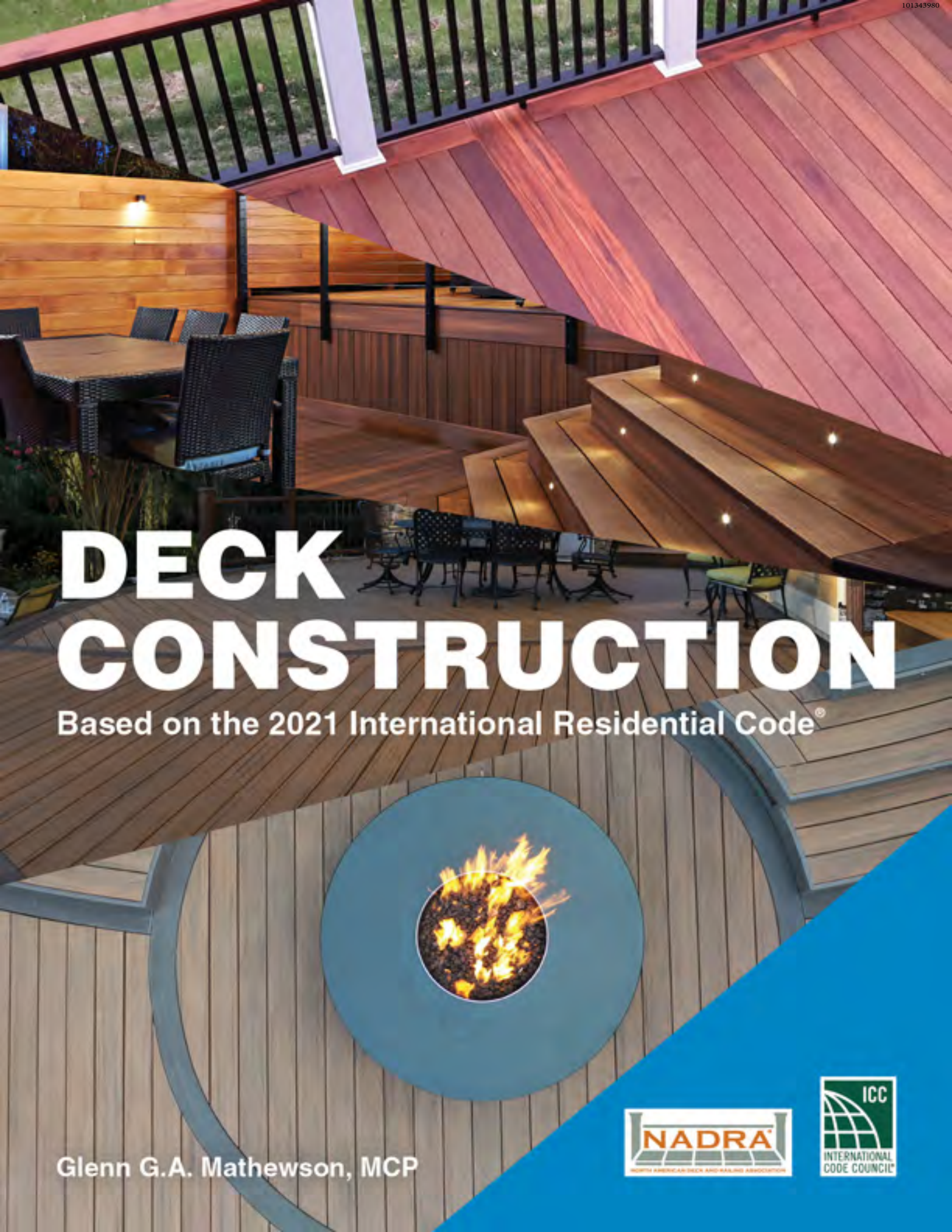

DECK CONSTRUCTION

Based on the 2021 International Residential Code®

Glenn G.A. Mathewson, MCP

NADRA
NORTH AMERICAN DECK AND RAILING ASSOCIATION

ICC
INTERNATIONAL CODE COUNCIL®

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Preface

Deck Construction Based on the 2021 International Residential Code® puts the provisions of the 2021 *International Residential Code*® (IRC®) that affect deck design and construction in the hands of the deck industry. The sections in this book are extracted from over 1,000 pages of the 2021 IRC, and retain the original section numbers and text. Commentary and graphics explain the application of each provision, thus providing code and education in one book. Deck contractors, installers, designers, homebuilders, inspectors, plan reviewers, and manufacturers will all find this book helpful in completing their work in accordance with the IRC provisions as well as enhancing their comprehension of how the IRC applies to deck design and construction. Sections of the 2018 IRC that were significantly altered in the 2021 edition were also provided in this book for those working under the previous edition. Code sections included are not necessarily in sequence because the code sections that are directly related to deck construction have been selected. For example, for Prescriptive and Engineered Design, Sections R301.1, R301.1.2, R301.1.3 and R507.1 have been included because they are related to the subject, but Section R301.1.1 has not been included. The same approach applies to exception numbers or other similar situations.

While novice deck builders will greatly benefit from this book, it is not written in the format of a “how-to” book and does not intend to teach novice deck builders about the fundamentals of deck construction. Rather, individuals with a basic understanding of deck construction can now take their skills to the next level, with a deck-specific comprehension of the leading residential code adopted in the United States. Unlike other deck books on the market, either with design ideas or how-to advice, the information contained in this book is organized in a manner that allows the reader to see and compare the author’s explanation and the IRC text simultaneously. The book can be used for training or simply read cover to cover or also can function as a jobsite reference of the IRC during plan approval, construction and inspections.

Though deck construction is popular in backyards across the country and construction and occupancy permits are approved daily, the code design and prescriptive provisions plus local government amendments are challenging for all involved in a deck project. Many new deck provisions have been added since the 2015 edition, but subjects such as lateral bracing, stairs, guards and any nonstandard load path through beams are not addressed prescriptively. This book is clear when presenting explanations to code provisions not prescriptively addressed in the code. It is the intent of this book to clearly present the code and establish an understanding of the baseline “minimum standards” such that above code designs or designs not covered by prescriptive code are more easily identifiable. This book is focused on the 2021 IRC but addresses the 2018 IRC as well, where the distinction is significant. For some subjects, the provisions from different editions will be presented and discussed independently. In other instances, small modifications will be presented together. Where modifications are clerical in nature or do not significantly affect the application in construction, only the 2021 code text is provided. The 2021 deck provisions are an improvement on the 2018 and are encouraged to be

used and approved as an alternative in accordance with Section R104.11, regardless of what code is adopted by the jurisdiction.

In an industry that has long been absent from model code development process, local government authorities have historically used their own discretion or documents for approving construction. The new deck provisions in the IRC in some cases may be contrary to these long-established local regulations and may take time to become commonplace nationwide. Minimum code provides for safe decks and maximum freedom and allows more people the opportunity for a deck under their feet. For those with a stronger budget, more discretionary design to suit one's preferences is always encouraged.

About the *International Residential Code*®

Building officials, design professionals, contractors and others involved in the field of residential building construction recognize the need for a modern, up-to-date residential code addressing the design and installation of building systems through both prescriptive and performance requirements. The 2021 *International Residential Code*® (IRC®) is intended to meet these needs through model code regulations that safeguard the public health and safety in all communities, large and small. The IRC is kept up to date through ICC's open code development process. The provisions of the 2018 edition, along with those code changes approved in the most recent code development cycle, make up the 2021 edition.

The IRC is one in a family of 15 International Codes® (I-Codes®) published by ICC. This comprehensive residential code establishes minimum regulations for residential building systems by means of prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new building designs.

The IRC is a comprehensive code containing provisions for building, energy conservation, mechanical, fuel gas, plumbing and electrical systems. The IRC is available for adoption and use by jurisdictions internationally. Its use within a governmental jurisdiction is intended to be accomplished through adoption by reference, in accordance with proceedings established by the jurisdiction's laws.

About the International Code Council®

The International Code Council is the leading global source of model codes and standards and building safety solutions that include product evaluation, accreditation, technology, codification, training and certification. The Code Council's codes, standards and solutions are used to ensure safe, affordable and sustainable communities and buildings worldwide. The International Code Council family of solutions includes the ICC Evaluation Service, the International Accreditation Service, General Code, S. K. Ghosh Associates, NTA Inc., ICC Community Development Solutions and the Alliance for National & Community Resilience. The Code Council is the largest international association of building safety professionals and is the trusted source of model codes and standards,

establishing the baseline for building safety globally and creating a level playing field for designers, builders and manufacturers.

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About NADRA®

The North American Deck and Railing Association, Inc. (NADRA) encourages best building practices to the industry and promotes deck safety to the consumer. NADRA is the voice of the industry, which is made up of deck builders, designers, engineers, inspectors, manufacturers, dealers/distributors, lumberyards, wholesalers and retailers, along with a wide spectrum of related service providers of the deck and railing industry.

NADRA's unwavering mission is to provide a qualified and unified source for the professional development, promotion, growth, and sustenance of the deck and railing industry so that members can continually exceed the expectations of their customers.

Outdoor living became popular over 40 years ago and continues to grow at an unprecedented and dynamic rate today. Estimates show that more than 69 percent of decks in use (approximately 30 million) are past their useful life and need to be replaced or repaired.

The Deck Safety Academy (DSA) provides for NADRA online classes, testing, an industry-supported Deck Safety Manual, and an online inspection program that delivers a qualified and efficient Deck Inspection Process.

At NADRA, we generate and connect great ideas with great people to inspire quality, knowledgeable leadership and achievement within the deck and railing industry. For more information, visit www.NADRA.org.

About the Author

Glenn Mathewson began his construction career in 1996 as a laborer and carpenter's apprentice. In 2005, he became a building, plumbing and mechanical inspector for the City of Westminster, Colorado, where for 13 years, he worked as an inspector and plan reviewer and earned his Master Code Professional Certification from ICC.

In 2012, he began exploring the use of technology to make codes more accessible and understandable, and opened www.BuildingCodeCollege.com, an ICC- and AIA-approved online school. Drawing on his experience as a tradesman, contractor, consultant and building inspector, he is able to review, discuss and teach the standards of construction with a true understanding of the realities involved with applying them in the field.

Glenn has authored over 100 technical articles in publications such as "Professional Deck Builder," "The Journal of Light Construction," "Fine Homebuilding" and "The Building Safety Journal," as well as ICC's *Deck Construction Based on the 2009 International Residential Code*. In 2011, he became Technical Advisor to the North American Deck and Railing Association (NADRA), where he assists the association with code-related initiatives and the development of the Master Deck Professional, Codes and Standards Certification. He represented the decking industry in the ICC code development process for the creation of many of the deck provisions in the 2015 and 2021 editions of the *International Residential Code*. He is a professional speaker and educator in residential codes, with audiences ranging from contractors to building officials at both public and private events.

Acknowledgments

Glenn Mathewson extends his foremost gratitude to Michael and Margie Beaudry and Heather Marchand for their tireless efforts to raise the professionalism of the deck and railing industry through their work for the North American Deck and Railing Association (NADRA). Being focused on the same mission, they have consistently supported and encouraged him professionally. However, they also have had an incredibly positive impact on his life through the great friendships they have formed.

Glenn also thanks the leading contributing members of the Deck Code Coalition with whom he has collaborated for years to develop new, quality, well-vetted, minimum standards of deck construction for the IRC. From this work, the codes available to the deck industry and provided in this book are so much more complete than what was available in the previous 2009 edition. Glenn knows he likely drove them crazy with his unwavering passion for the decking industry and his unabashed preaching of code philosophies. However, through their perseverance to put up with him, better codes were created. Though many others have contributed through the years, Billy Viars, Charles Bajnai, David Cooper, Erik Farrington, Gary Ehrlich, John Woestman, Loren Ross, and Mark Guthrie stuck it out with Glenn, most recently, through the uncomfortable arguments and disagreements necessary to create the new 2021 deck codes collectively, not individually. He offers his sincere thanks and respect to these professionals, for

without their efforts, there would be no deck code to update in this second edition book.

Glenn thanks the researchers who seek answers to the unique and unknown concepts of structural deck design. As you will learn in this book, decks do not fit any standard method of construction and there are many unanswered questions in our current industry practices. Across the country, this truth is overlooked by most, but not by Dr. Frank Woeste, Dr. Don Bender, and their professional colleagues. From ledger attachment, to guard post attachment, to lateral load evaluation, these researchers put their efforts toward finding scientific answers for something that many mistakenly think is simple, silly, and elementary—deck construction. In his goals to raise the decking industry, their research has been brave and incredibly valuable, and he hopes it will continue.

Finally, Glenn thanks all the members of NADRA for financially, passionately, and intellectually supporting their nonprofit industry association in the effort of deck code development. More specifically, Glenn thanks the deck builder members who have given so many hours of their time to lead the organization and recognizes the importance of that work. There are too many to name over the decade he has worked with NADRA but know that he remembers you and your contributions. It is the deck builders who drive his heart in the work he does in deck codes, and he is proud to have their trust.

Chapter 1

Administration and Design

Introduction

Before diving into the technical code provisions related to deck construction, it's important to understand a little about the code itself. The first chapter of the IRC lays out the administrative rules related to the application of the code. It details the authority of the building official and the responsibility of the builder. Permitting, inspections, plans, and even fees are laid out in this chapter. Being significantly related to operations, procedures, and some legality, it is most often amended by states or local jurisdictions when adopted.

This chapter will provide only select administrative provisions to assist in using the code and understanding everyone's roles and responsibilities. Designers and builders are strongly encouraged to research the administrative rules, procedures, and processes in the jurisdictions they work in. While they are likely to find differences from the IRC, there will be similarities. Building authorities are encouraged to establish policies and procedures to streamline the code

Figure 1-0-1: The only way a deck is built to code is through the work of humans. The designer, builder, plan reviewer, and inspector should "have a seat together," work together, and be human together. Then they can worry about the actual code provisions.

compliance process for the building community and themselves. The better the code is administered, the better the code compliance in the community, and that is related to people, not code provisions.

The IRC provides two different kinds of provisions: mandatory requirements and prescriptive design. Mandatory requirements come in different packages. The code will mandate certain features be provided, like a landing outside a door. It can also limit the design of a feature, such as how many steps down the landing can be from a door and how large each step must be. It also establishes minimum performance expectations, like a landing supporting a 40 psf live load. No matter how the landing is built or its materials, it must be able to demonstrate these limits. Prescriptive design, the second function of the IRC, provides this demonstration, but with limited variety. It offers a method of construction that includes assurance of code compliance, but this is not to say other methods are not capable of the same.

Part One: The Code

Part One: The Code

Subject: Definitions

2021 Code

[RB] ACCESSORY STRUCTURE. A structure that is accessory to and incidental to that of the *dwelling(s)* and that is located on the same *lot*.

[RB] APPROVED. Acceptable to the *building official*.

[RB] APPROVED AGENCY. An established and recognized agency that is regularly engaged in conducting tests, furnishing inspection services or furnishing product certification, and has been *approved* by the building official.

[RB] BUILDING. Any one- or two-family dwelling or *townhouse*, or portion thereof, used or intended to be used for human habitation, for living, sleeping, cooking or eating purposes, or any combination thereof, or any *accessory structure*. For the definition applicable in Chapter 11, see Section N1101.6.

[RB] BUILDING OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative. For the definition applicable in Chapter 11, see Section N1101.6.

[RB] DEAD LOADS. The weight of the materials of construction incorporated into the building, including but not limited to walls, floors, roofs, ceilings, *stairways*, built-in partitions, finishes, cladding, and other similarly incorporated architectural and structural items, and fixed service equipment.

[RB] DWELLING. Any building that contains one or two *dwelling units* used, intended, or designed to be built, used, rented, leased, let or hired out to be occupied, or that are occupied for living purposes.

[RB] DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation. For the definition applicable in Chapter 11, see Section N1101.6.

[RB] JURISDICTION. The governmental unit that has adopted this code.

[RB] LIVE LOADS. Those loads produced by the use and occupancy of the building or other structure and do not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load or dead load.

[RB] MANUFACTURER'S INSTALLATION INSTRUCTIONS. Printed instructions included with equipment as part of the conditions of their *listing* and *labeling*.

[RB] PERMIT. An official document or certificate issued by the *building official* that authorizes performance of a specified activity.

[RB] PLATFORM CONSTRUCTION. A method of construction by which floor framing bears on load bearing walls that are not continuous through the *story* levels or floor framing.

[RB] SHALL. The term, where used in the code, is construed as mandatory.

[RB] TOWNHOUSE. A *building* that contains three or more attached *townhouse units*.

Application: The IRC applies to just about every type of construction action imaginable on a private residential property, but only to the extent described or referenced in the provisions. This includes decks attached to a dwelling or townhouse and free-standing decks per the definition of accessory structure. However, not all residential property is regulated by the IRC, such as apartments and hotels. Review of the definitions for dwelling unit and townhouse are critical to applying this code to the correct residences. *The International Building Code*® (IBC®) is the proper code for use on most multifamily residential properties.

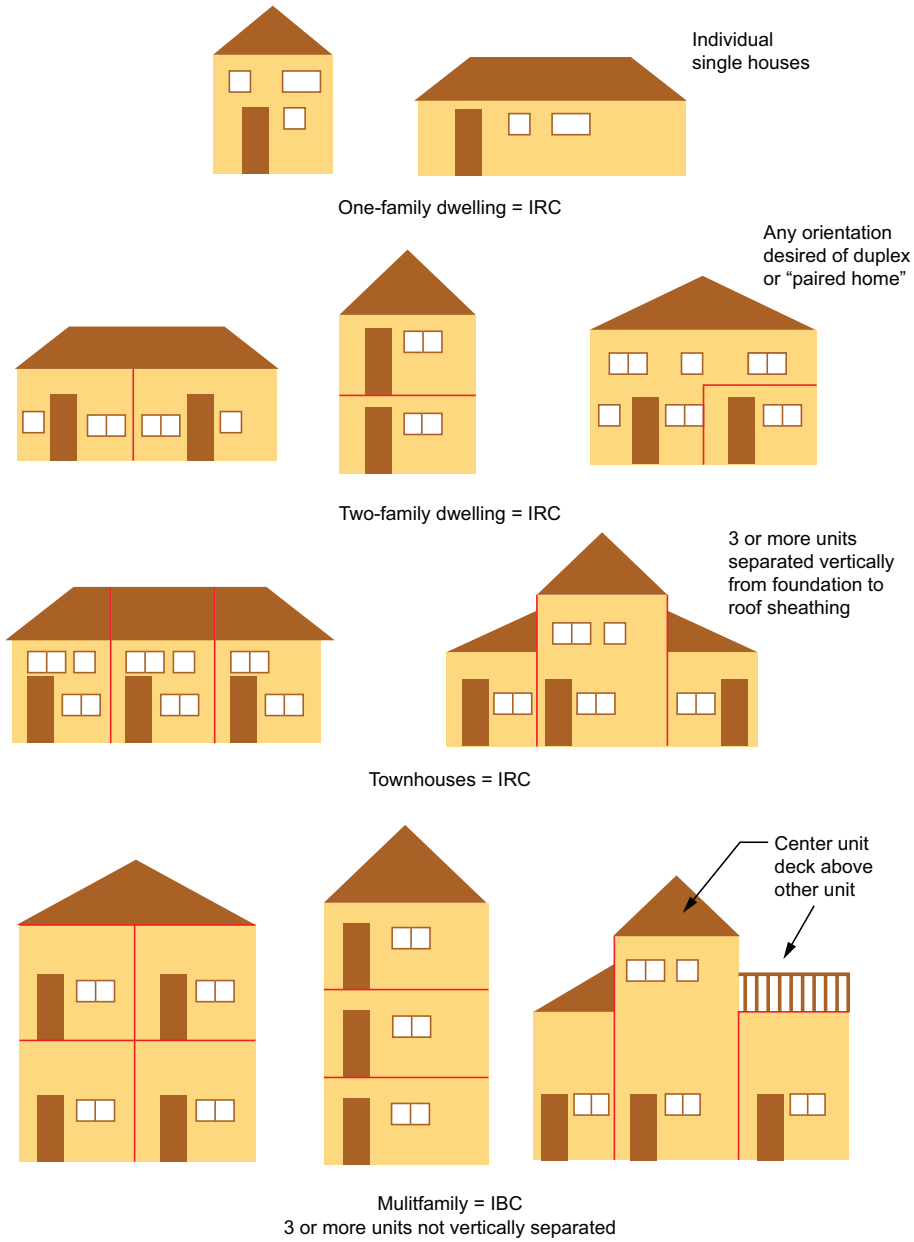


Figure 1-1-1: Before any code provisions can be applied, you’ve got to know what code to use. The easiest clue is if there are three or more dwelling units in the same structure, they are only under the IRC if they are separated from each other with vertical walls that extend from the foundation to the roof sheathing or above. Under the IRC, a building can only have two dwelling units if any portion of one is above or below another, and that includes roof-top decks.

Part One: The Code

Subject: Application of Code

2021 Code:

R101.2 Scope. The provisions of this code 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 plane* in height with a separate means of egress and their *accessory structures* not more than three stories above *grade plane* in height.

[User Note: For clarity of the subject matter of this book, the remaining text from this section is not provided]

R102.7 Existing structures. The legal occupancy of any structure existing on the date of adoption of this code shall be permitted to continue without change, except as is specifically covered in this code, the *International Property Maintenance Code* or the *International Fire Code*, or as is deemed necessary by the *building official* for the general safety and welfare of the occupants and the public.

R102.7.1 Additions, alterations or repairs. *Additions*, *alterations* or repairs to any structure shall conform to the requirements for a new structure without requiring the existing structure to comply with the requirements of this code, unless otherwise stated. *Additions*, *alterations*, repairs and relocations shall not cause an existing structure to become less compliant with the provisions of this code than the existing building or structure was prior to the *addition*, *alteration* or *repair*. An existing building together with its *additions* shall comply with the height limits of this code. Where the *alteration* causes the use or occupancy to be changed to one not within the scope of this code, the provisions of the *International Existing Building Code* shall apply.

Application: When a deck is built on an existing house, only the deck and the extent to which it modifies the house are regulated by the adopted code. This would include the addition of deck area to an existing deck, provided that the existing structure is legally occupied (i.e., permitted as necessary when originally constructed). However, a caveat in this provision allows a building official to require compliance to current code where the existing deck is found detrimental to the general safety or welfare of the occupant. It's not unusual for this determination to be made when deck additions, repairs, or alterations are proposed, due to the insufficiency of previous deck construction practices that have been revealed and corrected in recent code editions. Similarly, repairs may be required when altering an existing deck and there are hazards related to decay or corrosion. Requirements for ledger fasteners and installation of joist hangers and post to beam connectors on existing, legal decks are common when deck additions or repairs occur. Evaluation of decay and replacement of certain members, such as joists, can be required by the building official if deemed necessary for safety.

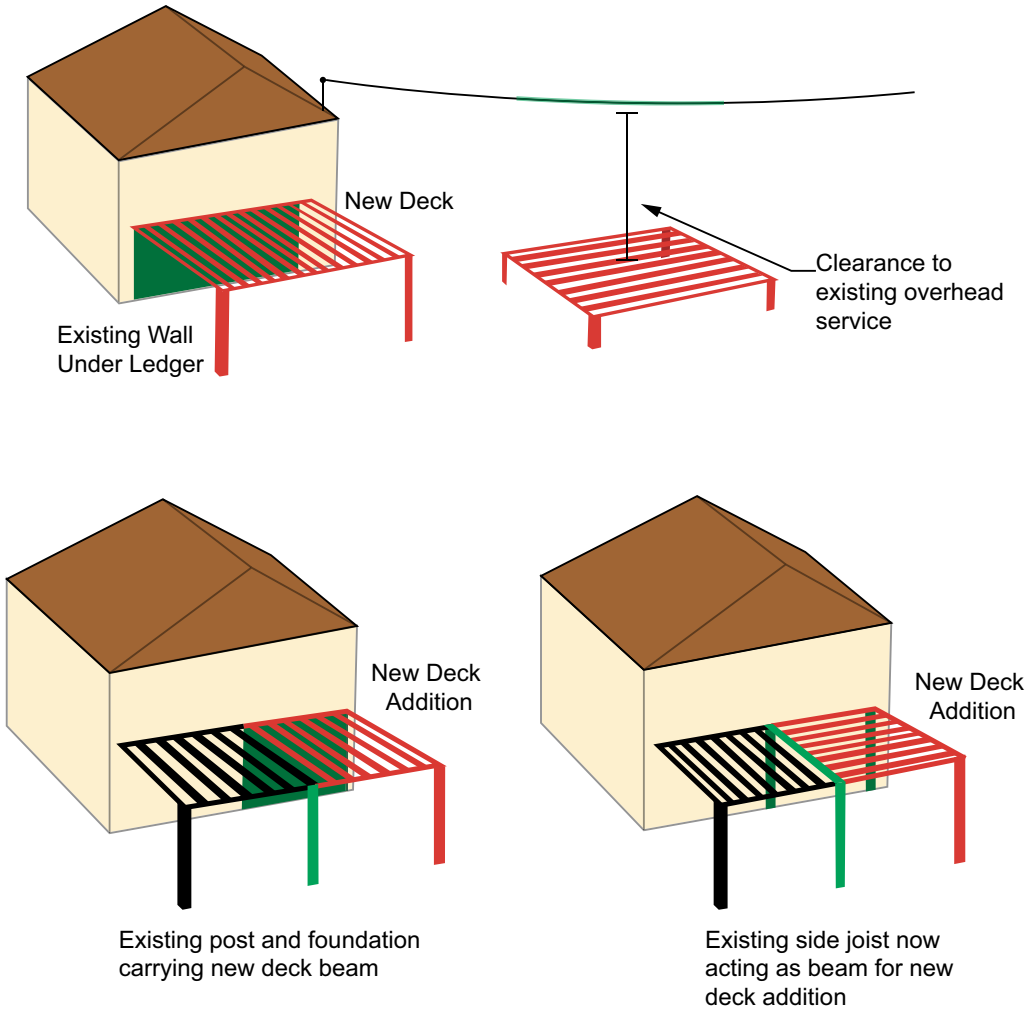


Figure 1-1-2: In these graphics, the black elements are existing, and the red represent the new construction. The green elements are those that were existing but are part of the new load path for the new construction and would be regulated under the currently adopted code for their new role in the new construction.

Part One: The Code

Subject: Intent and Purpose

2021 Code: **R101.3 Purpose.** The purpose of this code is to establish minimum requirements to provide a reasonable level of safety, health and general welfare through affordability, structural strength, means of egress, stability, sanitation, light and ventilation, energy conservation and safety to life and property from fire and other hazards and to provide a reasonable level of safety to fire fighters and emergency responders during emergency operations.

Application: This section is the cornerstone to all interpretations of the IRC. When it is difficult to determine how to apply the provision to a specific situation or a unique design, the performance and functions described in this section should be referenced. The first statement is critical in that provisions are merely the minimum requirements. The code is not a "best practices" document and should not be interpreted as such. The code safeguards the public to the extent of safety, health, and general welfare, the latter of which is relatively ambiguous. The final list in this section is how the safeguards are to be provided. Affordability is a critical balance to safety because it is the greatest barrier to human shelter. If buildings are not affordable, occupancy does not occur, and none of the other safeguarding methods can be utilized.

2021 Modification:

The phrase "to provide a reasonable level of" was added twice to Section 101.3 to help guide professionals in appropriately interpreting code provisions with a judgment based not only on these purposes but also on reason.

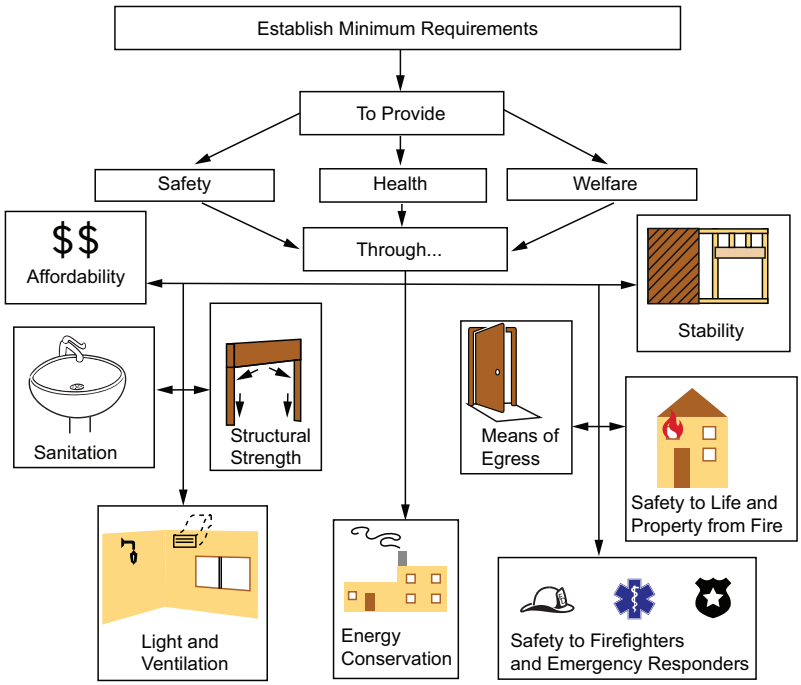


Figure 1-1-3: This flowchart shows the foremost purpose of the code is the establishment of minimum standards, and to do so through the specific means listed in this section and depicted here.

Part One: The Code

Subject: When Permits Are Required

2021 Code:

R105.1 Required. Any *owner* or owner's authorized agent who intends to construct, enlarge, alter, *repair*, move, demolish or change the occupancy of a building or structure, or to erect, install, enlarge, alter, *repair*, remove, convert or replace any electrical, gas, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be performed, shall first make application to the *building official* and obtain the required *permit*.

R105.2 Work exempt from permit. Exemption from *permit* requirements of this code shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of this code or any other laws or ordinances of this *jurisdiction*. *Permits* shall not be required for the following:

1. Other than *storm shelters*, one-*story* detached *accessory structures*, provided that the floor area does not exceed 200 square feet (18.58 m^2).

5. Sidewalks and driveways.

10. Decks not exceeding 200 square feet (18.58 m^2) in area, that are not more than 30 inches (762 mm) above *grade* at any point, are not attached to a dwelling and do not serve the exit door required by Section R311.4.

Application: Though the IRC applies to all manner of construction, some projects are considered minor enough to not require oversight (a permit) by the building authority. A list of specific conditions is provided for when a permit is not required; however, it's critical to understand this only eliminates the oversight for code compliance, not the requirement for code compliance. The code will always apply. Though item 1 is generally meant for garden or storage sheds, it can equally apply to small gazebos or shade structures over decks or patios. Item 5 makes it clear that permits are not required for sidewalks and driveways, and this similarly applies to other types of "on grade" floor surfaces, such as concrete, paver, or flagstone patios. Item 10 speaks directly to small decks and correlates with the allowable size of other accessory structures, but it also adds additional parameters. Referencing height assures the fall hazard is low enough to not require guards, and not serving the required exit door assures that the primary exiting from the house won't be affected with lack of oversight. Details about the one required egress door are provided in Chapter Two, Part Two.

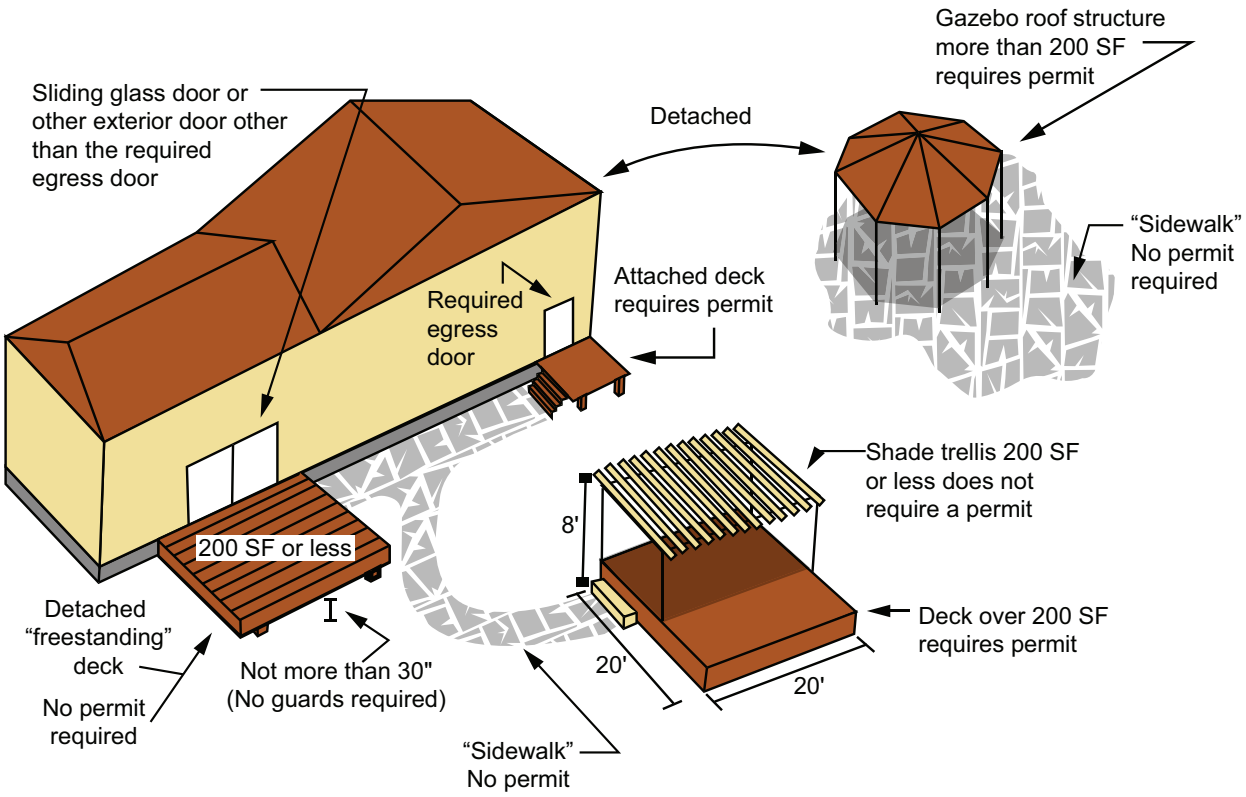


Figure 1-1-4: Though not written as specific in this section, the 30-inch height measurement is intended to address that no guards are required. However, Section R312.1.1 requires the 30-inch measurement to be taken at a point 36 inches horizontally from the edge. It would be appropriate to take the measurement in the same manner to determine if a permit is required.

Part One: The Code

Subject: Hierarchy of Authority

2021 Code:

R102.1 General. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

R102.2 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

R102.4 Referenced codes and standards. The codes and standards referenced in this code shall be considered part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections R102.4.1 and R102.4.2.

Exception: Where enforcement of a code provision would violate the conditions of the *listing* of the *equipment* or *appliance*, the conditions of the *listing* and manufacturer's instructions shall apply.

R102.4.1 Conflicts. Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

R102.4.2 Provisions in referenced codes and standards. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

Application: Recognizing the other documents that regulate construction, these sections explain how to handle conflicting requirements between them. Even within the IRC, there are times that conflict appears, typically between a general and specific provision. The IRC provides references to other standards for compliance, but these standards would only be applicable to the extent described in the IRC reference. Many standards may only be referenced for a particular subject or to a particular section, and thus the remaining dialog of the standard would not be mandated. At other times, standards are referenced as an option in lieu of the prescriptive designs in the IRC. Requirements in product listings and manufacturer installation instructions are also mandated by the code, and they are considered the most specific and accurate to their application.

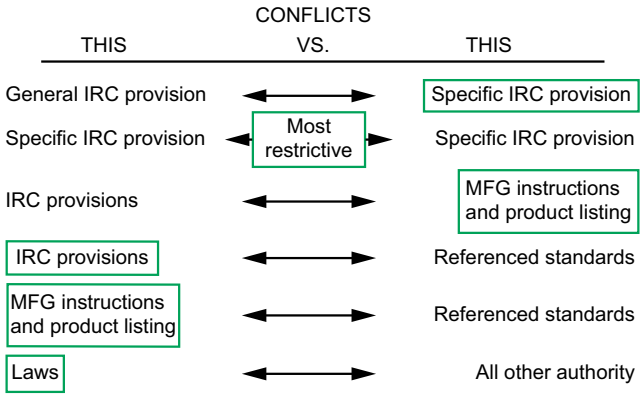


Figure 1-1-5: Where there is conflict between documents in this graphic, the one in the green box is the authority.

Part Two: The People

Part Two: The People

Subject: Building Official Authority

2021 Code:

R103.3 Deputies. In accordance with the prescribed procedures of this *jurisdiction* and with the concurrence of the appointing authority, the *building official* shall have the authority to appoint a deputy *building official*, the related technical officers, inspectors, plan examiners and other employees. Such employees shall have powers as delegated by the *building official*.

R104.1 General. The *building official* is hereby authorized and directed to enforce the provisions of this code. The *building official* shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.

R104.4 Inspections. The *building official* shall make the required inspections, or the *building official* shall have the authority to accept reports of inspection by *approved agencies* or individuals. Reports of such inspections shall be in writing and be certified by a responsible officer of such *approved agency* or by the responsible individual. The *building official* is authorized to engage such expert opinion as deemed necessary to report on unusual technical issues that arise, subject to the approval of the appointing authority.

R104.10 Modifications. Where there are practical difficulties involved in carrying out the provisions of this code, the *building official* shall have the authority to grant modifications for individual cases, provided the *building official* shall first find that special individual reason makes the strict letter of this code impractical and the modification is in compliance with the intent and purpose of this code and that such modification does not lessen health, life and fire safety or structural requirements. The details of action granting modifications shall be recorded and entered in the files of the department of building safety.

R109.2 Inspection agencies. The *building official* is authorized to accept reports of *approved* agencies, provided such agencies satisfy the requirements as to qualifications and reliability.

R112.2 Limitations on authority. An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The board shall not have authority to waive requirements of this code.

