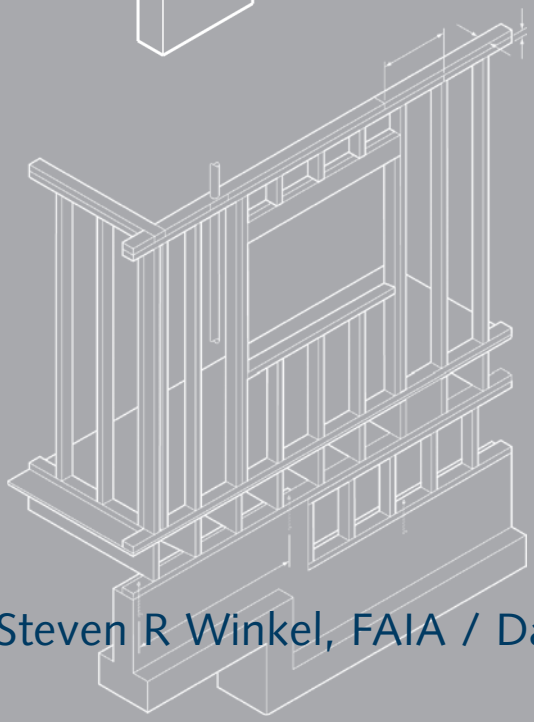
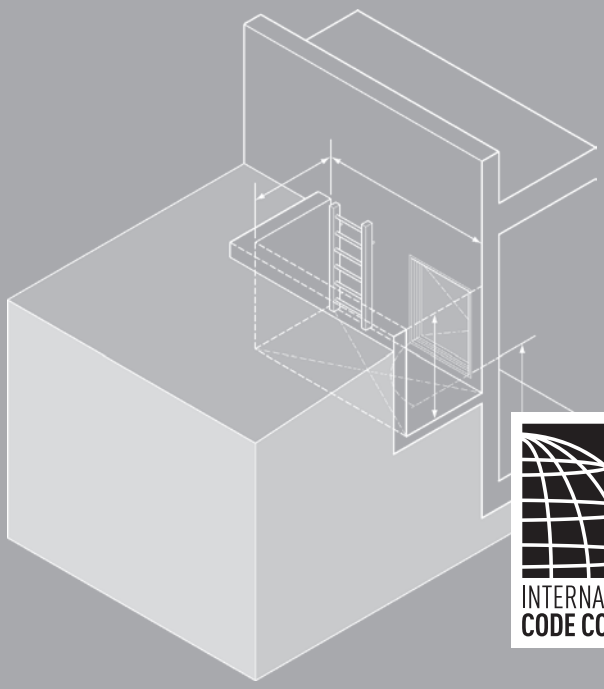
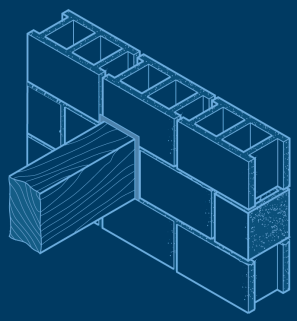
Residential Building Codes Illustrated

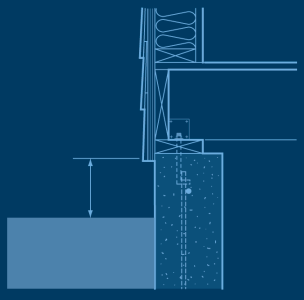
A Guide to Understanding the 2009 INTERNATIONAL RESIDENTIAL CODE®

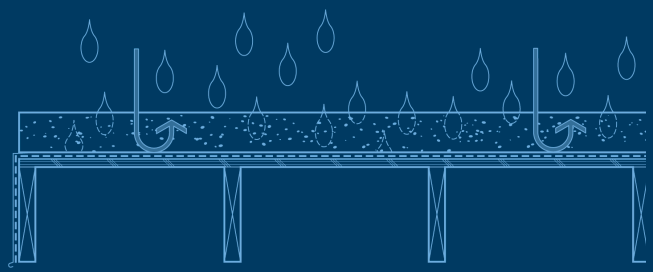




Steven R Winkel, FAIA / David S. Collins, FAIA / Steven P. Juroszek, AIA
Francis D.K. Ching, Series Advisor







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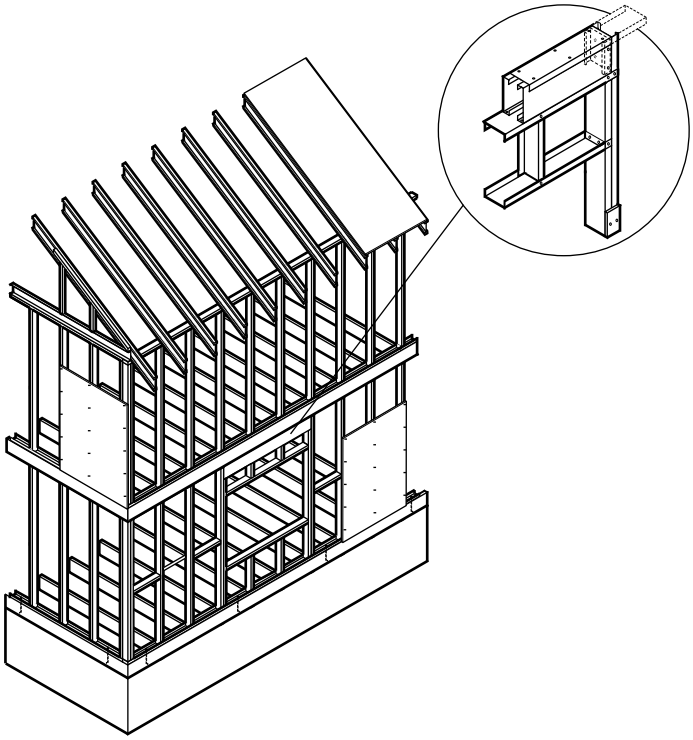

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Disclaimer

The book contains the authors' analyses and illustrations of the intent and potential interpretations of the building construction provisions of the 2009 International Residential Code® (IRC) for the design of one- and two-family dwellings and townhouses. The illustrations and examples are general in nature and not intended to apply to any specific project without a detailed analysis of the unique nature of the project. As with any code document, the IRC is subject to interpretation by the Authorities Having Jurisdiction (AHJ) for their application to a specific project. Designers should consult the local Building Official early in project design if there are questions or concerns about the meaning or application of code sections in relation to specific design projects.

The interpretations and illustrations in the book are those of the authors. The authors do not represent that the illustrations, analyses, or interpretations in this book are definitive. They are not intended to take the place of detailed code analyses of a project, the exercise of professional judgment by the reader, or interpretive application of the code to any project by permitting authorities. While this publication is designed to provide accurate and authoritative information regarding the subject matter covered, it is sold with the understanding that neither the publisher nor the authors are engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional person should be sought.

The authors and John Wiley & Sons would like to thank Peter Kulczyk of the International Code Council for his thorough review of the manuscript and illustrations in this book. This review does reflect in any way the official position of the International Code Council. Any errors in the interpretatons or illustrations in the book are solely those of the authors and are in no way the responsibility of the Interntional Code Council.

Acknowledgments

The authors would like to acknowledge the contributions of Francis D.K. Ching, whose drawings in *Building Codes Illustrated* provided the foundation and standard for the illustrations in this book. Finally, the authors would like to thank Barbara Sahm, Sarah Rice, and Sheri Juroszek for their support and encouragement throughout the process of producing this book.

Contents

Preface

The primary purpose of this book is to familiarize code users with the use of the *2009 International Residential Code®* (IRC) with a focus on the code provisions related to building construction. It is intended as an instructional text on how the code was developed and how it is organized, as well as a reference document on how to use the code for the design of one- and two-family dwellings. It is intended to be a companion to the IRC, not a substitute for it. This book must be read in concert with the IRC.

This book is designed to give an understanding of how the International Residential Code was developed, and how it is likely to be interpreted when applied to the design and construction of single family houses, two-family houses and townhouses no more than three stories high and with separate entries for each townhouse. The intent of this book is to give a fundamental understanding of the relationship of codes to practice for design professionals, especially those licensed or desiring to become licensed as architects, engineers or other related design professionals. Code knowledge is among the fundamental reasons for licensing design professionals, for the protection of public health, safety and welfare. It is our goal to make the acquisition and use of code knowledge easier and clearer for code users.

Many designers feel intimidated by building codes. Codes can seem daunting and complex at first glance. It is important to know that they are a product of years of accretion and evolution. Sections start simply and become more complex as they are modified, and new material is added to address additional concerns or to address interpretation issues from previous code editions. The complexity of a building code often comes from this layering of new information upon old without regard to overall continuity. Building codes are living documents, constantly under review and modification. It is vital to an understanding of codes to keep in mind that they are a human institution, written by ordinary people with specific issues in mind or specific agendas they wish to advance.

