scope, intent, and correlation of the family of International Codes, and the proper administration of those codes. Such fundamental information is provided in the opening chapters of this publication. The book also explains the interaction of a building code with other local and state regulations and includes discussion of common hazards of the built environment that may be regulated by state or federal agencies.

This book does not intend to cover all provisions of the IRC or all of the accepted materials and methods of construction of residential buildings. Focusing in some detail on the most common conventional construction provisions affords an opportunity to fully understand the basics without exploring every variable and alternative. This is not to say that information not covered is any less important or valid. This book is best used as a companion to the IRC, which should be referenced for more complete information.

Building Code Basics: Residential features full-color illustrations to assist the reader in visualizing the application of the code requirements. Practical examples, simplified tables, and highlights of particularly useful information also aid in understanding the provisions and determining code compliance. References to the applicable sections of the 2009 edition of the IRC are helpful in locating the corresponding code language and related topics in the code. A glossary of code and construction terms clarifies the meaning of the technical provisions.

ABOUT THE INTERNATIONAL RESIDENTIAL CODE

The IRC is a comprehensive, stand-alone residential code that establishes minimum regulations for the construction of one- and two-family dwellings and townhouses up to three stories in height, including provisions for fire and life safety, structural design, energy conservation, and mechanical, fuel-gas, plumbing, and electrical systems. The IRC incorporates prescriptive provisions for conventional construction as well as performance criteria that allow the use of new materials and new building designs.

The IRC is one of the codes in the family of International Codes published by the International Code Council (ICC). All are maintained and updated through an open code development process and are available internationally for adoption by the governing authority to provide consistent enforceable regulations for the built environment.

ACKNOWLEDGMENTS

Building Code Basics: Residential is the result of a collaborative effort, and the author is grateful for the valuable contributions by the following talented staff of ICC Product Development: Hamid Naderi, PE, Senior
Vice President, developed the original concept for the book and was instrumental in launching the Building Code Basics series; John Henry, PE, Principal Staff Engineer, for his generous assistance and patient explanations relating to the structural provisions; Scott Stookey, senior technical staff, for welcome expertise on fire resistance and fire protection systems; Sandra Hyde, PE, Staff Engineer, for her review and for offering a fresh perspective on the presentation of the material; Peter Kulczyk, technical staff, for his helpful comments and access to his photo library; Doug Thornburg, AIA, Vice President and Technical Director, for his usual expert direction and advice. All contributed to the accuracy and quality of the finished product.

ABOUT THE AUTHOR

Stephen A. Van Note, CBO
International Code Council
Managing Director, Product Development

Stephen A. Van Note is the Managing Director of Product Development for the International Code Council (ICC), where he is responsible for developing technical resource materials in support of the International Codes. His role also includes the management, review, and technical editing of publications developed by expert authors. In addition, Steve develops and presents International Residential Code seminars nationally. Prior to joining ICC in 2006, Steve was building official for Linn County, Iowa. He has 15 years of experience in code administration and enforcement, and over 20 years of experience in the construction field, including project planning and management for residential, commercial, and industrial buildings. A certified building official and plans examiner, Steve also holds certifications in several inspection categories.

About the International Code Council

The International Code Council® (ICC®) is a member-focused association dedicated to helping the building safety community and construction industry provide safe, sustainable and affordable construction through the development of codes and standards used in the design, build and compliance process. Most U.S. communities and many global markets choose the International Codes®. ICC Evaluation Service (ICC-ES), a subsidiary of the International Code Council, has been the industry leader in performing technical evaluations for code compliance fostering safe and sustainable design and construction.

Headquarters:
500 New Jersey Avenue, NW, 6th Floor,
Washington, DC 20001-2070

District Offices:
Birmingham, AL; Chicago, IL; Los Angeles, CA

1-888-422-7233
www.iccsafe.org