Application:

The IRC provisions are only written words that discuss potential applications in generic buildings. These sections make it clear that humans are required to reveal the purpose of the code provisions in real construction. The building official is granted the authority to interpret the code and create procedures to administer it, but they must do so in alignment with the intent and purpose discussed previously. They cannot waive code requirements, but they can apply the intent and purpose of the code and not “the letter” of the code when unique circumstances arise. This section offers confidence to building officials to “make the right call” and allow the spirit of the code provisions to shine through the words. This also speaks to the purpose of affordability, where at times complying with the letter of the code would be impractical.

Diversity of Authority

AUTHORITY	REASONING	EXAMPLE
“The letter” of the IRC	Some code provisions are relatively definitive.	Maximum riser height of stair treads.
Policies and procedures	Local methods of verifying and applying code provisions are necessary, but they cannot create new requirements or waive requirements.	Requiring a rough framing inspection before installing decking. Requiring empty nail boxes on site to verify correct product usage.
Deputies	The building official authority can extend to others.	Inspectors and plan reviewers can perform better when granted building official authority.
Inspections by jurisdiction	The building official and/or deputies must inspect construction for code compliance.	Foundation excavation inspections prior to concrete placement are necessary to verify depth and soil quality.
Expert opinions	Third-party expert opinions assist a building official in making the appropriate interpretation for subjects outside of their knowledge or for a second opinion.	Use of ICC commentary publications (like this book) for assistance in interpretation. Third-party structural review services.
Third-party inspections/reports	Inspections outside the expertise of the building official can be conducted by approved agencies. Engineering reports can be accepted for certain installations.	Inspections requested outside of normal business hours. Understaffed jurisdictions. Torque correlation reports for helical pier installations. Inspections of welded members.
Modifications	When the strict “letter of the code” is impractical or unnecessary, modifications can be accepted that are deemed equivalent in performance and safety.	Allowing a lightly loaded beam carrying a small stair landing to be supported by a ledger with a couple of extra lag screws near the beam connection (see R507.9.1.1 Ledger details).
Board of appeals	As a balance of power, the authority of the building official can be appealed to a citizen board of professionals.	A building official provides insufficient reasoning for refusal of a reasonable modification or a tested alternative product.

Part Two: The People

Subject: Approval of Alternatives

2021 Code: **R104.11 Alternative materials, design and methods of construction and equipment.** 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. The *building official* shall have the authority to approve an alternative material, design or method of construction upon application of the *owner* or the owner's authorized agent. The *building official* shall first find that 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, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety. Compliance with the specific performance-based provisions of the International Codes shall be an alternative to the specific requirements of this code. Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons why the alternative was not *approved*.

> **R104.11.1 Tests.** Where there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the *building official* shall have the authority to require tests as evidence of compliance to be made at no expense to the *jurisdiction*. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the *building official* shall approve the testing procedures. Tests shall be performed by an *approved* agency. Reports of such tests shall be retained by the *building official* for the period required for retention of public records.

Application: Section 104.11 is an incredibly important provision as it allows for alternative designs and materials to be approved in place of the prescriptive IRC requirements, provided they are equivalent in the performances specified. The market demand for decking products and designs relies heavily on alternative products and construction methods. Testing and engineering are the most commonly accepted methods a building official employs to determine equivalency. Third-party agencies, such as the International Code Council Evaluation Service, provide testing criteria for product equivalency to prescriptive code requirements and review test results to issue code compliance reports. Reviewing these reports or other testing or engineering documents is a necessary but time-consuming responsibility of the building official. For this reason, the product market has at times received a simple disapproval in place of a thorough review. For this reason, the 2015 IRC added the requirement that a disapproval be provided in writing and with reasoning.

As will be mentioned numerous times throughout this book, a more recently published edition of the IRC, such as the 2021 provisions provided herein, are always a reasonable validation for approval as an alternative means of construction. Designers, builders, and building authorities are encouraged to utilize the 2021 IRC provisions.

Approval of Alternatives

PERFORMANCE	PRESCRIPTIVE	ALTERNATIVE
Application	Ledger connection with lag screws.	Ledger connection with structural screws.
Structural strength	Lag screw spacing in ledgers was tested by a university research facility, and this was the basis for inclusion in the 2009 IRC.	Third-party tests for fasteners in wood, such as ICC-ES AC233, provide design values for engineering analysis.
Installation details	Minimum edge distances and required washers for lag screws are provided for in the National Design Standards (NDS), and this was the basis for inclusion in the 2012 IRC.	Engineering analysis of spacing, minimum edge distances, and other details generates a product-specific load table for structural screw spacing and installation.
Corrosion resistance	Galvanization must be per ASTM A153 or a metal with a low corrosion likelihood, such as stainless steel.	Third-party tests for the performance of an alternative coating in comparison to a prescriptive ASTM galvanized product in the same application, such as ICC-ES AC257.
Installation methods	Follow prescriptive IRC provisions for lag screws.	Follow structural screw manufacturer's installation instructions and engineered load tables. Do not use prescriptive details intended for lag screws.

Structural screws are a common and effective alternative product used in place of lag screws for ledger connections. This table compares the prescriptive performance requirements behind prescriptive lag screw ledger connections in comparison to example evidence of structural screws in the same application. This is an example process of how to evaluate equivalency of an alternative to prescriptive code provisions.

Part Two: The People

Subject: Responsibility

2021 Code:

R104.8 Liability. The *building official*, member of the board of appeals or employee charged with the enforcement of this code, while acting for the *jurisdiction* in good faith and without malice in the discharge of the duties required by this code or other pertinent law or ordinance, shall not thereby be rendered civilly or criminally liable personally and is hereby relieved from personal liability for any damage accruing to persons or property as a result of any act or by reason of an act or omission in the discharge of official duties.

R105.1 Required. Any *owner* or owner's authorized agent who intends to construct, enlarge, alter, *repair*, move, demolish or change the occupancy of a building or structure, or to erect, install, enlarge, alter, *repair*, remove, convert or replace any electrical, gas, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be performed, shall first make application to the *building official* and obtain the required *permit*.

R105.8 Responsibility. It shall be the duty of every *person* who performs work for the installation or *repair* of building, structure, electrical, gas, mechanical or plumbing systems, for which this code is applicable, to comply with this code.

R113.1 Unlawful acts. It shall be unlawful for any *person*, firm or corporation to erect, construct, alter, extend, *repair*, move, remove, demolish or occupy any building, structure or equipment regulated by this code, or cause same to be done, in conflict with or in violation of any of the provisions of this code.

Application: The IRC requires property owners or their agents (such as management companies, contractors, or real estate agents) to make application to the building official before commencing any construction activities or directing others to do so. By "make application," the code is saying, "you've got to talk to your building department." After such application is made, one would discover if a permit is required and if so, be required to obtain one. Whoever performs the work or directs someone else to is the one responsible for code compliance, and Section R113.1 makes it clear it is an "unlawful act" not to comply. This responsibility is reinforced by Section R104.8, which states the building official and employees aren't liable, and this applies even if they passed the inspection or approved the plans.

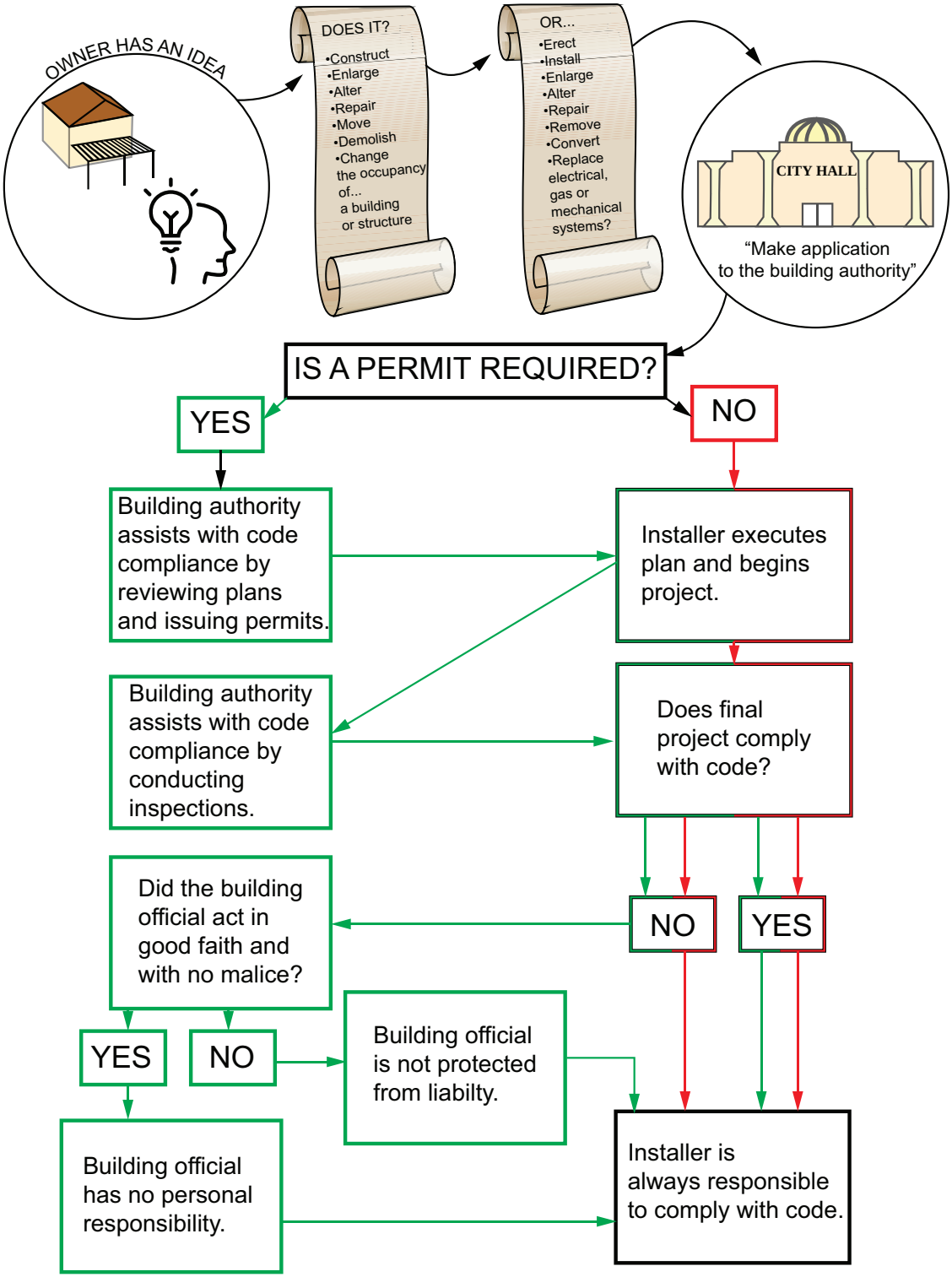


Figure 1-2-1: This flowchart depicts how, no matter whether a permit is required or not, the installer will always be responsible. NOTE: The statements of "responsibility" and "liability" in this book and the IRC are not intended to provide legal counsel.

Part Three: Design

Part Three: **Design**

Subject: **Prescriptive and Engineered**

2021 Code: **R301.1 Application.** Buildings and structures, and parts thereof, shall be constructed to safely support all loads, including dead loads, *live loads*, roof loads, flood loads, snow loads, wind loads and seismic loads as prescribed by this code. The construction of buildings and structures in accordance with the provisions of this code shall result in a system that provides a complete load path that meets the requirements for the transfer of loads from their point of origin through the load-resisting elements to the foundation. Buildings and structures constructed as prescribed by this code are deemed to comply with the requirements of this section.

R301.1.2 Construction systems. The requirements of this code are based on platform and balloon-frame construction for light-frame buildings. The requirements for concrete and masonry buildings are based on a balloon framing system. Other framing systems must have equivalent detailing to ensure force transfer, continuity and compatible deformations.

R301.1.3 Engineered design. Where a building of otherwise conventional construction contains structural elements exceeding the limits of Section R301 or otherwise not conforming to this code, these elements shall be designed in accordance with accepted engineering practice. The extent of such design need only demonstrate compliance of nonconventional elements with other applicable provisions and shall be compatible with the performance of the conventional framed system. Engineered design in accordance with the *International Building Code* is permitted for buildings and structures, and parts thereof, included in the scope of this code.

R507.1 Decks. Wood-framed decks shall be in accordance with this section. Decks shall be designed for the *live load* required in Section R301.5 or the ground snow load indicated in Table R301.2, whichever is greater. For decks using materials and conditions not prescribed in this section, refer to Section R301.

Application: Section R507.1 provides prescriptive methods of deck design, such as sizing joists, beams, and posts and making connections between members. These methods are provided to satisfy the general requirements of Section R301.1 that requires all loads generated on a structure to be transmitted to the ground. However, deck-specific codes in Section R507 are relatively new to the last few editions of the IRC and currently do not provide a complete package of deck structural design.

The IRC prescriptive designs are based on platform and balloon framing, both of which utilize braced walls to provide lateral stability. Decks, absent of walls, do not have a prescriptive method to brace them from sway and horizontal deformation and additional design is required. The IRC requires structural performance for many features of decks, yet no prescriptive method of construction, such as stair construction, guard assemblies, uplift forces in special wind regions, pier foundations, and lateral movement (sway).

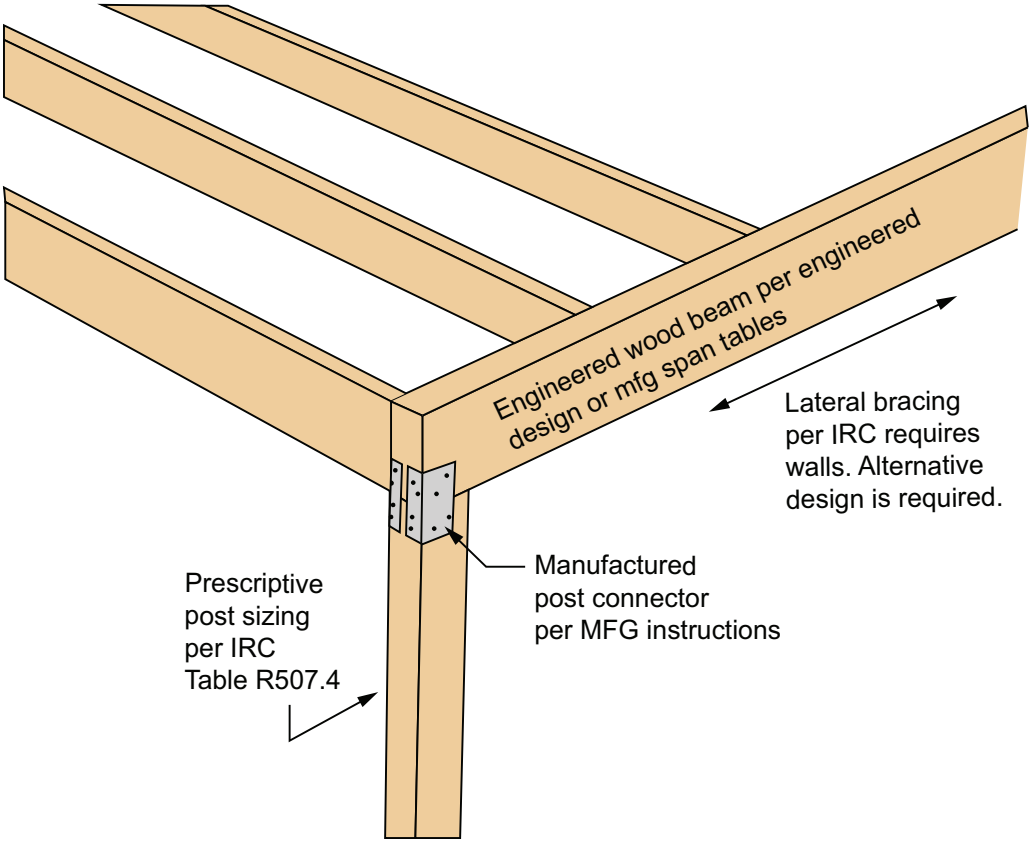


Figure 1-3-1: Section R301.1.2 allows a combination of engineered design with prescriptive design. This is commonly appreciated when utilizing structural composite lumber beams, but conventional construction elsewhere that can be designed through the IRC.

Part Three: Design

Subject: Design Criteria

2021 Code: **R301.2 Climatic and geographic design criteria.** Buildings shall be constructed in accordance with the provisions of this code as limited by the provisions of this section. Additional criteria shall be established by the local *jurisdiction* and set forth in Table R301.2(1).

R301.2.3 Snow loads. Wood-framed construction, cold-formed, steel-framed construction and masonry and concrete construction, and structural insulated panel construction in regions with ground snow loads 70 pounds per square foot (3.35 kPa) or less, shall be in accordance with Chapters 5, 6 and 8. Buildings in regions with ground snow loads greater than 70 pounds per square foot (3.35 kPa) shall be designed in accordance with accepted engineering practice.

R301.4 Dead load. The actual weights of materials and construction shall be used for determining dead load with consideration for the dead load of fixed service *equipment*.

R301.5 Live load. The minimum uniformly distributed live load shall be as provided in Table R301.5.

TABLE R301.5—partial
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Balconies (exterior) and decks[e]	40	—
Fire escapes	40	—
Guards	—	200[h, i]
Guard in-fill components[f]	—	50[h]
Handrail[d]	—	200[h]
Stairs	40[c]	300[c]

Application: The IRC provides minimum required design loads for the various loads a structure may receive. Many of these are climatic and geographic and will be determined by the location where the construction takes place. The IRC provides design tables for decks up to a 10 psf dead load and 40 psf live load. The 2021 IRC also includes snow loads of 50, 60, and 70 psf. Other climatic and geographic design criteria don't exactly involve loads but are a variable in design. Frost depth dictates the depth of foundations, termite presence drives protective measures for lumber, and cold temperatures and use of deicing chemicals change concrete weathering requirements.

Live, snow and dead loads are assumed to be uniformly distributed loads across the entire deck surface. Not including any furniture, a 40 psf live load is equivalent to a 200 lb person standing in every 2.5 ft × 2 ft area on the deck. Stairways must support this load, but in addition must support a concentrated load. Guards and handrails are also intended to receive loads from occupants and thus have their own unique requirements. Details from the table footnotes regarding stairway, guard, and handrail live loads are discussed in their respective chapters in this book.

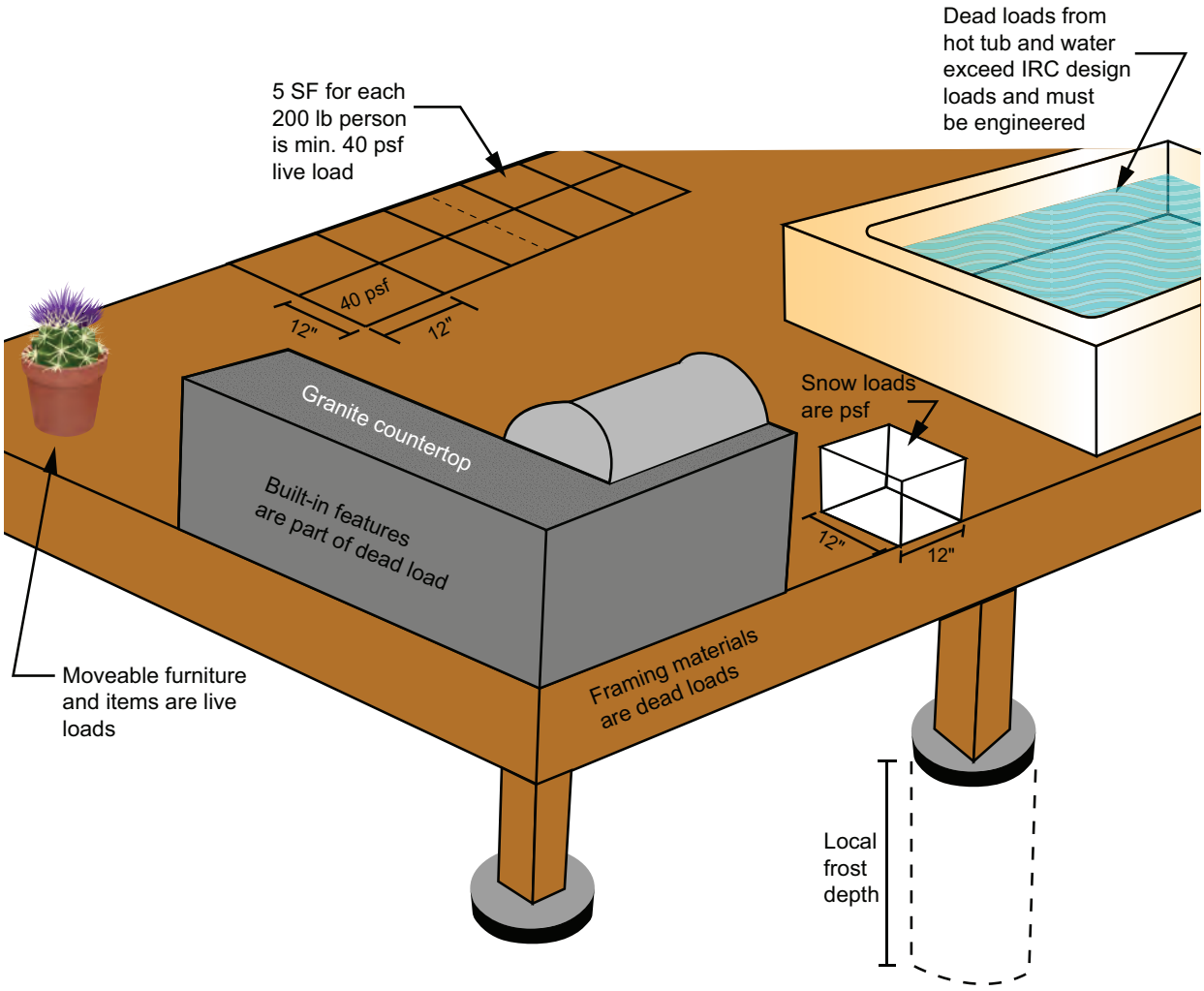


Figure 1-3-2: Dead loads include the weight of the construction material and any permanently installed equipment or features. Hot tubs are common on decks, but they provide a significant concentrated dead load not assumed in any prescriptive design tables. If supported on a deck, engineered or alternative designs are necessary. Other features like heavy, built-in planter boxes or BBQ kitchens with stone countertops should be accounted for as well but can likely be handled with casual overdesign in the joist and beam sizing, spacing, or spans, and engineering may not be necessary.

Chapter 2

The Existing Structure

Introduction

Other than those found at a park site or nature trail, most decks are constructed against or near an existing structure—like a house. A house, or any other type of building, is a complete system; locations of gas and dryer vents, window openings, glass, lights, and many other features are designed to work together to produce a safe environment for human occupancy. Additions and alterations to this "system" can have dramatically negative effects if not properly designed. A deck must be designed thoughtfully, with the features of the existing structure in mind. It's easy to overlook little features like a window location or a gas vent, which could create serious hazards to the occupants' safety if handled improperly. Before the first line of a deck design is put on paper, the locations of the various elements of the existing structure should be noted and analyzed so that all clearances and other related code provisions can be incorporated into the initial design. In addition to the systems and components, the location on the property must considered.


Courtesy of NADRA Member Company, Decks Unlimited - Indiana

Part One: The Site

Part One: The Site

Subject: Fire Separation Distance

2021 Code:

[RB] FIRE SEPARATION DISTANCE. The distance measured from the building face to one of the following:

1. To the closest interior *lot line*.
2. To the centerline of a street, an alley or public way.
3. To an imaginary line between two buildings on the *lot*.

The distance shall be measured at a right angle from the face of the wall.

[RB] PUBLIC WAY. Any street, alley or other parcel of land open to the outside air leading to a public street, that has been deeded, dedicated or otherwise permanently appropriated to the public for public use and that has a clear width and height of not less than 10 feet (3048 mm).

R302.1 Exterior walls. Construction, projections, openings and penetrations of exterior walls of *dwellings* and accessory buildings shall comply with Table R302.1(1); or *dwellings* equipped throughout with an *automatic sprinkler system* installed in accordance with Section P2904 shall comply with Table R302.1(2).

Exceptions:

1. Walls, projections, openings or penetrations in walls perpendicular to the line used to determine the *fire separation distance*.
2. Walls of *individual dwelling units* and their *accessory structures* located on the same *lot*.
3. Detached tool sheds and storage sheds, playhouses and similar structures exempted from *permits* are not required to provide wall protection based on location on the *lot*. Projections beyond the exterior wall shall not extend over the *lot line*.
4. Detached garages accessory to a *dwelling* located within 2 feet (610 mm) of a *lot line* are permitted to have roof eave projections not exceeding 4 inches (102 mm).
5. Foundation vents installed in compliance with this code are permitted.

Application:

Fire spread between buildings was the motivation behind early building codes and this concern is represented by “fire separation distance” provided in this section. Though common on the outside of many houses, decks are not discussed in the IRC in regard to fire spread, and thus local code requirements vary greatly. The term is defined in relation to walls and is also provided in the details of Table R302.1(1) in reference to projections. When 5 feet or more away from a property line, there are no requirements for fire protection in the IRC. Between 5 feet and 2 feet from the property line, projections are regulated, and this is often applied to decks. However, footnotes in the IRC table (not provided in this book) remove the requirement for fire-protected projections when soffit ventilation is not provided. This does not translate well to decks because this section on projections was never meant to address decks. Though a deck fire can spread to a house, it is not concealed like an attic fire and thus the response time is more rapid due to increased visibility. However, a deck is typically a large amount of combustible material arranged in such a manner as to promote airflow and a strong fire.

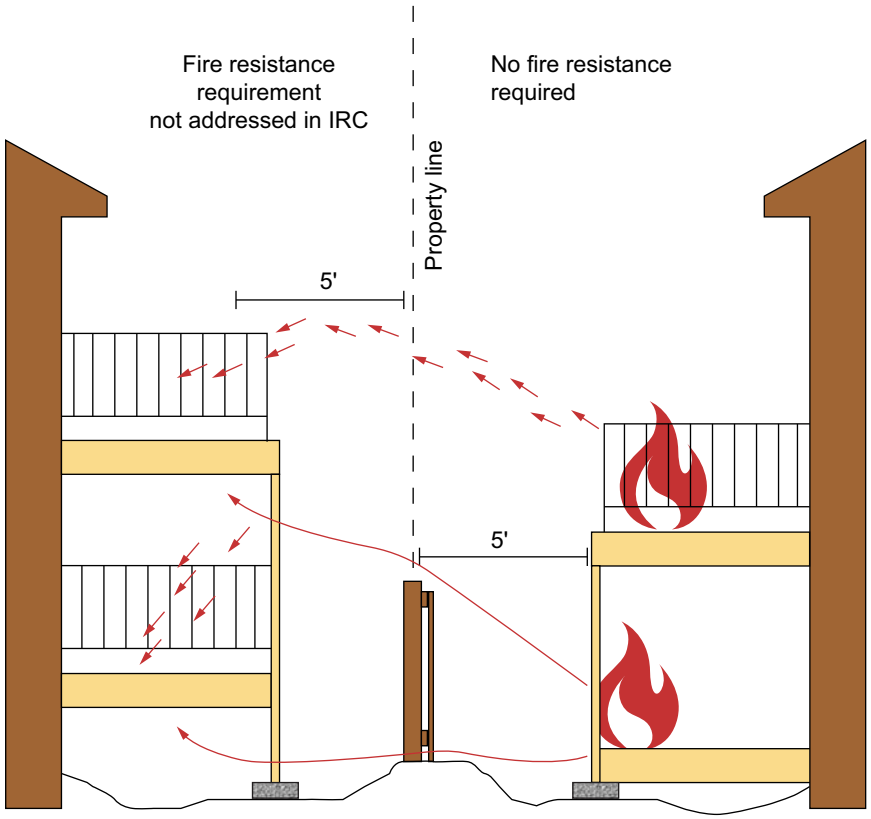


Figure 2-1-1: Providing equal freedom on both sides of the property line, each owner is responsible for the protection of their own construction when they build less than 5 feet from the line. Decks can receive fire in three common ways: a ground fire spreading under the deck, burning brands and hot ashes landing on a deck surface, and hot gases and fire rising up to the underside of a deck. There are no fire separation distance provisions for decks in the IRC at this time.

Part One: The Site

Subject: Fire Resistance of Decks

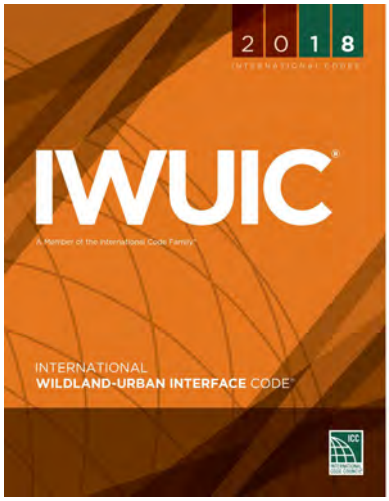
2018 & 2021 International Wildland-Urban Interface Code:

[A] 101.3 Purpose. The purpose of this code is to establish minimum regulations consistent with nationally recognized good practice for the safeguarding of life and for property protection. Regulations in this code are intended to mitigate the risk to life and structures from intrusion of fire from wildland fire exposures and fire exposures from adjacent structures and to mitigate structure fires from spreading to wildland fuels. The extent of this regulation is intended to be tiered commensurate with the relative level of hazard present.

The unrestricted use of property in *wildland-urban interface areas* is a potential threat to life and property from fire and resulting erosion. Safeguards to prevent the occurrence of fires and to provide adequate fire protection facilities to control the spread of fire in *wildland-urban interface areas* shall be in accordance with this code.

This code shall supplement the jurisdiction's building and fire codes, if such codes have been adopted, to provide for special regulations to mitigate the fire- and life-safety hazards of the *wildland-urban interface areas.*

Application: The IRC provides no direction for when decks must be fire-resistive construction due to the fire separation distance. However, fire protection may be required by locally amended codes or interpretation, and looking to the *International Wildland-Urban Interface Code*® (IWUIC®) can provide some guidance for achieving this. Further details about the IWUIC are provided in Chapter 11 of this book.



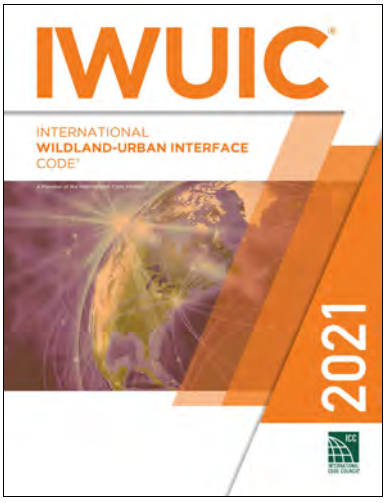


Figure 2-1-2: Though designed to address fire spread in wildland environments, provisions in this code can assist with methods for designing and constructing a fire-resistant or ignition-resistant deck to address other deck fire hazards, whether required by local codes or by choice.

Part One: The Site

Subject: Underground Services

2021 Code: **G2415.12 (404.12) Minimum burial depth.** Underground *piping systems* shall be installed a minimum depth of 12 inches (305 mm) below grade, except as provided for in Section G2415.12.1.

G2415.12.1 (404.12.1) Individual outdoor appliances. Individual lines to outdoor lights, grills and other *appliances* shall be installed not less than 8 inches (203 mm) below finished grade, provided that such installation is *approved* and is installed in locations not susceptible to physical damage.

Application: Gas and electrical cables can be as shallow below grade as 12 inches, and in some instances, even less. These underground services are not something you want to discover while you're excavating for a footing. The most effective time to locate the underground services is before you even begin designing a deck. This ensures last-minute modifications to the structural design do not occur. A nationwide free service can help you schedule an underground locate service by calling 811 or going to www.call811.com.

Figure 2-1-3: Make sure you get the underground services located, but keep a small kit with landscape sprinkler repair parts like couplings and hose clamps. The locate services won't find those lines.

Part Two: Landings at Exterior Doors

Part Two: Landings at Exterior Doors

Subject: The Egress Door

2021 Code:

R311.2 Egress door. Not less than one egress door shall be provided for each *dwelling unit*. The egress door shall be side-hinged, and shall provide a clear width of not less than 32 inches (813 mm) where measured between the face of the door and the stop, with the door open 90 degrees (1.57 rad). The clear height of the door opening shall be not less than 78 inches (1981 mm) in height measured from the top of the threshold to the bottom of the stop. Other doors shall not be required to comply with these minimum dimensions. Egress doors shall be readily openable from inside the *dwelling* without the use of a key or special knowledge or effort.

R311.3.1 Floor elevations at the required egress doors. Landings or finished floors at the required egress door shall be not more than $1^{1}/_{2}$ inches (38 mm) lower than the top of the threshold.

> **Exception:** The landing or floor on the exterior side shall be not more than $7^{3}/_{4}$ inches (196 mm) below the top of the threshold provided that the door does not swing over the landing or floor.

Where exterior landings or floors serving the required egress door are not at *grade*, they shall be provided with access to *grade* by means of a *ramp* in accordance with Section R311.8 or a *stairway* in accordance with Section R311.7.

Application: The IRC only requires one exterior door in a house and it's the only door with size and style limitations. It also has more limitations than all the other doors regarding the elevation of the required exterior landing. To understand the limits of the landing, you've first got to identify the required egress door. Being side-hinged and at least a 36-inch door panel, it's almost always the front door of the house.

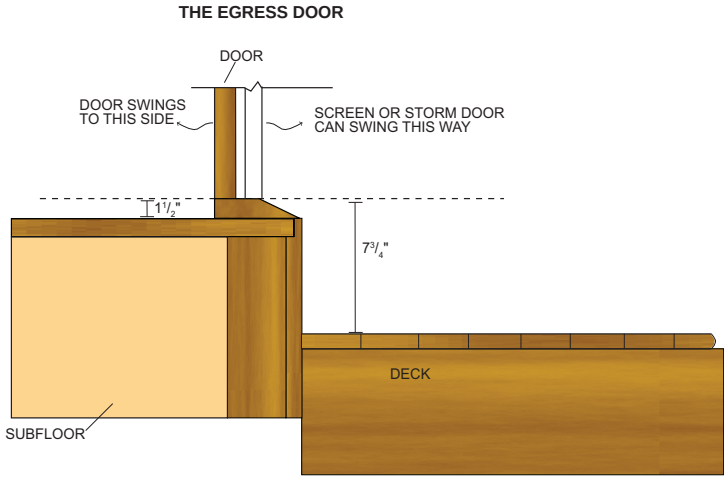


Figure 2-2-1: As long as the door swings to the inside, the deck outside the door can be up to $7^{3}/_{4}$-inch below the top of the door threshold. Dropping the deck down a step from the door is ideal, as it allows for a proper seal between the door and the cladding and for sufficient wall space above the ledger for flashing behind the cladding. However, dropping a ledger down a step from the floor will prohibit the use of the prescriptive ledger fastening tables for connection to a wood band joist, as discussed in Chapter Four, Ledgers.

Part Two: Landings at Exterior Doors

Subject: All Other Exterior Doors

2021 Code:

R311.3 Floors and landings at exterior doors. There shall be a landing or floor on each side of each exterior door. The width of each landing shall be not less than the door served. Landings shall have a dimension of not less than 36 inches (914 mm) measured in the direction of travel. The slope at exterior landings shall not exceed $^{1}/_{4}$ unit vertical in 12 units horizontal (2 percent).

Exception: Exterior balconies less than 60 square feet (5.6 m^2) and only *accessed* from a door are permitted to have a landing that is less than 36 inches (914 mm) measured in the direction of travel.

R311.3.2 Floor elevations at other exterior doors. Doors other than the required egress door shall be provided with landings or floors not more than $7^{3}/_{4}$ inches (196 mm) below the top of the threshold.

Exception: A top landing is not required where a *stairway* of not more than two *risers* is located on the exterior side of the door, provided that the door does not swing over the *stairway*.

R311.3.3 Storm and screen doors. Storm and screen doors shall be permitted to swing over exterior stairs and landings.

Application:

All the other doors in the house other than the one required egress door can be of any size, shape and style, and the exterior landing can be an additional step down from the door threshold. This allowance is helpful for ledger connections. Ledgers can be dropped below the floor framing to extend under a cantilevered floor for a connection to a foundation or wall. Similarly, a first-floor deck on a house with brick veneer can be dropped and connected to the concrete foundation.

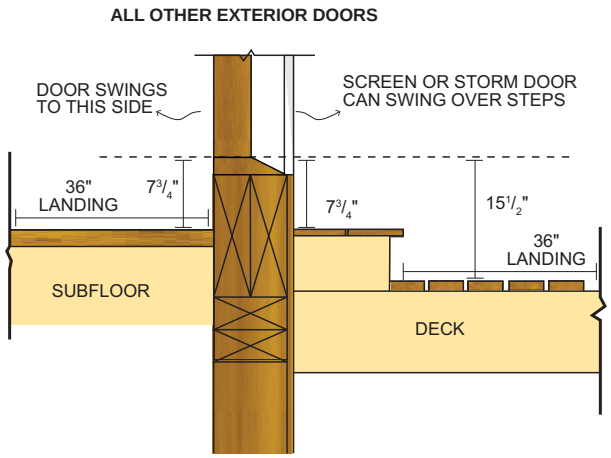


Figure 2-2-2: In some house designs, an enlarged beam may take the place of what would normally be a standard band joist, and flexibility in the landing heights is helpful.

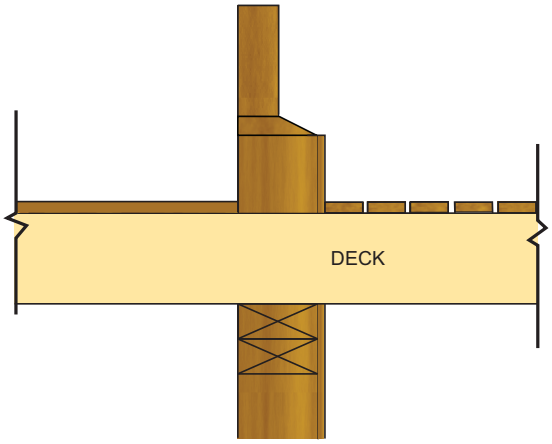


Figure 2-2-3: When the floor joists of a house extend beyond the exterior wall for a cantilevered balcony, it is ideal to build a small curb below the door. This will allow for sufficient space for a careful flashing job at the joists where they penetrate the weather-resistive barrier. This creates a step at both sides of the door but is ideal from a weather-resistive standpoint, specifically in regions with snow.