BUILDING CODE

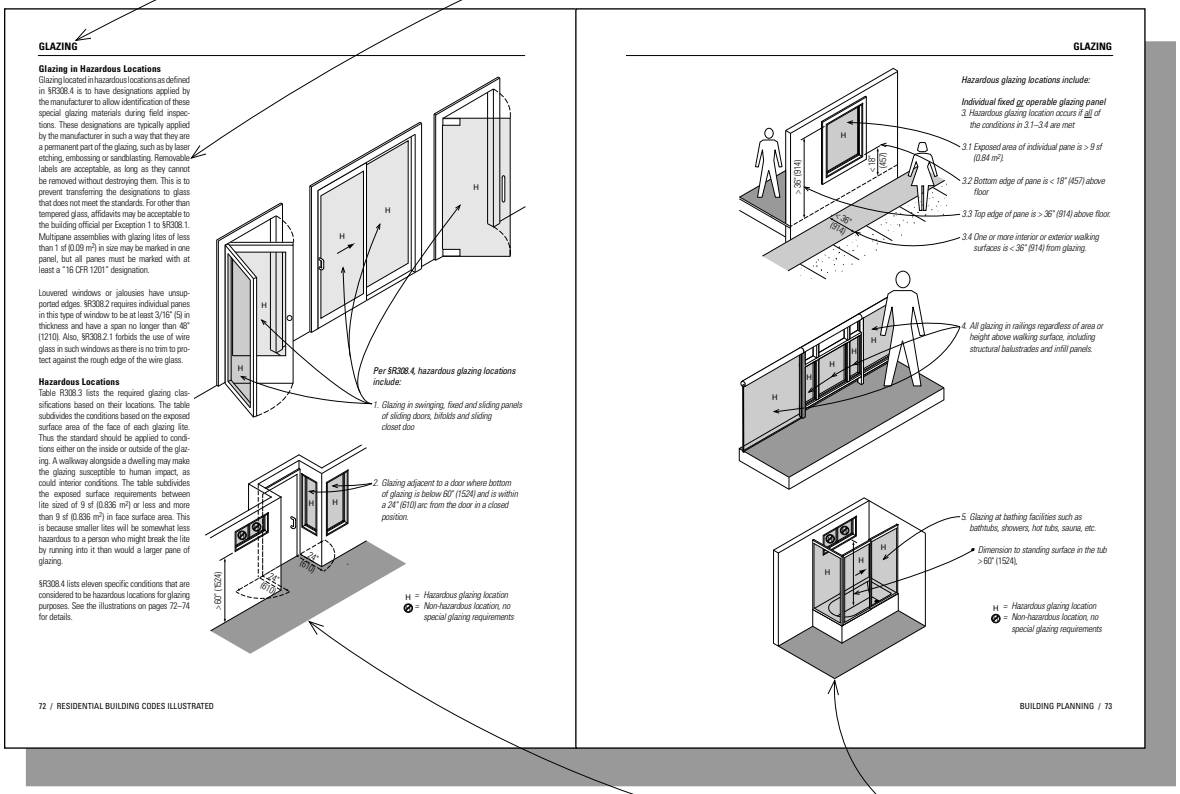
Webster's Third New International Dictionary defines a building code as: "A set of rules of procedure and standards of materials designed to secure uniformity and protect the public interest in such matters as building construction and public health, established usually by a public agency and commonly having the force of law in a particular jurisdiction."

How This Book Is Organized

The first two chapters of this book give background and context regarding the development, organization and use of the IRC. Chapters 3 through 10 are organized and numbered the same as the corresponding subject-matter chapters in the IRC.

Page headings refer to major sections within each chapter of the code.

Text is arranged in columns, typically on the left side of a single page or of two facing pages.



GLAZING

Glazing in Hazardous Locations

Glazing located in hazardous locations as defined in §R308.4 is to have designations applied by the manufacturer to allow identification of these special glazing materials during field inspections. These designations are typically applied by the manufacturer in such a way that they are a permanent part of the glazing, such as by laser etching, embossing or sandblasting. Removable labels are acceptable, as long as they cannot be removed without destroying them. This is to prevent transferring the designations to glass that does not meet the standards. For other than tempered glass, affidavits may be acceptable to the building official per Exception 1 to §R308.1. Multipane assemblies with glazing lites of less than 1 sf (0.09 m²) in size may be marked in one panel, but all panes must be marked with at least a "16 CFR 1201" designation.

Louvered windows or jalousies have unsupported edges. §R308.2 requires individual panes in this type of window to be at least 3/16" (5) in thickness and have a span no longer than 48" (1210). Also, §R308.2.1 forbids the use of wire glass in such windows as there is no trim to protect against the rough edge of the wire glass.

Hazardous Locations

Table R308.3 lists the required glazing classifications based on their locations. The table subdivides the conditions based on the exposed surface area of the face of each glazing lite. Thus the standard should be applied to conditions either on the inside or outside of the glazing. A walkway alongside a dwelling may make the glazing susceptible to human impact, as could interior conditions. The table subdivides the exposed surface requirements between lite sized of 9 sf (0.836 m²) or less and more than 9 sf (0.836 m²) in face surface area. This is because smaller lites will be somewhat less hazardous to a person who might break the lite by running into it than would a larger pane of glazing.

§R308.4 lists eleven specific conditions that are considered to be hazardous locations for glazing purposes. See the illustrations on pages 72–74 for details.

Per §R308.4, hazardous glazing locations include:

1. Glazing in swinging, fixed and sliding panels of sliding doors, bifolds and sliding closet doo

2. Glazing adjacent to a door where bottom of glazing is below 60" (1524) and is within a 24" (610) arc from the door in a closed position.

H = *Hazardous glazing location*
Ø = *Non-hazardous location, no special glazing requirements*

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GLAZING

Hazardous glazing locations include:

Individual fixed or operable glazing panel

3. Hazardous glazing location occurs if all of the conditions in 3.1–3.4 are met

3.1 Exposed area of individual pane is > 9 sf (0.84 m²).

3.2 Bottom edge of pane is < 18" (457) above floor

3.3 Top edge of pane is > 36" (914) above floor.

3.4 One or more interior or exterior walking surfaces is < 36" (914) from glazing.

4. All glazing in railings regardless of area or height above walking surface, including structural balustrades and infill panels.

5. Glazing at bathing facilities such as bathtubs, showers, hot tubs, sauna, etc.

Dimension to standing surface in the tub >60" (1524).

H = *Hazardous glazing location*
Ø = *Non-hazardous location, no special glazing requirements*

BUILDING PLANNING / 73

Drawings are typically to the right, accompanied by captions or explanatory notes. The illustrations are intended to help the reader visualize what is described in the text. They should therefore be considered to be diagrams that explain and clarify design relationships rather than representing specific design solutions.

PREFACE

Target Audiences

This book addresses code issues specific to the design and construction of dwellings. It accompanies and expands upon the basic principles addressed in the *2009 International Residential Code*® (IRC).

For Emerging Professionals

Whether encountered during the design, production, management or construction administration phases for construction of one- and two-family dwellings and townhouses, codes and standards are an integral and inescapable part of the practice of architecture and engineering. New practitioners need to refine their skills and knowledge of codes to make their projects safe and buildable with few costly changes. The more practitioners know about the code the more it can become a tool for design rather than an impediment. The better the underlying criteria for code development and the reasons for code provisions are understood the easier it is to create code-compliant designs. Early understanding and incorporation of code-compliant design provisions in a project reduces the necessity for costly and time-consuming rework or awkward rationalizations to justify dubious code decisions late in project documentation, or even during construction. Code use and understanding should be part of accepted knowledge for professionals, so that it becomes a part of the vocabulary of design.

For Experienced Practitioners

The greatest value of this book is that it is based upon the broadly adopted International Residential Code. This is a code that is similar but by no means identical to the old Council of American Building Officials (CABO) One- and Two-Family Dwelling Code that many experienced practitioners have used in the past. New state and federal standards have been developed using the IRC and the new requirements, while similar, are by no means identical to those in prior codes. This book will guide experienced practitioners out of the old grooves of code use they may have fallen into with the old codes. The code-analysis methods and outcomes will vary between the old codes and the new IRC. While there are seemingly familiar aspects from each code interspersed throughout the new code, the actual allowable criteria and how they are determined are often quite different. It is likely that the illustrations and the underlying reasons for the development of each code section will look familiar to experienced practitioners. The experienced practitioner must not rely on memory or old habits of picking construction types or assemblies based on prior practice. Each dwelling must be looked at anew until the similarities and sometimes-critical differences between the new code and old habits are understood and acknowledged.

It is also worth remembering that building officials and plan checkers are now becoming more familiar with these codes as well. We are still in a period of transition during which dialogue between designers and plan reviewers will be essential. The precedents that people on each side of the plan-review counter in the building department are most familiar with may no longer apply. Designers and building officials must arrive at new consensus interpretations together as they use the new codes for specific projects.

How to Use This Book

This book focuses on the use and interpretation of the provisions of the *2009 International Residential Code®* (IRC). There are references to basic structural requirements, but this book does not attempt to go into the derivation of the structural requirements in depth. That is a subject for another volume. This book does discuss and illustrate the prescriptive structural requirements contained in the IRC. This book covers the first 10 chapters of the IRC. These chapters are the core of the provisions related to building planning and building structure. These chapters cover requirements for the major components of the building envelope: foundations, floors, walls and roofs. This volume does not address provisions for energy efficiency or requirements for mechanical, electrical or plumbing work.

The organization of this book presumes that the reader has a copy of the latest version of the IRC itself as a companion document to this book. The book is intended to expand upon, interpret and illustrate various provisions of the code. The IRC has been adopted in many jurisdictions. It is now being extensively applied, and while there is not yet a large body of precedent in application and interpretation, code users do have a history of prior use to draw upon. It is our hope that the analysis and illustrations in the book will aid the designer and the Authorities Having Jurisdiction (AHJ) in clarifying their own interpretations of the application of code sections to projects.

The book is not intended to take the place of the *2009 International Residential Code®* in any way. The many detailed tables and criteria contained in the IRC are partially restated in the book for illustrative purposes only. For example, we show how various tables are meant to be used and how we presume certain parts will be interpreted. When performing a code analysis for a specific project, we anticipate the reader will use our book to understand the intent of the applicable code section and then use the code itself to find the detailed criteria to apply. One can, however, start with either the IRC or this book in researching a specific topic:

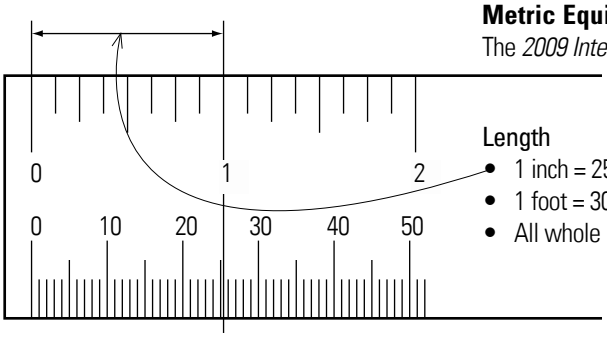
Beginning with the *2009 International Residential Code®*

- Search Contents or Index.
- Read relevant section(s).
- For further explanation and/or clarification, refer to this book.

Beginning with *Residential Building Codes Illustrated*

- Search Code Index for section number or Subject Index for topic.
- Refer back to specific text of *2009 International Residential Code®*.

The text is based upon the language of the code and interprets it to enhance the understanding of the user. The interpretations are those of the authors and may not correspond to those rendered by the AHJ. We would encourage the users of the book to confer with the AHJ early in the design process, using the illustrations from this book to validate interpretations. Reconciling text with construction drawings often benefits from additional illustrations. We trust that this will be the case with the explanations and graphics in this book.

