

International Residential Code

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Abstract

In 2000, the International Code Council published the first edition of the *International Residential Code*, a code that addresses design and construction of dwellings. The document, which is based on the *One- and Two-Family Dwelling Code* (published since the 1970s by the Council of American Building Officials), is a mandatory document that is a companion code to the *International Building Code* and is being widely adopted throughout the United States. The *International Residential Code* contains prescriptive provisions for design and construction of dwellings without the need for professional design, although there may be some instances in which professional design is needed.

International Residential Code

In 2000, the International Code Council (ICC) completed a 5-year project to publish a family of coordinated construction codes. Publication of those codes, including a new dwelling code, for all practical purposes put an end to further development of the three existing model building codes, as well as the existing dwelling code, all of which were used in some parts of the country for nearly 30 years.

Background

Beginning in the early 1900s, three groups of building code practitioners were formed to promulgate “model” building codes. These groups – the Building Officials and Code Administrators International, the International Conference of Building Officials, and the Southern Building Code Conference International – published codes that reflected the characteristics of construction and environmental conditions prevalent in their region of the country. Although they imposed similar regulations on many aspects of construction, the codes differed in details, format, and appearance.

In 1972, the Council of American Building Officials (CABO) was created by the model code groups as an organization that would, among other things, provide the means to address matters of common concern among the three code groups. CABO, in turn, established the Board for Coordination of the Model Codes (BCMC), which was intended

to identify conflicts between the three model building codes and to recommend revisions to address those conflicts.

Beginning with simple steps for coordination, such as the three groups reorganizing the format of their code books around a common BCMA format, the groups eventually progressed to form the ICC as a new umbrella organization dedicated to developing a single set of comprehensive and coordinated codes to be published in time for the new millennium.

In 1995 and 1996, the ICC code development process quickly produced several elements of its family of codes, promulgating the International Mechanical, Plumbing, Sewage Disposal, and Zoning codes. Work also began on the *International Building Code (IBC)*. Additionally, in 1996 the ICC Board of Directors established the ICC/NAHB Task Force, composed of ICC members and members of the National Association of Home Builders (NAHB). The task force was created to review the CABO *One- & Two-Family Dwelling Code* and determine its place in the ICC family of codes (CABO, by this time, had been incorporated into the ICC).

One of the early joint code-writing efforts by the three code groups under CABO was development of the *One- & Two-Family Dwelling Code (OTFDC)*. The *OTFDC* was a specification code applicable to one- and two-family dwellings and townhouses which addressed not only the construction of the structural elements of the building, but also plumbing, mechanical, electrical, and fuel gas systems. Although all of these elements were addressed in the larger building codes and their related codes, the *OTFDC* provided a single source of primarily prescriptive requirements for houses and contained little performance language. Even though it was recognized by all three code organizations as an alternative to compliance with the more comprehensive codes, the *OTFDC* was not a mandatory document unless specifically adopted by a jurisdiction.

The ICC/NAHB Task Force recommended that a new stand-alone residential code be developed, called the *International Residential Code (IRC)*. ICC also decided that, unlike the *OTFDC*, the *IRC* would be mandatory. It was ICC’s intent that all materials related to one- and two-family

dwellings and townhouses, as defined in the *IRC*, be deleted from the *IBC* and its related codes, and that the code provisions for those structures be found only in the *IRC*. The *IRC* drafting committee was composed of one code official from each of the three code groups, three home builders, and three industry individuals nominated by the ICC Industry Advisory Committee. The industry members of the original drafting committee were all architects.

Because the *OTFDC* was familiar to many code users, and because development time was limited, the 1995 edition of the *OTFDC*, as amended through 1997, was used as the basis for the *IRC*. The format for the *OTFDC* was retained.

General Content

The *IRC* applies to detached one- and two-family dwellings and multiple single-family dwellings (*townhouses* as they are referred to in the code) not more than three stories in height with separate means of egress. The term “with separate means of egress” is not defined, leaving the subject of exits for multi-family dwellings built under the *IRC* somewhat confused. Additionally, the scope of the code is expanded when one reads the definition of *townhouse* in the code: “A single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from foundation to roof and with open space on at least two sides.” This allows use of the *IRC* to construct some versions of multi-family buildings regardless of whether they’re referred to as townhouses, condominiums, or apartments.