Part Three: Obstructions at the Ledger

Part Three: **Obstructions at the Ledger**

Subject: **Combustion Air Openings**

2021 Code: **[MP] COMBUSTION AIR.** The air provided to fuel-burning equipment including air for fuel combustion, draft hood dilution and *ventilation* of the equipment enclosure.

G2407.11 (304.11) Combustion air ducts. *Combustion air* ducts shall comply with all of the following:

2. Ducts shall terminate in an unobstructed space allowing free movement of *combustion air* to the *appliances*.
8. *Combustion air* intake openings located on the exterior of a building shall have the lowest side of such openings located not less than 12 inches (305 mm) vertically from the adjoining finished ground level.

Application: Fuel-gas appliances, such as furnaces and water heaters, need combustion air to operate safely and efficiently. Combustion air includes the oxygen necessary for combustion, but also air for ventilation of the appliance and for dilution into a natural draft hood, like that on a water heater. Combustion air is often brought in from the outside through ducts or direct openings located at the band joist.

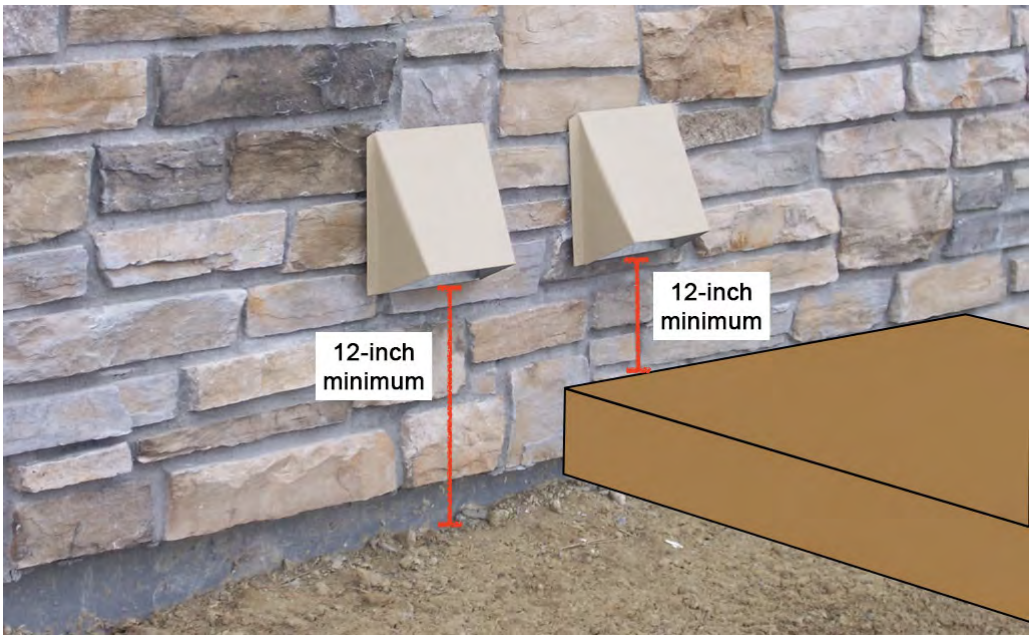


Figure 2-3-1: Combustion air ducts often come in pairs, as high and low openings inside promote thermocycling and better ventilation. Decks built below their openings must be at least 12 inches below to protect against their obstruction.

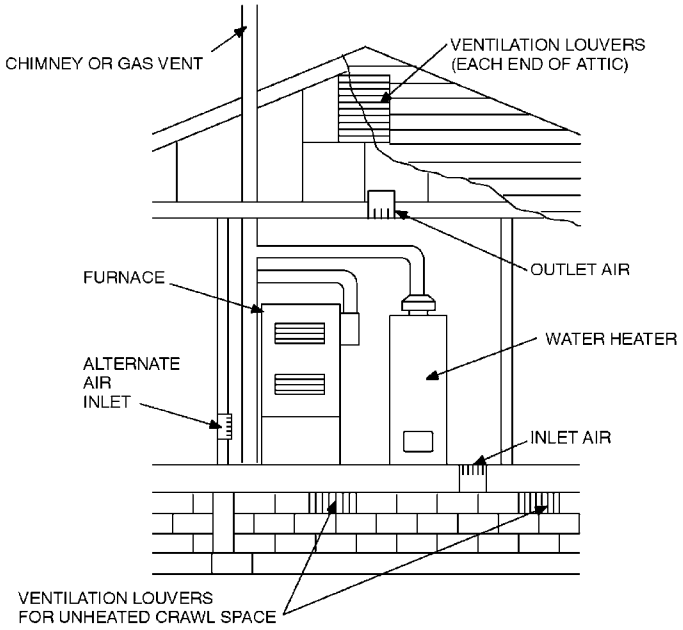


Figure G2407.6.1(1) [304.6.1(1)]
ALL AIR FROM OUTDOORS—INLET AIR FROM VENTILATION CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC
(see Section G2407.6.1)

Figure 2-3-2: This figure from the IRC makes it clear that combustion air can be taken from crawl spaces. Under the same logic, as long as there is "free air movement of combustion to the appliance," combustion air can also be drawn from under decks.

Figure 2-3-3: Similar to IRC Figure G2407.6.1(1), above, combustion air can come from under a deck. However, the airflow to the openings can't be obstructed. The beam shown here does not obstruct airflow. The overall deck design must be considered to determine if sufficient airflow can move under the deck.

Part Three: Obstructions at the Ledger

Subject: Vent Terminations

2021 Code:

G2425.14 (501.14) Category II, III and IV appliance venting systems. The design, sizing and installation of vents for Category II, III and IV *appliances* shall be in accordance with the *appliance* manufacturer's instructions.

G2427.2.1 (503.2.3) Direct-vent appliances. *Listed direct-vent appliances* shall be installed in accordance with the manufacturer's instructions. Through-the-wall vent terminations for listed direct-vent *appliances* shall be in accordance with Section G2427.8.

G2427.3.1 (503.3.1) Appliance draft requirements. A *venting system* shall satisfy the *draft* requirements of the *appliance* in accordance with the manufacturer's instructions.

G2427.6.2 (503.6.2) Installation, general. Gas vents shall be installed in accordance with the manufacturer's instructions.

G2427.8 (503.8) Venting system terminal clearances. The clearances for through-the-wall direct-vent and nondirect-vent terminals shall be in accordance with Figure G2427.8 and Table G2427.8.

> **Exception:** The clearances in Table G2427.8 shall not apply to the *combustion air* intake of a direct-vent *appliance*.

Application:

Fireplaces and high-efficiency appliances (Category IV), such as furnaces and water heaters, are often vented out the side wall of the house. These vents can be exhaust only or can include a combustion air intake, with either a concentric termination or as a pair of pipes. These appliances and their venting must be installed in accordance with the manufacturer's installation instructions.

2021 Modification:

Section G2427.8 was modified to expand the termination clearance requirements around through-the-wall vents, including above and below decks.

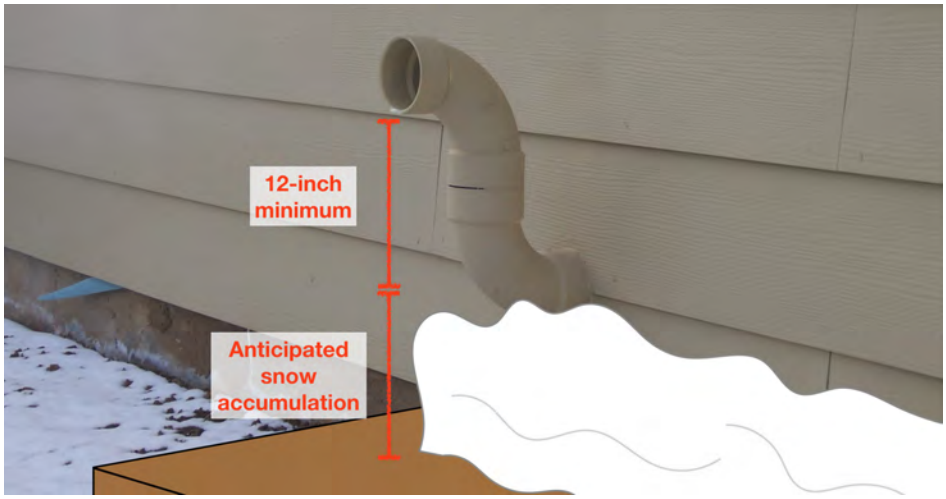


Figure 2-3-4: Appliance manufacturers' installation instructions must be reviewed for additional requirements of the vent termination, as often they require the 12-inch clearance to be measured from "anticipated snow accumulation," something that must be determined by the local building authority. In many localities, a 12-inch snow accumulation is expected, resulting in the termination being no less than 24 inches above a deck.

Part Three: Obstructions at the Ledger

Subject: Vent Termination Clearances

2021 Code (new to 2021):

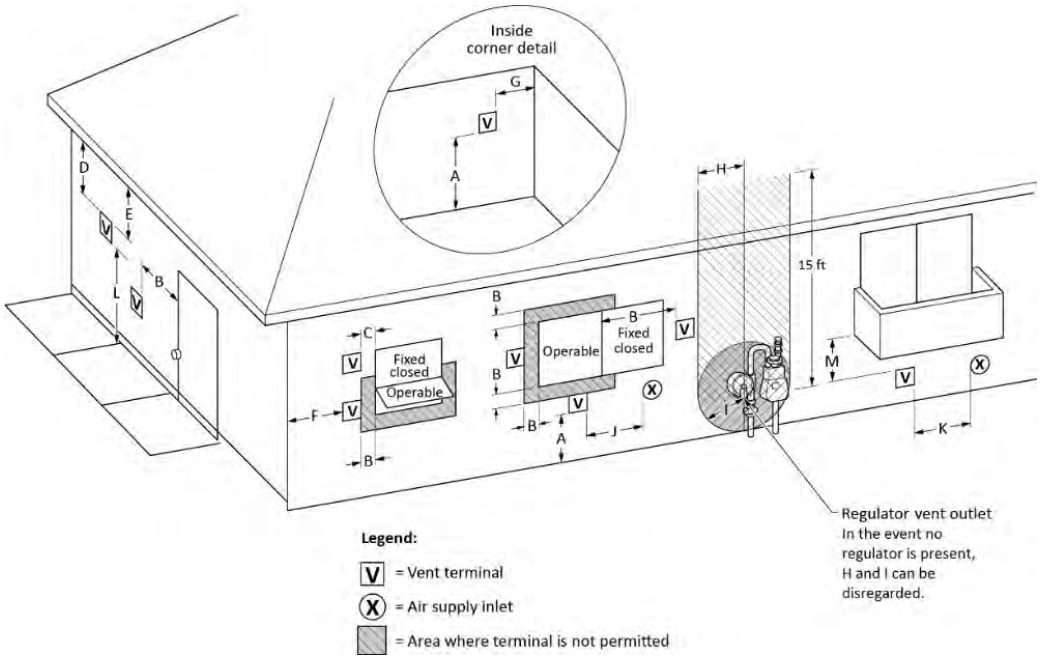


FIGURE G2427.8 (503.8)
THROUGH-THE-WALL VENT TERMINAL CLEARANCES

Figure 2-3-5: The alphabetical annotations in this graphic correspond with minimum clearances provided in the new Table G2427.8 (see next page). This should look familiar to anyone who has read fuel-gas appliance installation instructions, as similar graphics are commonly found there. A much less detailed figure has been provided in Appendix C of the IRC, unchanged, since the 2000 edition. This figure replaces that appendix.

TABLE G2427.8 (503.8)
THROUGH-THE-WALL VENT TERMINAL CLEARANCES

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCES FOR DIRECT-VENT TERMINALS	MINIMUM CLEARANCES FOR NONDIRECT-VENT TERMINALS
A	Clearance above finished grade level, veranda, porch, deck or balcony	12 inches	
B	Clearance to window or door that is openable	6 inches: Appliances ≤ 10,000 Btu/hr 9 inches: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 inches: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B	4 feet below or to side of opening or 1 foot above opening
C	Clearance to nonopenable window	None unless otherwise specified by the appliance manufacturer	
D	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet from the centerline of the terminal	None unless otherwise specified by the appliance manufacturer	
E	Clearance to unventilated soffit	None unless otherwise specified by the appliance manufacturer	
F	Clearance to outside corner of building	None unless otherwise specified by the appliance manufacturer	
G	Clearance to inside corner of building	None unless otherwise specified by the appliance manufacturer	
H	Clearance to each side of centerline extended above regulator vent outlet	3 feet up to a height of 15 feet above the regulator vent outlet	
I	Clearance to service regulator vent outlet in all directions	3 feet for gas pressures up to 2 psi; 10 feet for gas pressures above 2 psi	
J	Clearance to nonmechanical air supply inlet to building and the combustion air inlet to any other appliance	Same clearance as specified for Row B	
K	Clearance to a mechanical air supply inlet	10 feet horizontally from inlet or 3 feet above inlet	
L	Clearance above paved sidewalk or paved driveway located on public property	7 feet and shall not be located above public walkways or other areas where condensate or vapor can cause a nuisance or hazard	
M	Clearance to underside of veranda, porch deck or balcony	12 inches where the area beneath the veranda, porch deck or balcony is open on not less than two sides. The vent terminal is prohibited in this location where only one side is open.	

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square inch = 6.895 kPa, 1 Btu/h = 0.293 W.

Clearances A and M in this table are directly related to decks built over or above through-the-wall gas vent terminations, and are the same 12 inches required for combustion air intakes, discussed previously. When under a deck, however, at least two sides of the deck must be open to allow cross-ventilation to remove the combustion products. It is still critical to evaluate the clearances required by the manufacturer, as they would take authority over the code and may be greater than 12 inches. The clearances in location B may also be important in deck construction, as often a door opening is added as part of a deck project. See Chapter 10, Amenities, of this book.

Part Three: Obstructions at the Ledger

Subject: Dryer Exhaust Duct Terminations

2021 Code: **M1502.3 Duct termination.** Exhaust ducts shall terminate on the outside of the building. Exhaust duct terminations shall be in accordance with the dryer manufacturer's installation instructions. If the manufacturer's instructions do not specify a termination location, the exhaust duct shall terminate not less than 3 feet (914 mm) in any direction from openings into buildings, including openings in ventilated soffits. Exhaust duct terminations shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination.

Application: Clothes dryer exhaust is not just exhausting moisture, but also the heat from the dryer and combustion products from gas-fired dryers. Obstructing a dryer vent can cause dryer fires. Dryer exhaust often terminates through the band joist and at the same location as the ledger connection.

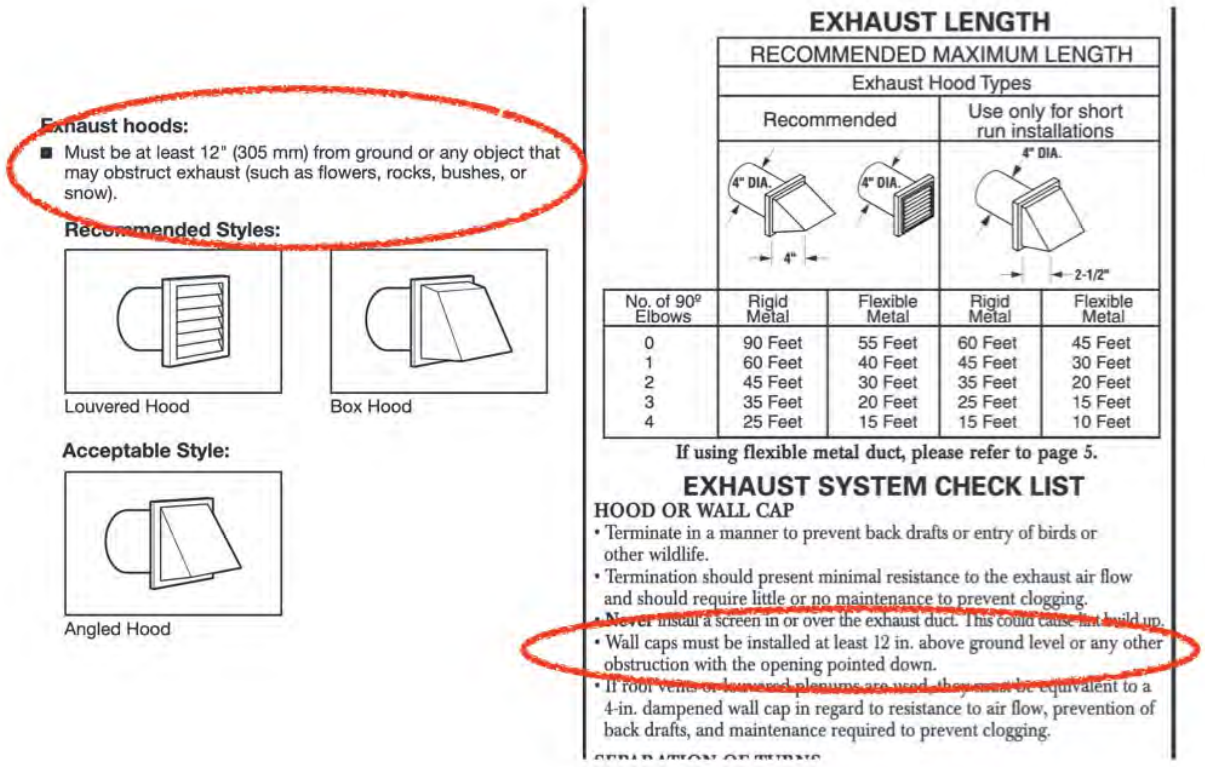


Figure 2-3-6: The IRC requires the termination to be in compliance with the dryer manufacturer's installation instructions. These two examples are common in the leading manufacturers' instructions, and correlate with the 12-inch clearance discussed previously for fuel-gas vents and combustion air. Access is also necessary at clothes dryer exhaust. Lint buildup at the backdraft damper affects proper closure and can ultimately block the opening. Dryer duct cleaning is also more effective if accessible from the outside. Access hatches can be built into the deck floor.

Part Three: Obstructions at the Ledger

Subject: Cladding Weeps

2021 Code: **R703.7.2.1 Weep screeds.** A minimum 0.019-inch (0.5 mm) (No. 26 galvanized sheet gage), corrosion-resistant weep screed or plastic weep screed, with a minimum vertical attachment flange of $3^1/_2$ inches (89 mm), shall be provided at or below the foundation plate line on exterior stud walls in accordance with ASTM C926. The weep screed shall be placed not less than 4 inches (102 mm) above the earth or 2 inches (51 mm) above paved areas and shall be of a type that will allow trapped water to drain to the exterior of the building. The weather-resistant barrier shall lap the attachment flange. The exterior lath shall cover and terminate on the attachment flange of the weep screed.

R703.8.6 Weepholes. Weepholes shall be provided in the outside wythe of masonry walls at a maximum spacing of 33 inches (838 mm) on center. Weepholes shall be not less than $^3/_{16}$ inch (5 mm) in diameter. Weepholes shall be located immediately above the flashing.

Application: Weep screeds and weephole clearances are discussed in more depth in Chapter 4, Ledgers, but are included in this chapter as well. Masonry (anchored or adhered), plaster (stucco or EIFS), and other cementitious-type claddings are not waterproof or vapor barriers. Water that gets through or that condenses behind the cladding is designed to flow out openings at the bottom. These openings can also act as ventilation openings in some designs. It is critical that deck ledgers or concrete slabs do not obstruct these openings. Anchored masonry can be installed in a manner that raises the weepholes above the bottom course.

Figure 2-3-7: Weepholes for anchored veneers come in a variety of styles, sometimes corrugated plastic, a tube, a wick, or even simply not grouting a head joint. These can open onto a deck or below, just not into the back of a ledger or beam.

Part Three: Obstructions at the Ledger

Subject: Under-floor Ventilation Openings

2021 Code: **R408.2 Openings for under-floor ventilation.** Ventilation openings through foundation or exterior walls surrounding the under-floor space shall be provided in accordance with this section. The minimum net area of ventilation openings shall be not less than 1 square foot (0.0929 m^2) for each 150 square feet (14 m^2) of under-floor area. One ventilation opening shall be within 3 feet (915 mm) of each external corner of the under-floor space. [Remaining text not provided.]

Application: Many houses are built with ventilated crawl spaces, and openings in the band joist are provided to allow air to evacuate and carry moisture with it. A minimum opening area is required based on the crawl space size, and openings must be dispersed at all corners. These openings are not prohibited from terminating under decks, but caution should be taken to not negatively affect the current ventilation. A casual examination of the crawl space should be conducted for existing signs of moisture issues prior to any alteration to the air outside the vent opening.

2021 Modification:

Section R408.1 of the 2018 IRC was modified and expanded into Section R408.2 of the 2021 edition. The entire section and the modifications are not provided as they do not directly relate to deck construction.

Figure 2-3-8: Though this one is nearly painted shut already, it's also right where a ledger would connect. Ledgers must be severed at vent locations and joists laid out on either side. Shallower blocking spaced away from the wall can be installed between joists to support angled decking if necessary.

Part Four: Electrical Equipment and Cables

Part Four: **Electrical Equipment and Cables**

Subject: **Service Conductor Clearances at Buildings**

2021 Code: **E3604.1 Clearances on buildings.** Open conductors and multiconductor cables without an overall outer jacket shall have a clearance of not less than 3 feet (914 mm) from the sides of doors, porches, decks, stairs, ladders, fire escapes and balconies, and from the sides and bottom of windows that open. See Figure E3604.1. [230.9(A)]

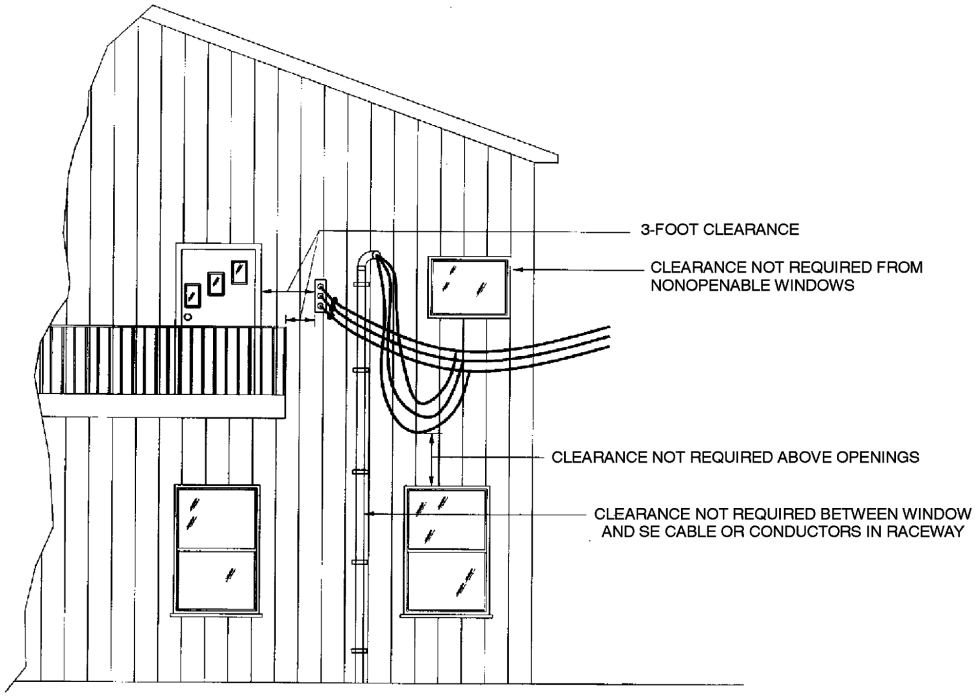


FIGURE E3604.1
CLEARANCES FROM BUILDING OPENINGS

Application: An overhead service conductor strung to a house must be at least 3 feet horizontally from the edge of a deck, so it is recommended staying $3^1/_2$ feet away. An alternative would be to raise the service conductors high enough above the deck surface, as discussed on the next page in Section E3604.2.2.

Part Four: Electrical Equipment and Cables

Subject: Service Conductor Clearances Over Decks

2021 Code: **E3604.2.2 Vertical clearance from grade.** Overhead service conductors shall have the following minimum clearances from final grade:

1. For conductors supported on and cabled together with a grounded bare messenger wire, the minimum vertical clearance shall be 10 feet (3048 mm) at the electric service entrance to buildings, at the lowest point of the drip loop of the building electric entrance, and above areas or sidewalks accessed by pedestrians only. Such clearance shall be measured from final grade or other accessible surfaces.
2. Twelve feet (3658 mm)—over residential property and driveways.
3. Eighteen feet (5486 mm)—over public streets, alleys, roads or parking areas subject to truck traffic. [(230.24(B)(1), (2), and (4)]

Application: When overhead service entrance conductors are within 3 feet horizontally from the edge of a deck, they must be at least 10 feet above the walking surface. Often a service cable may meet code, being 12 feet above a residential yard, but when a new deck is built underneath, the clearance is reduced to below 10 feet.

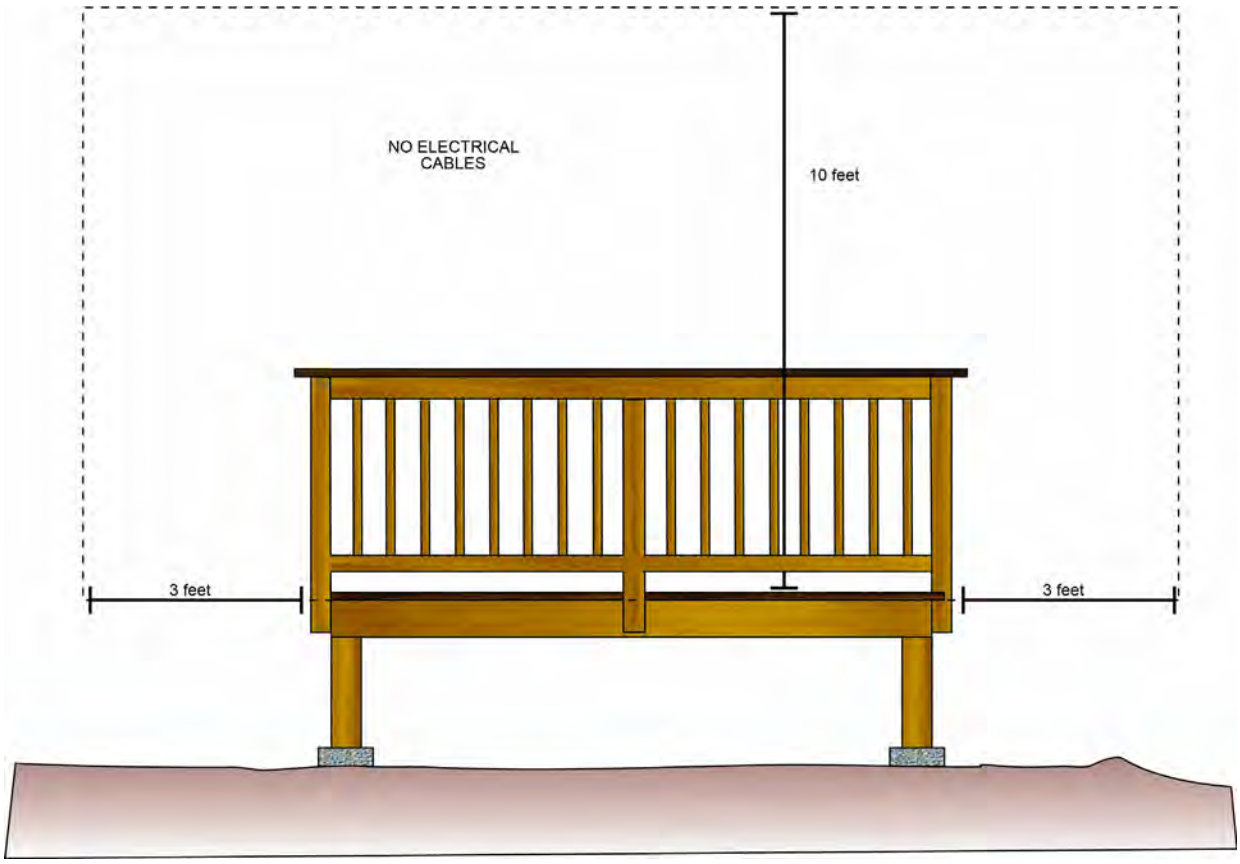


Figure 2-4-1: Electricians and electrical inspectors are not typically involved with deck construction and thus this important safety provision is too often overlooked.

Part Four: Electrical Equipment and Cables

Subject: Working Clearances at Electrical Equipment and Panels

2021 Code: **E3405.1 Working space and clearances.** Access and working space shall be provided and maintained around all electrical equipment to permit ready and safe operation and maintenance of such equipment in accordance with this section and Figure E3405.1. (110.26)

E3405.2 Working clearances for energized equipment and panelboards. Except as otherwise specified in Chapters 34 through 43, the dimension of the working space in the direction of access to panelboards and live parts of other equipment likely to require examination, adjustment, servicing or maintenance while energized shall be not less than 36 inches (914 mm) in depth. Distances shall be measured from the energized parts where such parts are exposed or from the enclosure front or opening where such parts are enclosed. In addition to the 36-inch dimension (914 mm), the work space shall not be less than 30 inches (762 mm) wide in front of the electrical equipment and not less than the width of such equipment. The work space shall be clear and shall extend from the floor or platform to a height of 6.5 feet (1981 mm) or the height of the equipment, whichever is greater. In all cases, the work space shall allow at least a 90-degree (1.57 rad) opening of equipment doors or hinged panels. Equipment or support structures, such as concrete pads, associated with the electrical installation located above or below the electrical equipment shall be permitted to extend not more than 6 inches (152 mm) beyond the front of the electrical equipment.

[Exceptions to this section do not relate to decks and are not provided.]

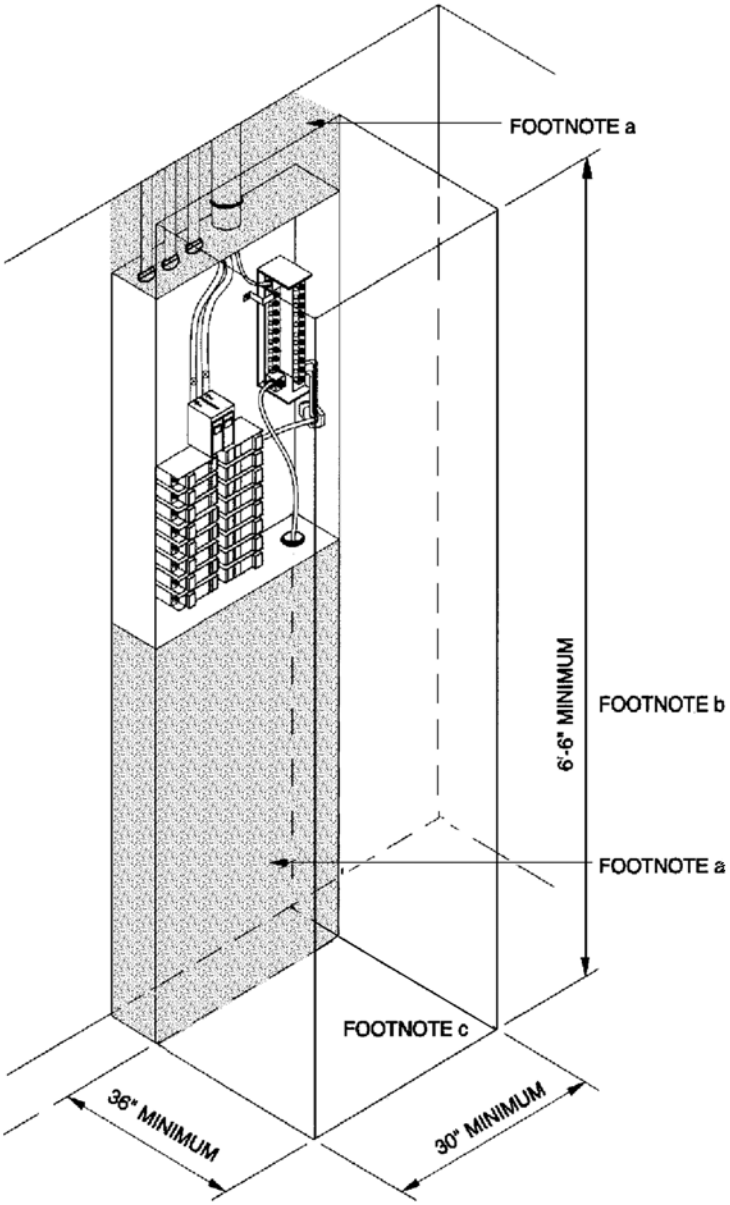


FIGURE E3405.1
WORKING SPACE AND CLEARANCES

Part Four: Electrical Equipment and Cables

Subject: Working Clearances at Electrical Equipment and Panels

Application: Though the figure and section title reference panelboards, the minimum working clearances are applicable to any electrical “equipment” that is likely to meet human contact while energized. The term *equipment* is defined by the IRC and can apply to practically any material used in an electrical installation. Through the need to test for voltage drop, practically anything could be examined while energized. This strict interpretation could apply a 6.5-foot height to everything electrical, but this is not the intent. The intent is to provide workers safe access to do what work is necessary to install, repair and maintain electrical equipment and systems.

Figure 2-4-2: It could be interpreted that an air conditioning compressor must have a 6.5-foot-high clearance around it, but that could also be considered unnecessary. Manufacturer’s installation instructions, however, will require a clearance above the unit for airflow, usually between 12 and 48 inches depending on the size of the unit.

Part Four: Electrical Equipment and Cables

Subject: Required Receptacles for Decks

2018 Code: **E3901.7 Outdoor outlets.** Not less than one receptacle outlet that is readily accessible from grade level and located not more than 6 feet, 6 inches (1981 mm) above grade, shall be installed outdoors at the front and back of each dwelling unit having direct access to grade level. Balconies, decks, and porches that are accessible from inside of the dwelling unit shall have at least one receptacle accessible from the balcony, deck, or porch. The receptacle shall be located not more than 6 feet, 6 inches (1981 mm) above the balcony, deck, or porch surface. [210.52(E)]

2021 Code: **E3901.7 Outdoor outlets.** Not less than one receptacle outlet that is readily accessible from grade level and located not more than 6 feet 6 inches (1981 mm) above grade, shall be installed outdoors at the front and back of each dwelling unit having direct access to grade level. Balconies, decks and porches that are within 4 inches (102 mm) horizontally of the dwelling unit shall have at least one receptacle outlet accessible from the balcony, deck or porch. The receptacle shall be located not more than 6 feet 6 inches (1981 mm) above the balcony, deck, or porch surface. [210.52(E)]

Application: The provisions for a required receptacle outlet at decks have evolved nearly every code cycle since first appearing in the 2008 *National Electrical Code*® (NEC®), where the requirement in the IRC is borrowed from. In the 2014 NEC, a requirement was added that a deck had to be “attached” to the dwelling for a receptacle to be required. This led to incorrect interpretations that the manner of structural design of a deck was related to the occupant’s likely need for a receptacle, and freestanding decks, built without ledger support, were excluded from the requirement by some building authorities. Other issues surfaced as well, with each edition’s modifications.

In order to better clarify the relationship of a deck to a house in regards to when an occupant is likely to seek a receptacle, the 2020 NEC requires that any deck within a 4-inch proximity from the dwelling unit (presumably serving it) requires a receptacle to be accessible from that deck. This eliminates any discussion about doors, access or the structural design of the deck and is meant to make interpretation much more simple.

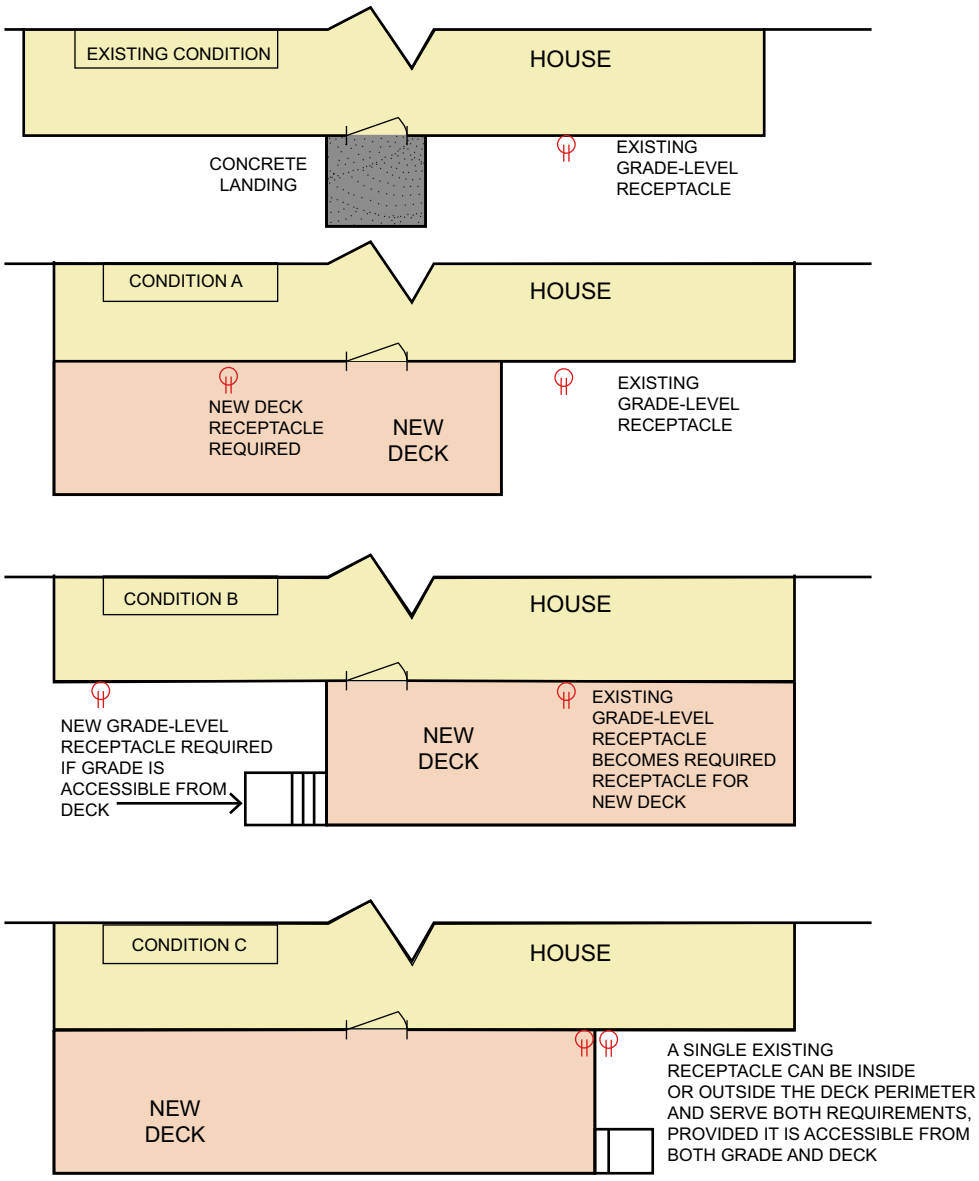


Figure 2-4-3: Depending on the design of the new deck, an existing outlet may or may not satisfy the requirement for an outlet accessible from the deck. When a deck is built at grade, a single outlet could satisfy the requirement for both the grade-level and the deck receptacle. A two-level deck should be provided outlets accessible from both decks, but a multilevel deck with only a handful of steps between would not.