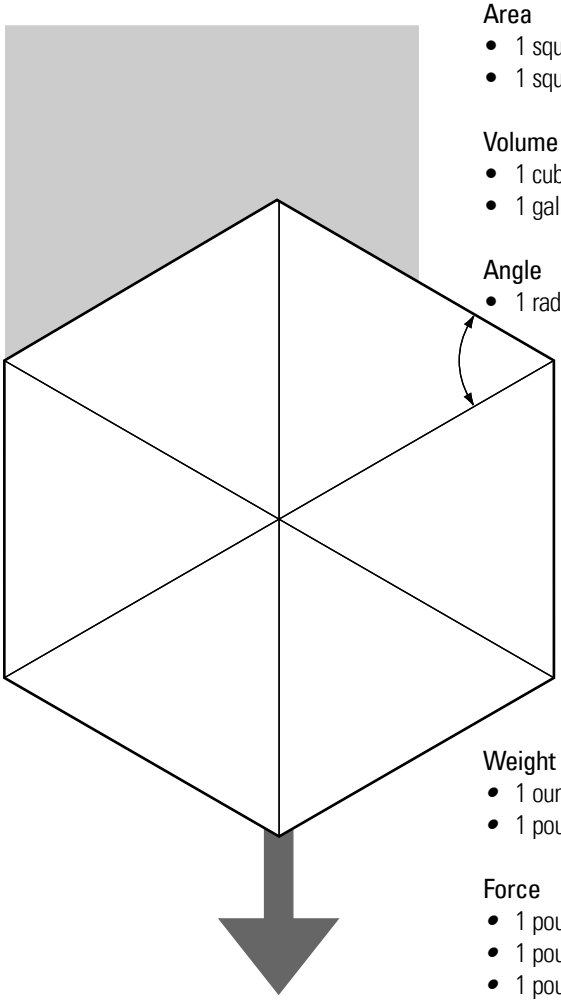


Metric Equivalencies

The *2009 International Residential Code*® uses the following SI units.

Length

- 1 inch = 25.4 mm
- 1 foot = 304.8 mm
- All whole numbers in parentheses are millimeters unless otherwise noted.



Area

- 1 square inch = 645.2 mm^2
- 1 square foot (sf) = 0.0929 m^2

Volume

- 1 cubic foot (cf) = 0.028 m^3
- 1 gallon (gal) = 3.785 L

Angle

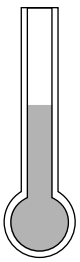
- 1 radian = $360/2\pi$ = 57.3°; 1 degree = 0.01745 radian (rad)

Weight

- 1 ounce = 28.35 g
- 1 pound = 0.454 kg = 0.004448 kN

Force

- 1 pound per square inch (psi) = 6.9 kPa
- 1 pound per linear foot (plf) = 1.4882 kg/m = 0.01459 kN/m
- 1 pound per square foot (psf) = 4.882 kg/m^2 = 0.0479 kN/m^2 = 0.0479 kPa
- 1 pound per cubic foot (pcf) = 16.02 kg/m^3



Light

- 1 foot-candle = 10.76 lux

Speed

- 1 mile per hour (mph) = 0.44 m/s = 1.609 km/h

Heat

- 1 British thermal unit (Btu) = 0.293 watts (w)
- °C = [(°F)-32]/1.8

1
Building Codes

The existence of building regulations goes back almost 4,000 years. The Babylonian Code of Hammurabi decreed the death penalty for a builder if a house he constructed collapsed and killed the owner. If the collapse killed the owner's son, then the son of the builder would be put to death; if goods were damaged then the contractor must repay the owner, and so on. This precedent is worth keeping in mind as you contemplate the potential legal ramifications of your actions in designing and constructing a building in accordance with the code. The protection of the health, safety and welfare of the public is the basis for professional licensure and the reason that building regulations exist.

"If a builder build a house for some one, and does not construct it properly, and the house which he built fall in and kill its owner, then that builder shall be put to death.

If it kill the son of the owner, the son of that builder shall be put to death.

If it kill a slave of the owner, then he shall pay slave for slave to the owner of the house.

If it ruin goods, he shall make compensation for all that has been ruined, and inasmuch as he did not construct properly this house which he built and it fell, he shall re-erect the house from his own means.

If a builder build a house for some one, even though he has not yet completed it; if then the walls seem toppling, the builder must make the walls solid from his own means."

Laws 229-233
Hammurabi's Code of Laws
(ca.1780 BC)

From a stone slab discovered in 1901 and preserved in the Louvre, Paris.

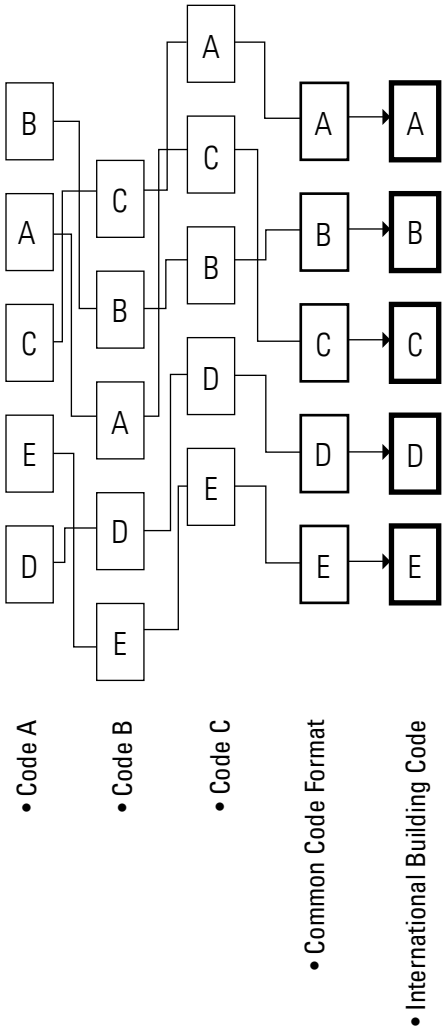
Various civilizations over the centuries have developed building codes. The origins of the codes we use today lie in the great fires that swept cities regularly in the 1800s. Concerns about fire regulations in urban areas can even be seen dating as far back as the Great Fire of London in 1666. Chicago developed a building code in 1875 to placate the National Board of Fire Underwriters who threatened to cut off insurance for businesses after the fire of 1871. It is essential to keep the fire-based origins of the codes in mind when trying to understand the reasoning behind many code requirements.

The various and often conflicting city codes were refined over the years and began to be brought together by regional nongovernmental organizations to develop so-called "model codes." These model codes were developed and written by members of the code organizations. The codes were then published by those code organizations. Model codes are developed by private code groups for subsequent adoption by local and state government agencies as legally enforceable regulations. The first major model-code group was the Building Officials and Code Administrators (BOCA), founded in 1915. They published the *BOCA National Building Code*. Next was the International Conference of Building Officials (ICBO), formed in 1922. The first edition of their *Uniform Building Code* was published in 1927. The Southern Building Code Congress, founded in 1940, published the *Standard (Southern) Building Code*.

These three model-code groups published the three different building codes previously in widespread use in the United States. These codes were developed by regional organizations of building officials, building materials experts, design professionals and life safety experts to provide communities and governments with standard construction criteria for uniform application and enforcement. The ICBO *Uniform Building Code* was used primarily west of the Mississippi River and was the most widely applied of the model codes. The BOCA *National Building Code* was used primarily in the north-central and northeastern states. The SBCCI *Standard Building Code* was used primarily in the Southeast. The model-code groups have merged together to form the International Code Council and have ceased maintaining and publishing their own codes. Also included in this merger was the incorporation of the Council of American Building Officials (CABO) into the International Code Council. CABO published the *One- and Two- Family Dwelling Code*. This code, which was limited in coverage to the types of occupancies noted in its title, was the closest thing to a national model building code in the decades preceding the development of the *International Building Code*.

The International Building Code

Over the past few years a real revolution has taken place in the development of model codes. There was recognition in the early 1990s that the nation would be best served by comprehensive, coordinated national model building codes developed through a general consensus of code writers. There was also recognition that it would take time to reconcile the differences between the existing codes. To begin the reconciliation process, the three model codes were reformatted into a common format. The International Code Council, made up of representatives from the three model-code groups, was formed in 1994 to develop a single model code using the information contained in the three current model codes. While detailed requirements still varied from code to code, the organization of each code became essentially the same after the mid-1990s. This allowed direct comparison of requirements in each code for similar design situations. Numerous drafts of the new *International Building Code* were reviewed by the model-code agencies along with code users. From that multiyear review grew the *International Building Code* (IBC), first published in 2000. There is now a single national model building code, maintained by a group composed of representatives of the three prior model-code agencies, the International Code Council, headquartered in Washington, D.C. This group was formed from a merger of the three model-code groups and CABO into a single agency to update and maintain the "I Code" family, which includes the *International Building Code* and the *International Residential Code*.



The International Residential Code

In addition to the *International Building Code* (IBC) there is the *International Residential Code* (IRC). This stand-alone code is meant to regulate construction of detached one- and two-family dwellings and townhouses that are not more than three stories in height with a separate means of egress. This code is designed to supplant residential requirements contained in the IBC in jurisdictions where the IRC is adopted.