Chapter 3 of the *IRC*, *Building Planning*, contains a large portion of the general requirements applicable to buildings of all types of construction. As it existed in the *OTFDC*, the section dealing with design criteria was limited and outdated. The initial edition of the *IRC* reflected an effort to modernize the code, with both wind- and seismic-related provisions expanded and updated to contemporary methodology. One of the seismic-related concepts in the *IRC* has been the division of Seismic Design Category D in the *IBC* into D_1 and D_2 . The short period design spectral response acceleration (S_{DS}) for Seismic Design Category D_1 is $0.50\text{ g} < S_{DS} \leq 0.83\text{ g}$, and for Seismic Design Category D_2 , it is $0.83 < S_{DS} \leq 1.17$.

The general prescriptive provisions for all types of construction are applicable to all buildings within the scope of the *IRC* which are in Seismic Design Categories A and B, and for detached one- and two-family dwellings in Seismic Design Category C. There are more restrictive prescriptive requirements for townhouses in Seismic Design Category C and for all buildings in D_1 and D_2 . Construction in Seismic Design Category E is generally beyond the scope of the *IRC*, and design in accordance with the *IBC* is required. However, some structures in E may be reclassified into D_2 when complying with additional restrictions detailed in Section R301.2.2.1.2.

Although the *IRC* provides the means to prescriptively design buildings in most of the Seismic Design Categories, prescriptive wind design is very limited. For wood-frame

construction the *IRC* requires building design in high-wind areas to be in accordance with either:

1. American Forest & Paper Association’s *Wood Frame Construction Manual for One- and Two-Family Dwellings*, an engineering-based prescriptive document that addresses high-wind, -seismic, and -snow design for wood framing, or
2. Southern Building Code Congress International’s *Standard for Hurricane Resistant Residential Construction (SSTD 10)*, an engineering-based prescriptive document that applies to all types of construction, or
3. *Minimum Design Loads for Buildings and Other Structures (ASCE-7)*.

Additionally, the *IRC* permits the design of portions of a structure, allowing the mixture of prescriptive construction with elements that have been engineered because they are either beyond the limitations of the code or because they otherwise do not comply with the code.

The format of the *IRC*, which is based on the old *OTFDC*, is different from that of the *IBC* and of the older regional codes that preceded the *IBC*. The format of the *IBC* and of the older codes divides the material-specific construction requirements into chapters containing provisions devoted entirely to a single material. In the *IRC*, however, the division is based on building elements, and there are chapters on foundations, floors, walls, roof–ceilings, etc. Each of these chapters contains requirements that pertain to all code-recognized materials.

Wood Construction

Framing requirements for the various building elements reflect traditionally accepted conventional wood-frame construction as it has appeared in older building codes. The conventional construction provisions of the *OTFDC* were updated during the *IRC* development process, and some conventional construction requirements from the *IBC* were incorporated in the *IRC* in an attempt at consistency. However, the conventional construction section of the *IBC* (Section 2308), and the framing requirements in the *IRC*, are not always consistent. At the time that the wood chapter, Chapter 23, of the *IBC* was written, the *IRC* didn’t exist, and it was unclear whether ICC would have a separate dwelling code. Therefore, conventional construction was added to the chapter, and many provisions were taken from the last edition of the *Uniform Building Code (UBC)*. These requirements reflected then-recent rewrites of conventional construction to limit applicability and to address seismic force resistance.

However, with development of the *IRC* some conflicts exist between conventional construction portions of the two codes. Additionally, given the scope of the *IRC* and its mandatory nature, applicability of *IBC* Section 2308 is questionable. Once the dwelling-related material is eliminated from the scope of *IBC*’s conventional construction requirements, construction provisions seem to be applicable only to limited areas of multi-family buildings (because of the loads on

which the requirements are based), and to single-story slab-on-grade nonresidential buildings.

One subject in the *IRC* applying specifically to the use of wood is protection against damage from decay and termites. Although requirements that provide decay protection are similar to those contained in the *IBC*, the *IRC* termite protection section is very different from regulations in the *IBC*. Rather than requiring the use of naturally durable or preservatively treated wood for termite protection, as is done for decay protection (and as is done in the *IBC* for termite protection), the *IRC* text requires the use of one, or a combination of any, of the following: chemical soil treatment, naturally durable or preservatively treated wood, or physical barriers. Unfortunately, no details are given for the application of any of these requirements. Code officials who are familiar with the requirements of the older codes, which were similar to what is now in the *IBC*, are finding the termite-related requirements in the *IRC* to be vague and difficult to interpret and enforce. As a result, several code change proposals have been submitted to ICC for the 2003–2004 revision cycle to clean up the termite section.