Part Five: Safety Glazing of Windows

Part Five: Safety Glazing of Windows

Subject: Providing Safety Glazing

2021 Code: **R308.3 Human impact loads.** Individual glazed areas, including glass mirrors in hazardous locations such as those indicated as defined in Section R308.4, shall pass the test requirements of Section R308.3.1.

Exceptions:

1. Louvered windows and jalousies shall comply with Section R308.2.
2. Mirrors and other glass panels mounted or hung on a surface that provides a continuous backing support.
3. Glass unit masonry complying with Section R607.

R308.3.1 Impact test. Where required by other sections of the code, glazing shall be tested in accordance with CPSC 16 CFR 1201. Glazing shall comply with the test criteria for Category II unless otherwise indicated in Table R308.3.1(1).

Exception: Glazing not in doors or enclosures for hot tubs, whirlpools, saunas, steam rooms, bathtubs and showers shall be permitted to be tested in accordance with ANSI Z97.1. Glazing shall comply with the test criteria for Class A unless otherwise indicated in Table R308.3.1(2).

TABLE R308.3.1(1)
MINIMUM CATEGORY CLASSIFICATION OF GLAZING USING CPSC 16 CFR 1201

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZING IN STORM OR COMBINATION DOORS (Category Class)	GLAZING IN DOORS (Category Class)	GLAZED PANELS REGULATED BY SECTION R308.4.3 (Category Class)	GLAZED PANELS REGULATED BY SECTION R308.4.2 (Category Class)	GLAZING IN DOORS AND ENCLOSURES REGULATED BY SECTION 308.4.5 (Category Class)	SLIDING GLASS DOORS PATIO TYPE (Category Class)
9 square feet or less	I	I	NR	I	II	II
More than 9 square feet	II	II	II	II	II	II

For SI: 1 square foot = 0.0929 m^2.
NR = No Requirement.

TABLE R308.3.1(2)
MINIMUM CATEGORY CLASSIFICATION OF GLAZING USING ANSI Z97.1

EXPOSED SURFACE AREA OF ONE SIDE OF ONE LITE	GLAZED PANELS REGULATED BY SECTION R308.4.3 (Category Class)	GLAZED PANELS REGULATED BY SECTION R308.4.2 (Category Class)	DOORS AND ENCLOSURES REGULATED BY SECTION R308.4.5[a] (Category Class)
9 square feet or less	No requirement	B	A
More than 9 square feet	A	A	A

For SI: 1 square foot = 0.0929 m^2.
a. Use is permitted only by the exception to Section R308.3.1.

Application: The IRC describes various “hazardous locations” where the likelihood of human impact with the glass is higher than normal. Two recognized safety standards for “safety glazing” are referenced by the IRC, and each has two categories of performance. The hazardous areas the IRC identifies require differing levels of performance and thus different categories of the standards. It can be confusing, unless you use tempered glass. Tempered glass is the most common form of safety glazing and is compliant in all applications.

Part Five: Safety Glazing of Windows

Subject: Safety Glazing Identification

2021 Code: **R308.1 Identification.** Except as indicated in Section R308.1.1 each pane of glazing installed in hazardous locations as defined in Section R308.4 shall be provided with a manufacturer's designation specifying who applied the designation, the type of glass and the safety glazing standard with which it complies, and that is visible in the final installation. The designation shall be acid etched, sandblasted, ceramic-fired, laser etched, embossed, or be of a type that once applied cannot be removed without being destroyed. A *label* shall be permitted in lieu of the manufacturer's designation.

Exceptions:

1. For other than tempered glass, manufacturer's designations are not required provided that the *building official* approves the use of a certificate, affidavit or other evidence confirming compliance with this code.
2. Tempered spandrel glass is permitted to be identified by the manufacturer with a removable paper designation.

Application: Safety glazing must be able to be identified at the time of installation, by the installer first and the inspector second. When using labels and other means of identification that can be removed, they must be of a type that is destroyed in removal, so that they cannot be reapplied fraudulently on other glass. Glass films are available that are marketed as security enhancements, but many of them also comply with the safety glazing standards. Use of these products can be verified using the first exception. Specifications for a product can be provided, and if commercially installed, a billing invoice or other such record of delivery or installation should be provided.

Figure 2-5-1: For tempered glass, a permanent etching is typically provided on the glass that lists the necessary information. They are as hard to read in person as they are in this photo.

Part Five: Safety Glazing of Windows

Subject: Decorative Glass

2021 Code: **[RB] DECORATIVE GLASS.** A carved, leaded or Dalle glass or glazing material with a purpose that is decorative or artistic, not functional; with coloring, texture or other design qualities or components that cannot be removed without destroying the glazing material; and with a surface, or assembly into which it is incorporated, that is divided into segments.

[RB] DALLE GLASS. A decorative composite glazing material made of individual pieces of glass that are embedded in a cast matrix of concrete or epoxy.

Application: Throughout most of the requirement for safety glazing in the IRC, “decorative glazing” is an exception. When safety glazing is tested, two of the criteria are whether the glass either breaks into small pieces or resists breakage altogether. The definition is very specific about the glass being divided into segments. It also makes it clear that it must be decorative and not functional, and it must be colored or textured. This limits the frequency and locations of common use and design. Dalle glass is also allowed, as the definition also specifies individual pieces of glass, presumably small ones.

Figure 2-5-2: Stained glass in homes is not very common, but when it is installed, it is often only in showcase areas, such as a front door sidelight or a transom over a picture window. The probability of hazard is reduced, so the IRC allows the design freedom.

Part Five: Safety Glazing of Windows

Subject: Glazing at Walking Surfaces

2021 Code: **R308.4.3 Glazing in windows.** Glazing in an individual fixed or operable panel that meets all of the following conditions shall be considered to be a hazardous location:

1. The exposed area of an individual pane is larger than 9 square feet (0.836 m^2).
2. The bottom edge of the glazing is less than 18 inches (457 mm) above the floor.
3. The top edge of the glazing is more than 36 inches (914 mm) above the floor.
4. One or more walking surfaces are within 36 inches (914 mm), measured horizontally and in a straight line, of the glazing.

Exceptions:

1. Decorative glazing.
2. Where glazing is adjacent to a walking surface and a horizontal rail is installed 34 to 38 inches (864 to 965 mm) above the walking surface. The rail shall be capable of withstanding a horizontal load of 50 pounds per linear foot (730 N/m) without contacting the glass and have a cross-sectional height of not less than $1^1/_2$ inches (38 mm).
3. (This exception is not applicable to decks.)

Application: Every floor you walk on is an IRC "hazardous location," but only if nearby glass is too large, too close, too low but also too high. Decorative glass is the first exception for many of the hazardous areas identified in the IRC, and was discussed on the previous page. The second exception is essentially a bandage that will fall off a wound that never heals. A rail at 36 inches high across the front of a picture window is no one's intended design, and when installed for an inspection, it is likely removed soon after. Attention in design and plan review may reduce the need for this exception being used.

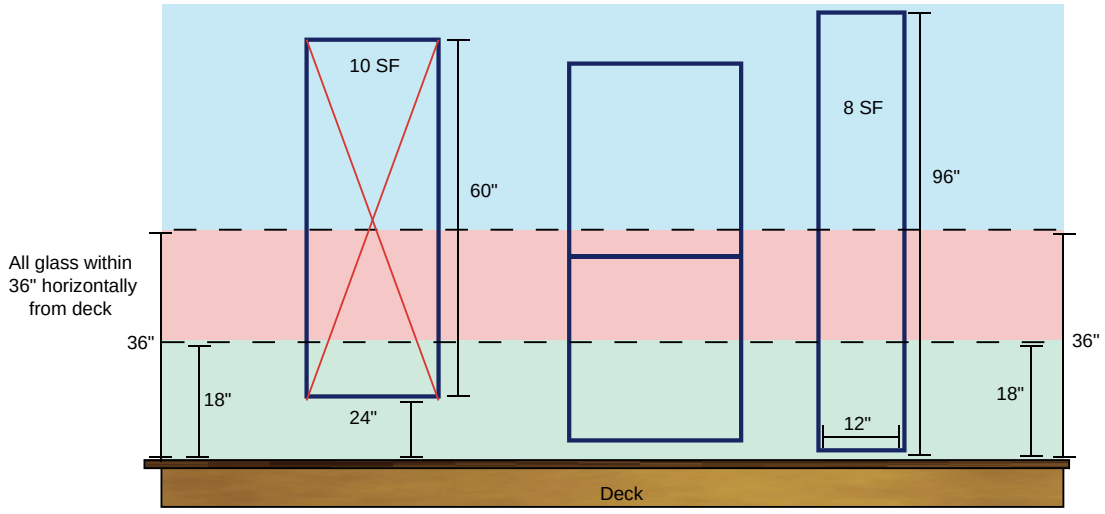


Figure 2-5-3: If you divided a wall into three bands, a single pane of glass more than 9 square feet must be in all three for safety glazing to be required. In this illustration, only the leftmost glass with the red "X" must be safety glazed.

Part Five: Safety Glazing of Windows

Subject: Glazing Adjacent to Hot Tubs and Pools

2021 Code: **R308.4.5 Glazing and wet surfaces.** Glazing in walls, enclosures or fences containing or adjacent to hot tubs, spas, whirlpools, saunas, steam rooms, bathtubs, showers and indoor or outdoor swimming pools where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) measured vertically above any standing or walking surface shall be considered to be a hazardous location. This shall apply to single glazing and each pane in multiple glazing.

> **Exception:** Glazing that is more than 60 inches (1524 mm), measured horizontally, from the water's edge of a bathtub, hot tub, spa, whirlpool or swimming pool or from the edge of a shower, sauna or steam room.

Application: Often a deck will be designed in conjunction with a hot tub. Water poses an electrical hazard that is discussed in Chapter 10 of this book. Water also poses a slipping hazard, and thus any walking surface within 6 feet horizontally of the water's edge is a hazardous location. Glass of any size less than 5 feet above a walking surface that is within 5 feet of water must be safety glazed.

2021 Modification:

The term "facing" was replaced with the term "adjacent to" so that interpretation of this provision would be more consistent. Many professionals interpreted the 2018 and previous editions to include glass just outside of a wet feature, such as a shower or hot tub, and found no differentiation between glass specifically facing the feature or at 90 degrees to it and facing only the space outside of the feature. Others, recognizing the term "facing," believed differently. The 2021 IRC has addressed this inconsistency with this modification.

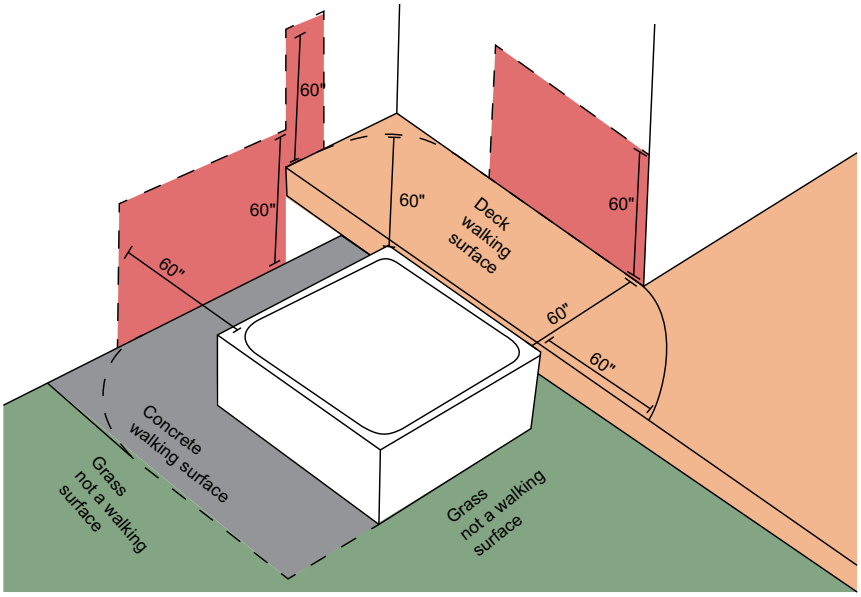


Figure 2-5-4: Interpretation of a "walking surface" requires a little examination. The hazard is wet people exiting the tub and making the walking surface wet and slippery. In the illustration, it is highly improbable that the adjacent grass will be used as the path to and from the tub. Applying safety glazing provisions to vegetative landscape surfaces and similar surfaces that are not designed specifically for human habitation is outside the intent of this protection.

Part Five: Safety Glazing of Windows

Subject: Glazing Adjacent to Stairs and Ramps

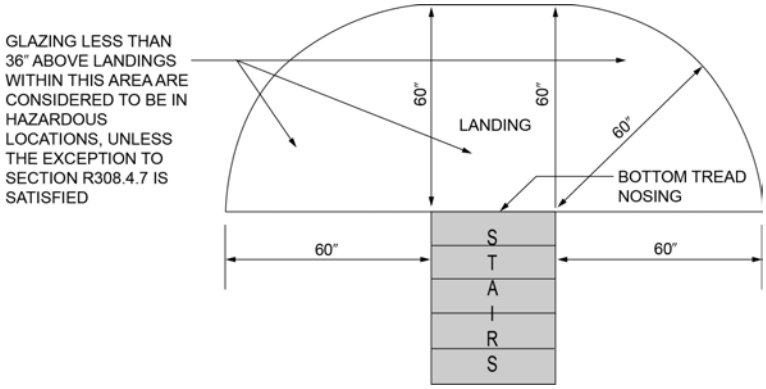
2021 Code: **R308.4.6 Glazing adjacent to stairs and ramps.** Glazing where the bottom exposed edge of the glazing is less than 36 inches (914 mm) above the plane of the adjacent walking surface of stairways, landings between flights of stairs and ramps shall be considered to be a hazardous location.

Exceptions:

1. Where glazing is adjacent to a walking surface and a horizontal rail is installed at 34 to 38 inches (864 to 965 mm) above the walking surface. The rail shall be capable of withstanding a horizontal load of 50 pounds per linear foot (730 N/m) without contacting the glass and have a cross-sectional height of not less than $1^1/_2$ inches (38 mm).
2. Glazing 36 inches (914 mm) or more measured horizontally from the walking surface.

R308.4.7 Glazing adjacent to the bottom stair landing. Glazing adjacent to the landing at the bottom of a stairway where the glazing is less than 36 inches (914 mm) above the landing and within a 60-inch (1524 mm) horizontal arc less than 180 degrees (3.14 rad) from the bottom tread nosing shall be considered to be a hazardous location. (See Figure R308.4.7.)

Exception: Where the glazing is protected by a guard complying with Section R312 and the plane of the glass is more than 18 inches (457 mm) from the guard.



For SI: 1 inch = 25.4 mm.

FIGURE R308.4.7
HAZARDOUS GLAZING LOCATIONS AT BOTTOM STAIR LANDINGS

Application: Stairs and ramps require greater attention in travel and thus create a higher probability for a fall. Glazing (windows) adjacent to stairs and to landings between stairs must be safety glazed if within a practical horizontal distance. At the bottom landings of stairways, whether a single step or the last landing in a series of stairs, there is an assumption that fall distance will be greater, and thus the distance where safety glazing is required is increased. The exception to the general glazing adjacent to stairs and landings is identical to glazing at walking surfaces, previously discussed. The exception for the bottom landing, however, is different. It requires an entire guard assembly, which includes infill below the top, and the guard must be 18 inches away from the glass.

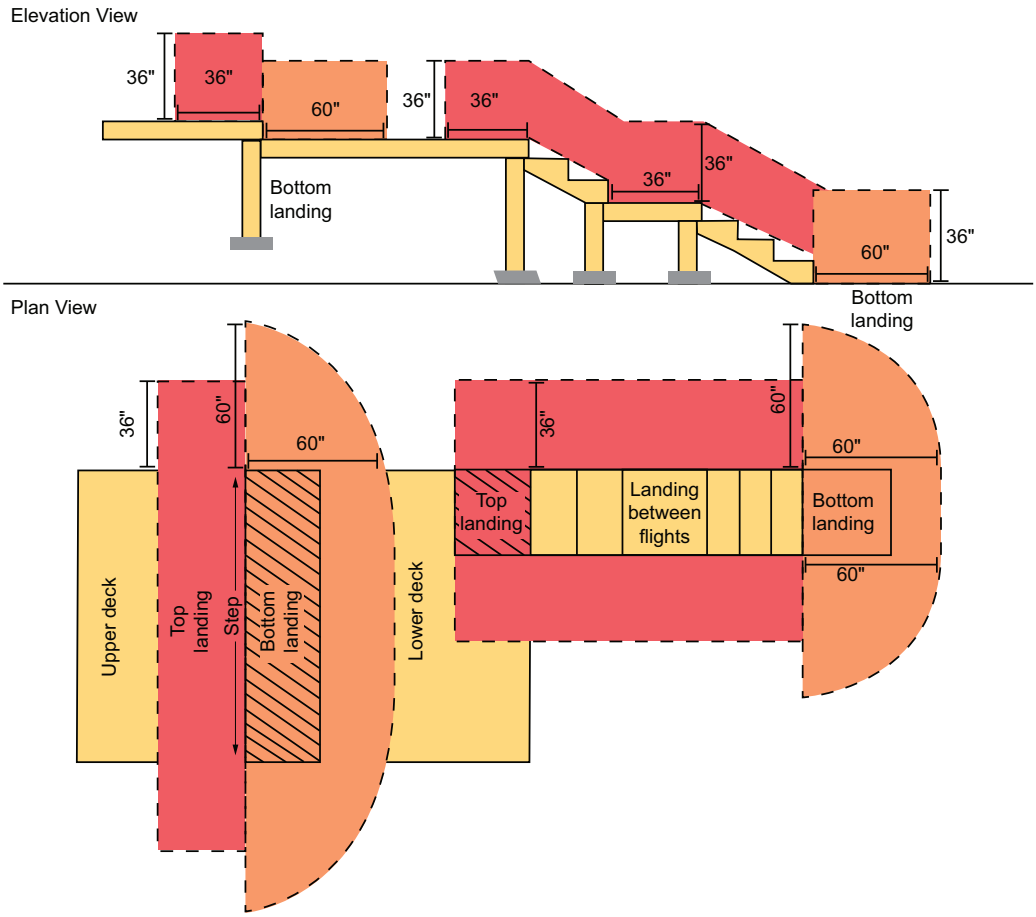


Figure 2-5-5: The different stairways in this illustration are shown from both angles. The larger hazardous area at the bottom landing is shown in orange and the area adjacent to stairs and landings is shown in red. Any glazing in these areas less than 36 inches above the floor or nosing must be safety glazed.

Part Six: Emergency Escape and Rescue Openings

Part Six: Emergency Escape and Rescue Openings

Subject: Location of Openings

2021 Code:

[RB] EMERGENCY ESCAPE AND RESCUE OPENING. An operable exterior window, door or other similar device that provides for a means of escape and access for rescue in the event of an emergency. (See also "*Grade floor emergency escape and rescue opening*.")

R310.1 Emergency escape and rescue opening required. *Basements, habitable attics* and every sleeping room shall have not less than one operable *emergency escape and rescue opening*. Where *basements* contain one or more sleeping rooms, an *emergency escape and rescue opening* shall be required in each sleeping room. *Emergency escape and rescue openings* shall open directly into a *public way*, or to a *yard* or court having a minimum width of 36 inches (914 mm) that opens to a *public way*.

Exceptions: [Not applicable to decks.]

Application:

While sleeping, our response to an emergency is delayed. By the time we wake, it may be too late to escape the room through the door we came in. For this reason, every bedroom, sleeping room, habitable attic, and basement, whether finished or not, must have a secondary opening to the exterior for escape and rescue. Older homes or those with noncompliant basement bedrooms may have smaller windows than the IRC allows, but a new deck cannot make them any more hazardous. Never obstruct these openings in deck design, regardless of their size.

2021 Modification:

The final sentence in Section R310.1 was added in 2021 to require the path from a yard or court to a public way to be at least 36 inches wide.

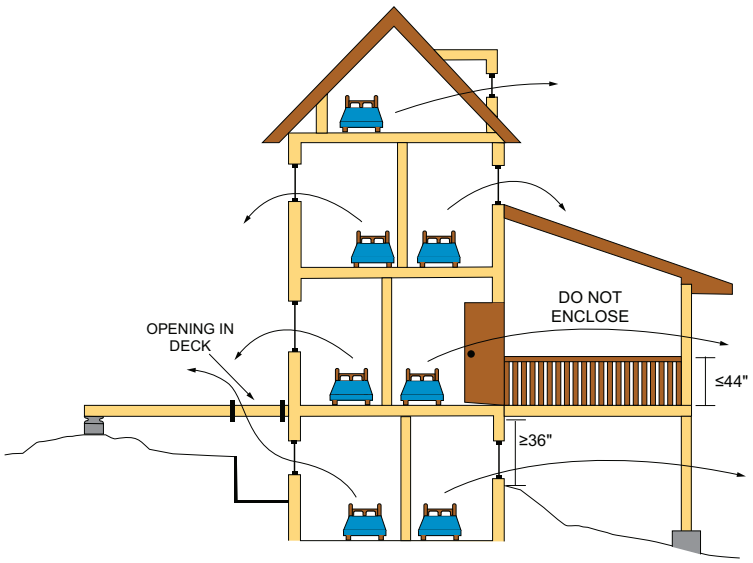


Figure 2-6-1: Emergency escape openings need to open directly to the exterior and to the public way or yard court or path that accesses it. The opening could be a window three stories up and require a ladder rescue or it could be onto a roof, under a deck, onto a deck, out a door, or out a grade-level window.

Part Six: Emergency Escape and Rescue Openings

Subject: Emergency Escape and Rescue Through a Deck

2018 Code: **R310.2.3 Window wells.** The horizontal area of the window well shall be not less than 9 square feet (0.9 m^2), with a horizontal projection and width of not less than 36 inches (914 mm). The area of the window well shall allow the emergency escape and rescue opening to be fully opened.

Exception: The ladder or steps required by Section R310.2.3.1 shall be permitted to encroach not more than 6 inches (152 mm) into the required dimensions of the window well.

R310.2.3.1 Ladder and steps. Window wells with a vertical depth greater than 44 inches (1118 mm) shall be equipped with a permanently affixed ladder or steps usable with the window in the fully open position. Ladders or steps required by this section shall not be required to comply with Section R311.7. Ladders or rungs shall have an inside width of not less than 12 inches (305 mm), shall project not less than 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center vertically for the full height of the window well.

2021 Code: **R310.4 Area wells.** An *emergency escape and rescue opening* where the bottom of the clear opening is below the adjacent grade shall be provided with an area well in accordance with Sections R310.4.1 through R310.4.4.

R310.4.1 Minimum size. The horizontal area of the area well shall be not less than 9 square feet (0.9 m^2), with a horizontal projection and width of not less than 36 inches (914 mm). The size of the area well shall allow the *emergency escape and rescue opening* to be fully opened.

Exception: The ladder or steps required by Section R310.4.2 shall be permitted to encroach not more than 6 inches (152 mm) into the required dimensions of the area well.

R310.4.2 Ladder and steps. Area wells with a vertical depth greater than 44 inches (1118 mm) shall be equipped with an *approved*, permanently affixed ladder or steps. The ladder or steps shall not be obstructed by the *emergency escape and rescue opening* where the window or door is in the open position. Ladders or steps required by this section shall not be required to comply with Section R311.7.

R310.4.2.1 Ladders. Ladders and rungs shall have an inside width of not less than 12 inches (305 mm), shall project not less than 3 inches (76 mm) from the wall and shall be spaced not more than 18 inches (457 mm) on center vertically for the full height of the area well.

R310.4.2.2 Steps. Steps shall have an inside width of not less than 12 inches (305 mm), a minimum tread depth of 5 inches (127 mm) and a maximum *riser* height of 18 inches (457 mm) for the full height of the area well.

Application: When an emergency escape and rescue opening is below grade, a minimum size window well is required. If deeper than 44 inches, the window well must have a ladder or steps. Just as a concrete patio is often poured around a window well, so can a deck be built around a window well. The opening in the deck must be at least as large as the required window well area, 36 inches by 36 inches.

2021 Modification:

Section 310 was heavily reorganized in the 2021 edition, yet also included some technical modifications. Duplicate sections for area wells serving emergency escape and rescue doors and window wells for windows are now combined in one section with one term, “area wells.” Though the well distinction was eliminated, a new one was included that created a technical change in application. The geometry for steps leading out of these wells is now described separately from ladders, and the result is a minimum 5-inch tread depth as opposed to the 3-inch projection still required for ladders.

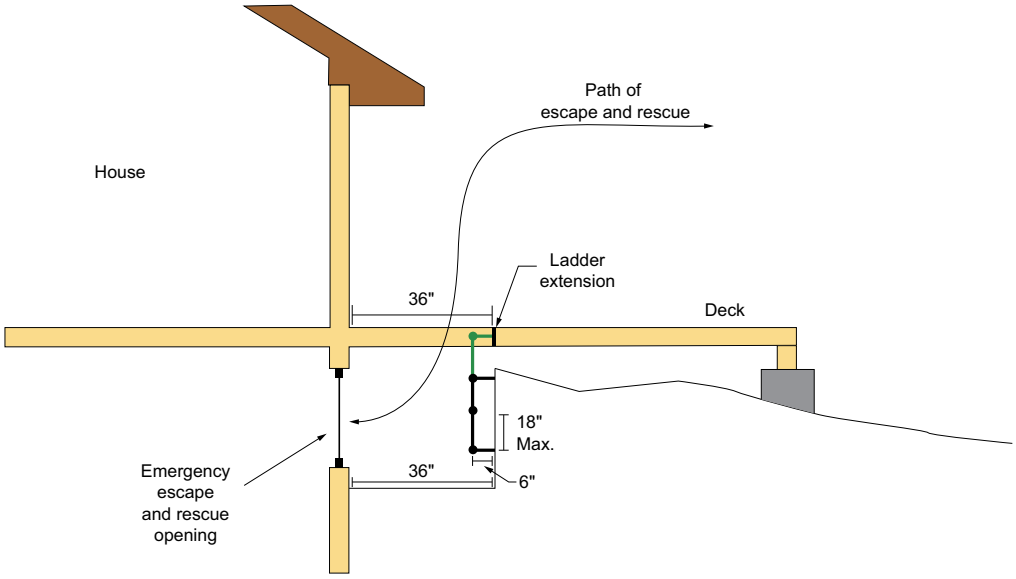


Figure 2-6-2: When a window well is extended through a deck, the depth will increase. A ladder may need to be installed or an existing ladder may need to be extended. With a likely depth of more than 30 inches, required guards would not be practical for the function of the ladder. The IRC provisions for window well covers are provided later in this chapter and can serve as fall protection in the plane of the decking.

Part Six: Emergency Escape and Rescue Openings

Subject: Covers over Emergency Escape and Rescue Openings

2021 Code: **R310.4.4 Bars, grilles, covers and screens.** Where bars, grilles, covers, screens or similar devices are placed over *emergency escape and rescue openings*, bulkhead enclosures or area wells that serve such openings, the minimum net clear opening size shall comply with Sections R310.2 through R310.2.2 and R310.4.1. Such devices shall be releasable or removable from the inside without the use of a key or tool or force greater than that required for the normal operation of the escape and rescue opening.

Application: When the path to and from an emergency escape and rescue opening goes through a deck, a cover over the opening is likely going to be necessary. Though very possible, this design can be tricky. The cover has to satisfy the weight limit so it can be easily removed in an emergency, but it must also support a 40 psf live load.

2021 Modification:

In the 2018 and previous editions, “special knowledge” was also prohibited alongside “key or tool” as a means to open a cover from the inside. Though hooks, clasps, eyelets, carabiners and other constraint mechanisms are commonly used for window well covers out of security concerns and can certainly impede rapid escape, it was most recently decided the term “special knowledge” was too ambiguous to remain in the section and was removed in the 2021 edition.

Figure 2-6-3: A drop-in panel, such as this composite material, is lightweight enough to remove with a simple push, yet strong enough to resist live loads. This is all that must be satisfied, regardless of the design.

Part Six: Emergency Escape and Rescue Openings

Subject: Openings Under Decks

2021 Code: **R310.2.4 Emergency escape and rescue openings under decks, porches and cantilevers.** *Emergency escape and rescue openings* installed under decks, porches and cantilevers shall be fully openable and provide a path not less than 36 inches (914 mm) in height and 36 inches (914 mm) in width to a *yard* or court.

Application: A deck can be built over an emergency escape and rescue opening or an area well serving one and designed with a path out from below the deck, as opposed to vertical ascent through the deck, as previously discussed. The path must be at least 36 inches in clear height from the opening to a yard or court.

2021 Modification:

A minimum width of 36 inches was added to the requirement for the path. Though not related to decks, “cantilevers” was added alongside decks and porches in this section as they could also impede escape or rescue.

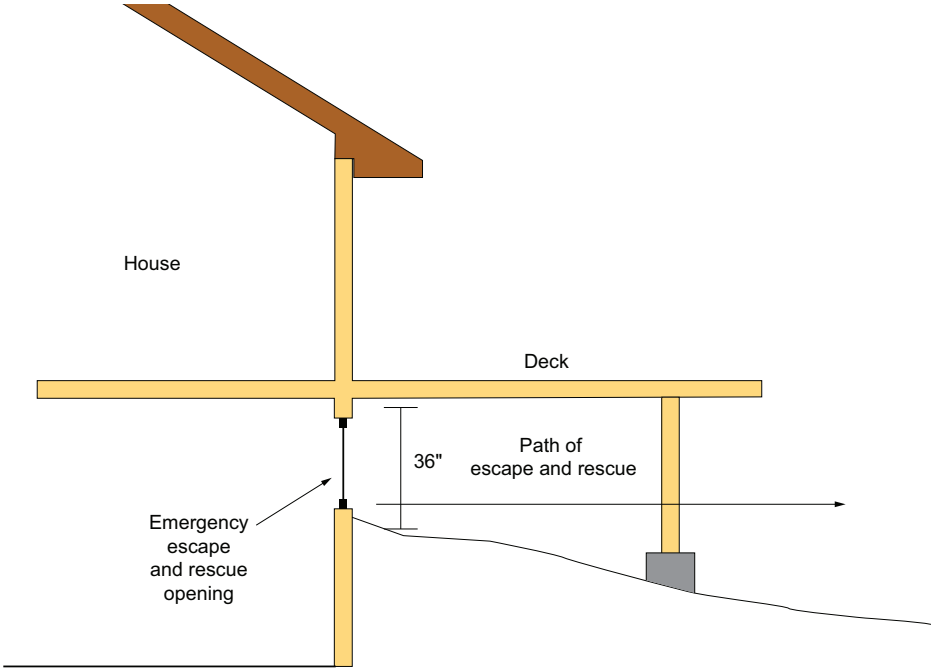


Figure 2-6-4: In many designs, a deck 4 to 5 feet above the ground will still be skirted to grade at the perimeter. Construction could be plastic or thin wood lattice, or it could be built as a wall. Regardless of the design, an opening must be provided with a clear path to the window.

Chapter 3

Materials

Introduction

Materials in deck construction are continuously exposed to the effects of weather and are thus unique from any other materials commonly used in floor construction. However, deck materials are also unique from the other common materials exposed to the weather, such as windows, doors, and siding. The IRC contains provisions for materials throughout the chapters, but Section 507 of Chapter Five is where deck materials are addressed.

Though generic terms are used, many deck and railing materials have unique compositions. Plastic composite decking, for example, has endless possibilities of makeup, and products are regularly evolving. Materials such as steel cable, glass, aluminum, wire mesh, and numerous others are available in a variety of different guard and handrail products. The provisions for deck materials make it clear other materials beyond what is specified are permitted, but they must be approved.

Part One: Wood

Part One: **Wood**

Subject: **Wood Materials**

2021 Code: **R507.2 Materials.** Materials used for the construction of decks shall comply with this section.

> **R507.2.1 Wood materials.** Wood materials shall be No. 2 grade or better lumber, preservative-treated in accordance with Section R317, or *approved*, naturally durable lumber, and termite protected where required in accordance with Section R318. Where design in accordance with Section R301 is provided, wood structural members shall be designed using the wet service factor defined in AWC NDS. Cuts, notches and drilled holes of preservative-treated wood members shall be treated in accordance with Section R317.1.1. All preservative-treated wood products in contact with the ground shall be labeled for such usage.

Application: This section lays out a number of general requirements for wood materials used in decks, and it references other, more specific portions of the IRC. Of significance is the requirement that regardless of height above grade, all wood materials used for deck construction must be decay resistant. Due to the nature of deck construction, which creates many contact points between materials where water can become trapped, there is inhibited drying between members. Where drying is inhibited, decay is more prevalent, regardless of proximity to grade. Provisions for preservative treatment in Section 317 are provided later in this chapter.

Decay Resistance Summary

SUBJECT	DETAILS
Grade	All wood for deck construction must be No. 2 or better.
Preservative treated	All wood materials in deck construction must be decay resistant per the AWPA U1 standard referenced in Section R317.
Field treatment	Cuts, notches and holes in preservative-treated lumber expose the less-treated internal fibers and thus must be retreated per Section R317.1.1.
Ground contact rated treatment	When required, lumber must be labeled as ground contact rated.
Termite protection	Per Section R318.
Naturally durable lumber	As an alternative to treated lumber, naturally durable lumber, per the IRC definition, can be used for above-ground decay resistance.
Wet use factor	Wet environments reduce structural capacity. All IRC deck design tables include a wet use factor, and any alternative design must use a wet use factor as well.

Part One: Wood

Subject: Engineered Wood Products

2021 Code:

[RB] STRUCTURAL COMPOSITE LUMBER. Structural members manufactured using wood elements bonded together with exterior adhesives.

Examples of structural composite lumber are:

Laminated strand lumber (LSL). A composite of wood strand elements with wood fibers primarily oriented along the length of the member, where the least dimension of the wood strand elements is 0.10 inch (2.54 mm) or less and their average lengths are not less than 150 times the least dimension of the wood strand elements.

Laminated veneer lumber (LVL). A composite of wood veneer elements with wood fibers primarily oriented along the length of the member, where the veneer element thicknesses are 0.25 inch (6.4 mm) or less.

Oriented strand lumber (OSL). A composite of wood strand elements with wood fibers primarily oriented along the length of the member, where the least dimension of the wood strand elements is 0.10 inch (2.54 mm) or less and their average lengths are not less than 75 times and less than 150 times the least dimension of the wood strand elements.

Parallel strand lumber (PSL). A composite of wood strand elements with wood fibers primarily oriented along the length of the member, where the least dimension of the wood strand elements is 0.25 inch (6.4 mm) or less and their average lengths are not less than 300 times the least dimension of the wood strand elements.

R507.2.1.1 Engineered wood products. Engineered wood products shall be in accordance with Section R502.

R502.1.3 Structural glued laminated timbers. Glued laminated timbers shall be manufactured and identified as required in ANSI A190.1, ANSI 117 and ASTM D3737.

R502.1.5 Structural composite lumber. Structural capacities for structural composite lumber shall be established and monitored in accordance with ASTM D5456.

R502.8.2 Engineered wood products. Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members, cross-laminated timber members or I-joists are prohibited except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a *registered design professional*.

Application: For engineered wood products, Section R507.2.1.1 directs code users out of the deck section and to the general Section 502. Engineered wood products include all wood products other than solid sawn lumber and logs. Many of these products are marketed to the deck industry, as they are constructed of naturally durable lumber or are preservative treated. Glued-laminated timbers, parallel strand lumber (PSL) and, recently, laminated veneer lumber (LVL) are some examples. Engineered lumber allows for longer spans than traditional beams, which can reduce the number of support posts. These products need to be provided with engineered or tested load/span tables or with an engineered design, as they are not provided for prescriptively in the IRC. Modifying engineered wood products with cuts, notches and holes is strictly prohibited unless directed by manufacturer instructions or an engineered design.

Part One: Wood

Subject: Preservative Treated Lumber

2018 Code: **R317.1.3 Geographical areas.** In geographical areas where experience has demonstrated a specific need, *approved* naturally durable or pressure-preservative-treated wood shall be used for those portions of wood members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where those members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering that would prevent moisture or water accumulation on the surface or at joints between members. Depending on local experience, such members typically include:

1. Horizontal members such as girders, joists and decking.
2. Vertical members such as posts, poles and columns.
3. Both horizontal and vertical members.

2021 Code: **R317.1 Location required.** Protection of wood and wood-based products from decay shall be provided in the following locations by the use of *naturally durable wood* or wood that is preservative-treated in accordance with AWPA U1.

8. Portions of wood structural members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where those members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering that would prevent moisture or water accumulation on the surface or at joints between members.

   Exception: Sawn lumber used in buildings located in a geographical region where experience has demonstrated that climatic conditions preclude the need to use naturally durable or preservative-treated wood where the structure is exposed to the weather.