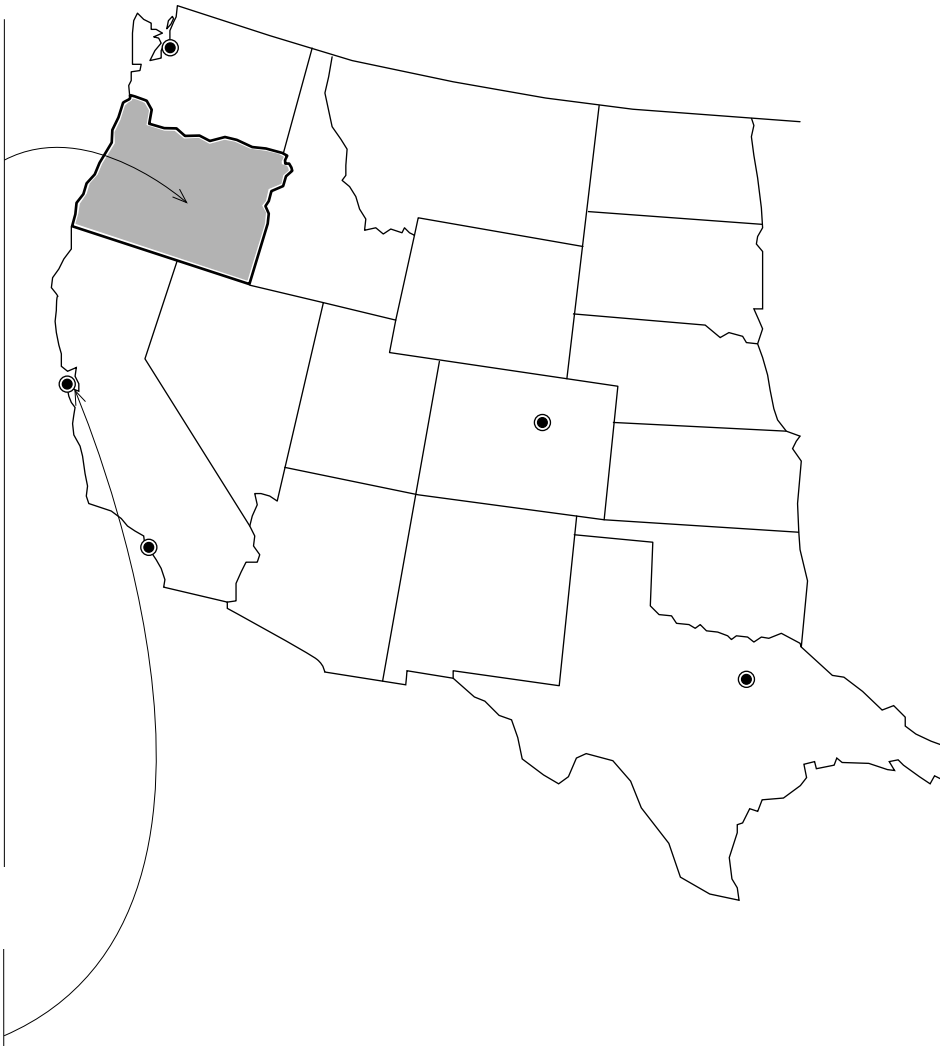
The IRC is derived from a predecessor residential building code published by the Council of American Building Officials (CABO), the *One- and Two-Family Dwelling Code*. In 1996 CABO and the predecessor code organizations that ultimately became the International Code Council agreed to begin development of an updated stand-alone national model residential building code. This resulted in the first publication of the *International Residential Code* in 2000. This code includes provisions that replace the requirements of the *International Building Code* with requirements specific to buildings within the scope of the IRC. The IRC includes provisions for code requirements for all the systems typically contained in the one- and two-family buildings and townhouses regulated by the IRC. Among these "external" codes are the electrical sections of the IRC, which are taken from NFPA 70: *National Electrical Code*. The electrical chapters are produced under the auspices of the National Fire Protection Association (NFPA), which produces and copyrights the *National Electrical Code*. The IRC also contains materials regarding fuel gas provisions included through an agreement with the American Gas Association (AGA). [Note this book focuses on the first 10 chapters of the IRC, the requirements related to building design and construction, and does not address IRC requirements for such things as electrical or plumbing work.]

Note also that many local jurisdictions make other modifications to the codes in use in their communities. For example, many jurisdictions make amendments to require fire sprinkler systems, even in single-family residences, where they may be optional, or not even required, in the model codes. In such cases mandatory sprinkler requirements may change the design options offered in the model code for inclusion of sprinklers where not otherwise required by the code. It is imperative that the designer determines what local adoptions and amendments have been made in order to be certain which codes apply to a specific project.

There are also specific federal requirements that may need to be considered in design and construction in addition to the locally adopted version of the model codes. Among these are the Americans with Disabilities Act of 1990 and the Federal Fair Housing Act of 1988. While knowledge of these regulations will promote universal design for access to housing for persons with disabilities, note that these regulations typically do not apply to the types of buildings regulated by the *International Residential Code*. Accordingly they will not be discussed in any detail in this book.

State Building Codes

Each state has a separate and distinct code adoption process. Many states may have adopted one of the three previous model codes and perhaps the CABO *One- and Two-Family Dwelling Code* in the past but some states have their own building codes. The geographic areas for current state model-code adoptions correspond roughly to the areas of influence of the three previous model codes as noted previously on page 3. The BOCA *National Building Code* predominated in the northeastern United States. The *Standard (Southern) Building Code* was adopted throughout the southeastern United States. West of the Mississippi River, the *Uniform Building Code* was adopted in most states. These adoption-area boundaries were loosely defined and flexible. Note also that the predecessor document to the IRC, the CABO *One- and Two-Family Dwelling Code* had a broader national adoption than the three predecessor model building codes. Many states allow local adoption of codes so that in some states, such as Texas, adjacent jurisdictions in the same state may have different building codes based on different model codes. State processes often defer completely to local adoption. Make certain you know what code you are working with at the permitting level.



Local Building Codes

Many localities adopt model-code documents with little modification except for the administrative chapters that relate to local operations of the building department. Larger cities such as Los Angeles, New York, Chicago and San Francisco adopt much more sweeping revisions to the model codes. In the past, codes in such large cities were often not based on model codes and bore little resemblance to them. Many cities make local amendments to the model codes due to local conditions or building traditions. Also, since codes are general and building projects occur in specific places, the codes must be interpreted by both the designer and by code officials to apply the intent of the code to the project at hand. Coupled to local modifications, the need to interpret how the code applies to a specific project should be expected as part of the code review process. Be aware of local modifications and be prepared for varying interpretations of the same code sections among various jurisdictions. Do not proceed too far in the design process based on review of similar designs in another jurisdiction without verification of the code interpretation in the jurisdiction where the project is located. Similarly, although this book offers opinions of what code sections mean, all such opinions are subject to interpretation by local authorities as they are applied to specific projects.

The IRC is much more than just a "building" code. It contains code requirements taken from various codes for other design and construction disciplines beyond architecture and structural engineering. The Building Code regulations are usually the focus of interest for architectural and structural work and as noted above are the focus of this book, but you need to be aware of the existence of additional requirements in the IRC for such work as electrical plumbing, mechanical, fire sprinklers and fire alarms. Each of these may impact the work of design consultants and in turn the work of the architect. While these other requirements are contained in separate stand-alone codes for buildings other than those regulated by the IRC, the intent of the IRC is to provide a single source for all construction regulations related to one- and two-family dwellings and townhouses as defined in the IRC scope descriptions.

Code Interactions

The Authorities Having Jurisdiction (AHJ)—a catch-all phrase for all planning, zoning, fire and building officials having something to say about buildings—may not inform the designer of overlapping jurisdictions or duplicate regulations. Fire departments often do not check plan drawings at the time building permit documents are reviewed by the building department. Fire and life-safety deficiencies are often discovered at the time of field inspections by fire officials, usually at a time when additional cost and time is required to fix these deficiencies. The costs of tearing out noncomplying work and replacing it may be considered a designer's error. Whenever starting a project, it is therefore incumbent upon the designer to determine exactly which codes and standards are to be enforced for the project and by which agency. It is also imperative to obtain copies of any revisions or modifications made to model codes by local or state agencies. This must be assured for all AHJs.

The model codes have no force of law unto themselves. Only after adoption by a governmental agency are they enforceable under the police powers of the state. Enforcement powers are delegated by state or local statutes to officials in various levels of government. Designers must verify local amendments to model codes to be certain which code provisions apply to specific projects.

There are many different codes that may apply to various aspects of construction projects. Typically the first question to be asked is whether the project requires a permit. There are typically cost thresholds for when permits are required. These are usually set by local amendments to model code provisions. Certain projects, such as interior work for movable furniture or finishes, are usually exempt. Carpeting may be replaced and walls painted without a permit, but moving walls, relocating doors, or doing plumbing and electrical work will require a permit in most jurisdictions.

Traditionally, codes have been written with new construction in mind. In recent years more and more provisions have been made applicable to alteration, repair and renovation of existing facilities. For renovation work it is critical to define the scope of alteration or addition work to be able to define the area where the code applies to the work. The code does not come into effect in those areas not impacted by the work. The code requires new work to meet the current code, but does not require remedial work in those areas not affected by the new work. It is typically not required to bring a whole house up to the new code in those areas not impacted by new work. Again, this should be verified against local code requirements.

Standard of Care

The designer should always remember that codes are legally and ethically considered to be the minimum criteria that must be met by the design and construction community. The protection of health, safety and welfare is the goal of these minimum standards. Registered design professionals and licensed contractors will be held by legal and ethical precedents to a much higher standard than the code minimum.

This concept is best described by the legal term "Standard of Care," which holds that the code is the minimum standard for practitioners, but that they also must respond to all of the other conditions affecting the project at hand. This is higher than the minimum standard defined by the code. The code is the level that a practitioner must never go below. Because professional work involves judgment, perfection is not expected of a design professional. The standard of care is defined for an individual designer as being those actions that any other well-informed practitioner would have taken given the same level of knowledge in the same situation. It is a relative measure, not an absolute one.

Life Safety vs. Property Protection

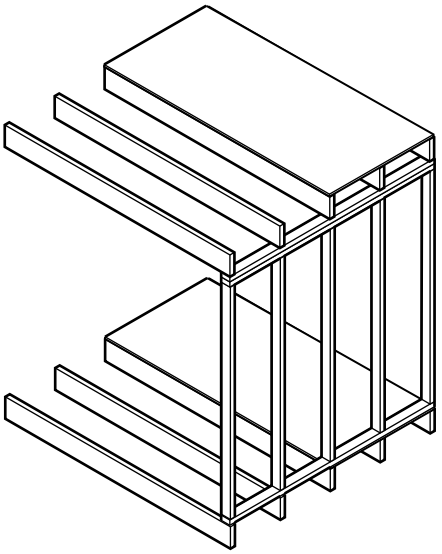
The basis for building-code development is to safeguard the health, safety and welfare of the public. The first and foremost goal of building codes is the protection of human life from the failure of building life safety provisions or from structural collapse. There is also a strong component of property protection contained in code requirements. Sprinkler provisions can serve both purposes. When buildings are occupied, sprinklers can contain or extinguish a fire, allowing the building occupants to escape. The same sprinkler system can protect a structure from loss if a fire occurs when the structure is not occupied. While many systems may perform both life safety and property protection functions, it is essential that code developers keep the issue of life safety versus property protection in mind. Security measures to prevent

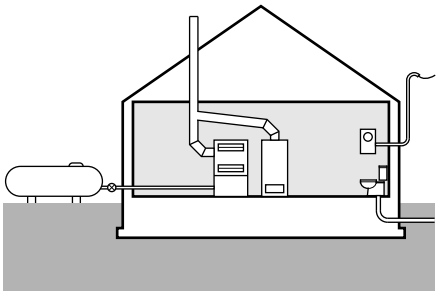
intrusion into a structure may become hazards to life safety. A prime example of this is burglar bars on the exterior of ground-floor windows that can trap inhabitants of the building in an emergency if there is not an interior release to allow occupants to escape while still maintaining the desired security. In no case should property-protection considerations ever have primacy over life safety.