In *IRC* Chapter 4, *Foundations*, prescriptive provisions permit the construction of permanent wood foundations for buildings having no more than two floors and a roof, having interior basement walls and foundation walls at intervals not exceeding 50 feet, and having no more than 4 feet of backfill against the foundation wall. It was believed by both the wood industry and the *IRC* development committee that any other wood foundation configuration would be complex enough to require an engineering analysis in compliance with Technical Report No. 7, *The Permanent Wood Foundation System*, published by the American Forest & Paper Association.

Within Chapter 5 of the *IRC* (*Floors*), and Chapter 8 (*Roof–Ceiling Construction*), the code user will find pre-calculated span tables for both joists and rafters. In contrast to generic span tables found in the old codes, these tables allow the reader to determine spans of four major species groups – Douglas Fir-Larch, Hem-Fir, Southern Pine, and Spruce-Pine-Fir – in a simple fashion. A reference to AF&PA's *Span Tables for Joist and Rafters* is included for determining spans of other species.

Also found in Chapter 5 are pre-calculated spans for girders and headers (there is a reference to these tables in the chapter on walls) of the same four species. These spans apply to applications that support a roof as well as clear span floors and center-bearing floors.

Chapter 6 addresses wall construction. The wall bracing table, which is predicated on wind speed or seismic design categories, is similar to that found in Section 2308 of the *IBC*, but the minimum amounts of bracing specified in the two codes are different, the result of two different groups creating the tables. *IRC* bracing requirements, like those in the *IBC*, are based on the concept of braced wall lines, taken from the *UBC*. Within the 2000 edition of the *IRC* it remains

unclear as to the maximum spacing of braced wall lines allowed in low seismic areas. Changes in the 2003 edition make it clear that spacing between braced wall lines is generally limited to 35 feet.

Another table in *IRC* Chapter 6 addresses allowable height of studs and is a carryover from the *OTFDC*. Table R602.3.1 is intended to permit stud heights greater than the default 10 foot limitation prescribed elsewhere in the chapter. In the 2000 edition of the code, the relationship between this table and the rest of the chapter is unclear. In the 2003 edition, however, the text has been revised to be explicit about the table's purpose.

A major change made to the original contents of the *OTFDC* in converting it to the *IRC* concerned trusses. In Chapter 8 (*Roof–Ceiling Construction*), Section R802.10 addresses wood trusses and specifies the minimum information to be provided in the truss design drawings. Some of the information required, such as truss depth, span, and spacing, is generally shown on all drawings. However, of the 12 items listed, some are not always supplied with the trusses when they are delivered to the jobsite. These include providing such information as reaction forces and directions and adjustments to lumber and joint connector design values for conditions of use. The section also requires that trusses be braced either in accordance with the building's construction documents or as indicated on the individual truss design drawings. In lieu of specific bracing requirements, compliance with Truss Plate Institute standards is required.

The related subjects of truss-to-wall connections and uplift resistance are somewhat confusing in the 2003 edition of the *IRC*. There is a general requirement that trusses be attached to wall plates using approved connectors, implying that the connection must be made in some fashion other than nailing. In the section on uplift resistance, however, roof assemblies are simply required to be provided with connections which will resist specific uplift pressures. This would seem to indicate that in low-wind areas, trusses must be provided with connectors, but conventional framing may only need nailed connections called for in the fastener schedule.

Conclusion

The *IRC* is a comprehensive document that addresses the use of conventional wood-frame construction in low-wind areas and almost all seismic areas, and references prescriptive engineering-based documents for high-wind design. The process of converting the outdated *OTFDC* into a contemporary dwelling code was done relatively quickly, and as a result there were some glitches and gaps in the first edition of the *IRC*, as mentioned above. The ICC code change process, however, is open to all interested parties and provides an ongoing method of modifying and updating the code. Differences between the original 2000 edition of the code and the 2003 edition reflect the desire of construction-related communities to improve the *IRC*.

The *IRC* and its parent document, the *IBC*, are being adopted by local and state jurisdictions across the country. Some jurisdictions will continue to enforce old codes adopted previously, but those codes are no longer being published and receive limited support from ICC, which has officially replaced the older code-making organizations. For this reason there will be changes throughout the country as more jurisdictions move to a newer code. At this time, it appears that the majority of jurisdictions in the country will adopt some segment of the international codes although the international codes have competition from the National Fire Protection Association's *Building Construction and*

Safety Code (NFPA 5000). However, *NFPA 5000* does not contain prescriptive provisions such as conventional wood-frame construction and doesn't have a companion dwelling code. Those jurisdictions which adopt *NFPA 5000* will either require professional design of all dwellings, provide prescriptive requirements in some other fashion, or reference the *IRC*.

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