Application: Section R507.2.1 is specific to decks and requires wood materials to be preservative treated in accordance with Section R317 or be naturally durable lumber. Section R317 is where the reference to the AWPA U1 standard for approved preservative-treated lumber is provided, and a number of subsections describe locations where decay-resistant lumber is required. Section R317.1.3, Geographic areas, has been included in the IRC since the 2000 edition, but being written more like a suggestion, many decks have been built without decay-resistant material. Time has proven that due to the manner of deck construction, regardless of height above grade, drying between members is inhibited and decay is common.

2021 Modification:

Section R317.1.3 was modified and relocated into Section R317.1 as another location for required decay resistance. Direct examples of deck components were removed, as Section R507.2.1 more specifically addresses them.

Figures 3-1-1 and 3-1-2: Though this deck is 5 feet above grade, the 3-ply, wood, non-treated beam is able to trap water between the plies. This inhibited drying and resulted in structurally catastrophic decay.

Part One: Wood

Subject: AWPA U1

2021 Code: The AWPA standard U1 is the copyrighted property of the American Wood Protection Association, but permission to reprint the deck-critical portions of the standard in this educational book could not be obtained. To read the standard, please refer to the AWPA.

Application: The U1 standard provides the approved chemical treatments, processes, and limitations of use for lumber subject to potential decay. Multiple categories of lumber use are provided, and depending on the use, the standard provides the acceptable treatments. In the 2016 revision of this standard, new and specific installations of lumber are described for ground contact conditions that are not actually in contact with the ground. Unfortunately, these significantly descriptive yet nondefinitive applications could not be provided in this book, but they generally describe how the nature of certain outdoor construction methods and outdoor environments can inhibit drying between wetted wood members and ground contact treatment may be appropriate.

This elusive guidance from AWPA is not foul advice, but it is not the minimum standard per the IRC. It is in conflict with the provisions of IRC Sections R507.2.1 and R317.1.2 that only require ground contact treatment when actually in contact with the ground or embedded in concrete in contact with the ground. According to Section R102.4.2, provided in Chapter One of this book, when a referenced standard addresses a subject also addressed by the IRC, the IRC, and not the most restrictive standard, shall prevail. A conflict like this is not ideal, but the subject of deck codes and standards is under significant review and revision in current times. This conflict is well known in the industry. In the development of the 2018 IRC, a public comment modification proposed a ground contact requirement for all structural wood members in alignment with the AWPA standard. It was disapproved, and therefore the portions of the U1 standard specifying ground contact have no authority under the IRC.

Part One: Wood

Subject: Ground Contact

2021 Code: **R317.1.2 Ground contact.** All wood in contact with the ground, embedded in concrete in direct contact with the ground or embedded in concrete exposed to the weather that supports permanent structures intended for human occupancy shall be *approved* pressure-preservative-treated wood suitable for ground contact use, except that untreated wood used entirely below groundwater level or continuously submerged in fresh water shall not be required to be pressure-preservative treated.

Application: Foundation designs for decks can include conditions where wood is embedded in concrete or embedded in the ground. Four of the six options provided in Chapter 6 of this book in Figure R507.3 for the post-to-foundation interface are such that ground-contact-treated lumber is required. Ground-contact lumber generally requires a greater retention of the preservative treatments than above-ground treatment, depending on the type of treatment used. In ground-contact conditions described in this section, naturally durable wood, such as redwood or cedar, is not permitted.

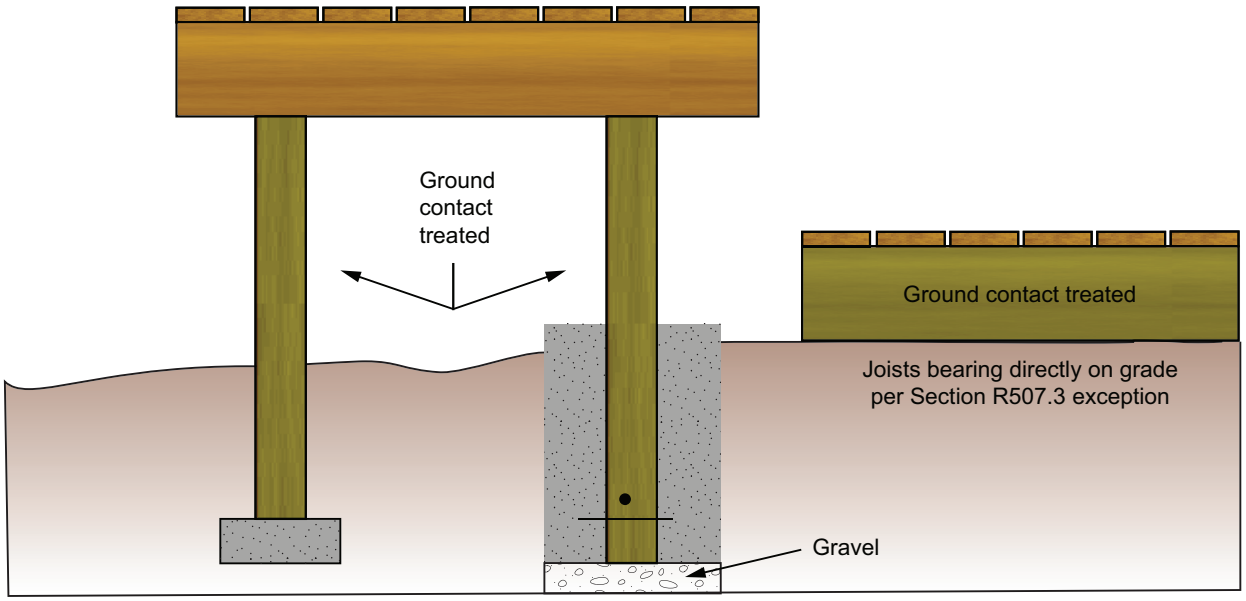


Figure 3-1-3: Though recommendations in the industry standard suggest ground-contact-rated treatment may be required for most structural wood in decks, the IRC takes a more minimum approach when it comes to drawing a strict line of what is and is not acceptable.

Part One: Wood

Subject: Field Treatment

2021 Code: **R317.1.1 Field treatment.** Field-cut ends, notches and drilled holes of preservative-treated wood shall be treated in the field in accordance with AWPA M4.

Application: Some IRC referenced standards contain critical information, but not being in the IRC, they are underutilized and thus not an industry standard. There is no better example of this than the required field treatment of preservative lumber cuts that has been required since the 2006 IRC edition, about 15 years ago. When treated lumber is cut, notched, or drilled, it exposes less-treated wood fibers that were once internal to the member and must be retreated.

The IRC references the American Wood Protection Association Standard M4 for the materials and methods of field treatment that must occur during installation. Unfortunately, permission to reprint portions of that standard in this book could not be obtained. To read the code requirements for a compliant installation of preservative-treated lumber, you must contact the AWPA. In general terms, the standard requires the original treatment be used on the field modification. However, it further recognizes many of those products are not available in the consumer market and offers alternative choices. Copper naphthenate products are the most effective choice, as they can be used in ground-contact conditions. Oxine copper products are only approved for above-ground-contact conditions. These products often list “copper 8-quinolate” as the active ingredient, and this is a synonym for oxine copper with equivalent performance.

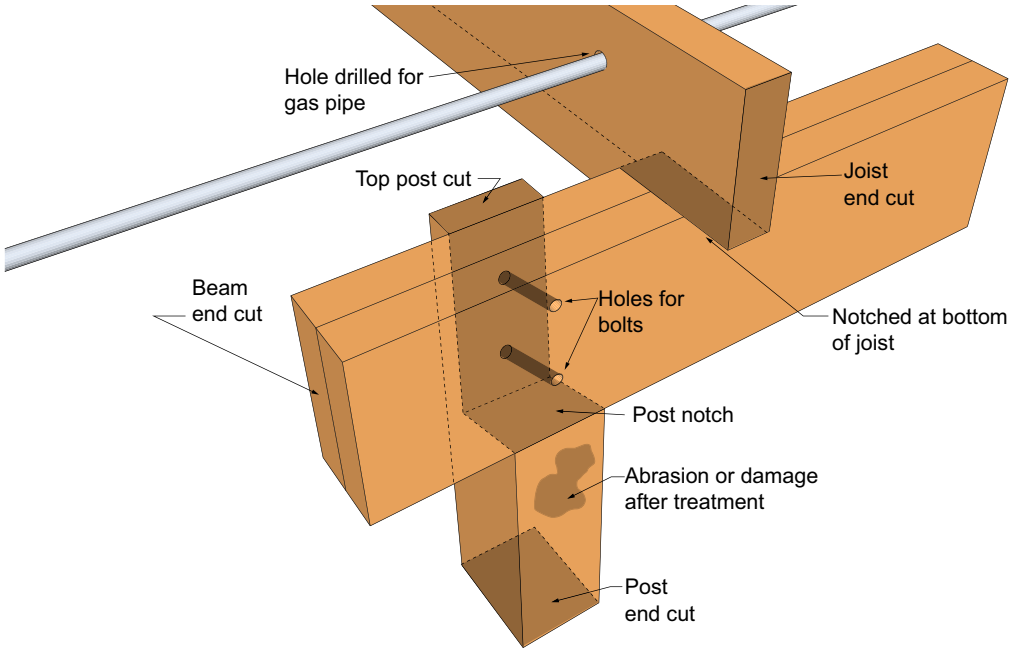


Figure 3-1-4: Another option for retreatment is specific to drilled holes, such as at ledger installations. Prior to installing the bolt, coal tar roofing cement compliant to ASTM D5643 can be injected into the hole.

Part One: Wood

Subject: Naturally Durable Lumber

2021 Code: **[RB] NATURALLY DURABLE WOOD.** The heartwood of the following species with the exception that an occasional piece with corner sapwood is permitted if 90 percent or more of the width of each side on which it occurs is heartwood.

Decay resistant. Redwood, cedar, black locust and black walnut.

Termite resistant. Alaska yellow cedar, redwood, Eastern red cedar and Western red cedar including all sapwood of Western red cedar.

Application: Though most often used as decking, the span tables for joists and beams include naturally durable species of redwood and cedar. Decay-resistant lumber is required for deck framing by Section 507.2.1, and this option allows for materials other than just preservative treated. However, it is only the harder heartwood of these species that provides the decay-resistant properties. By IRC definition, only minor sapwood is allowed in each piece, up to 10 percent of each side. Black locust and black walnut are available in decking profiles, but are not common in framing member sizes.

For termite resistance, more specific species of cedar are listed, including one species where sapwood is not limited.

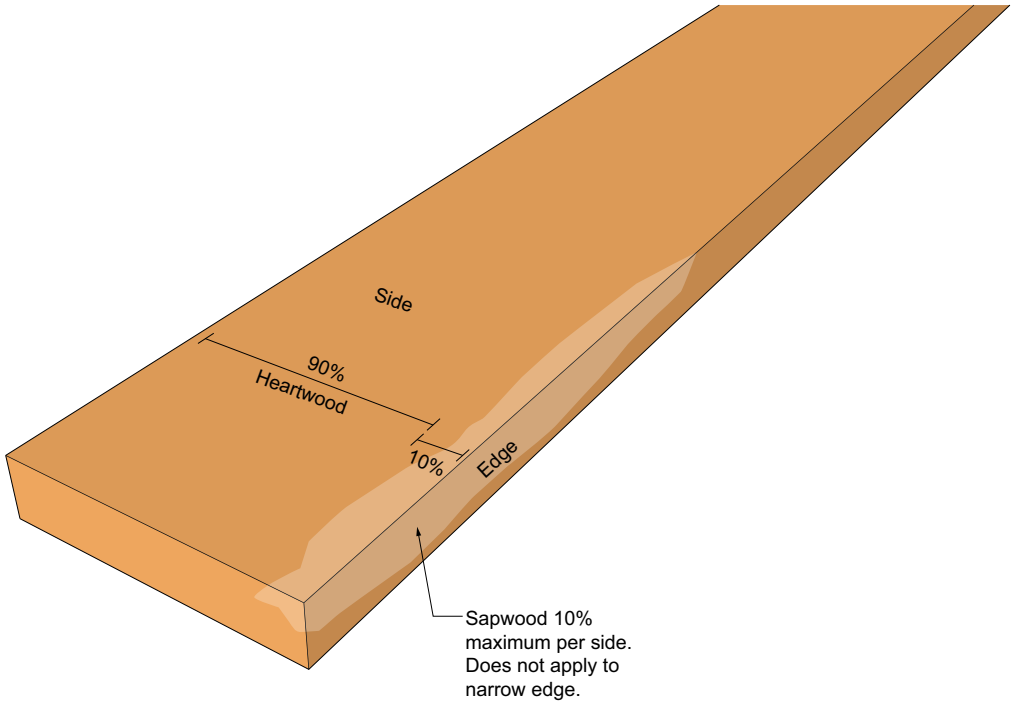


Figure 3-1-5: Reference to 90 percent of a "side" applies to the wide faces of nominal lumber, not the narrower edges. Sap present at any corner would include these $1^{1}/_{2}$-inch-wide edges, and it would take very little to cover the $^{5}/_{32}$ of an inch that would be 10 percent. That is not the intent of this provision.

Part One: Wood

Subject: Termite Resistance

2021 Code:

R318.1 Subterranean termite control methods. In areas subject to damage from termites as indicated by Table R301.2(1), protection shall be by one, or a combination, of the following methods:

1. Chemical termiticide treatment in accordance with Section R318.2.
2. Termite-baiting system installed and maintained in accordance with the *label*.
3. Pressure-preservative-treated wood in accordance with the provisions of Section R317.1.
4. Naturally durable termite-resistant wood.
5. Physical barriers in accordance with Section R318.3 and used in locations as specified in Section R317.1.
6. Cold-formed steel framing in accordance with Sections R505.2.1 and R603.2.1.

R318.1.1 Quality mark. Lumber and plywood required to be pressure-preservative treated in accordance with Section R318.1 shall bear the quality *mark* of an *approved* inspection agency that maintains continuing supervision, testing and inspection over the quality of the product and that has been *approved* by an accreditation body that complies with the requirements of the American Lumber Standard Committee treated wood program.

R318.1.2 Field treatment. Field-cut ends, notches and drilled holes of pressure-preservative-treated wood shall be retreated in the field in accordance with AWPA M4.

R318.2 Chemical termiticide treatment. Chemical termiticide treatment shall include soil treatment or field-applied wood treatment. The concentration, rate of application and method of treatment of the chemical termiticide shall be in strict accordance with the termiticide *label*.

R318.3 Barriers. *Approved* physical barriers, such as metal or plastic sheeting or collars specifically designed for termite prevention, shall be installed in a manner to prevent termites from entering the structure. Shields placed on top of an exterior foundation wall shall be used only if in combination with another method of protection.

R318.4 Foam plastic protection. In areas where the probability of termite infestation is "very heavy" as indicated in Figure R301.2(7), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below *grade*. The clearance between foam plastics installed above *grade* and exposed earth shall be not less than 6 inches (152 mm).

Exceptions:

1. Buildings where the structural members of walls, floors, ceilings and roofs are entirely of noncombustible materials or pressure-preservative-treated wood.
2. Where in *addition* to the requirements of Section R318.1, an *approved* method of protecting the foam plastic and structure from subterranean termite damage is used.
3. On the interior side of *basement walls*.

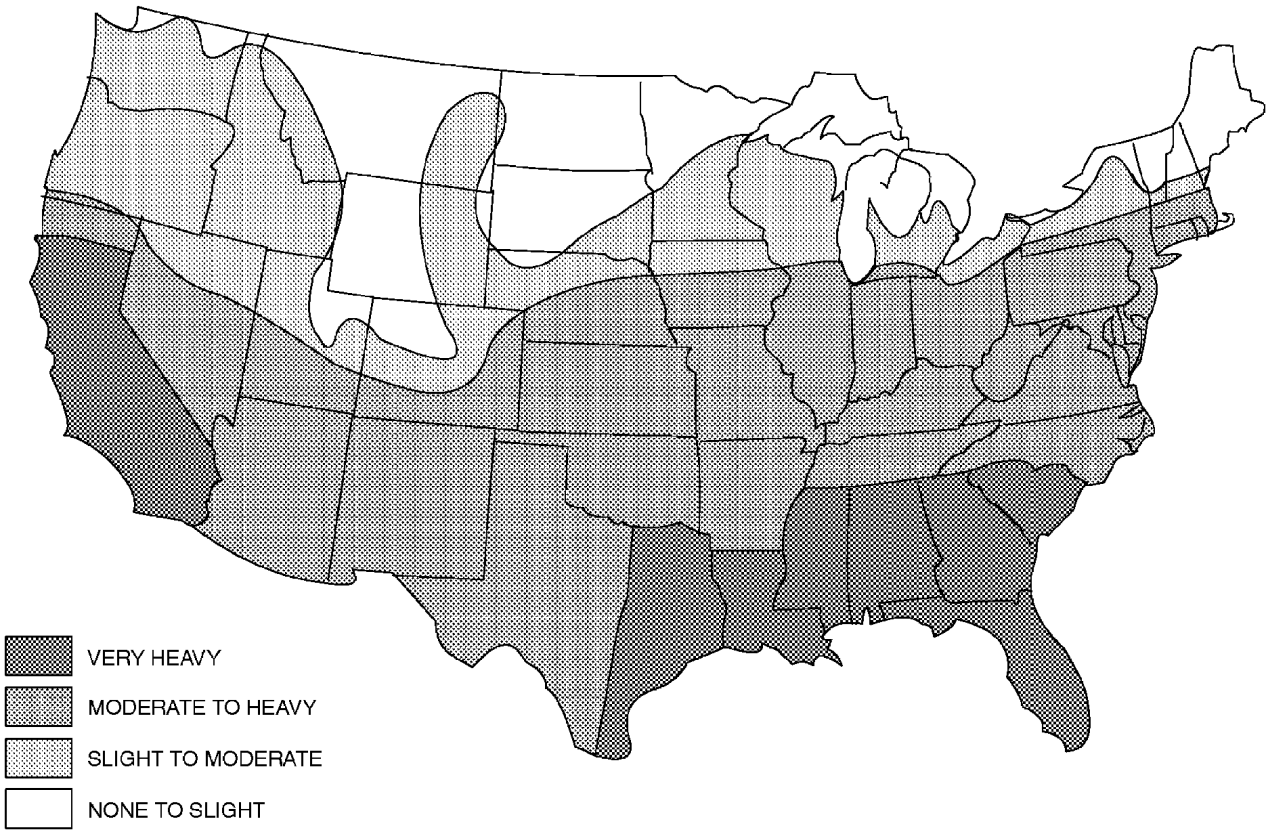


FIGURE R301.2(7)
TERMITE INFESTATION PROBABILITY MAP

Application: Where decks are subject to termite infestation, premature deterioration of the structure may occur. The IRC provides this probability map for the local building authority to determine if termite protection is required. The most common and feasible means to protect a deck structure from termite damage is the use of preservative-treated lumber or lumber with natural resistance to termites, as detailed in the IRC definition of “naturally durable wood.” The other options provided by the IRC in this section are not as commonly employed for exterior deck applications and are outside the scope of this book.

Part One: Wood

Subject: Lumber Identification

2021 Code:

[RB] MARK. An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material. (See also "Manufacturer's designation" and "Label.")

R317.2 Quality mark. Lumber and plywood required to be pressure-preservative treated in accordance with Section R318.1 shall bear the quality *mark* of an *approved* inspection agency that maintains continuing supervision, testing and inspection over the quality of the product and that has been *approved* by an accreditation body that complies with the requirements of the American Lumber Standard Committee treated wood program.

R317.2.1 Required information. The required quality *mark* on each piece of pressure-preservative-treated lumber or plywood shall contain the following information:

1. Identification of the treating plant.
2. Type of preservative.
3. The minimum preservative retention.
4. End use for which the product was treated.
5. Standard to which the product was treated.
6. Identity of the *approved* inspection agency.
7. The designation "Dry," if applicable.

R502.1.1 Sawn lumber. Sawn lumber shall be identified by a grade *mark* of an accredited lumber grading or inspection agency and have design values certified by an accreditation body that complies with DOC PS 20. In lieu of a grade *mark*, a certificate of inspection issued by a lumber grading or inspection agency meeting the requirements of this section shall be accepted.

R502.1.1.1 Preservative-treated lumber. Preservative treated dimension lumber shall be identified as required by Section R317.2.

Application:

Section R507.2.1 requires a minimum No. 2 grade lumber and preservative treatment (if not naturally durable lumber). To ensure this material is installed, it must be identified, both for the installer and for the building inspector. All sawn lumber used in construction must be graded by an inspection agency and provided a grade mark. Though "mark" is defined in Chapter Two, it doesn't provide the information that must be contained in the mark. The IRC reference to American Softwood Lumber Standard PS 20 is where the additional details are found. Section 7.3 of DOC PS 20 requires the mark to identify the species, grade, mark or insignia of the grading agency, and whether the lumber was dry or green when graded. For preservative-treated material, the IRC provides the details for the quality mark in Section R317.2.1.

Part Two: Plastic Composite

Part Two: **Plastic Composite**

Subject: **Plastic Composite**

2021 Code: **[RB] PLASTIC COMPOSITE.** A generic designation that refers to wood-plastic composites and plastic lumber.

R311.7.5.4 Exterior plastic composite stair treads. *Plastic composite* exterior stair treads shall comply with the provisions of this section and Section R507.2.2.

R311.7.8.6 Exterior plastic composite handrails. *Plastic composite* exterior *handrails* shall comply with the requirements of Section R507.2.2.

R312.1.4 Exterior plastic composite guards. Plastic composite exterior *guards* shall comply with the requirements of Section R317.4.

R317.4 Plastic composites. *Plastic composite* exterior deck boards, stair treads, guards and handrails containing wood, cellulosic or other biodegradable materials shall comply with the requirements of Section R507.2.2.

R507.2.2 Plastic composite deck boards, stair treads, guards, or handrails. Plastic composite exterior deck boards, stair treads, guards and handrails shall comply with the requirements of ASTM D7032 and this section.

R507.2.2.1 Labeling. Plastic composite deck boards and stair treads, or their packaging, shall bear a label that indicates compliance with ASTM D7032 and includes the allowable load and maximum allowable span determined in accordance with ASTM D7032. Plastic or composite handrails and guards, or their packaging, shall bear a label that indicates compliance with ASTM D7032 and includes the maximum allowable span determined in accordance with ASTM D7032.

R507.2.2.2 Flame spread index. Plastic composite deck boards, stair treads, guards, and handrails shall exhibit a flame spread index not exceeding 200 when tested in accordance with ASTM E84 or UL 723 with the test specimen remaining in place during the test.

Exception: Plastic composites determined to be noncombustible.

R507.2.2.3 Decay resistance. Plastic composite deck boards, stair treads, guards and handrails containing wood, cellulosic or other biodegradable materials shall be decay resistant in accordance with ASTM D7032.

R507.2.2.4 Termite resistance. Where required by Section 318, plastic composite deck boards, stair treads, guards and handrails containing wood, cellulosic or other biodegradable materials shall be termite resistant in accordance with ASTM D7032.

Application: Nearly all of the requirements in these sections point to the ASTM D7032 test standard for plastic composite materials. Installing plastic composite products per the manufacturer's installation instructions ensures the performance found during the standardized tests will be duplicated in application. Discussion regarding installation of these materials is provided in Chapters Five and Eight of this book.

Part Three: Hardware and Fasteners

Part Three: Hardware and Fasteners

Subject: Fasteners in Contact with Treated Wood

2021 Code:

R507.2.3 Fasteners and connectors. Metal fasteners and connectors used for all decks shall be in accordance with Section R317.3 and Table R507.2.3.

R317.3 Fasteners and connectors in contact with preservative-treated and fire-retardant-treated wood. Fasteners, including nuts and washers, and connectors in contact with preservative-treated wood and fire-retardant-treated wood shall be in accordance with this section. The coating weights for zinc-coated fasteners shall be in accordance with ASTM A153. Stainless steel driven fasteners shall be in accordance with the material requirements of ASTM F1667.

R317.3.1 Fasteners for preservative-treated wood. Fasteners, including nuts and washers, for preservative-treated wood shall be of hot-dipped, zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Staples shall be of stainless steel. Coating types and weights for connectors in contact with preservative-treated wood shall be in accordance with the connector manufacturer's recommendations. In the absence of manufacturer's recommendations, not less than ASTM A653 type G185 zinc-coated galvanized steel, or equivalent, shall be used.

Exceptions:

1. $^{1}/_{2}$-inch-diameter (12.7 mm) or greater steel bolts.
2. Fasteners other than nails, staples and timber rivets shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B695, Class 55 minimum.'
3. Plain carbon steel fasteners in SBX/DOT and zinc borate preservative-treated wood in an interior, dry environment shall be permitted.

Application: The general provisions in Section 317.3 apply to all applications where fasteners and hardware are in contact with preservative-treated lumber. Though the deck section, Section R507, references these general provisions, it is essentially redundant in reference to decks. All the requirements in Table R507.2.3, discussed in the next section, are more specific to decks, more restrictive, and thus the final authority.

Part Three: Hardware and Fasteners

Subject: Fastener and Connector Specifications

2021 Code:

TABLE R507.2.3
FASTENER AND CONNECTOR SPECIFICATIONS FOR DECKS[a, b]

ITEM	MATERIAL	MINIMUM FINISH/COATING	ALTERNATE FINISH/COATING[e]
Nails and glulam rivets	In accordance with ASTM F1667	Hot-dipped galvanized per ASTM A153, Class D for $^3/_8$-inch diameter and less	Stainless steel, silicon bronze or copper
Bolts[c] Lag screws[d] (including nuts and washers)	In accordance with ASTM A307 (bolts), ASTM A563 (nuts), ASTM F844 (washers)	Hot-dipped galvanized per ASTM A153, Class C (Class D for $^3/_8$-inch diameter and less) or mechanically galvanized per ASTM B695, Class 55 or 410 stainless steel	Stainless steel, silicon bronze or copper
Metal connectors	Per manufacturer's specification	ASTM A653 type G185 zinc-coated galvanized steel or post hot-dipped galvanized per ASTM A123 providing a minimum average coating weight of 2.0 oz./ft^2 (total both sides)	Stainless steel

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Equivalent materials, coatings and finishes shall be permitted.
b. Fasteners and connectors exposed to salt water or located within 300 feet of a salt water shoreline shall be stainless steel.
c. Holes for bolts shall be drilled a minimum $^1/_{32}$ inch and a maximum $^1/_{16}$ inch larger than the bolt.
d. Lag screws $^1/_2$ inch and larger shall be predrilled to avoid wood splitting per the *National Design Specification (NDS) for Wood Construction*.
e. Stainless-steel-driven fasteners shall be in accordance with ASTM F1667.

Application:

The framing members of a deck are only as reliable as the connections between them. This table specifies the structural and corrosion-resistant test standards with which various fasteners and hardware must comply. All nails must be hot-dipped galvanized to a weight in accordance with ASTM A153, and this is often the benchmark used for testing alternative products. Bolts and lag screws must be hot-dipped galvanized or mechanically galvanized. Of important note, typical joist hangers, straps, hold-downs, rafter clips, and other connectors intended for interior use are only coated to G90 weights of galvanization. The IRC requires all connectors on decks to be a minimum G185 galvanization or equivalent.

Footnotes provide more details. Due to more rapid corrosion in salty conditions, fasteners and connectors in proximity to saltwater must be stainless steel. Connectors must be installed in accordance with the manufacturer's installation instructions, and it is there you find the critical requirement that fasteners and connectors must be a similar metal. Corrosion between dissimilar metals can occur when a galvanized nail is used in a stainless steel connector or vice versa.

2021 Modification:

The term "timber rivets" in regard to ASTM F1667 was changed to the more accurate term from that standard, "glulam rivets."

Part Three: Hardware and Fasteners

Subject: Fastener and Connector Specifications, continued

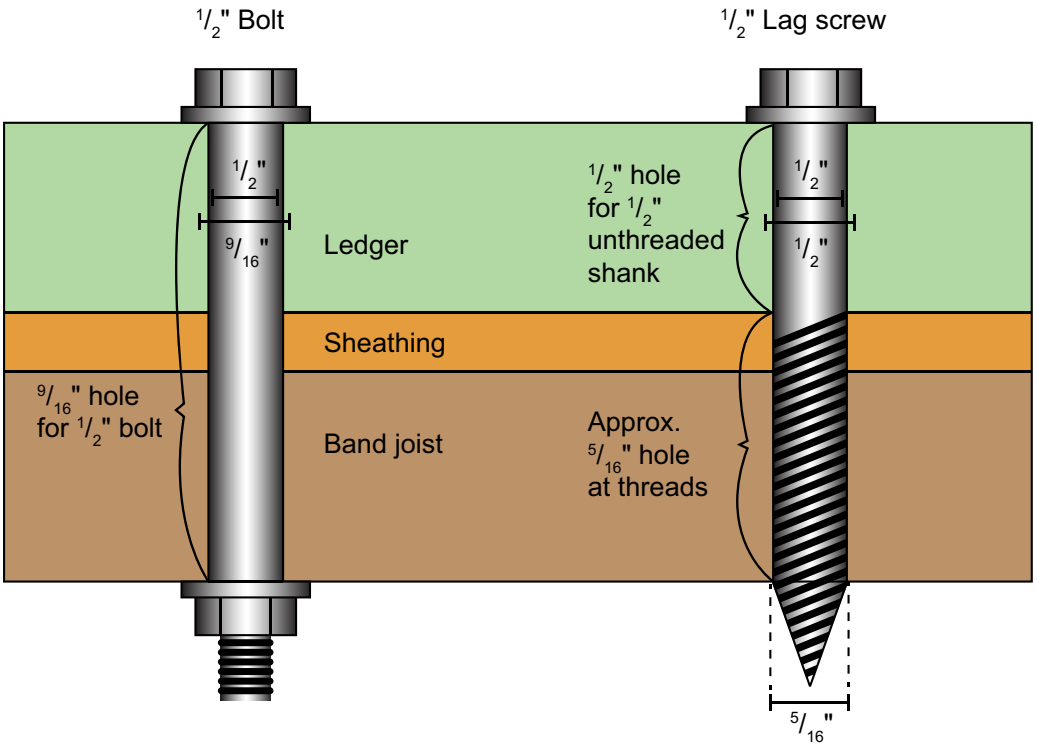


Figure 3-3-1: Footnotes c and d of Table R507.2.3 require predrilling prior to the installation of bolts and lag screws. For $^{1}/_{2}$-inch bolts, a $^{9}/_{16}$-inch hole must be drilled through the ledger and band joist. However, for lag screws, the NDS (National Design Specifications) is referenced, and the provisions in that document are rather cumbersome but can be generalized. The length of hole receiving the unthreaded shank of the lag screw must be drilled to the diameter of the lag screw, presumably $^{1}/_{2}$ inch. The portion of lumber receiving the threads (the band joist) must be drilled a percentage smaller than the diameter of the shank. For a $^{1}/_{2}$-inch lag screw, it is $^{5}/_{16}$ inch. It is critical that the larger hole not be drilled past the depth of the unthreaded shank. A lubricant is also required during installation, but the coal-tar roofing cement approved for field treatment of treated lumber would be sufficient for this purpose.

Part 3: Hardware and Fasteners

Subject: Connector Manufacturer Testing and Instructions

2021 Code: **IBC 2304.10.4 Joist hangers and framing anchors.** Connections depending on joist hangers or framing anchors, ties and other mechanical fastenings not otherwise covered are permitted where approved. The vertical load-bearing capacity, torsional moment capacity and deflection characteristics of joist hangers shall be determined in accordance with ASTM D7147.

Application: Throughout the IRC there are references to “mechanical connectors” and “approved joist hangers” being required for certain connections. These products are proprietary, and the code does not provide standardized installation methods or load capacities. Approval of these products falls under approval of an alternative, and thus proof of their performance must be provided to the building official. In the absence of a referenced test standard in the IRC, Section R104.11.1, Tests, allows for other recognized test methods. The 2015 *International Building Code* introduced a new standard for joist hangers, ASTM D7147. It is through the results of this testing that a designer can select a connector with the proper load rating for its intended use. When a product is approved through a test standard, it must be installed according to the manufacturer’s installation instructions employed during the testing. Installers and inspectors are encouraged to review installation instructions for each connector and hanger. Though there is a standardized test for performance, how that performance is achieved will be unique to each product and provided only in the manufacturer’s installation instructions.

Part 3: Hardware and Fasteners

Subject: Connector Manufacturer Testing and Instructions, continued

Example of Manufacturer Requirements

SUBJECT	EXAMPLE OF MANUFACTURER REQUIREMENTS
Fasteners	Different nails or structural screws are specified for different holes in the connectors. Using the correct fasteners is critical to the performance of a metal connector.
Fastener compatibility	Fasteners must be of the same material as the connector they are installed in—stainless with stainless and galvanized with galvanized. This will reduce the likelihood of corrosion that can occur between dissimilar metals.
Fastener angle	Certain connectors require fasteners to be placed at a particular angle. This may be to produce a toenailed connection between members within the connector, to avoid delaminating between veneers, or to place the fastener in the correct tension or shear it was designed for.
Load tables	Connectors must be selected with sufficient capacity for the loads they must carry. Generally, a properly sized and installed joist hanger will support the loads from the maximum span of common lumber its designed for, but assumptions should not be made in structural design.
Bearing	Connectors with a saddle or bearing surface must be in contact with the member's bearing area surface when required by installation instructions.
Gaps between members	In a common joist hanger, the gap between a carried member and carrying member can be no greater than $^{1}/_{8}$ inch. Larger gaps may be acceptable with a reduced load capacity.
Modifications	Unless specifically directed in the installation instructions, connectors cannot be bent, cut, or otherwise modified. Connectors designed to be bent during installation can usually only be bent once.
Sizing	Connectors must be sized and designed for the size of the material they support. Rough-sawn materials, for example, cannot be carried by a connector designed for a milled (smaller) profile.

Part Four: Other Materials

Part Four: **Other Materials**

Subject: **Concrete Standards**

2021 Code: **R402.2 Concrete.** Concrete shall have a minimum specified compressive strength of f'_c, as shown in Table R402.2. Concrete subject to moderate or severe weathering as indicated in Table R301.2(1) shall be air entrained as specified in Table R402.2. The maximum weight of fly ash, other pozzolans, silica fume, slag or blended cements that is included in concrete mixtures for garage floor slabs and for exterior porches, carport slabs and steps that will be exposed to deicing chemicals shall not exceed the percentages of the total weight of cementitious materials specified in Section 19.3.3.4 of ACI 318. Materials used to produce concrete and testing thereof shall comply with the applicable standards listed in Chapters 19 and 20 of ACI 318 or ACI 332.

Application: Concrete is the common material used for deck foundations, but it is also common to see bottom stair landings and patios incorporated into a deck design. Table R402.2 requires compressive strength between 2500 psi and 3500 psi for concrete exposed to the outdoors, but where the minimum lands within that range is dependent on exposure to weathering and deicing chemicals. Deicing chemicals are a concern with concrete slabs for vehicular use where roadway chemicals will frequently land. This variable is not intended for casual exposure from an occupant occasionally deicing concrete deck stair landings. Weathering is the exposure of concrete to freeze-thaw cycles in wet environments. Table R301.2(1) for geographic and climatic design criteria provides the weathering potential for the region. Colder, northern regions will have more weathering than warmer regions. However, concern about compressive strength is only necessary when ordering premixed cement, as nearly all bag mix concrete on the market, more typical for deck construction, exceeds 3500 psi. Some lightweight fence post concrete mixes, however, can be found closer to 2000 psi and would not be acceptable.

Part Four: Other Materials

Subject: Steel Framing

2021 Code:

R507.2.5 Alternate materials. Alternative materials, including glass and metals, shall be permitted.

R505.2 Structural framing. Load-bearing cold-formed steel floor framing members shall be in accordance with this section.

R505.2.1 Material. Load-bearing cold-formed steel framing members shall be cold formed to shape from structural quality sheet steel complying with the requirements of AISI S240, Section A3.

R505.2.2 Corrosion protection. Load-bearing cold-formed steel framing shall have a metallic coating complying with AISI S240, Section A4.

R505.2.3 Dimension, thickness and material grade. Load-bearing cold-formed steel floor framing members shall comply with AISI S230, Section A4.3 and material grade requirements as specified in AISI S230, Section A4.4.

R505.2.4 Identification. Load-bearing cold-formed steel framing members shall meet the product identification requirements of AISI S240, Section A5.5.

Application:

Section R507.2.5, Alternate materials, recognizes there are other building materials used in deck construction that aren't provided a prescriptive design method in the IRC. Steel framing for exterior decks has increased in popularity, specifically those planning long term for their homes. Though the IRC provides steel floor framing provisions in Section R505, they weren't developed with decks in mind. The sections provided above set forth requirements for the steel material and are appropriate for deck construction with the exception of corrosion resistance. They were modified in 2021 to reference sections of various American Iron and Steel Institute standards. These standards are available for free download at the AISI website. For corrosion resistance, Section A4.1.1 of AISI S240 requires a minimum galvanized coating of CP60, a designation that corresponds to a weight of zinc coating. However, A4.3 requires the member to be "within the building envelope and shielded from direct contact with moisture from the ground or exterior climate." A heavier CP90 coating is also recognized in the AISI and is the recommendation for exterior conditions.

Span tables for steel joists and some of the fastening details from the IRC can work for decks, but there are no beam design tables provided. Snow loads would also be limited to 40 psf as the tables are for interior joists. There are a number of manufacturers on the market that offer tested and engineered deck steel framing systems. The products can be approved as alternatives via their compliance reports and installation instructions. Engineering with material specifications of commodity steel can also be approved.