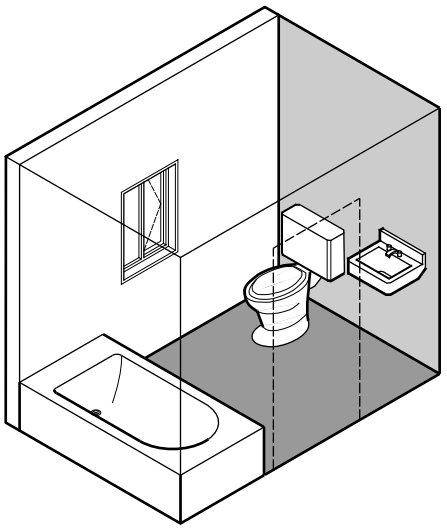
The Code Development Process

As described above, the three previously existing model-code development agencies and CABO have merged into one organization. These agencies modified their code development processes into a unified national format. This new format has been modified slightly over the past few years as it had been developed, but it now seems well settled.

As in the past, any person may propose a code revision. Any designer, material supplier, code official or interested member of the public who feels they have a better way to describe code requirements or to accommodate new life safety developments or new technology may prepare revised code language for consideration. Proposed code changes are published for review by all interested parties. They are then categorized, based on what section of the code is being revised and assigned to a committee of people experienced in those matters for review and consideration. Committees are typically organized around specific issues such as means of egress, fire safety, structural, general, plumbing, mechanical and so forth. Anyone may testify at these committee hearings regarding the merits or demerits of the code change. The committee then votes to make its recommendation to the ICC annual business meeting. At the annual business meeting, testimony will be heard from interested parties, both from non-voting industry representatives and building officials who are given voting privileges. Only governmental members of the organization—typically public employees serving as building officials, fire officials or mechanical and plumbing officials—are allowed to vote on the proposed changes. This is described by the ICC as a "governmental consensus process."







The *International Residential Code* is a living document. It is subject to yearly review and comment cycles. A new code is published at regular intervals, usually every three years. This publication cycle gives some measure of certainty for building designers that the code will remain constant during the design-and-construction process. The code development cycle allows the code to respond to new information, growing by accretion and adaptation.

Performance vs. Prescriptive Codes

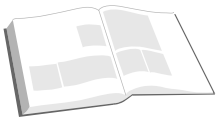
The *International Residential Code* is, as were the codes that preceded it, "prescriptive" in nature. It is developed to mitigate concerns by creating specific and prescribed responses to problems that have been identified. Designers identify the problem to be addressed, such as the size of egress windows, and then they look up the prescribed response in the applicable code section. For example, guard heights are prescribed to be 42" (1067) high in non-residential buildings and 36" (914) high in residential buildings and are required when adjacent changes in grade exceed 30" (762). The designer follows the prescribed requirements to avoid the problem the code has identified—that is, preventing falls over an edge higher than 30" (762). The code provides a defined solution to an identified problem. We will discuss briefly the distinctions between prescriptive and performance codes.

Performance codes define the problem and allow the designer to devise the solution. The word *performance* in this context refers to the problem definition and to the setting of parameters for deciding if the proposed solution solves the problem adequately. These standards define the problem, but do not define, describe or predetermine the solution.

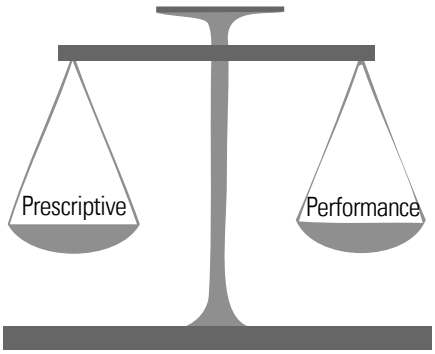
The use of performance codes has been increasing in the past few years, due in large part to the development of new modeling techniques for predicting how a building will react under certain fire, earthquake or other stimuli. Performance codes are used in many countries around the world. Their requirements may be as broad as "the building shall allow all of its prospective occupants to safely leave the building in the event of a fire." Most performance codes in reality have much more tightly defined requirements, but the guard requirements stated above are a good example of the essence of what performance-code requirements can be.

The basic form of modem performance-code language can be described as objective-based. Each code requirement is broken into three sections. We will use fall prevention as our example. Note that provision of guard rails is only one example of many solutions to the performance objective, not the only solution.

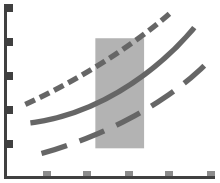
Objective: What is to be accomplished? In this case, the prevention of falls from heights of more than 30" (762).



Functional Statement: Why do we want to accomplish this? We wish to safeguard building occupants by preventing them from accidentally falling from a height great enough to result in an injury.



Performance Requirement: How is this to be accomplished? Performance codes could become prescriptive at this juncture, mandating a guard rail. More likely, such a performance standard would require that the barrier be high enough, strong enough and continuous enough to prevent falls under the objective circumstances. Note that a guard rail meeting current code standards would be deemed to satisfy those requirements, but alternate means and methods could also achieve the same ends. For example, landscaping could prevent access to the grade change, or innovative railing substitutes could be designed to function like automobile air bags to catch falling persons without having a visible rail present in most conditions. Let your imagination provide other alternatives.



Performance codes give designers more freedom to comply with the stated goals. They also require the designer to take on more responsibility for knowing the consequences of their design actions. We anticipate that performance codes will be used in limited ways for innovative projects, but that many typical, repetitive designs will continue to use prescriptive code for speed, clarity and assurance of compliance during design review. Also, given the current legal climate, designers are often reluctant to assume the responsibility for long-term code compliance for innovative systems.

2

Navigating the Code, Administrative Procedures, Definitions

Navigation and Administrative Procedures

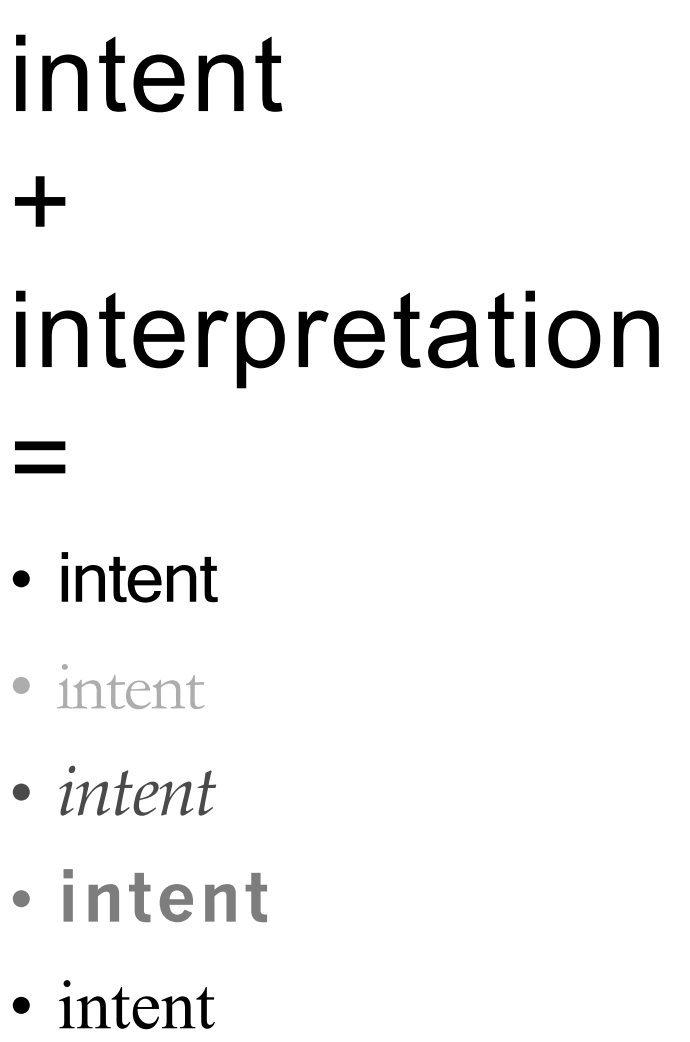
The key word to remember about how all building codes are developed and how they all work is *intent*. The intent of the author of a building code section in the *International Residential Code* (IRC) is to solve a specific design problem with prescriptive language. Designers are usually trying to measure the appearance and spatial arrangements of their projects against the language of the code. Builders try to determine the physical constraints dictated by the code to be certain they provide the materials and assemblies dictated by the code. During this process the designer or builder should ask themselves what problem, or performance criteria, the code section is addressing. The language may start to make more sense as one tries to go beyond the specific language to determine why the words say what they say.

Designers and builders also have intent. They are trying to achieve certain functional or appearance goals in the design of the building. Designers and builders should measure their own intent for the design against their interpretations of the intent of the code. When examined together, the intent of the code and that of the design or construction solution should be concurrent. It is also important to understand that the true intent of the original code writer will be subject to later interpretation both by the designer and builder as code users and by the authorities having jurisdiction as code administrators. The understanding of the code intent is filtered through the experiences, needs and wishes of each of the code users. It should therefore not be surprising that the "obvious" meaning of a code requirement can come to be so different for various parties in the construction process. When there is a misunderstanding or a disagreement about what the code requires, trying to determine the original intent of the code section in question is always a valuable way to have a productive dialogue rather than a non-productive argument between the parties to the construction process.

It is critical to understand that each section of the code was developed to solve a certain problem. The code is typically written in relatively short sections, by many different authors, generally working independently of each other. There is no single "author" of the code. There are literally thousands of authors: among them are code officials, fire officials, design professionals and construction professionals. We suggest that readers visit the ICC website for a detailed description of the code development process. The International Code Council is the *publisher* of the IRC, not the *author*. Sections are organized into chapters based on common themes, but sections in each chapter are often developed in isolation from one another with little attention to continuity of the entire document. As you look at the code, try and visualize the intent of the writer of that section and try to understand the problem they are addressing. Code language usually arises from a specific issue the code writer wishes to address based on experience, or on a construction or life safety issue. The writer then makes the requirements general so that they apply to more typical conditions than the specific instance that generated the concern.

The intent of the code is a crucial idea to understand. *Why* is a much more important question than *what* when you are puzzled by the actual language of a code passage. The code is a general document that must then be interpreted for its specific application to a specific project. If you know the code in general and think about its intent, you will be in a better position to formulate your own interpretation of code sections as they apply to your specific project. You will thus be in a position to help building officials see the validity of your opinion when interpretation of the code is required for a specific design condition. Confidence will come with experience in use of the code. Learning the code is vital to the success of a well-rounded designer or builder.

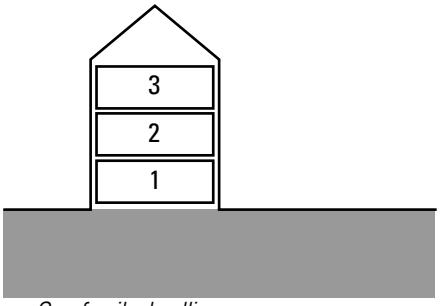
Learn the table of contents and use the index. It is very useful to get a copy of the CD-ROM of the code for use in your practice. This allows key word searches. Don't try and memorize passages of the code, as the code is a living document, and these will likely change over time as the code is amended. Learn the organization of the code and learn where to find things in that fashion. Use the index if the table of contents doesn't get you where you want to be. Think of synonyms for the topic you are researching to facilitate key word or index searches. Remember to try both singular and plural words when using key word searches in the CD-ROM. If you don't find *"handrail,"* try *"handrails."* You may have to scan large portions of the index to locate potential items. Remember also that the model code is often amended during adoption by state and local agencies. Be certain to know what local code amendments to the code apply to your projects. Also determine if the local AHJ has published written opinions regarding their interpretation of the code in their jurisdiction.



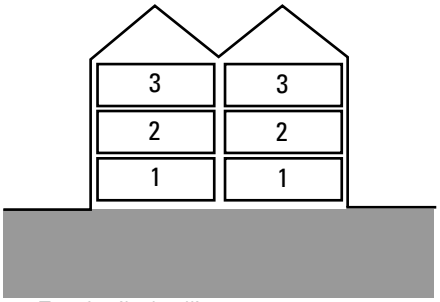
Scope, Purpose and Intent

§R101.1 states that the IRC shall "apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, removal and demolition of detached one- and two-family dwellings and townhouses not more than three stories above-grade in height with a separate means of egress and their accessory structures." Therefore, just about any activity on a dwelling or townhouse that fits within this scope definition will require a permit. The intent of the code is that any work on a dwelling will be done under permit so that the housing stock will become more code compliant with contemporary codes as work is done on them.

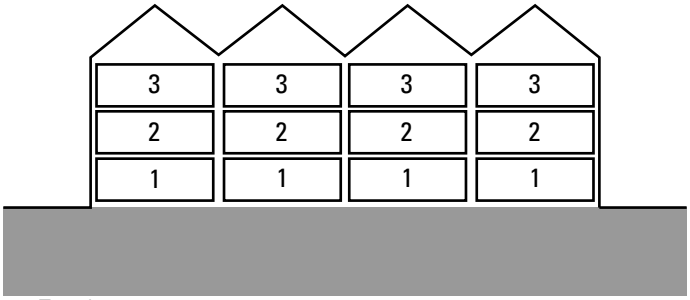
From our analysis of the code text and its definitions, we believe that the intent of the code is that the three-story maximum apply to both one- and two-family dwellings and to townhouses. Per §R105.2, certain activities are exempt from building permit requirements. These include items such as: work on small sheds or playhouses smaller than 120 square feet (11.15 m^2); fences under 6 feet (1829) high; short retaining walls less than 4 feet (1219) high; sidewalks and driveways; painting, wallpapering, carpeting and similar finish work; prefab swimming pools less than 24 inches (610) deep; swings and similar playground equipment or small window awnings. Similarly, maintenance items are exempt from mechanical, gas, or electrical permits. These include items such as: lamp replacement, portable gas heating equipment; portable fans and portable cooling units.



- *One-family dwelling*



- *Two-family dwelling*

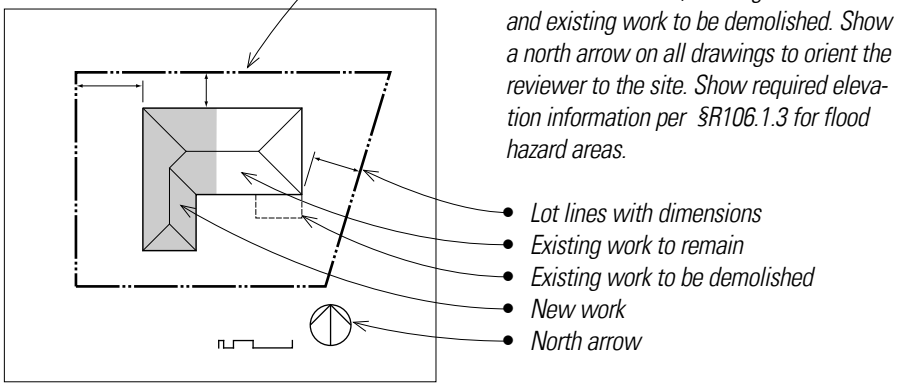


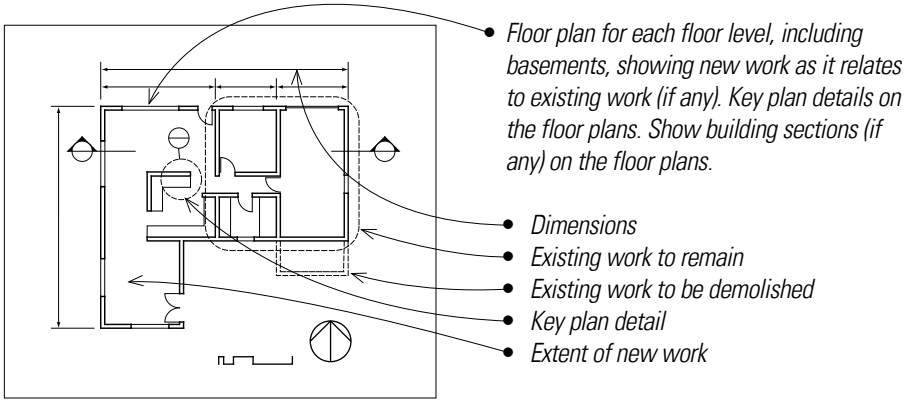
- *Townhouses*

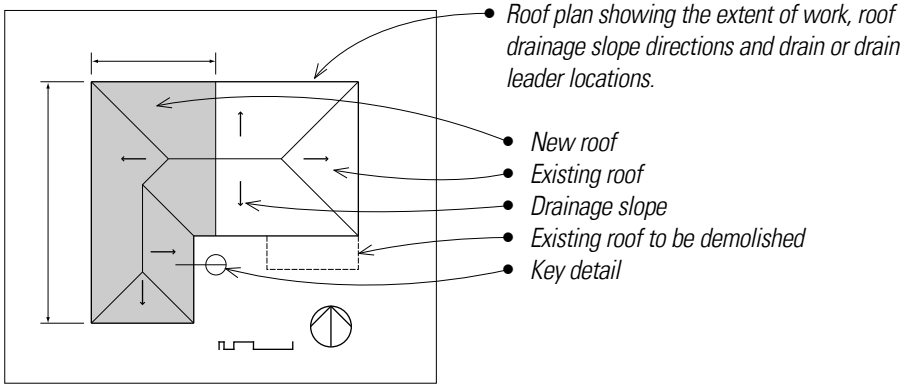
Construction Documents

Construction documents are defined in IRC §R202 as: "Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit. Construction drawings shall be drawn to an appropriate scale to be submitted." They are to be submitted per §R106. The building official may waive the requirement for construction documents for minor work where review of such documents would not be necessary to be sure that code compliance is obtained by the proposed work. The proponent for the proposed work must verify with the AHJ to what extent the design work needs to be done by a registered design professional in the locality where the work is to occur. Different jurisdictions have widely varying thresholds for when a registered design professional is to be utilized. Note also that the size and complexity of the proposed project may move the AHJ to require that the construction documents be prepared by a registered design professional. This is within the purview of the building official per §R106.1.

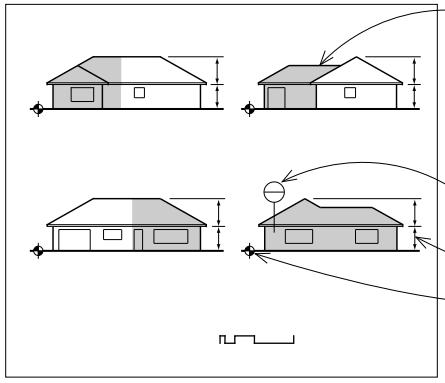
As noted above, the drawings should be to scale so that parts of the building are depicted in the proper graphic relationships for sizes and configurations. Details should be clear and sufficient to allow the building official to verify code compliance. If the dwelling is in a flood hazard area the requirements of §R106.1.3 should be noted for location in flood hazard areas and the elevations of such elements as finished floor elevations at the lowest level should be shown to allow verification of compliance with code requirements. The construction documents should have a site plan showing the proposed new construction in relation to existing structures. Existing structures should be described as to what portions are to be demolished and which are to remain. Lot lines should be shown and the distances from the lot lines to new and existing structures should be shown. The construction documents should graphically verify the code compliance of the proposed project without requiring the building official to request additional information to determine code compliance. The quantity and complexity of contract documents is directly related to the size, scope and complexity of the proposed work. We recommend the following minimum contents for the contract documents for any project. The minimum drawing sizes are often dictated by local code requirements. Verify with the AHJ what their minimum size requirements are for drawings. Recommended document contents for a typical new dwelling or alteration, all drawn to scale, are:



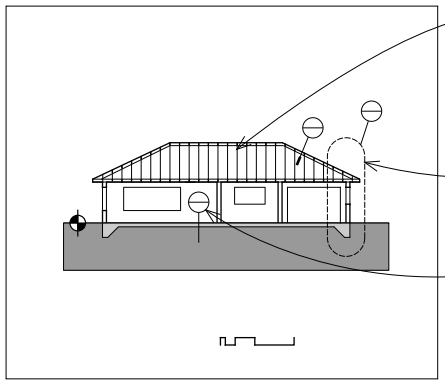




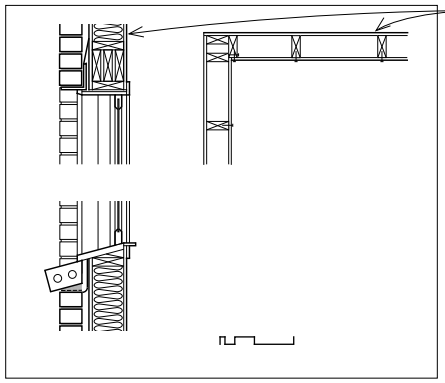
The AHJ will review the submitted permit documents and when they are deemed satisfactory will issue a permit and mark the drawings as approved per §R106.3.1. The permit set is to be kept on the work site and available for use by the building official or by the field inspector. If amendments are made to the construction documents during the construction process the documents should be resubmitted for approval by the AHJ per the amended document provisions contained in §R106.4.