Chapter 4

Ledgers

Introduction

The ledger connection of a deck to a house is by far the most problematic part of the construction. In most designs it carries half the load of the deck along its length, so it's got to have a good structural connection to the house. The exterior cladding on a house is almost never structural, with the exception of board and batten sheathing, so it's got to be removed at the ledger. Now that the ledger can go up, what is it going to connect to? All that's visible is the outside of the sheathing, but how thick is the sheathing? It matters. Visibility is likely necessary at the inside of the band joist of the house. Access too, if you're using bolts. Did you get roofing cement for the ledger holes? It's code, sort of. Sandwiching a ledger against the sheathing is going to create a spot for water and decay, so flashing is installed. What about the side, behind or below? Will bulk water flow down or sneak inside? Above the flashing, the water-resistive barrier is lapped over the flashing. Now comes the big variable, the cladding. Is it stucco? Or adhered masonry? Hopefully it's just lap siding; that's pretty easy. But not vinyl siding. If you crack the old stuff, finding a matching replacement is a nightmare. What's the required clearance to the decking though? It's different for different claddings.

Ledgers are by far the most problematic part of the construction.

Part One: Cladding and Flashing

Part One: Cladding and Flashing

Subject: Clearances to Cladding

2021 Code:

R317.1 Location required. Protection of wood and wood-based products from decay shall be provided in the following locations by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1.

5. Wood siding, sheathing and wall framing on the exterior of a building having a clearance of less than 6 inches (152 mm) from the ground or less than 2 inches (51 mm) measured vertically from concrete steps, porch slabs, patio slabs and similar horizontal surfaces exposed to the weather.

R703.7.2.1 Weep screeds. A minimum 0.019-inch (0.5 mm) (No. 26 galvanized sheet gage), corrosion-resistant weep screed or plastic weep screed, with a minimum vertical attachment flange of $3^1/_2$ inches (89 mm), shall be provided at or below the foundation plate line on exterior stud walls in accordance with ASTM C926. The weep screed shall be placed not less than 4 inches (102 mm) above the earth or 2 inches (51 mm) above paved areas and shall be of a type that will allow trapped water to drain to the exterior of the building. The weather-resistant barrier shall lap the attachment flange. The exterior lath shall cover and terminate on the attachment flange of the weep screed.

R703.9.1 Exterior insulation and finish systems (EIFS). EIFS shall comply with the following:

5. EIFS shall terminate not less than 6 inches (152 mm) above the finished ground level.

R703.9.2 Exterior insulation and finish system (EIFS) with drainage. EIFS with drainage shall comply with the following:

8. EIFS with drainage shall terminate not less than 6 inches (152 mm) above the finished ground level.

R703.11.1 Installation. Vinyl siding, soffit and accessories shall be installed in accordance with the manufacturer's instructions.

R703.12 Adhered masonry veneer installation. Adhered masonry veneer shall comply with the requirements of Section R703.7.3 and the requirements in Sections 12.1 and 12.3 of TMS 402. Adhered masonry veneer shall be installed in accordance with Section R703.7.1, Article 3.3C of TMS 602 or the manufacturer's instructions.

R703.12.1 Clearances. On exterior stud walls, adhered masonry veneer shall be installed:

2. Minimum of 2 inches (51 mm) above paved areas; or
3. Minimum of $^1/_2$ inch (12.7 mm) above exterior walking surfaces that are supported by the same foundation that supports the exterior wall.

R703.13.1 Insulated vinyl siding and accessories. Insulated vinyl siding and accessories shall be installed in accordance with the manufacturer's installation instructions.

R703.14.1 Polypropylene siding and accessories. Polypropylene siding and accessories shall be installed in accordance with manufacturer's installation instructions.

Application: Table 507.9.1.3(1), for ledger connections, allows up to 1 inch of space between the house band and the ledger, and this is intended for wall sheathing and/or drainage and ventilation. It is not intended for cladding. Removing the cladding and reinstalling it properly around the ledger is dependent on what type of cladding is installed. Vinyl siding and adhered stone veneer are quite different from each other. The IRC specifies a clearance below all these products or references the manufacturer's installation instructions. However, none of the clearances reference "decks." This makes finding the required clearance between the cladding and the decking below a bit mysterious to figure out. Throughout the IRC and manufacturer instructions, minimum clearances are required between cladding and the ground, exposed earth, paved surfaces, and finished ground level, "grade," but rarely does anything ever refer directly to "decks."

Clearances to Cladding

CLEARANCE TO WHAT?	MINIMUM CLEARANCE SPECIFIED	REASON FOR CLEARANCE	WHERE FOUND?
Finished ground level and exposed earth	6 inches	6-inch clearances to "earth" speak to issues involved with the properties of earth, such as insects, moisture, vegetation and dirt. The clearance protects wood-based products from decay and reduces the dirt splashing that occurs on the cladding during precipitation.	EIFS cladding and protection of wood from decay
Exposed earth	4 inches	This clearance has the same function as the 6-inch clearance above but is a reduction for particular claddings, such as masonry veneers.	Adhered and anchored brick veneer
Paved surfaces, porch and patio slabs and "other horizontal surfaces exposed to the weather"	2 inches	These listed features are most similar to decks in that they are the final surface to collected debris, yet they do not have the properties expected with exposed soil.	Adhered masonry, wood and cement-based siding installation instructions
Exterior floors supported by same foundation as exterior wall	$^1/_2$ inch to 1 inch	Section R703.12.1 provides a description of a $^1/_2$-inch clearance "where the walking surface is supported by the same foundation as the wall." This speaks very clearly to ledger-attached decks where differential movement between the deck and cladding is not expected. However, masonry veneer installation instructions often specify a 1-inch clearance specifically to "decks."	Adhered masonry veneer installation instructions
Low-slope roofs	$^1/_2$ inch	Vinyl siding is not subject to decay or degradation to moisture like other claddings; therefore, through common installation instructions, a $^1/_2$-inch clearance is specified to projections similar to decks, such as roof surfaces and the projecting trim over garage doors.	Common vinyl siding installation instructions

This table attempts to explain the reasoning for the various, sometimes inconsistent, clearances in the IRC, none of which refer to "decks." Where drainage or ventilation is necessary or where the cladding is negatively affected by moisture, 2 inches is the common clearance. Where the deck is ledger-connected, the cladding is not affected by moisture and ventilation, or drainage clearances are not necessary or are minor, $^1/_2$ inch is the common clearance.

Part One: Cladding and Flashing

Subject: Ledger Flashing

2021 Code:

[RB] CORROSION RESISTANCE. The ability of a material to withstand deterioration of its surface or its properties where exposed to its environment.

[RB] SHINGLE FASHION. A method of installing roof or wall coverings, water-resistive barriers, flashing or other building components such that upper layers of material are placed overlapping lower layers of material to provide drainage and protect against water intrusion at unsealed penetrations and joints or in combination with sealed joints.

R703.2 Water-resistive barrier. Not fewer than one layer of *water-resistive barrier* shall be applied over studs or sheathing of all exterior walls with flashing as indicated in Section R703.4, in such a manner as to provide a continuous water-resistive barrier behind the exterior wall veneer. The water-resistive barrier material shall be continuous to the top of walls and terminated at penetrations and building appendages in a manner to meet the requirements of the exterior wall envelope as described in Section R703.1. Water-resistive barrier materials shall comply with one of the following:

1. No. 15 felt complying with ASTM D226, Type 1.
2. ASTM E2568, Type 1 or 2.
3. ASTM E331 in accordance with Section R703.1.1.
4. Other approved materials in accordance with the manufacturer's installation instructions.

No.15 asphalt felt and *water-resistive barriers* complying with ASTM E2556 shall be applied horizontally, with the upper layer lapped over the lower layer not less than 2 inches (51 mm), and where joints occur, shall be lapped not less than 6 inches (152 mm).

R507.2.4 Flashing. Flashing shall be corrosion-resistant metal of nominal thickness not less than 0.019 inch (0.48 mm) or *approved* nonmetallic material that is compatible with the substrate of the structure and the decking materials.

R703.4 Flashing. Approved corrosion-resistant flashing shall be applied shingle-fashion in a manner to prevent entry of water into the wall cavity or penetration of water to the building structural framing components. Self-adhered membranes used as flashing shall comply with AAMA 711. Fluid-applied membranes used as flashing in exterior walls shall comply with AAMA 714. The flashing shall extend to the surface of the exterior wall finish. Approved corrosion-resistant flashings shall be installed at the following locations:

5. Where exterior porches, decks or stairs attach to a wall or floor assembly of wood-frame construction.

Application: No matter how robust a ledger connection, it's only as strong as the wood it holds. Rotten wood is not very strong. Ledger flashing is only required for decks attached to wood-frame construction. The ledger must be decay resistant, so the flashing is primarily protecting the house. Ledgers attached to concrete foundations would not require flashing, and it would be impractical to install unless there was counterflashing directly above it. A durable sealant is recommended in those applications. The IRC doesn't provide any prescriptive details for flashing but does make it clear that it must prevent the entry of water. It must be corrosion resistant to offer an enduring life in an important role. Where critical features aren't visible for prompt repair, a long service life is necessary. Materials can oth-

erwise be anything “approved,” including self-adhering membranes, steel, vinyl, aluminum, copper and other materials.

The materials must be installed shingle fashion, and horizontal laps should be no less than 2 inches, as is required for water-resistive barriers. Variables of installation include whether a water-resistive membrane is existing or being newly installed at the same time, the type of cladding, whether there is a weep screed, the clearance between the decking and cladding, whether the ledger wraps a corner or an inside corner, the flashing materials being used, and the preference and budget of the installer and the owner. It’s difficult to determine and describe a “minimum standard” method of deck flashing, so the IRC simply explains the minimum expectations: to keep the water from decaying the house and connection.

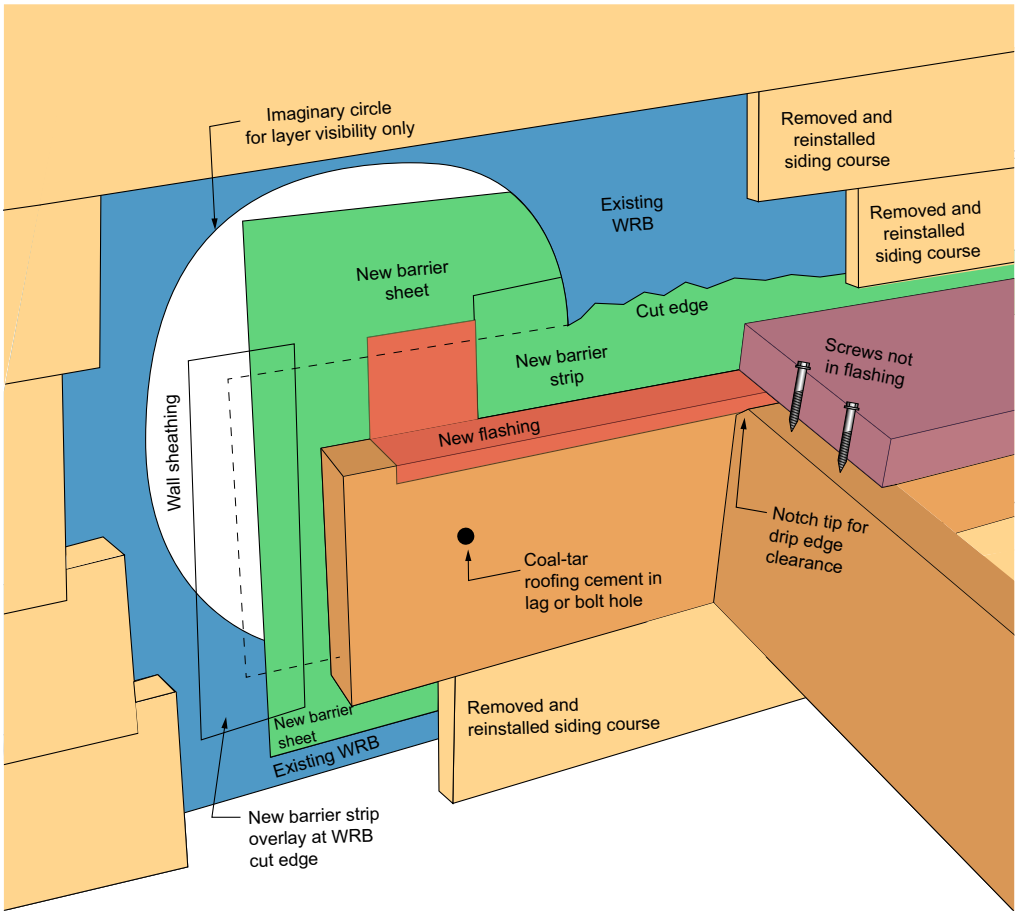


Figure 4-1-1: Ledger flashing installations vary depending on many factors, and just one example is shown here for illustrative purposes. The exterior cladding must be removed above and below to ensure the flashing can integrate into the weather-resistive barrier and the cladding can be properly terminated. Removing the existing water-resistive membrane behind the ledger allows the sheathing type and thickness to be verified. Where not visible from the inside, the band joist behind the sheathing can also be determined at this time by removing a portion of the sheathing. With ledger flashing methods, there is no definitive line of “the minimum,” so simply doing the best you practically can to “keep the water out” is a wise approach.

Part Two Ledger Connections

Part Two: **Ledger Connections**

Subject: **Support and Attachment**

2021 Code: **R311.5 Landing, deck, balcony and stair construction and attachment.** Exterior landings, decks, balconies, stairs and similar facilities shall be positively anchored to the primary structure to resist both vertical and lateral forces or shall be designed to be self-supporting. Attachment shall not be accomplished by use of toenails or nails subject to withdrawal.

R507.8 Vertical and lateral supports. Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads. Such attachment shall not be accomplished by the use of toenails or nails subject to withdrawal. For decks with cantilevered framing members, connection to exterior walls or other framing members shall be designed and constructed to resist uplift resulting from the full live load specified in Table R301.5 acting on the cantilevered portion of the deck. Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting.

Application: The language in both of these sections was the first mention of decks in model building codes over 25 years ago. Though new provisions have expanded deck construction standards in the IRC, there is still much that is not specifically addressed. The prohibition to decks connected with “nails subject to withdrawal” and the requirement to resist all loads has always been applied to the ledger to band joist connection. However, with the attention to lateral live loads over the last decade, other connection methods have been brought forth, discussed in Chapter Seven.

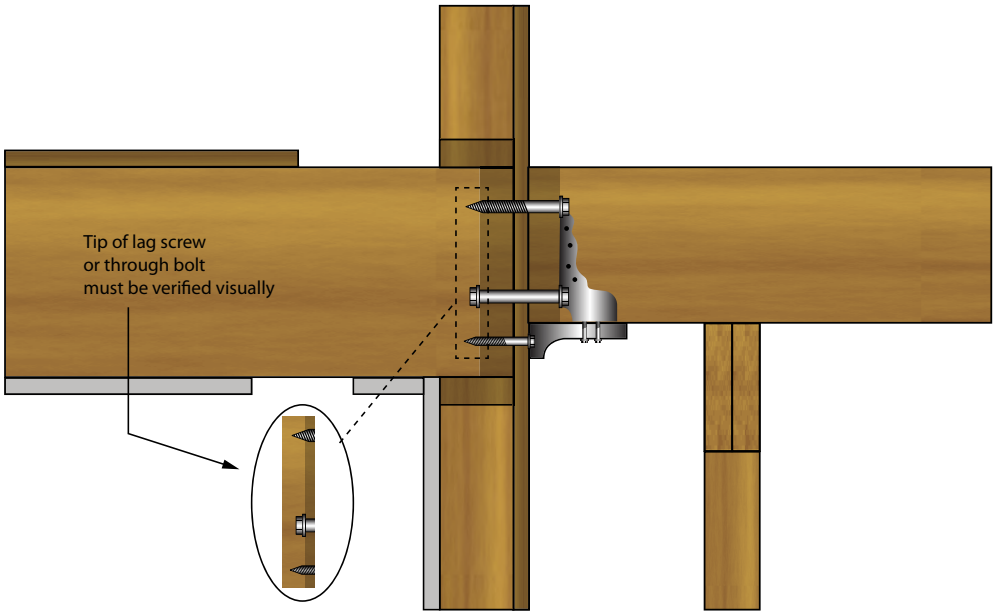


Figure 4-2-1: Decks must be designed to resist both vertical and lateral loads, and where this resistance is made by a connection to the house, the connection must be visible for inspection and verified. If the connection cannot be verified, the deck must be self-supporting (freestanding).

Part Two: Ledger Connections

Subject: Ledger Details

2021 Code: **R507.9 Vertical and lateral supports at band joist.** Vertical and lateral supports for decks shall comply with this section.

R507.9.1 Vertical supports. Vertical loads shall be transferred to band joists with ledgers in accordance with this section.

R507.9.1.1 Ledger details. Deck ledgers shall be a minimum 2-inch by 8-inch (51 mm by 203 mm) nominal, pressure-preservative-treated Southern pine, incised pressure-preservative-treated hem-fir, or approved, naturally durable, No. 2 grade or better lumber. Deck ledgers shall not support concentrated loads from beams or girders. Deck ledgers shall not be supported on stone or masonry veneer.

Application: The ledger provisions in the IRC are based on testing performed on specific assemblies. 2 × 6 was not part of the test, and thus is not provided for in the IRC. This does not mean a 2 × 6 ledger would not work or is prohibited. Similarly, ledgers designed from prescriptive IRC methods can only support uniformly distributed loads from joists. In the ledger fastening table, joist span is the only representation of load being placed on the ledger. Beams and girders collect loads from other joists and thus cannot be attached to ledgers using the fastener spacing provided in the IRC.

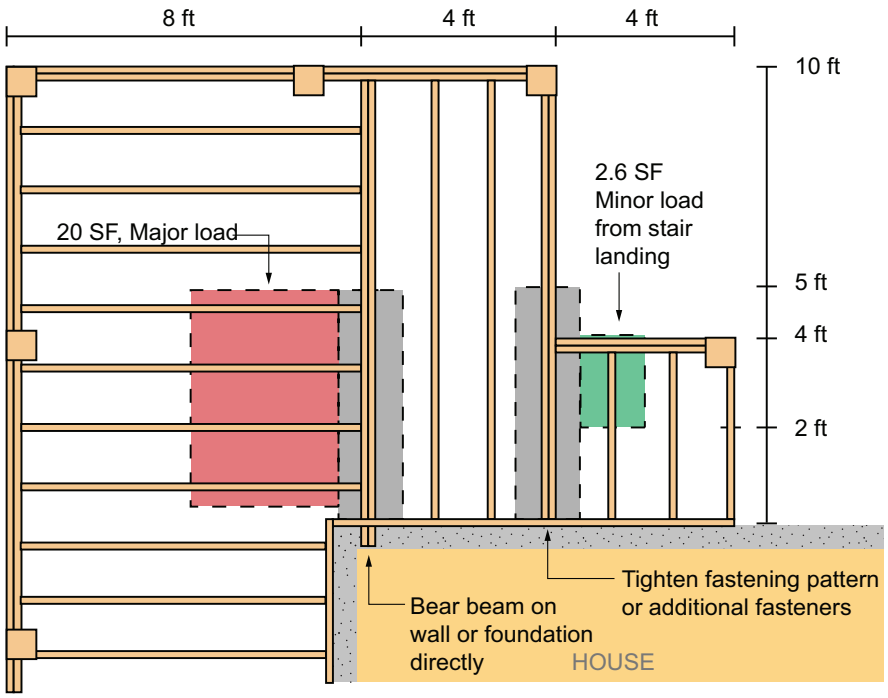


Figure 4-2-2: Concentrated loads cannot be supported on ledgers connected from Table R507.9.1.3, but this is likely an unnecessary restriction for small additional loads, such as from a portion of a stair landing. A few additional ledger fasteners nearby should be sufficient. For other beams supporting larger areas, the beam must be supported within the wall of the house, supported independently or installed according to an engineered design.

Part Two: Ledger Connections

Subject: Band Joist Details

2021 Code: **R507.9.1.2 Band joist details.** Band joists supporting a ledger shall be a minimum 2-inch-nominal (51 mm), solid-sawn, spruce-pine-fir or better lumber or a minimum 1-inch (25 mm) nominal engineered wood rim boards in accordance with Section R502.1.7. Band joists shall bear fully on the primary structure capable of supporting all required loads.

Application: Very specific details regarding the band joist are specified in this section to reflect the testing that generated the ledger fastening table. This fastening only moves the load path from the ledger to the band joist, which is not connected to the joists sufficiently to further transfer the load. The band joist must be fully supported underneath by a wall or foundation.

2021 Modification:

The only engineered lumber recognized for the band joist in the 2018 IRC was a minimum size of laminated veneer lumber. The 2021 edition expands the choices by allowing any engineered rim board in accordance with the standards referenced in Section R502.1.7 (beyond the scope of this book).

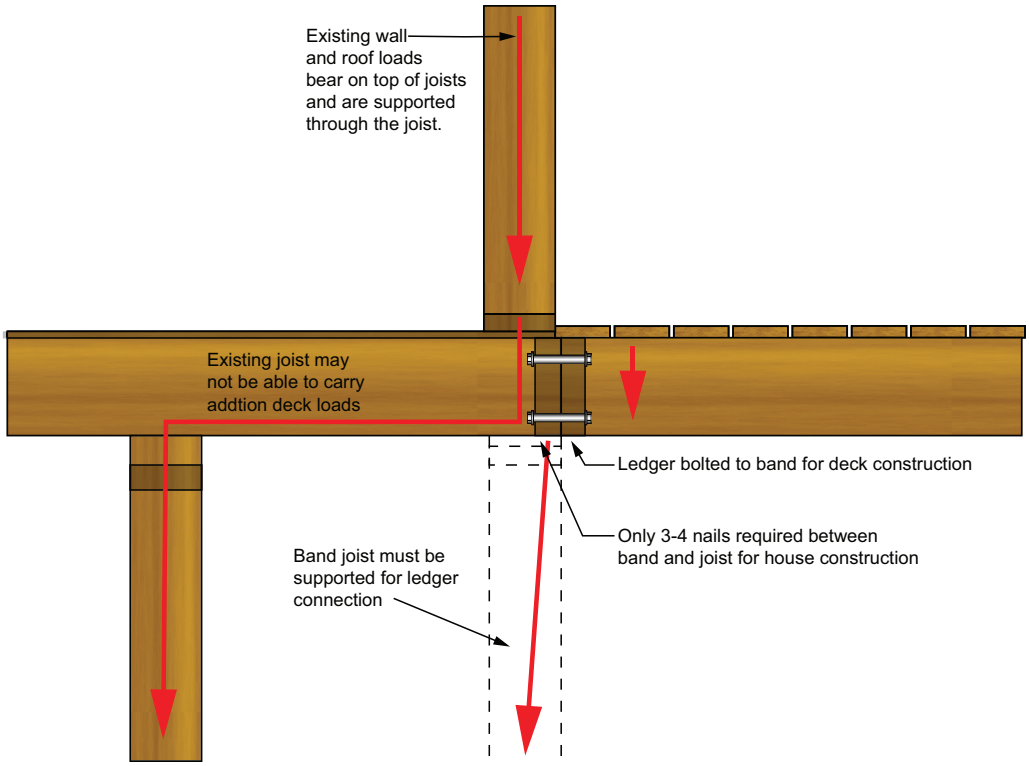


Figure 4-2-3: When house floors cantilever, even if only a few inches over thick foundation insulation or brick veneer below, the band joist is no longer supported. If mechanical connectors were used to transfer the load, the length of the cantilevered joist and the load from the wall above would need to be evaluated. The bending resistance of the cantilevered joists likely cannot carry the additional deck loads. Small cantilevers of a few inches would be the exception.

Part Two: Ledger Connections

Subject: Ledger Fastening

2021 Code: **R507.9.1.3 Ledger to band joist details.** Fasteners used in deck ledger connections in accordance with Table R507.9.1.3(1) shall be hot-dipped galvanized or stainless steel and shall be installed in accordance with Table R507.9.1.3(2) and Figures R507.9.1.3(1) and R507.9.1.3(2).

TABLE R507.9.1.3(1)
DECK LEDGER CONNECTION TO BAND JOIST

LOAD[c] (psf)	JOIST SPAN[a] (feet)	ON-CENTER SPACING OF FASTENERS[b] (inches)		
		1/2-inch diameter lag screw with 1/2-inch maximum sheathing[d, e]	1/2-inch diameter bolt with 1/2-inch maximum sheathing[e]	1/2-inch diameter bolt with 1-inch maximum sheathing[f]
40 live load	6	30	36	36
	8	23	36	36
	10	18	34	29
	12	15	29	24
	14	13	24	21
	16	11	21	18
	18	10	19	16
50 ground snow load	6	29	36	36
	8	22	36	35
	10	17	33	28
	12	14	27	23
	14	12	23	20
	16	11	20	17
	18	9	18	15
60 ground snow load	6	25	36	36
	8	18	35	30
	10	15	28	24
	12	12	23	20
	14	10	20	17
	16	9	17	15
	18	8	15	13
70 ground snow load	6	22	36	35
	8	16	31	26
	10	13	25	21
	12	11	20	17
	14	9	17	15
	16	8	15	13
	18	7	13	11

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.

a. Interpolation permitted. Extrapolation is not permitted.

b. Ledgers shall be flashed in accordance with Section R703.4 to prevent water from contacting the house band joist.

c. Dead Load = 10 psf. Snow load shall not be assumed to act concurrently with live load.

d. The tip of the lag screw shall fully extend beyond the inside face of the band joist.

e. Sheathing shall be wood structural panel or solid sawn lumber.

f. Sheathing shall be permitted to be wood structural panel, gypsum board, fiberboard, lumber or foam sheathing. Up to 1/2-inch thickness of stacked washers shall be permitted to substitute for up to 1/2 inch of allowable sheathing thickness where combined with wood structural panel or lumber sheathing.

Application: The ledger connection provisions in the IRC are very specific. They are based on testing results, so they are limited to the design of the ledgers tested. There are significant details in the footnotes that must be reviewed. They must be installed with care, as they generally carry half the load of the entire deck.

For a lag screw to function as designed, the tip of the lag screw must extend beyond the inside face of the band joist. Per Section R507.8 the connection must be verified. Even if not part of an inspection practice, installers must verify the solid connection themselves. Using this IRC table, lag screws can only be used to attach to band joists with no more than $^1/_2$-inch maximum wood structural panel sheathing or lumber sheathing between them.

Bolted connections are more robust than lag screws and thus are provided more flexibility. The allowable thickness of sheathing is increased to 1 inch and more materials are permitted. For ventilation and/or drainage, ledgers can be held off the band joist or sheathing by up to $^1/_2$ inch of stacked washers in lieu of $^1/_2$ inch of the maximum 1-inch sheathing.

2021 Modification:

The ledger connection table was expanded in 2021 to include 50, 60 and 70 psf snow load regions and a new footnote was included to allow interpolation between joist span rows in the table. The 2018 IRC version of this table is identical to the 40 psf live load row, and thus was not provided separately in this book.

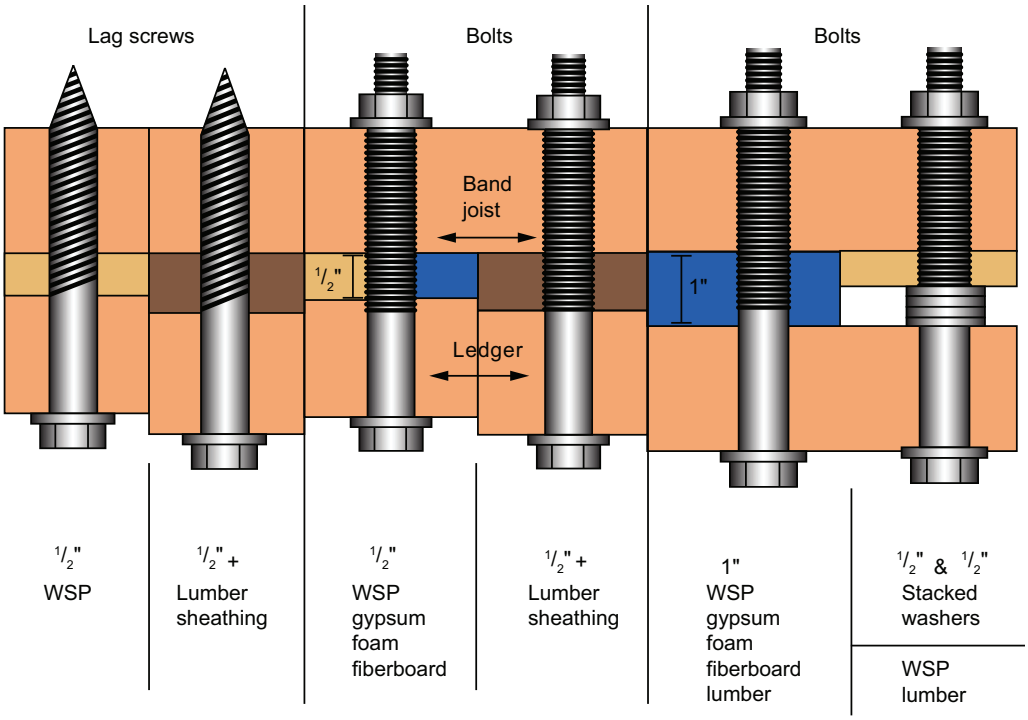


Figure 4-2-4: Lag screws are only permitted under the IRC provisions when fastening through $^1/_2$-inch wood structural panel sheathing or lumber sheathing. Lumber sheathing is closer to $^3/_4$ inch but is still acceptable. Bolts allow connection through other sheathings and other thicknesses as provided in the fastening table.

Part Two: Ledger Connections

Subject: Fastener Placement

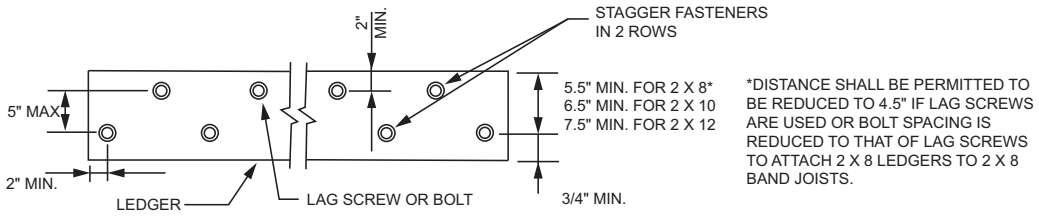
2021 Code:

TABLE R507.9.1.3(2)
PLACEMENT OF LAG SCREWS AND BOLTS IN DECK LEDGERS AND BAND JOISTS

MINIMUM END AND EDGE DISTANCES AND SPACING BETWEEN ROWS				
	TOP EDGE	BOTTOM EDGE	ENDS	ROW SPACING
Ledger[a]	2 inches[d]	$^3/_4$ inch	2 inches[b]	$1^5/_8$ inches[b]
Band Joist[c]	$^3/_4$ inch	2 inches	2 inches[b]	$1^5/_8$ inches[b]

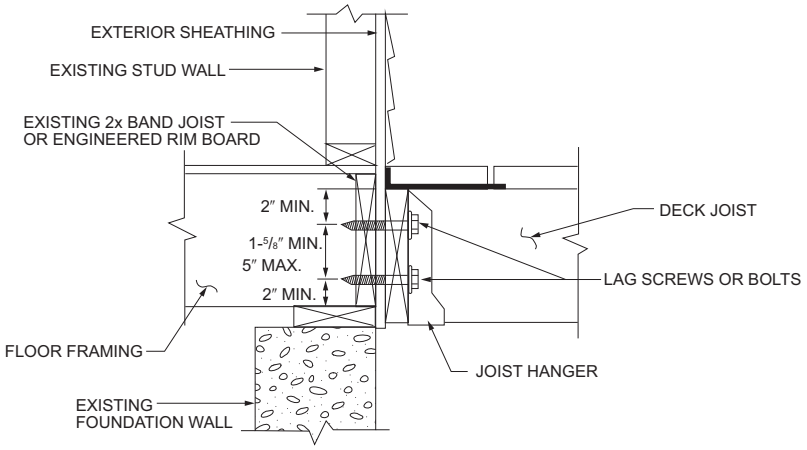
For SI: 1 inch = 25.4 mm.

a. Lag screws or bolts shall be staggered from the top to the bottom along the horizontal run of the deck ledger in accordance with Figure R507.9.1.3(1).
b. Maximum 5 inches.
c. For engineered rim joists, the manufacturer's recommendations shall govern.
d. The minimum distance from bottom row of lag screws or bolts to the top edge of the ledger shall be in accordance with Figure R507.9.1.3(1).



For SI: 1 inch = 25.4 mm.

FIGURE R507.9.1.3(1)
PLACEMENT OF LAG SCREWS AND BOLTS IN LEDGERS



For SI: 1 inch = 25.4 mm.

FIGURE R507.9.1.3(2)
PLACEMENT OF LAG SCREWS AND BOLTS IN BAND JOISTS

Part Two: Ledger Connections

Subject: Fastener Placement, continued

Application: In the 2012 edition, significant details were added specifying various edge and fastener distances for ledger fasteners. They were derived from engineering standards in the NDS (National Design Specifications), but coupled with the tested provisions already in the code, they are a bit tricky to put together. The band joist and ledger both have prohibited locations for fasteners. There is a minimum distance between the upper and lower fasteners. There are minimum distances the bottom fastener can be from the top of the ledger that differs between 2 × 8, 2 × 10, and 2 × 12 ledgers. There is also a single caveat described when a 2 × 8 ledger is fastened to a 2 × 8 band joist.

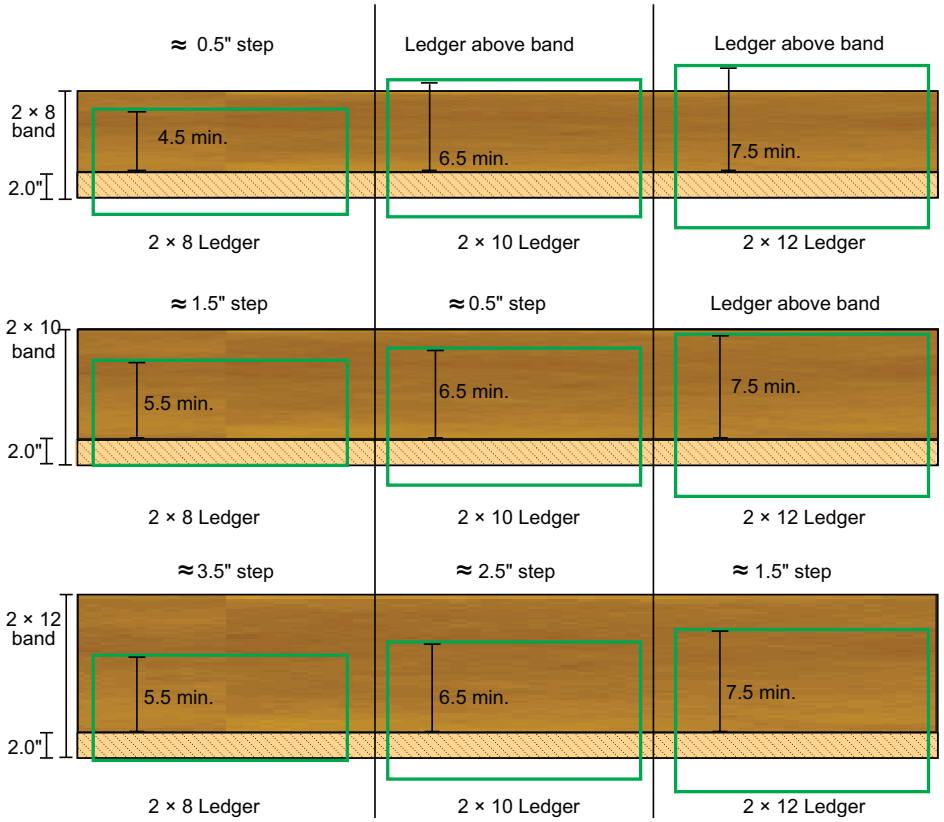


Figure 4-2-5: When you combine the 2-inch area at the bottom of the band joist, where fasteners are not permitted, with the minimum distance from the top of the ledger to the lowest fastener, a maximum step down to the deck is created. In some instances, the ledger is above the house floor and thus impractical. The greatest step down that can be achieved doesn't meet the minimum recommended 4 inches (from the IBC). A full height step down is ideal for clearance from saturated snow in many regions, and a step provides more separation between the door seal and the ledger flashing, making water-tight installation more likely. Understanding the difficulty of exact placement, it is recommended to be liberal with the number of fasteners used and reduce the minimum spacing in Table R507.9.1.3(1) to account for less-than-perfect installation. One with reasonable judgment may find themselves comfortable with moderate tolerances of these strict limitations. For dropping deck ledgers lower than the band joist, lag screw or structural screw installation into plates, window headers, multistud posts, and even single studs can be utilized, but they are not provided for in the prescriptive IRC method.

Part Three: Alternative Ledger Connections

Part Three: **Alternative Ledger Connections**

Subject: **Connections to Cantilevers**

2021 Code: **R507.9.1.4 Alternate ledger details.** Alternate framing configurations supporting a ledger constructed to meet the load requirements of Section R301.5 shall be permitted.

Application: Section R507.9.1.4 makes it clear that other methods of ledger attachment are permitted; they just have to provide a load path to the ground. Connections to cantilevers are not provided prescriptively in the IRC because the band joist is not supported, but alternative designs that can support and transfer the loads can be approved.