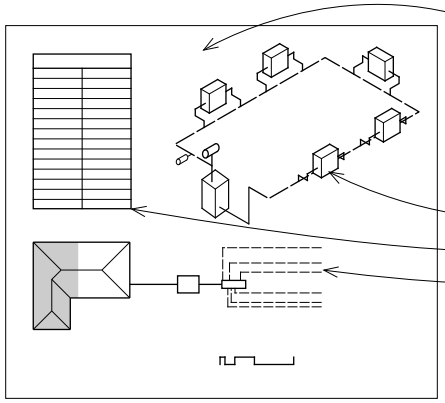
- *Exterior elevations of all affected elevations of the building, Show roof slopes for pitched roofs on elevations. Key elevation details on the elevations. Key section details on the elevations unless separate overall building sections are drawn*
- *Detail key*
- *Heights*
- *Lot elevations*



- *Building sections (if required to describe the work) with section details keyed here instead of on the elevations. If wall sections are drawn, key wall section on the building sections.*
- *Wall sections (if appropriate to the proposed work). Key details on wall sections.*
- *Detail key*



- *Details, as necessary to describe structural, fire protection and water protection. Enlarged scale as necessary to describe the work proposed.*

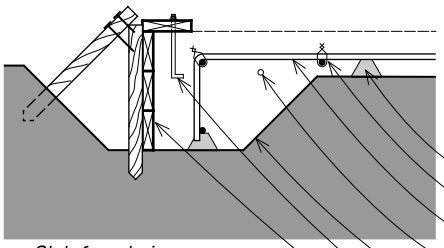


- *Drawings for other work such as mechanical, plumbing, and electrical should be drawn on "backgrounds" of current building plan, elevation or section base drawings to allow coordination of the work.*
- *Hot water heating single line diagram*
- *Panel schedule*
- *Sewage disposal system*

Inspections

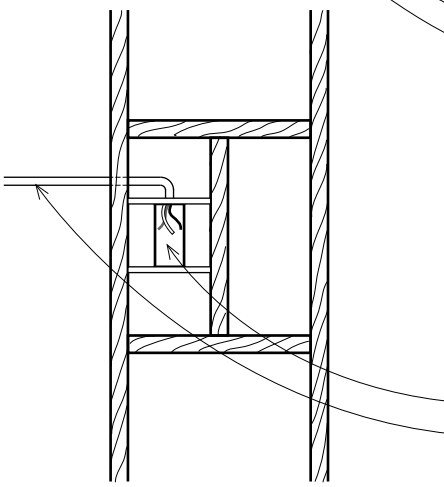
Work done under a building permit is subject to periodic inspection by the building official or other persons designated to perform inspections. The inspections are to verify that the work is being installed in the field in accordance with both the requirements of the code and the criteria stated in the approved permit documents. The inspections are to occur at designated phases of the work which are required to occur at times when the work to be inspected is complete enough to determine code compliance, but still visible for observation prior to covering up with subsequent construction. It is the responsibility of the person holding the permit to request inspections in a timely manner, to allow access to the work so it can be inspected and to uncover any work not done in a timely sequence to allow it to be adequately inspected. The code allows the AHJ to allow inspections to be done by pre-approved outside agencies and to accept inspection reports from them. Work is not to proceed beyond permit milestones without approval of the prior work subject to inspection. Project milestones as noted in §R109 are:

- Foundation inspection,
- Plumbing, mechanical, gas and electrical systems inspection,
- Floodplain inspections,
- Frame and masonry inspection,
- Other inspections,
  - Fire-resistance-rated construction inspection,
  - Final inspection



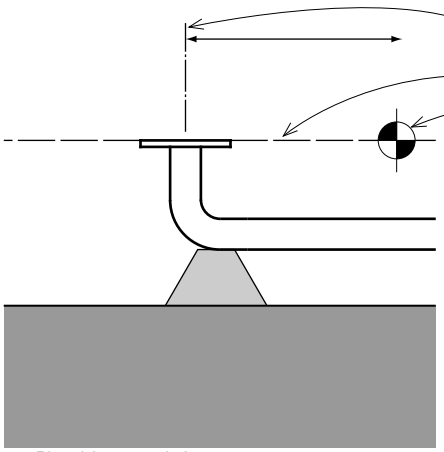
- *Slab foundation*

- *Foundations (§R109.1.1) This inspection is to review excavations, formwork and reinforcing for the foundations before these are obscured by concrete placement or installation of other types of foundation materials.*
  - *Reinforcing support*
  - *Tie wires*
  - *Reinforcing steel*
  - *Electrical conduit*
  - *Excavation for thickened slab*
  - *Anchor bolts*
  - *Formwork*



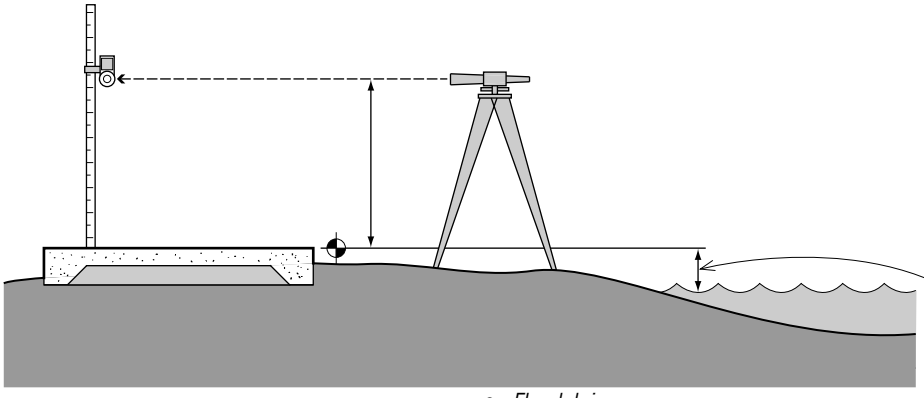
- *Electrical rough-in*

- *Plumbing, mechanical and electrical systems (§R109.1.2) Rough installation of these systems is to be inspected when the work is done, but prior to being enclosed in foundations of walls.*
  - *Switch box*
  - *Conduit*



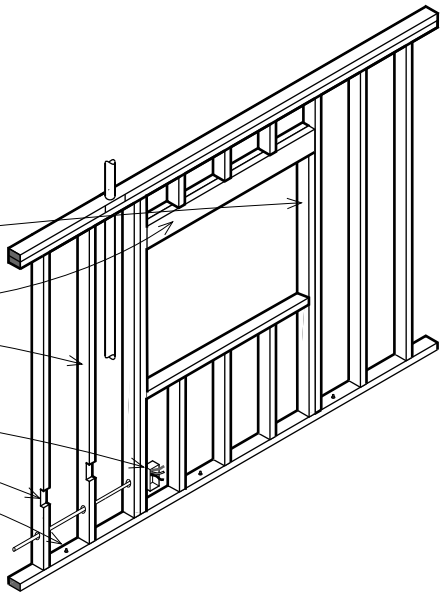
- *Plumbing rough-in*

  - *Horizontal location*
  - *Fixture floor elevation*
  - *Vertical location*



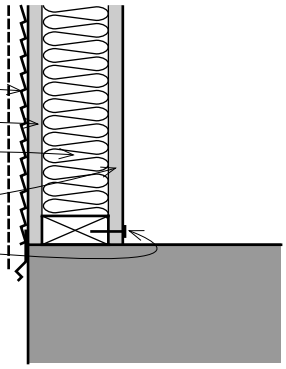
- *Floodplain survey*

- *Floodplain inspections (§R109.1.3) In flood-prone areas, as determined by Table R301.2(1) upon placement of the lowest floor level, which may be a basement level, a survey is to be made by a registered design professional verifying the actual elevation of that level and is to be submitted to the building department.*
  - *Required height above maximum flood elevation*



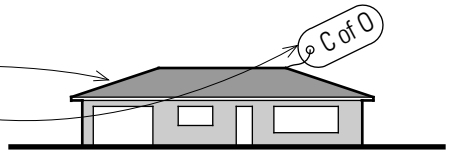
- *Jack studs*
- *Headers, wood species and grade*
- *Stud size and spacing, wood species and grade*
- *Electrical rough-in*
- *Notches at studs*
- *Anchor bolting at sill plate*

- *Framing and masonry inspection (§R109.1.4) After the wall framing and roof framing, including bracing, firestopping and draftstopping and all masonry is complete, the work shall be inspected for completeness and code compliance before the inspected systems are closed in by wall or roof coverings. This is to occur after the mechanical, plumbing and electrical inspections are complete.*



- *Lath, without finish*
- *Sheathing at lath*
- *Insulation (if required)*
- *Fire-resistance rated interior sheathing*
- *Nailing and sealants per fire rating*

- *Fire-resistance-rated construction (§R109.1.5.1) When fire-resistance-rated construction is required by the code, fire-resistive materials, such as lathing or wallboard, are to be inspected prior to installation of wall finishes.*

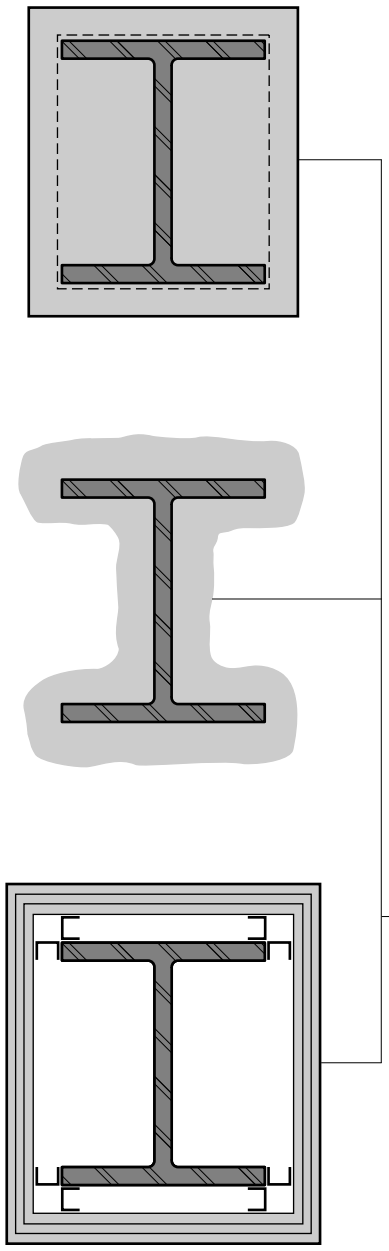


- *Completed dwelling*
- *Certificate of Occupancy upon acceptable final inspection*

- *Final inspection (§R109.1.6) The project is to be inspected when all of the permitted work is completed prior to occupancy. Upon successful completion of the final inspection the AHJ will issue a Certificate of Occupancy. No building or structure is to be used or occupied until the certificate is issued.*

Alternate Means and Methods

§R104.11 states that the provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. While written around prescriptive descriptions of tested assemblies and rated construction, the code recognizes that there may be many different ways of solving the same design problems. It recognizes that there will be innovations in building construction means and methods that do not fit neatly into prescribed classifications. New technologies may dictate new construction requirements. The code recognizes that there will be innovations in materials and construction technology that may happen faster than code revisions are made. Thus the code sets up a method for the building official to approve proposed alternative designs. Deviations from prescribed standards must be submitted for review and approval of the building official. The criteria they are to use are spelled out in the code. We have highlighted some of the key provisions of the approval in ***bold italics***. The alternative is to be approved when "the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the ***equivalent*** of that ***prescribed in this code***" (emphasis added). These words are also the fundamental criteria for why each and every code section is included in the basic code.

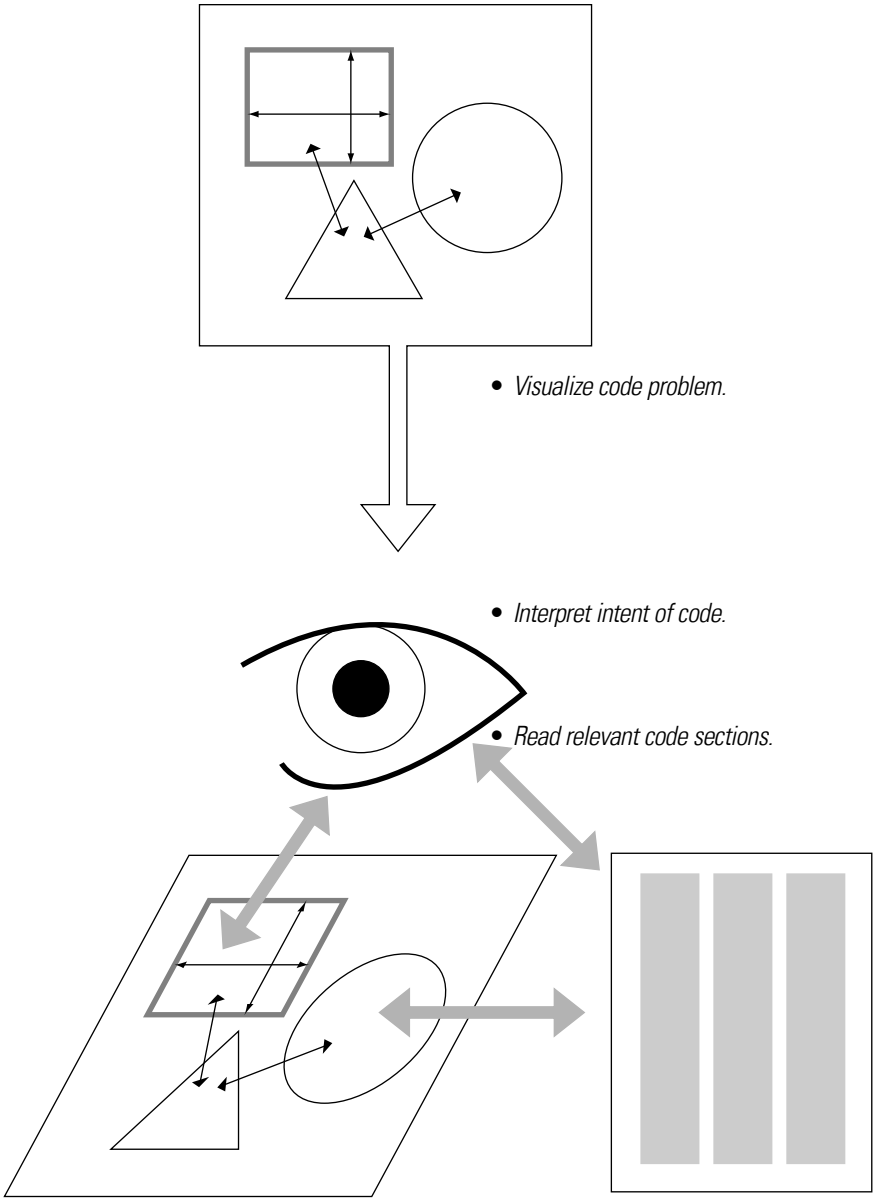


Concrete, spray-on fireproofing and gypsum board provide alternate means of fireproofing a structural steel member.

Code Interpretations

Designers, builders and code officials approach interpretations from quite different perspectives. The designer or builder is trying to make a functional design code compliant while satisfying project requirements in an aesthetic, economical and practical way. The AHJ examines completed drawings for compliance with code requirements. While the AHJ is not unaware of the practical requirements contained in the building design, they are charged first and foremost with verifying code compliance. It is the responsibility of the designer to demonstrate code compliance and to modify noncompliant areas while continuing to meet the project requirements.

Both the designer and the AHJ are working to apply generalized code provisions to a specific project. It is differences in opinion about the application of the general to the specific that most often give rise to differences in interpretation. Code officials also see many more similar examples of the relationship of code sections to various designs. Thus they may generalize interpretations from one project to another even though the projects may be different in significant ways. On the other hand, designers may find that similar designs receive quite different interpretations by the AHJ in different jurisdictions. When differences of opinion about interpretation occur, the designer must work with the AHJ to reconcile the intent of the design to the interpretations of the intent of the code. If reconciliation cannot be reached, the designer must decide whether to revise the project to obtain approval or appeal the ruling of the AHJ to some civic body prescribed in the jurisdiction for hearing appeals. Often the AHJ can be requested to apply to the model-code agency that published the code for a ruling as to the publisher's opinion of the intent of the code section in question.

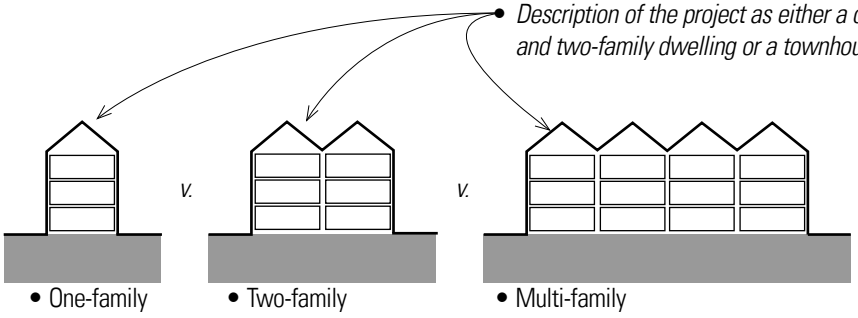


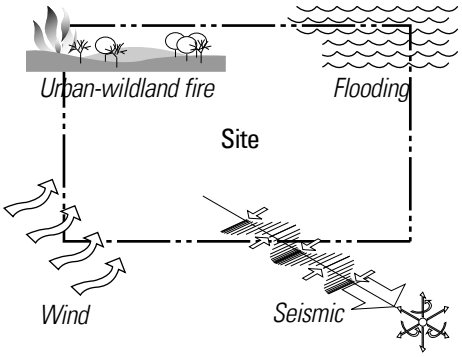
- *Visualize code problem.*
- *Interpret intent of code.*
- *Read relevant code sections.*
- *Re-visualize possible solution that satisfies both design intent and intent of the code.*

Documenting Code Interpretations

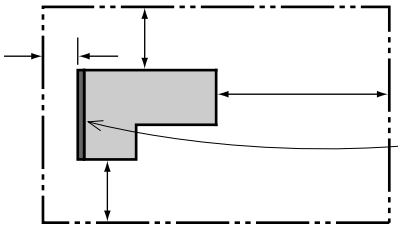
Every project, including residential projects designed and permitted under the IRC, should receive a basic code analysis that is recorded as a permanent part of the permit documents. All code interpretations and citations should have a reference to the code section in question to allow retracing steps in the code analysis. There is nothing more maddening than to have a statement in a code analysis upon which the design rests without any citation as to where it resides in the code.

The primary contents of the code analysis for residential construction are related to the following decisions:

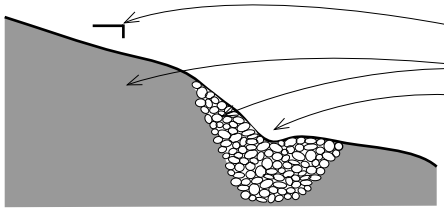




- *Site location to determine special requirements for wind design, seismic design, floodplain design or urban-wildland fire design criteria.*



- *Location of the project on the property, for determination of fire-resistance-rated construction requirements.*
- *Fire-resistance-rated construction requirements*



- *Site conditions relative to soils, slopes and drainage requirements.*
- *Slope*
- *Soil conditions*
- *Drainage*

- *Selection of foundation system(s), including subsurface systems such as excavations, fills and foundation piles.*