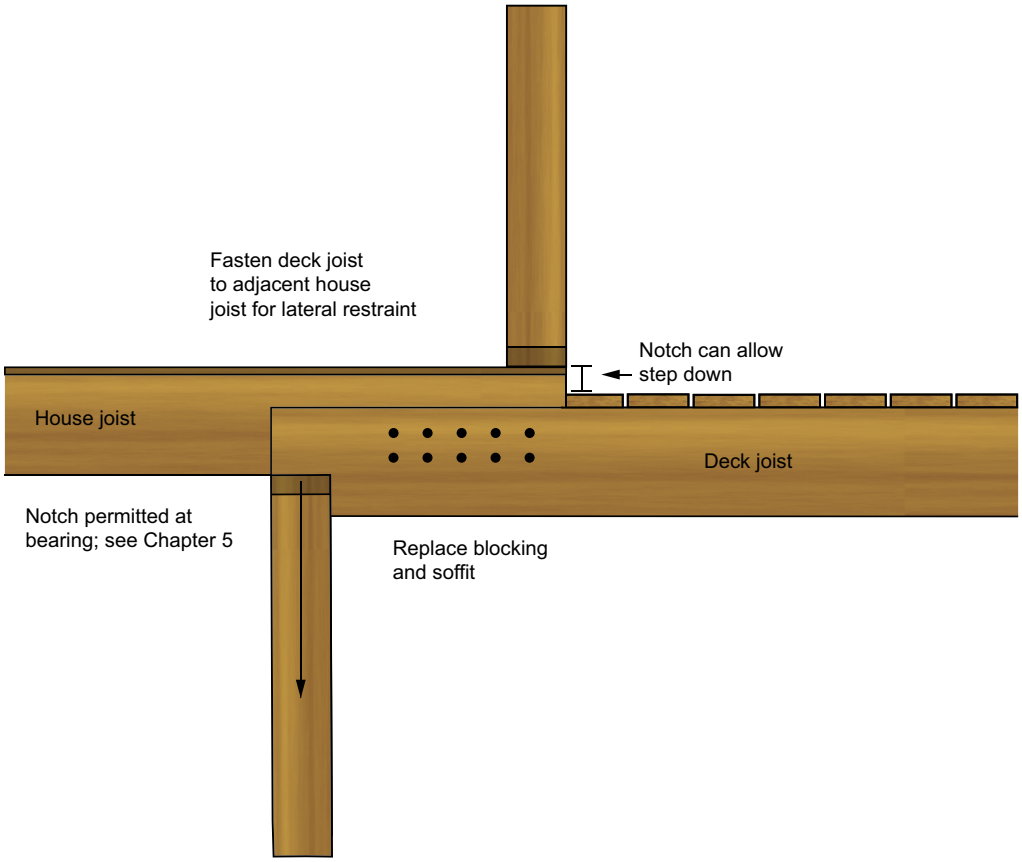


Figure 4-3-1: The band joist and soffit at the cantilevered floor of the house can be removed. Forgoing a ledger in this area altogether, the joists can be brought directly into the cantilever to bear on the wall below. Joists can be notched and sized smaller than the house joists to allow for a step down from the door. They can also be attached to the adjacent joists with nails (oriented in shear, not withdrawal) to resist lateral loads. Care will be necessary in the water management of this design, with effective use of flashing, sealing and drip edges to manage drainage around the deck joist penetrating into the house.

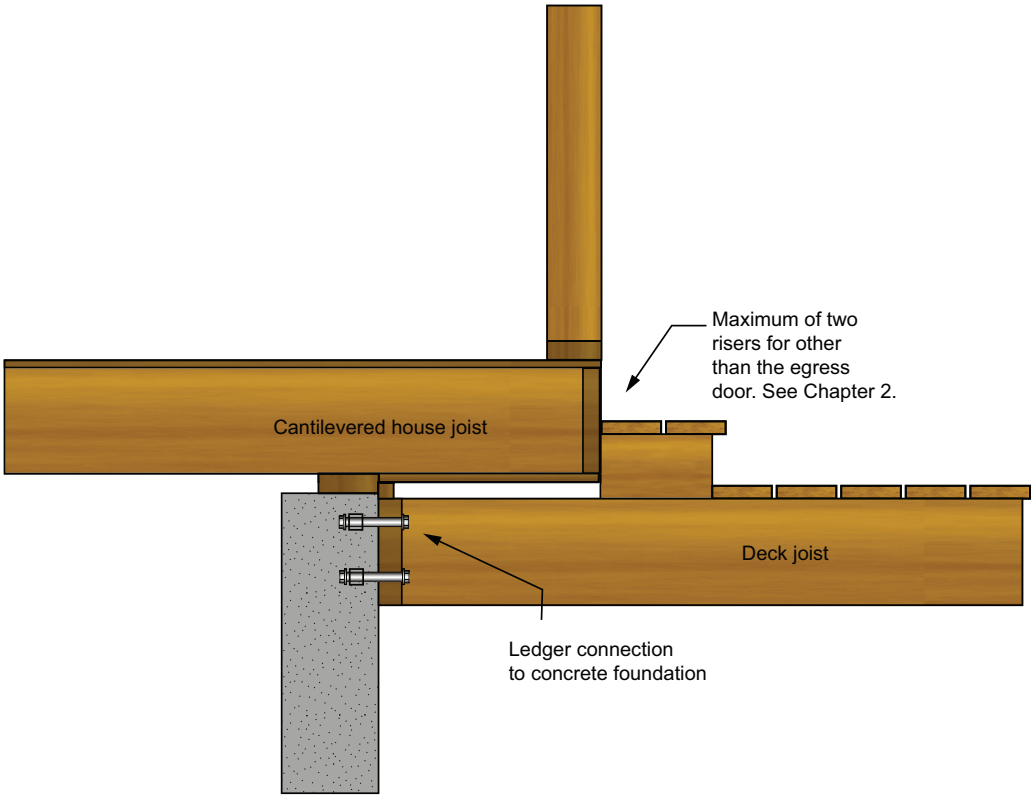


Figure 4-3-2: Another option is to drop the ledger completely beneath the brick and attach to a concrete foundation with anchors or a wall with structural screws, neither of which are provided prescriptive designs in the IRC. Alternative designs will need to be provided and approved for this connection, but all other problems with the cantilevered floor disappear.

Part Three: Alternative Ledger Connections

Subject: Brick Veneer

2021 Code:

R507.9.1.1 Ledger details. Deck ledgers shall be a minimum 2-inch by 8-inch (51 mm by 203 mm) nominal, pressure-preservative-treated Southern pine, incised pressure-preservative-treated hem-fir, or approved, naturally durable, No. 2 grade or better lumber. Deck ledgers shall not support concentrated loads from beams or girders. Deck ledgers shall not be supported on stone or masonry veneer.

R703.8.3 Lintels. Masonry veneer shall not support any vertical load other than the dead load of the veneer above. [remaining section not provided]

Application: Anchored brick veneer is a full-size brick and appears to be structurally capable of holding up a deck. However, both these sections prohibit brick veneer from carrying loads. This is not because of the brick; it is because of the stress that forces the bricks out laterally when under load. Brick veneers are only connected with wire ties or corrugated metal strips to the wall for minimal stability. Brick walls that take loads are two or three courses of brick thick, and they interconnect to each other for bracing.

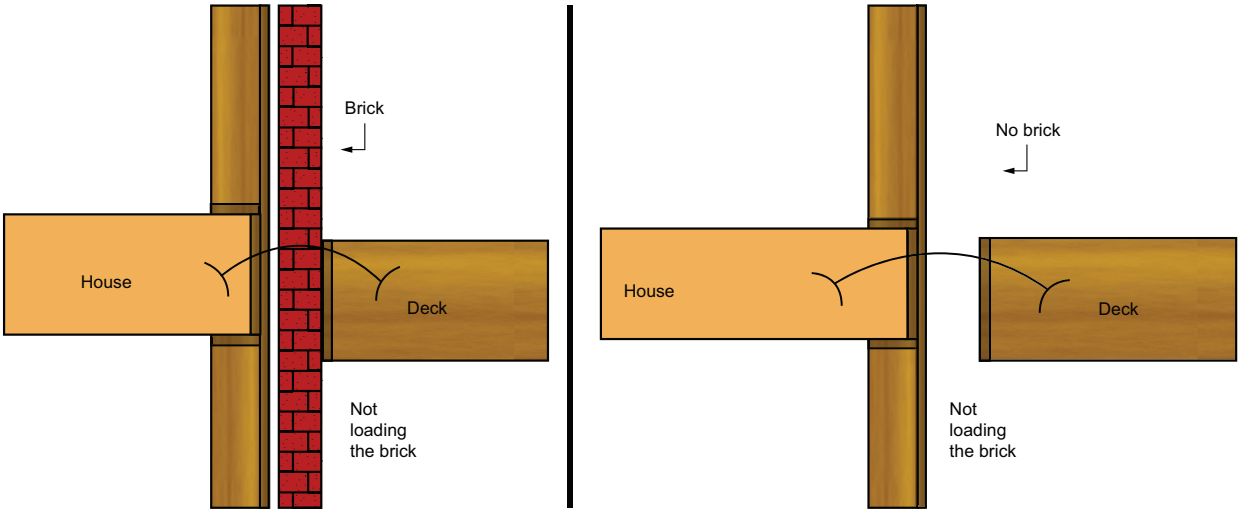


Figure 4-3-3: Ideas are often suggested for how a deck ledger could be supported through brick veneer without loading the brick, and some methods do work. Tested connectors were recently released to the market to do just that. Generally speaking, brick veneer is very difficult to work with when building a deck. This illustration provides a good way to illustratively determine if a proposed connection is loading the brick. Can you remove the brick and it still works?

Part Three: Alternative Ledger Connections

Subject: Open Web Floor Trusses

2021 Code: **R507.9.1.2 Band joist details.** Band joists supporting a ledger shall be a minimum 2-inch-nominal (51 mm), solid-sawn, spruce-pine-fir or better lumber or a minimum 1-inch (25 mm) nominal engineered wood rim boards in accordance with Section R502.1.7. Band joists shall bear fully on the primary structure capable of supporting all required loads.

Application: Another strong necessity for verifying the band joist, either from the inside of the house or when removing cladding for the ledger, is the possibility of open web floor trusses. Like roof trusses, these assemblies are made from shorter lengths of smaller-dimensional lumber connected together with metal gusset plates. Due to the geometry of their design, they are often taller than standard solid or structural composite lumber. There is no solid band joist, as required by the IRC method, to which to connect a ledger. Alternative design guidance is necessary.

Figure 4-3-4: Floor trusses don't have a band joist, so the connection methods from the IRC do not apply. Alternate connections are provided by the Structural Building Components Association at its website, sbcindustry.com.

Chapter 5

The Floor

Introduction

Prior to the 2015 edition of the IRC, there were no prescriptive design provisions specifically intended for deck structures, with the exception of ledger connections. Nearly all of the sections in this chapter are brand new since the 2015 edition. This chapter covers the decking, joists, and beams.

Decking lives a double life, as both an aesthetic finish and a structural element. As a finish, it comes in a variety of materials, colors, and textures. It can be used to create geometric patterns across the whole surface or centerpiece of figures, symbols or different materials. The fasteners can also be part of the pattern or concealed entirely with a diverse variety of proprietary systems.

As a structural member, it must span across two joists, in the same way a joist spans between beams or a beam between posts. They must be proven through testing or engineering

as to how far they can span, and the fasteners again play a role. Different ways to conceal them result in different strengths. Decking may be able to be used as part of the bracing mechanism for the whole deck, or it may not.

Creating prescriptive design tables for joist and beam design in the IRC was a monumental success, as for many decades code officials have had nothing but their own resources to approve the “simple” decks their communities have always been building. However, deck designs are incredibly varied, and the resulting load paths created are difficult to assume into a pre-engineered table. The IRC prescriptive provisions will allow common installations of joists and beams to be approved with confidence. Subtle variations from the prescriptive details can be approved through experienced and rational analysis by the building official. Engineered materials and designs allow for an endless variety of deck floors.

As the first model deck design codes in US history, the design tables for joists and beams have undergone revisions in each edition since 2015. The engineering fundamentals have not changed in these modifications, but rather the manner in which the pre-engineered values are presented and arranged in the tables. The tables in the 2021 IRC are more developed and better presented than in the 2018 IRC, though both have been provided for you in this chapter. Be sure to recognize the headings. Building authorities administering adopted IRC editions prior to 2021 are encouraged to utilize the 2021 design tables as an alternative design and allow greater design flexibility to their communities.

Part One: Decking

Part One: Decking

Subject: Wood Decking

2021 Code: **R507.7 Decking.** Maximum allowable spacing for joists supporting wood decking, excluding *stairways*, shall be in accordance with Table R507.7. Wood decking shall be attached to each supporting member with not less than two 8d threaded nails or two No. 8 wood screws. Maximum allowable spacing for joists supporting *plastic composite* decking shall be in accordance with Section R507.2. Other *approved* decking or fastener systems shall be installed in accordance with the manufacturer's installation requirements.

TABLE R507.7
MAXIMUM JOIST SPACING FOR WOOD DECKING

DECKING MATERIAL TYPE AND NOMINAL SIZE	DECKING PERPENDICULAR TO JOIST		DECKING DIAGONAL TO JOIST[a]	
	Single span[c]	Multiple span[c]	Single span[c]	Multiple span[c]
	Maximum on-center joist spacing (inches)			
$1^1/_4$-inch-thick wood[b]	12	16	8	12
2-inch-thick wood	24	24	18	24

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 degree = 0.01745 rad.

a. Maximum angle of 45 degrees from perpendicular for wood deck boards.

b. Other maximum span provided by an accredited lumber grading or inspection agency also allowed.

c. Individual wood deck boards supported by two joists shall be considered single span and three or more joists shall be considered multiple span.

Application: The American Lumber Standards Committee (ALSC) manages an industry-recognized document that lays out procedures for evaluating the span rating of wood decking, and that is the basis for the IRC table. Though updated after completion of the 2021 IRC, the ALSC evaluation procedure previously included a 70 psf uniform load, 220 lb concentrated load, and an L/180 maximum deflection. The loads were increased at the end of 2020 in a revision to the procedure and could affect these spans in future IRC editions. Plastic composite decking follows a different evaluation procedure, discussed later in the chapter.

2021 Modification:

The 2021 edition of this table, provided above, expands on the 2018 edition (not provided) to include single span conditions and to increase the allowable span of 2-inch nominal decking on a diagonal from 16 to 24. The 2018 IRC does not specify a detail in the ALSC procedures, that the resulting spans are only for two-span conditions, where decking is supported on three or more joists. To support the trend for decking patterns that may use shorter pieces of lumber in single-span conditions, the distinction was made that the current spans are for multispans and new columns were added with reduced, maximum, single spans. The reference to Section R507.2 for plastic composite was unchanged. It simply moved out of the table and into Section R507.7.

Part One: Decking

Subject: Wood Decking, continued

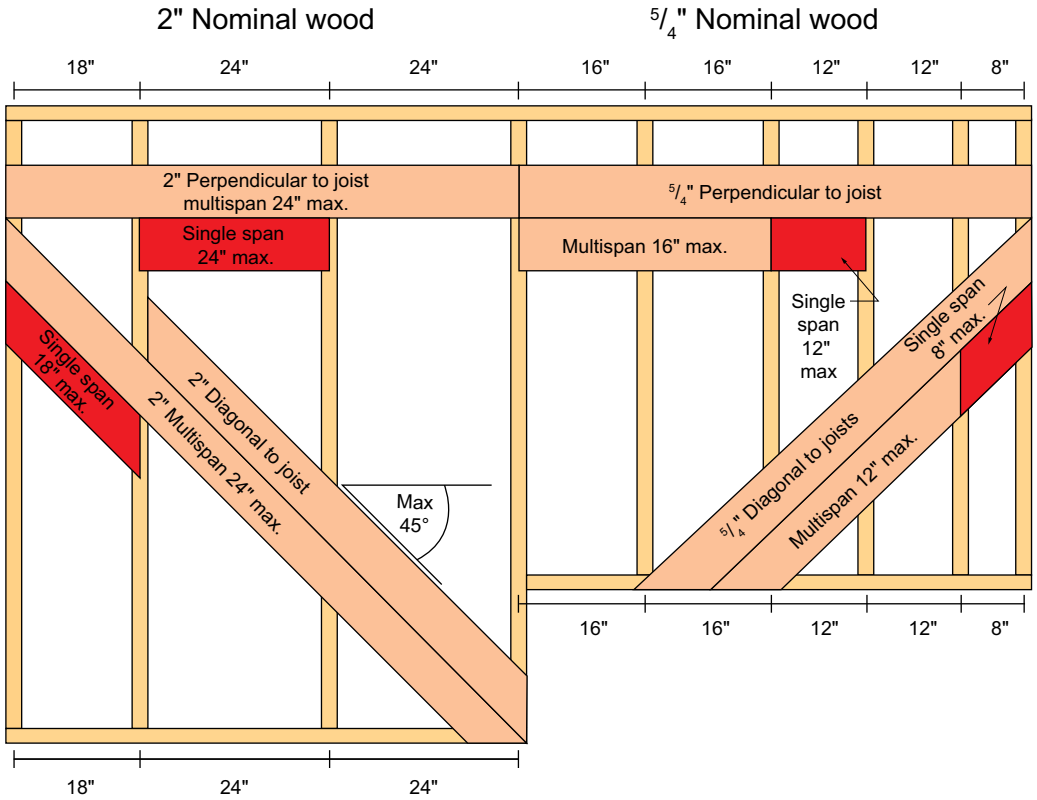


Figure 5-1-1: All the decking thicknesses and span conditions are shown in this graphic with their corresponding maximum spans. Though they don't specify it, the maximum spans in the 2015 and 2018 IRC editions are only intended for multispan conditions.

Part One: Decking

Subject: Plastic Composite Decking

2021 Code: **R507.2.2.5 Installation of plastic composites.** Plastic composite deck boards, stair treads, guards and handrails shall be installed in accordance with this code and the manufacturer's instructions.

Application: In Chapter Three of this book, IRC sections were provided regarding the material of plastic composite and the ASTM D7032 test standard they are required to meet. This section requires the installation of these products to be in accordance with the manufacturer's installation instructions derived from those test procedures. "Plastic" is a broad term that yields very different performance results. Consider a plastic shopping bag vs. a PVC pipe. Both are plastic, but they have quite different strengths. It is critical with plastic composite decking and all other decking approved as an alternative that they be installed in accordance with the manufacturer's instructions.

Examples of Installation Instructions

SUBJECT	EXAMPLE OF MANUFACTURER REQUIREMENTS
Fasteners	Specific screws and concealed fastener systems are specified.
Gapping	Gapping between members is dependent on the temperature at the time of installation.
End bearing	Often a double member or additional nailer is required at butt joints in decking.
Edge distance	Minimum fastener distances from the ends and edges of boards is specified.
Ventilation below	Minimum clearances below decking for ventilation are often required when placed on "sleeper" joists over a roof or when the decking is a tongue-and-groove profile with reduced ventilation between boards.
Overhang	The distance a board can overhang (cantilever) beyond the edge of a joist is limited.
Stair treads	Due to required concentrated design loads discussed in Chapter 8 of this book, decking spans are reduced when used as stair treads.

This table provides some examples of what can be found only in manufacturers' installation instructions. Plastic composite decking products are continually redeveloped and thus both the installer and inspector must reference the instructions for a code-compliant and warranty-backed installation.

Part Two: Joists

Part Two: **Joists**

Subject: **Joist Span and Cantilever**

2021 Code: **R507.6 Deck joists.** Maximum allowable spans for wood deck joists, as shown in Figure R507.6, shall be in accordance with Table R507.6. The maximum joist spacing shall be limited by the decking materials in accordance with Table R507.7. The maximum joist cantilever shall be limited to one-fourth of the joist span or the maximum cantilever length specified in Table R507.6, whichever is less.

Application: The maximum allowable joist spans are based on how close together the joists are located. When joists are closer together, more of them are carrying the load, and thus they can span farther. While 16-inch joist spacing is common, this section reminds the reader that joist spacing is first controlled by the maximum allowable decking span. Some decking profiles require 12-inch spacing when placed on an angle other than perpendicular to the joists.

In the 2018 edition, joist cantilever was limited by either one-quarter the span of the joist or the maximum provided in the joist span table, R507.6. This is discussed further on the following pages.

2021 Modification:

Table R507.6 was new to the 2015 edition, completely revised in the 2018, and has been completely revised again in the 2021. The engineering behind the maximum values hasn't changed, only the manner in which the tables present the information. Joist span and the allowable joist cantilever have a tricky relationship, and presenting it simplistically in a pre-engineered table proved challenging. The underlined final sentence in Section R507.6 was removed in the 2021 edition to eliminate the need to evaluate both a fraction of the back span and a tabular limit. This eliminated a confusing result that could be found in the 2018 table and is explained in the following pages. Those using the 2018 IRC are encouraged to utilize the 2021 joist span Table R507.6; however, both have been provided in this book.

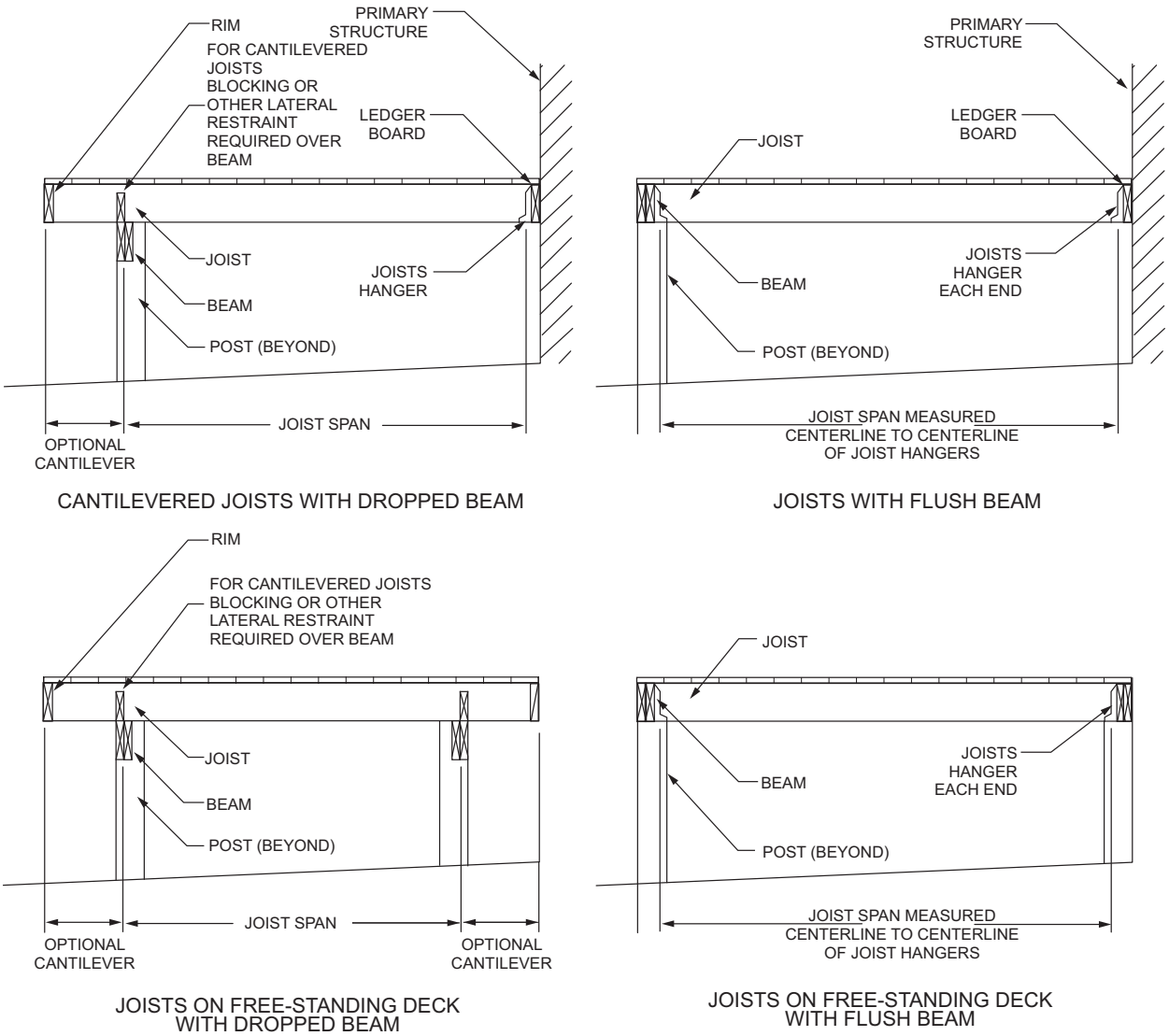


FIGURE R507.6
TYPICAL DECK JOIST SPANS

This IRC figure provides four examples of how joist spans are measured from center-of-bearing to center-of-bearing. It depicts allowable joist cantilevers and the requirement for lateral restraint over beams. Though blocking is commonly used, the code is specific to allow other means to prevent rotation. Blocks are only required to be 60% of the height of the joist, which may allow for in-deck drainage systems to pass over.

Part Two: Joists

Subject: Joist Sizing (2018 Edition)

2018 Code:

TABLE R507.6
DECK JOIST SPANS FOR COMMON LUMBER SPECIES (ft. - in.)

SPECIES[a]	SIZE	ALLOWABLE JOIST SPAN[b]			MAXIMUM CANTILEVER[c, f]		
		SPACING OF DECK JOISTS (inches)			SPACING OF DECK JOISTS WITH CANTILEVERS[c] (inches)		
		12	16	24	12	16	24
Southern pine	2 × 6	9-11	9-0	7-7	1-3	1-4	1-6
	2 × 8	13-1	11-10	9-8	2-1	2-3	2-5
	2 × 10	16-2	14-0	11-5	3-4	3-6	2-10
	2 × 12	18-0	16-6	13-6	4-6	4-2	3-4
Douglas fir-larch[d], hem-fir[d] spruce-pine-fir[d],	2 × 6	9-6	8-8	7-2	1-2	1-3	1-5
	2 × 8	12-6	11-1	9-1	1-11	2-1	2-3
	2 × 10	15-8	13-7	11-1	3-1	3-5	2-9
	2 × 12	18-0	15-9	12-10	4-6	3-11	3-3
Redwood, western cedars, ponderosa pine[e], red pine[e]	2 × 6	8-10	8-0	7-0	1-0	1-1	1-2
	2 × 8	11-8	10-7	8-8	1-8	1-10	2-0
	2 × 10	14-11	13-0	10-7	2-8	2-10	2-8
	2 × 12	17-5	15-1	12-4	3-10	3-9	3-1

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. No. 2 grade with wet service factor.

b. Ground snow load, live load = 40 psf, dead load = 10 psf, L/Δ = 360.

c. Ground snow load, live load = 40 psf, dead load = 10 psf, L/Δ = 360 at main span, L/Δ = 180 at cantilever with a 220-pound point load applied to end.

d. Includes incising factor.

e. Northern species with no incising factor.

f. Cantilevered spans not exceeding the nominal depth of the joist are permitted.

Application: The 2018 version of the joist span table provides a maximum joist span based on joist spacing and a maximum cantilever based on joist spacing. The lesser of one-quarter the actual joist span or the maximum in the table is taken as maximum cantilever. However, the table was flawed in limiting the cantilever based on joist spacing, as opposed to joist span, and in some conditions would allow more cantilever when joists were spaced at 16 inches than at 12 inches. An explanation to correct this is provided on the following page; however, the revisions to the 2021 table eliminated this condition and provide more accurate span and cantilever limits.

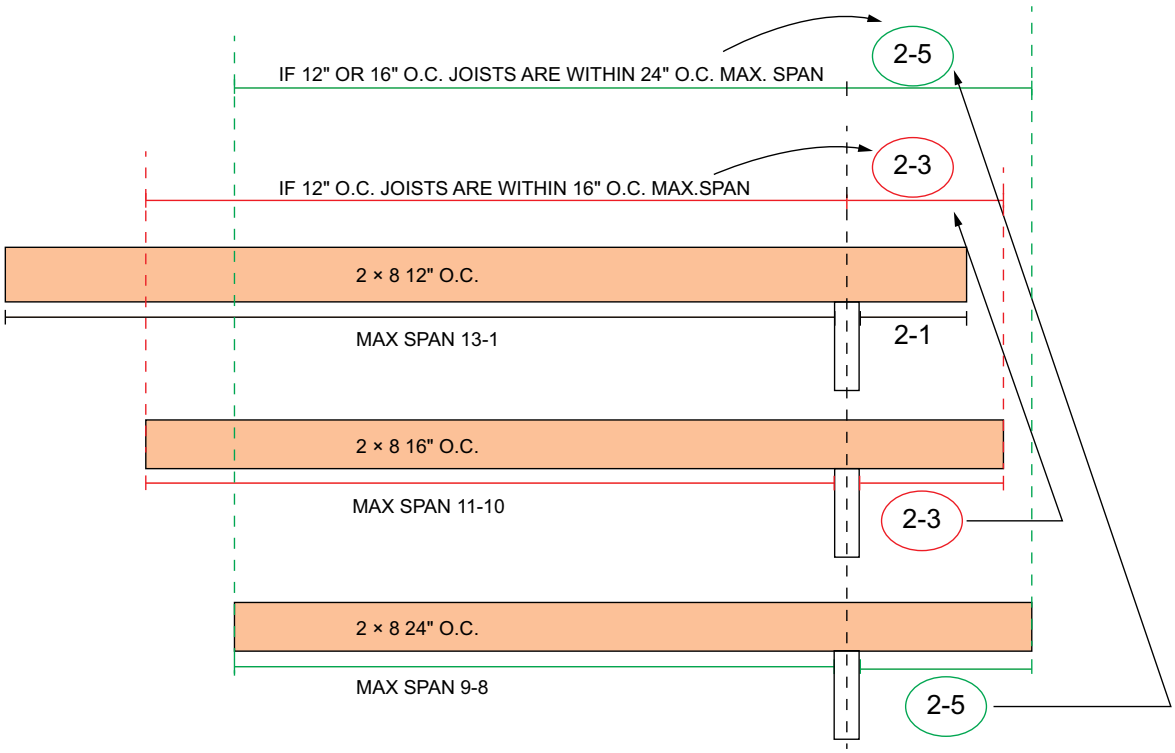


Figure 5-2-1: In some conditions (such as southern pine 2 × 8), less cantilever is allowed when joists are 12 inches on center compared to when 24 inches. Intuitively, this doesn't make sense, but it's due to how the 2018 table is formatted and the many variables of joist design. Joist spacing is often reduced to accommodate angled decking, and not to reach a further span. Though not explained in the code, when joists are within the maximum allowable span of the next wider spacing in the table, their tabular maximum cantilever can be increased to the next spacing. Essentially this means there is no penalty in the cantilever distance for having additional joists that are unnecessary for the span. Modifications to this table in the 2021 IRC eliminate this problem with a new organization.

Part Two: Joists

Subject: Joist Sizing (2021 Edition)

2021 Code:

TABLE R507.6
MAXIMUM DECK JOIST SPANS

LOAD[a] (psf)	JOIST SPECIES[b]	JOIST SIZE	ALLOWABLE JOIST SPAN[b, c] (feet-inches)			MAXIMUM CANTILEVER[d,f] (feet-inches)							
			Joist spacing (inches)			Joist back span[g] (feet)							
			12	16	24	4	6	8	10	12	14	16	18
40 live load	Southern pine	2 × 6	9-11	9-0	7-7	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	13-1	11-10	9-8	1-0	1-6	2-0	2-6	2-3	NP	NP	NP
		2 × 10	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-4	3-4	NP
		2 × 12	18-0	16-6	13-6	1-0	1-6	2-0	2-6	3-0	3-6	4-0	4-1
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	9-6	8-4	6-10	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	12-6	11-1	9-1	1-0	1-6	2-0	2-3	2-0	NP	NP	NP
		2 × 10	15-8	13-7	11-1	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP
		2 × 12	18-0	15-9	12-10	1-0	1-6	2-0	2-6	3-0	3-6	3-11	3-11
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	8-10	8-0	6-10	1-0	1-4	1-1	NP	NP	NP	NP	NP
		2 × 8	11-8	10-7	8-8	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	14-11	13-0	10-7	1-0	1-6	2-0	2-6	3-0	2-9	NP	NP
		2 × 12	17-5	15-1	12-4	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP
50 ground snow load	Southern pine	2 × 6	9-2	8-4	7-4	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	12-1	11-0	9-5	1-0	1-6	2-0	2-5	2-3	NP	NP	NP
		2 × 10	15-5	13-9	11-3	1-0	1-6	2-0	2-6	3-0	3-1	NP	NP
		2 × 12	18-0	16-2	13-2	1-0	1-6	2-0	2-6	3-0	3-6	3-10	3-10
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	8-10	8-0	6-8	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	11-7	10-7	8-11	1-0	1-6	2-0	2-3	NP	NP	NP	NP
		2 × 10	14-10	13-3	10-10	1-0	1-6	2-0	2-6	3-0	3-0	NP	NP
		2 × 12	17-9	15-5	12-7	1-0	1-6	2-0	2-6	3-0	3-6	3-8	NP
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	8-3	7-6	6-6	1-0	1-4	1-1	NP	NP	NP	NP	NP
		2 × 8	10-10	9-10	8-6	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	13-10	12-7	10-5	1-0	1-6	2-0	2-6	2-9	NP	NP	NP
		2 × 12	16-10	14-9	12-1	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
60 ground snow load	Southern pine	2 × 6	8-8	7-10	6-10	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	11-5	10-4	8-9	1-0	1-6	2-0	2-4	NP	NP	NP	NP
		2 × 10	14-7	12-9	10-5	1-0	1-6	2-0	2-6	2-11	2-11	NP	NP
		2 × 12	17-3	15-0	12-3	1-0	1-6	2-0	2-6	3-0	3-6	3-7	NP
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	8-4	7-6	6-2	1-0	1-6	1-4	NP	NP	NP	NP	NP
		2 × 8	10-11	9-11	8-3	1-0	1-6	2-0	2-2	NP	NP	NP	NP
		2 × 10	13-11	12-4	10-0	1-0	1-6	2-0	2-6	2-10	NP	NP	NP
		2 × 12	16-6	14-3	11-8	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	7-9	7-0	6-2	1-0	1-4	NP	NP	NP	NP	NP	NP
		2 × 8	10-2	9-3	7-11	1-0	1-6	2-0	1-11	NP	NP	NP	NP
		2 × 10	13-0	11-9	9-7	1-0	1-6	2-0	2-6	2-7	NP	NP	NP
		2 × 12	15-9	13-8	11-2	1-0	1-6	2-0	2-6	3-0	3-2	NP	NP

(continued)

TABLE R507.6
MAXIMUM DECK JOIST SPANS—continued

LOAD[a] (psf)	JOIST SPECIES[b]	JOIST SIZE	ALLOWABLE JOIST SPAN [b, c] (feet-inches)			MAXIMUM CANTILEVER[d,f] (feet-inches)							
			Joist spacing (inches)			Joist back span[g] (feet)							
			12	16	24	4	6	8	10	12	14	16	18
70 ground snow load	Southern pine	2 × 6	8-3	7-6	6-5	1-0	1-6	1-5	NP	NP	NP	NP	NP
		2 × 8	10-10	9-10	8-2	1-0	1-6	2-0	2-2	NP	NP	NP	NP
		2 × 10	13-9	11-11	9-9	1-0	1-6	2-0	2-6	2-9	NP	NP	NP
		2 × 12	16-2	14-0	11-5	1-0	1-6	2-0	2-6	3-0	3-5	3-5	NP
	Douglas fir-larch[e] Hem-fir[e] Spruce-pine-fir[e]	2 × 6	7-11	7-1	5-9	1-0	1-6	NP	NP	NP	NP	NP	NP
		2 × 8	10-5	9-5	7-8	1-0	1-6	2-0	2-1	NP	NP	NP	NP
		2 × 10	13-3	11-6	9-5	1-0	1-6	2-0	2-6	2-8	NP	NP	NP
		2 × 12	15-5	13-4	10-11	1-0	1-6	2-0	2-6	3-0	3-3	NP	NP
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	2 × 6	7-4	6-8	5-10	1-0	1-4	NP	NP	NP	NP	NP	NP
		2 × 8	9-8	8-10	7-4	1-0	1-6	1-11	NP	NP	NP	NP	NP
		2 × 10	12-4	11-0	9-0	1-0	1-6	2-0	2-6	2-6	NP	NP	NP
		2 × 12	14-9	12-9	10-5	1-0	1-6	2-0	2-6	3-0	3-0	NP	NP

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.
NP = Not Permitted.
a. Dead load = 10 psf. Snow load not assumed to be concurrent with live load.
b. No. 2 grade, wet service factor included.
c. $L/\Delta = 360$ at main span.
d. $L/\Delta = 180$ at cantilever with a 220-pound point load applied to end.
e. Includes incising factor.
f. Incising factor not included.
g. Interpolation allowed. Extrapolation is not allowed.

Application: The 2021 joist span Table R507.6 more appropriately limits the cantilever directly by the joist span. In most conditions, the maximum cantilever increases as the joist span increases, but this is not always the case, and is what has led to so many revisions of this table. In some conditions, when the joist span gets to a certain length, the maximum cantilever begins to decrease. This may appear like an error in the table, but it is not. There is no longer a need to evaluate the maximum cantilever one-quarter of the backspan against the table as in the 2018 edition. This version of the table also expands the load criteria to include 50, 60 and 70 psf snow load regions. A footnote was added to permit interpolation between tabular values, rather than forcing a designer to round up the actual joist span to the next higher value in the table.

Part Two: Joists

Subject: Joist Bearing and Connection

2021 Code: **R507.6.1 Deck joist bearing.** The ends of joists shall have not less than $1^1/_2$ inches (38 mm) of bearing on wood or metal and not less than 3 inches (76 mm) of bearing on concrete or masonry over its entire width. Joists bearing on top of a multiple-ply beam or ledger shall be fastened in accordance with Table R602.3(1). Joists bearing on top of a single-ply beam or ledger shall be attached by a mechanical connector. Joist framing into the side of a beam or ledger board shall be supported by *approved* joist hangers.

TABLE R602.3(1)
MAXIMUM DECK JOIST SPANS—partial

		Floor	
21	Joist to sill, top plate or girder	4-8d box ($2^1/_2$″ × 0.113″); or 3-8d common ($2^1/_2$″ × 0.131″); or 3-10d box (3″ × 0.128″); or 3-3″ × 0.131″ nails	Toe nail

Application: Loads collected along a joist are passed through a minimum $1^1/_2$-inch length of bearing to ensure the wood grain, perpendicular to the forces, will not be crushed at the bearing location. The increase to 3 inches reduces the potential for the concrete or masonry to spall at the corner of the bearing location. When bearing on a single-ply beam, a mechanical connector is required, but when on a two-ply or larger beam, joists may be connected by toenails specified in Table 602.3(1), Item 21.

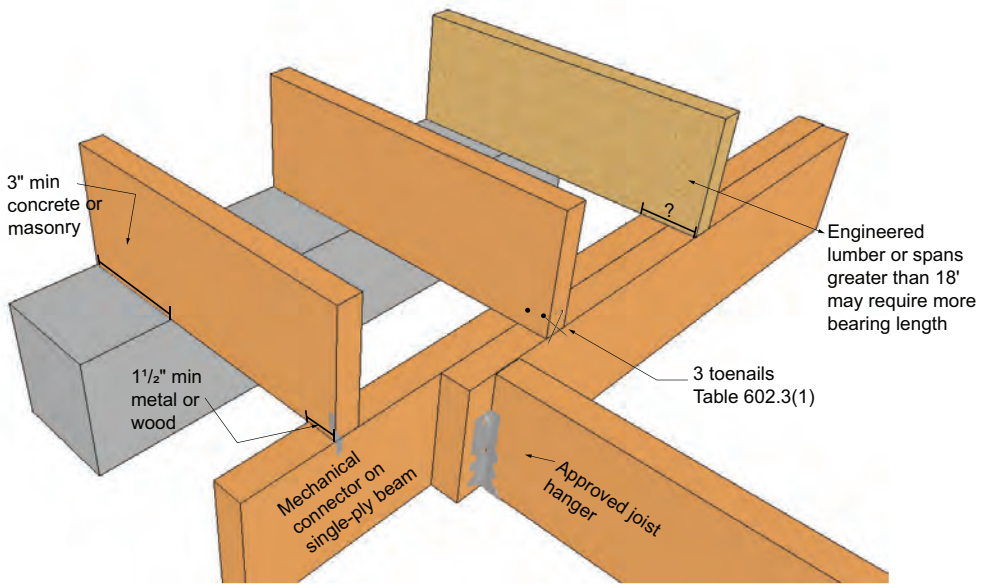


Figure 5-2-2: The minimum bearing length of $1^1/_2$ inches is only applicable up to an 18-foot joist span, the largest available in prescriptive design. Larger spans from engineered lumber may require additional bearing length.

Part Two: Joists

Subject: Joist Restraint and Lapping

2021 Code: **R502.6.1 Floor systems.** Joists framing from opposite sides over a bearing support shall lap not less than 3 inches (76 mm) and shall be nailed together with a minimum three 10d face nails. A wood or metal splice with strength equal to or greater than that provided by the nailed lap is permitted.

R507.6.2 Deck joist lateral restraint. Joist ends and bearing locations shall be provided with lateral resistance to prevent rotation. Where lateral restraint is provided by joist hangers or blocking between joists, their depth shall equal not less than 60 percent of the joist depth. Where lateral restraint is provided by rim joists, they shall be secured to the end of each joist with not fewer than three 10d (3-inch by 0.128-inch) (76 mm by 3.3 mm) nails or three No. 10x 3-inch (76 mm) long wood screws.

Application: When joists span between two bearing points, stresses develop causing the joist to rotate. This rotation must be resisted at the bearing locations. Hangers, blocks, and rim joists are all able to provide this, but they must be a minimum of 60 percent the overall depth. The allowance for shorter blocks may provide room for deck drainage systems to travel across the top of the block.

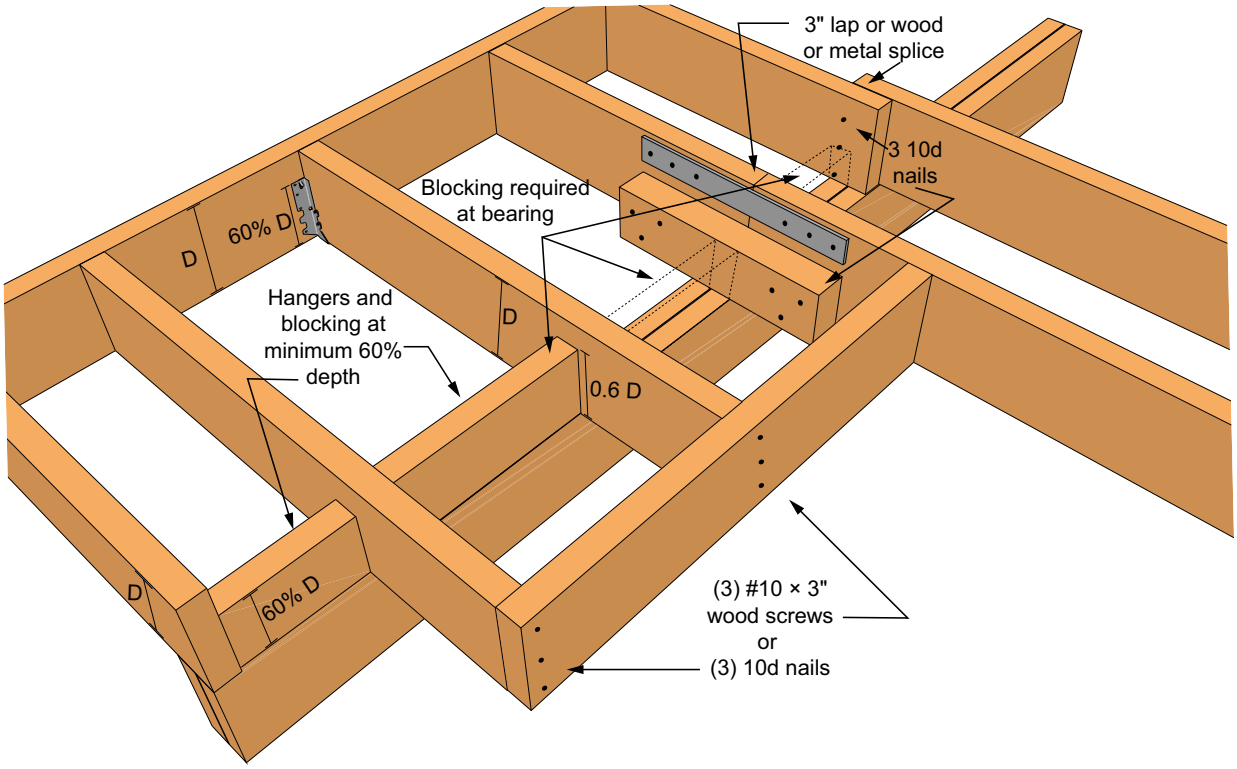


Figure 5-2-3: Section R502.6.1 is not in the deck section of the IRC but provides some guidance for attachment of two deck joists that splice over a center beam. Though footnote b in Table R507.5 prohibits a beam from supporting joists on both sides, this is only prohibited in the prescriptive design, not a universal prohibition. A beam can certainly be designed between two joist spans; it just can't be sized from the table in the IRC.

Part Two: Joists

Subject: Drilling and Notching Joists and Beams

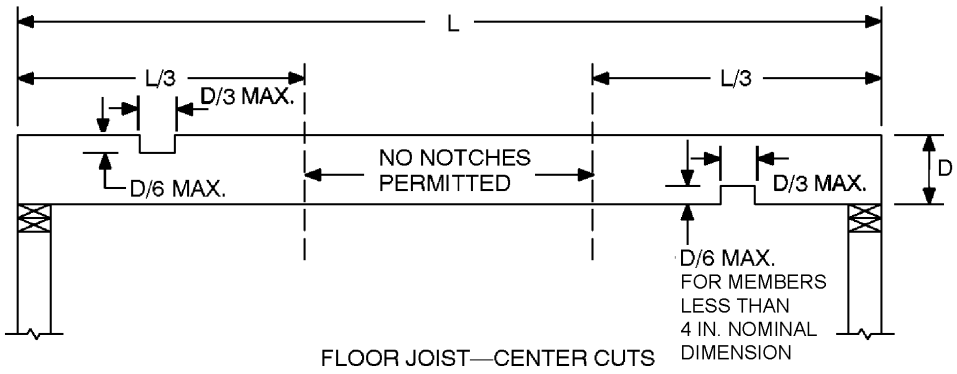
2021 Code: **R502.8 Cutting, drilling and notching.** Structural floor members shall not be cut, bored or notched in excess of the limitations specified in this section. See Figure R502.8.

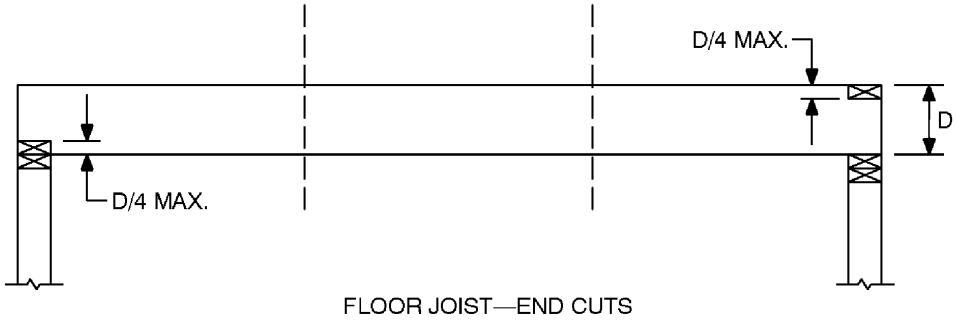
R502.8.1 Sawn lumber. Notches in solid lumber joists, rafters and beams shall not exceed one-sixth of the depth of the member, shall not be longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Notches at the ends of the member shall not exceed one-fourth the depth of the member. The tension side of members 4 inches (102 mm) or greater in nominal thickness shall not be notched except at the ends of the members. The diameter of holes bored or cut into members shall not exceed one-third the depth of the member. Holes shall not be closer than 2 inches (51 mm) to the top or bottom of the member, or to any other hole located in the member. Where the member is notched, the hole shall not be closer than 2 inches (51 mm) to the notch.

R502.8.2 Engineered wood products. Cuts, notches and holes bored in trusses, structural composite lumber, structural glue-laminated members, cross-laminated timber members or I-joists are prohibited except where permitted by the manufacturer's recommendations or where the effects of such alterations are specifically considered in the design of the member by a *registered design professional*.

Application: When determining the maximum span of a member, two stresses are evaluated in the lumber, bending and shear. Bending stresses resist deflection and are at their greatest in the top and bottom edges and the middle third of the span. For this reason, no notching is allowed in the middle third of joists or beams, though drilling is allowed in these areas at least 2 inches away from the edges.

Shear stresses are greatest near the bearing locations, but because span is limited by deflection, the shear stresses near the bearing areas are not at their maximum. For this reason, a joist or beam can be notched at the bearing locations yet is still allowed the maximum span of its unnotched thickness.





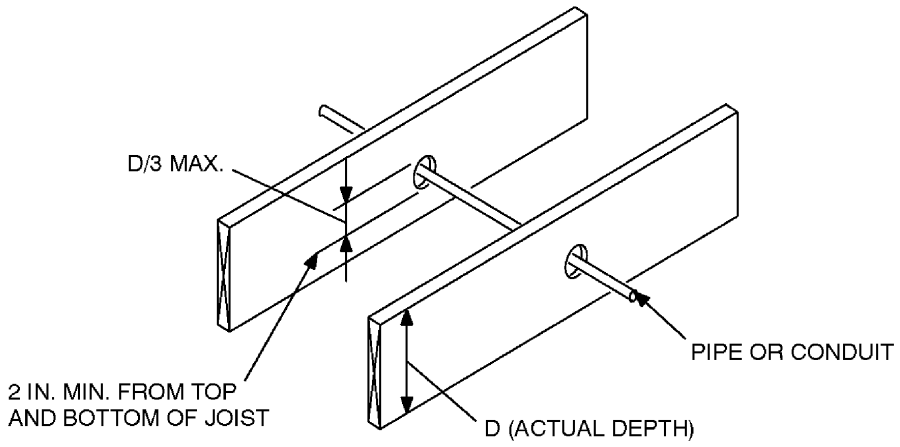


FIGURE R502.8
CUTTING, NOTCHING AND DRILLING

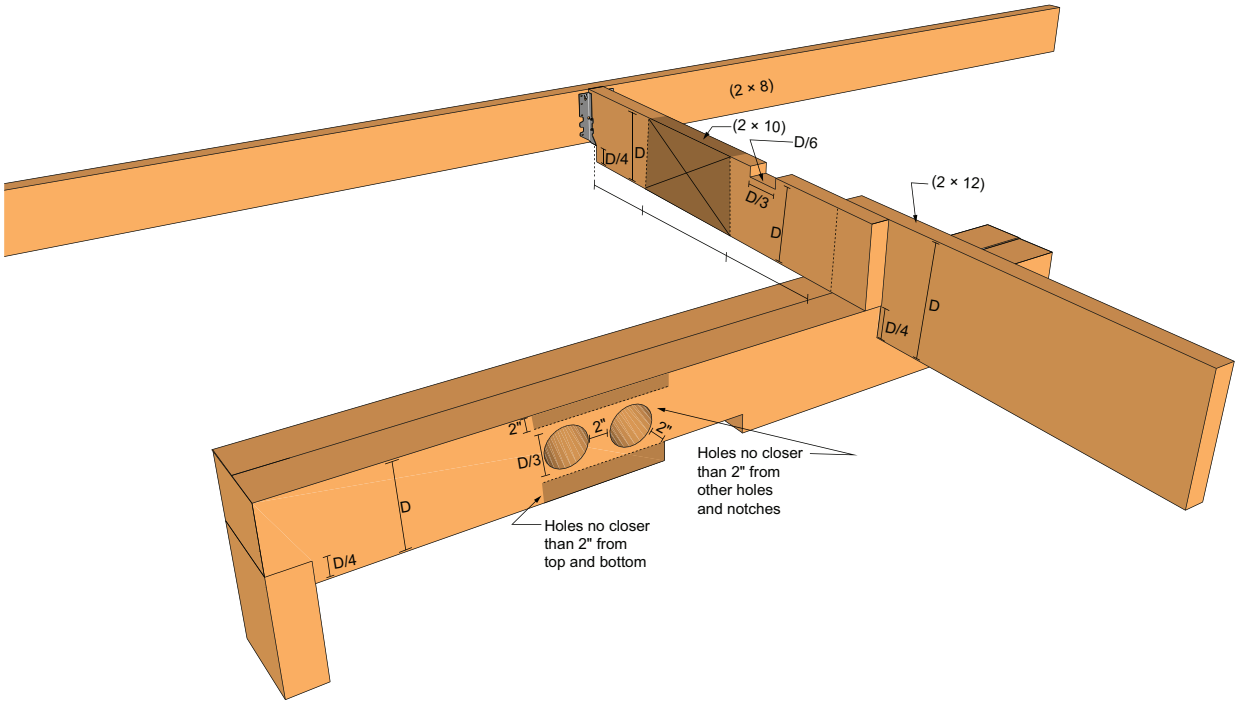


Figure 5-2-4: Notching joists can be helpful when using different size framing materials yet wishing to maintain alignment of the top surface of the deck. For craftsmanship, subtle differences in the height of joists bearing on beams can be corrected by notching the bottom edge of the taller joists. This eliminates the poor look of a wavy deck as the boards bend over the inconsistent joist heights. For design flexibility, a 2 × 12, for example, could be notched to the same height as a 2 × 10, allowing the different size joists to meet over a dropped beam. Similarly, a 2 × 10 joist could be notched to fit a 2 × 8 hanger on a 2 × 8 ledger. Don't forget to field treat those notches in preservative-treated lumber as described in Chapter 3 of this book.

Part Three: Beams

Part Three: **Beams**

Subject: **Beam Spans and Cantilevers**

2021 Code: **R507.5 Deck Beams.** Maximum allowable spans for wood deck beams, as shown in Figure R507.5, shall be in accordance with Tables R507.5(1) through R507.5(4). Beam plies shall be fastened together with two rows of 10d (3-inch × 0.128-inch) nails minimum at 16 inches (406 mm) on center along each edge. Beams shall be permitted to cantilever at each end up to one-fourth of the actual beam span. Deck beams of other materials shall be permitted where designed in accordance with accepted engineering practices.

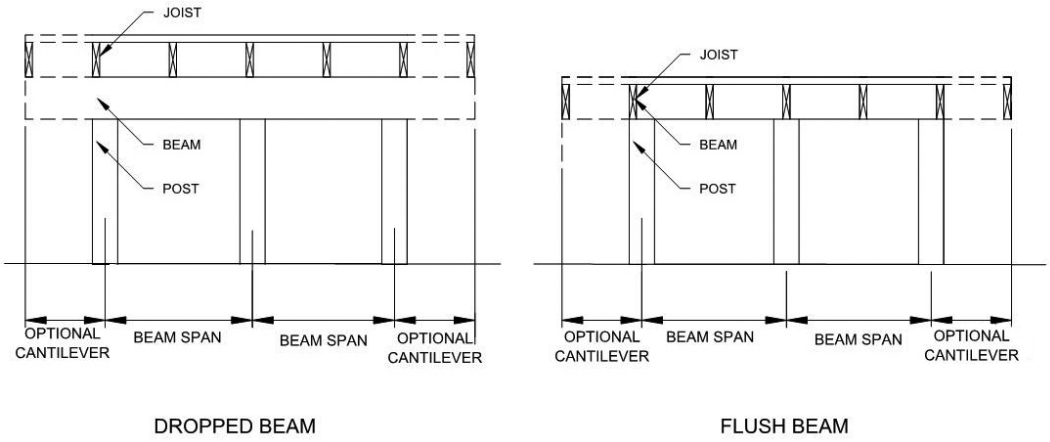


FIGURE R507.5
TYPICAL DECK BEAM SPANS

Application: Multi-ply beams cannot have their plies separated, as is sometimes seen where one is installed on each side of a post. The plies must be fastened together in accordance with this section. Beams are permitted to cantilever beyond an outside post but must be made up of continuous members that extend all the way to the next adjacent post or bearing location. Common use of a $^{1}/_{2}$-inch spacer between plies is acceptable, provided longer fasteners are used to engage both beams through the solid spacer material. Beam plies spaced by $^{1}/_{2}$ inch allow for better drying between the plies and thicken the beam to the standard $3^{1}/_{2}$-inch, 4 × 4 post size.

2021 Modification:

In the 2021 IRC, a few minor adjustments were made in the text. The word “together” was added for clarity. Later in the section, the word “actual” replaced “allowable” from the 2018 edition, as it was simply an error. Cantilevers are always based on the actual span of the joist or beam, not the maximum allowable span.

Part Three: Beams

Subject: Maximum Beam Spans (2018 edition)

2018 Code:

TABLE R507.5
DECK BEAM SPAN LENGTHS[a, b, g] (feet - inches)

SPECIES[c]	SIZE[d]	DECK JOIST SPAN LESS THAN OR EQUAL TO: (feet)						
		6	8	10	12	14	16	18
Southern pine	1 – 2 × 6	4-11	4-0	3-7	3-3	3-0	2-10	2-8
	1 – 2 × 8	5-11	5-1	4-7	4-2	2-10	3-7	3-5
	1 – 2 × 10	7-0	6-0	5-5	4-11	4-7	4-3	4-0
	1 – 2 × 12	8-3	7-1	6-4	5-10	5-5	5-0	4-9
	2 – 2 × 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0
	2 – 2 × 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0
	2 – 2 × 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0
	2 – 2 × 12	12-2	10-7	9-5	8-7	8-0	7-6	7-0
	3 – 2 × 6	8-2	7-5	6-8	6-1	5-8	5-3	5-0
	3 – 2 × 8	10-10	9-6	8-6	7-9	7-2	6-8	6-4
	3 – 2 × 10	13-0	11-3	10-0	9-2	8-6	7-11	7-6
	3 – 2 × 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10
Douglas fir-larch[e], hem-fire, spruce-pine-fire, redwood, western cedars, ponderosa pine[f], red pine[f]	3 × 6 or 2 – 2 × 6	5-5	4-8	4-2	3-10	3-6	3-1	2-9
	3 × 8 or 2 – 2 × 8	6-10	5-11	5-4	4-10	4-6	4-1	3-8
	3 × 10 or 2 – 2 × 10	8-4	7-3	6-6	5-11	5-6	5-1	4-8
	3 × 12 or 2 – 2 × 12	9-8	8-5	7-6	6-10	6-4	5-11	5-7
	4 × 6	6-5	5-6	4-11	4-6	4-2	3-11	3-8
	4 × 8	8-5	7-3	6-6	5-11	5-6	5-2	4-10
	4 × 10	9-11	8-7	7-8	7-0	6-6	6-1	5-8
	4 × 12	11-5	9-11	8-10	8-1	7-6	7-0	6-7
	3 – 2 × 6	7-4	6-8	6-0	5-6	5-1	4-9	4-6
	3 – 2 × 8	9-8	8-6	7-7	6-11	6-5	6-0	5-8
	3 – 2 × 10	12-0	10-5	9-4	8-6	7-10	7-4	6-11
	3 – 2 × 12	13-11	12-1	10-9	9-10	9-1	8-6	8-1

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Ground snow load, live load = 40 psf, dead load = 10 psf, L/D = 360 at main span, L/D = 180 at cantilever with a 220-pound point load applied at the end.
b. Beams supporting deck joists from one side only.
c. No. 2 grade, wet service factor.
d. Beam depth shall be greater than or equal to depth of joists with a flush beam condition.
e. Includes incising factor.
f. Northern species. Incising factor not included.
g. Beam cantilevers are limited to the adjacent beam's span divided by 4.

Application: Table R507.5 in the 2018 IRC provides a conservative method to size deck beams from a variety of species and sizes, but only supporting uniformly distributed loads from joists on one side of the beam. As discussed previously, joists are permitted to cantilever beyond the beam. The cantilever loads are placed entirely on the beam, which in turn affect its maximum span. Because the beam sizing table is based only on joist spans and not also the length of cantilever, it assumes the maximum cantilever exists every time. This results in beam oversizing when there is little to no joist cantilever.

Part Three: **Beams**

Subject: **Maximum Beam Spans (2021 edition)**

2021 Code: See tables following the Application discussion.

Application: The 2021 IRC expands Table R507.5 to allow beams to be sized in 50, 60 and 70 psf snow load regions. Some values in the 40 psf live load table were also adjusted slightly from the 2018 edition. As with all the Section R507 deck design tables, a footnote permits interpolation between tabular values. A new footnote b lets the reader know what the 2018 did not: that the table sizes beams to handle a joist cantilever whether one exists or not. However, a new footnote h also allows for an adjustment to the input joist span based on how much joist cantilever is actually present. This results in a greater maximum beam span, more fitting to the actual design. Table R507.5(5), provided after the following beam span tables, provides the ratios used to make these adjustments for when less or no cantilever exists.

TABLE R507.5(1)
MAXIMUM DECK BEAM SPAN—40 PSF LIVE LOAD[c]

BEAM SPECIES[d]	BEAM SIZE[e]	EFFECTIVE DECK JOIST SPAN LENGTH[a, i, j] (feet)						
		6	8	10	12	14	16	18
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches)[a, b, f]						
Southern pine	1 – 2 × 6	4-7	4-0	3-7	3-3	3-0	2-10	2-8
	1 – 2 × 8	5-11	5-1	4-7	4-2	3-10	3-7	3-5
	1 – 2 × 10	7-0	6-0	5-5	4-11	4-7	4-3	4-0
	1 – 2 × 12	8-3	7-1	6-4	5-10	5-5	5-0	4-9
	2 – 2 × 6	6-11	5-11	5-4	4-10	4-6	4-3	4-0
	2 – 2 × 8	8-9	7-7	6-9	6-2	5-9	5-4	5-0
	2 – 2 × 10	10-4	9-0	8-0	7-4	6-9	6-4	6-0
	2 – 2 × 12	12-2	10-7	9-5	8-7	8-0	7-5	7-0
	3 – 2 × 6	8-6	7-5	6-8	6-1	5-8	5-3	4-11
	3 – 2 × 8	10-11	9-6	8-6	7-9	7-2	6-8	6-4
	3 – 2 × 10	13-0	11-2	10-0	9-2	8-6	7-11	7-6
	3 – 2 × 12	15-3	13-3	11-10	10-9	10-0	9-4	8-10
Douglas fir-larch[g] Hem-fir[g] Spruce-pine-fir	1 – 2 × 6	4-1	3-6	3-0	2-8	2-5	2-3	2-1
	1 – 2 × 8	5-6	4-8	4-0	3-6	3-2	2-11	2-9
	1 – 2 × 10	6-8	5-10	5-1	4-6	4-1	3-9	3-6
	1 – 2 × 12	7-9	6-9	6-0	5-6	5-0	3-9	3-6
	2 – 2 × 6	6-1	5-3	4-9	4-4	3-11	3-7	3-3
	2 – 2 × 8	8-2	7-1	6-4	5-9	5-2	4-8	4-4
	2 – 2 × 10	10-0	8-7	7-9	7-0	6-6	6-0	5-6
	2 – 2 × 12	11-7	10-0	8-11	8-2	7-7	7-1	6-8
	3 – 2 × 6	7-8	6-8	6-0	5-6	5-1	4-9	4-6
	3 – 2 × 8	10-3	8-10	7-11	7-3	6-8	6-3	5-11
	3 – 2 × 10	12-6	10-10	9-8	8-10	8-2	7-8	7-2
	3 – 2 × 12	14-6	12-7	11-3	10-3	9-6	8-11	8-5
Redwood[h] Western cedars[h] Ponderosa pine[h] Red pine[h]	1 – 2 × 6	4-2	3-7	3-1	2-9	2-6	2-3	2-2
	1 – 2 × 8	5-4	4-7	4-1	3-7	3-3	3-0	2-10
	1 – 2 × 10	6-6	5-7	5-0	4-7	4-2	3-10	3-7
	1 – 2 × 12	7-6	6-6	5-10	5-4	4-11	4-7	4-4
	2 – 2 × 6	6-2	5-4	4-10	4-5	4-0	3-8	3-4
	2 – 2 × 8	7-10	6-10	6-1	5-7	5-2	4-10	4-5
	2 – 2 × 10	9-7	8-4	7-5	6-9	6-3	5-10	5-6
	2 – 2 × 12	11-1	9-8	8-7	7-10	7-3	6-10	6-5
	3 – 2 × 6	7-8	6-9	6-0	5-6	5-1	4-9	4-6
	3 – 2 × 8	9-10	8-6	7-7	6-11	6-5	6-0	5-8
	3 – 2 × 10	12-0	10-5	9-4	8-6	7-10	7-4	6-11
	3 – 2 × 12	13-11	12-1	10-9	9-10	9-1	8-6	8-1

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation permitted. Extrapolation not permitted.
b. Beams supporting a single span of joists with or without cantilever.
c. Dead load = 10 psf, $L/\Delta = 360$ at main span, $L/\Delta = 180$ at cantilever. Snow load is not assumed to be concurrent with live load.
d. No. 2 grade, wet service factor included.
e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.
f. Beam cantilevers are limited to the adjacent beam's span divided by 4.
g. Includes incising factor.
h. Incising factor not included.
i. Deck joist span as shown in Figure R507.5.
j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

TABLE R507.5(2)
MAXIMUM DECK BEAM SPAN—50 PSF GROUND SNOW LOAD[c]

BEAM SPECIES[d]	BEAM SIZE[e]	EFFECTIVE DECK JOIST SPAN LENGTH (feet)[a, i, j]						
		6	8	10	12	14	16	18
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches)[a, b, f]						
Southern pine	1 – 2 × 6	4-6	3-11	3-6	3-2	2-11	2-9	2-7
	1 – 2 × 8	5-9	4-11	4-5	4-0	3-9	3-6	3-3
	1 – 2 × 10	6-9	5-10	5-3	4-9	4-5	4-2	3-11
	1 – 2 × 12	8-0	6-11	6-2	5-8	5-3	4-11	4-7
	2 – 2 × 6	6-8	5-9	5-2	4-9	4-4	4-1	3-10
	2 – 2 × 8	8-6	7-4	6-7	6-0	5-7	5-2	4-11
	2 – 2 × 10	10-1	8-9	7-10	7-1	6-7	6-2	5-10
	2 – 2 × 12	11-11	10-3	9-2	8-5	7-9	7-3	6-10
	3 – 2 × 6	7-11	7-2	6-6	5-11	5-6	5-1	4-10
	3 – 2 × 8	10-5	9-3	8-3	7-6	6-11	6-6	6-2
	3 – 2 × 10	12-8	10-11	9-9	8-11	8-3	7-9	7-3
	3 – 2 × 12	14-11	12-11	11-6	10-6	9-9	9-1	8-7
Douglas fir-larch[g] Hem-fir[g] Spruce-pine-fir[g]	1 – 2 × 6	4-0	3-5	2-11	2-7	2-4	2-2	2-0
	1 – 2 × 8	5-4	4-7	3-11	3-5	3-1	2-10	2-8
	1 – 2 × 10	6-7	5-8	4-11	4-5	4-0	3-8	3-5
	1 – 2 × 12	7-7	6-7	5-11	5-4	4-10	4-6	4-2
	2 – 2 × 6	6-0	5-2	4-7	4-2	3-10	3-5	3-2
	2 – 2 × 8	8-0	6-11	6-2	5-8	5-0	4-7	4-2
	2 – 2 × 10	9-9	8-5	7-7	6-11	6-4	5-10	5-4
	2 – 2 × 12	11-4	9-10	8-9	8-0	7-5	6-11	6-6
	3 – 2 × 6	7-6	6-6	5-9	5-3	4-11	4-7	4-4
	3 – 2 × 8	10-0	8-8	7-9	7-1	6-6	6-1	5-8
	3 – 2 × 10	12-3	10-7	9-6	8-8	8-0	7-6	7-0
	3 – 2 × 12	14-3	12-4	11-0	10-1	9-4	8-9	8-3
Redwood[h] Western cedars[h] Ponderosa pine[h] Red pine[h]	1 – 2 × 6	4-1	3-6	3-0	2-8	2-5	2-3	2-1
	1 – 2 × 8	5-2	4-6	4-0	3-6	3-2	2-11	2-9
	1 – 2 × 10	6-4	5-6	4-11	4-6	4-1	3-9	3-6
	1 – 2 × 12	7-4	6-4	5-8	5-2	4-10	4-6	4-3
	2 – 2 × 6	6-1	5-3	4-8	4-4	3-11	3-6	3-3
	2 – 2 × 8	7-8	6-8	5-11	5-5	5-0	4-8	4-3
	2 – 2 × 10	9-5	8-2	7-3	6-8	6-2	5-9	5-5
	2 – 2 × 12	10-11	9-5	8-5	7-8	7-2	6-8	6-3
	3 – 2 × 6	7-1	6-5	5-11	5-5	5-0	4-8	4-5
	3 – 2 × 8	9-4	8-4	7-5	6-10	604	5-11	5-7
	3 – 2 × 10	11-9	10-2	9-1	8-4	7-8	7-2	6-9
	3 – 2 × 12	13-8	11-10	10-7	9-8	8-11	8-4	7-10

For SI: 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation allowed. Extrapolation is not allowed.
b. Beams supporting a single span of joists with or without cantilever.
c. Dead load = 10 psf, $L/\Delta = 360$ at main span, $L/\Delta = 180$ at cantilever. Snow load not assumed to be concurrent with live load.
d. No. 2 grade, wet service factor included.
e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.
f. Beam cantilevers are limited to the adjacent beam's span divided by 4.
g. Includes incising factor.
h. Incising factor not included.
i. Deck joist span as shown in Figure R507.5.
j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

TABLE R507.5(3)
MAXIMUM DECK BEAM SPAN—60 PSF GROUND SNOW LOAD[c]

BEAM SPECIES[d]	BEAM SIZE[e]	EFFECTIVE DECK JOIST SPAN LENGTH[a, i, j] (feet)						
		6	8	10	12	14	16	18
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches)[a, b, f]						
Southern pine	1 – 2 × 6	4-2	3-7	3-3	2-11	2-9	2-6	2-5
	1 – 2 × 8	5-3	4-7	4-1	3-9	3-5	3-3	3-0
	1 – 2 × 10	6-3	5-5	4-10	4-5	4-1	3-10	3-7
	1 – 2 × 12	7-5	6-5	5-9	5-3	4-10	4-6	4-3
	2 – 2 × 6	6-2	5-4	4-9	4-4	4-0	3-9	3-7
	2 – 2 × 8	7-10	6-10	6-1	5-7	5-2	4-10	4-6
	2 – 2 × 10	9-4	8-1	7-3	6-7	6-1	5-8	5-4
	2 – 2 × 12	11-0	9-6	8-6	7-9	7-2	6-9	6-4
	3 – 2 × 6	7-5	6-9	6-0	5-6	5-1	4-9	4-6
	3 – 2 × 8	9-9	8-6	7-8	6-11	6-5	6-0	5-8
	3 – 2 × 10	11-8	10-2	9-1	8-3	7-8	7-2	6-9
	3 – 2 × 12	13-9	11-11	10-8	9-9	9-0	8-5	7-11
Douglas fir-larch[g] Hem-fir[g] Spuce-pine-fir[g]	1 – 2 × 6	3-8	3-1	2-8	2-4	2-2	2-0	1-10
	1 – 2 × 8	5-0	4-1	3-6	3-1	2-10	2-7	2-5
	1 – 2 × 10	6-1	5-2	4-6	4-0	3-7	3-4	3-2
	1 – 2 × 12	7-1	6-1	5-5	4-10	4-5	4-1	3-10
	2 – 2 × 6	5-6	4-9	4-3	3-10	3-5	3-1	2-10
	2 – 2 × 8	7-5	6-5	5-9	5-0	4-6	4-1	3-9
	2 – 2 × 10	9-0	7-10	7-0	6-4	5-9	5-2	4-10
	2 – 2 × 12	10-6	9-1	8-1	7-5	6-10	6-4	5-10
	3 – 2 × 6	6-11	6-0	5-4	4-11	4-6	4-2	3-10
	3 – 2 × 8	9-3	8-0	7-2	6-6	6-1	5-6	5-0
	3 – 2 × 10	11-4	9-10	8-9	8-0	7-5	6-11	6-5
	3 – 2 × 12	13-2	11-5	10-2	9-4	8-7	8-1	7-7
Redwood[h] Western cedars[h] Ponderosa pine[h] Red pine[h]	1 – 2 × 6	3-9	3-2	2-9	2-5	2-2	2-0	1-11
	1 – 2 × 8	4-10	4-2	3-7	3-2	2-11	2-8	2-6
	1 – 2 × 10	5-10	5-1	4-6	4-1	3-8	3-5	3-3
	1 – 2 × 12	6-10	5-11	5-3	4-10	4-5	4-2	3-11
	2 – 2 × 6	5-7	4-10	4-4	3-11	3-6	3-2	2-11
	2 – 2 × 8	7-1	6-2	5-6	5-0	4-7	4-2	3-10
	2 – 2 × 10	8-8	7-6	6-9	6-2	5-8	5-4	4-11
	2 – 2 × 12	10-1	8-9	7-10	7-2	6-7	6-2	5-10
	3 – 2 × 6	6-8	6-1	5-5	5-0	4-7	4-3	3-11
	3 – 2 × 8	8-9	7-9	6-22	6-4	5-20	5-5	5-3
	3 – 2 × 10	10-11	9-5	8-5	7-8	7-3	6-8	6-3
	3 – 2 × 12	12-8	10-11	9-9	8-11	8-3	7-9	7-3

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation allowed. Extrapolation is not allowed.
b. Beams supporting a single span of joists with or without cantilever.
c. Dead load = 10 psf, $L/\Delta = 360$ at main span, $L/\Delta = 180$ at cantilever. Snow load not assumed to be concurrent with live load.
d. No. 2 grade, wet service factor included.
e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.
f. Beam cantilevers are limited to the adjacent beam's span divided by 4.
g. Includes incising factor.
h. Incising factor not included.
i. Deck joist span as shown in Figure R507.5.
j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

TABLE R507.5(4)
MAXIMUM DECK BEAM SPAN—70 PSF GROUND SNOW LOAD[c]

BEAM SPECIES[d]	BEAM SIZE[e]	EFFECTIVE DECK JOIST SPAN LENGTH (feet)[a, i, j]						
		6	8	10	12	14	16	18
		MAXIMUM DECK BEAM SPAN LENGTH (feet-inches)[a, b, f]						
Southern pine	1 – 2 × 6	3-11	3-4	3-0	2-9	2-6	2-4	2-3
	1 – 2 × 8	4-11	4-3	3-10	3-6	3-3	3-0	2-10
	1 – 2 × 10	5-10	5-1	4-6	4-2	3-10	3-7	3-4
	1 – 2 × 12	6-11	6-0	5-4	4-11	4-6	4-3	4-0
	2 – 2 × 6	5-9	5-0	4-6	4-1	3-9	3-6	3-4
	2 – 2 × 8	7-4	6-4	5-8	5-2	4-10	4-6	4-3
	2 – 2 × 10	8-9	7-7	6-9	6-2	5-8	5-4	5-0
	2 – 2 × 12	10-3	8-11	8-0	7-3	6-9	6-3	5-11
	3 – 2 × 6	7-0	6-3	5-7	5-1	4-9	4-5	4-2
	3 – 2 × 8	9-3	8-0	7-2	6-6	6-0	5-8	5-4
	3 – 2 × 10	10-11	9-6	8-6	7-9	7-2	6-8	6-4
	3 – 2 × 12	12-11	11-2	10-0	9-1	8-5	7-11	7-5
Douglas fir-larch[g] Hem-fir[g] Spruce-pine-fir[g]	1 – 2 × 6	3-5	2-10	2-5	2-2	2-0	1-10	1-9
	1 – 2 × 8	4-7	3-8	3-2	2-10	2-7	2-5	2-4
	1 – 2 × 10	5-8	4-9	4-1	3-8	3-4	3-1	2-11
	1 – 2 × 12	6-7	5-8	5-0	4-6	4-1	3-10	3-7
	2 – 2 × 6	5-2	4-6	4-0	3-5	3-1	2-10	2-7
	2 – 2 × 8	6-11	6-0	5-3	4-7	4-1	3-8	3-5
	2 – 2 × 10	8-5	7-4	6-6	5-10	5-2	4-9	4-5
	2 – 2 × 12	9-10	8-6	7-7	6-11	6-4	5-9	5-4
	3 – 2 × 6	6-6	5-7	5-0	4-7	4-2	3-9	3-5
	3 – 2 × 8	8-8	7-6	6-8	6-1	5-6	5-0	4-7
	3 – 2 × 10	10-7	9-2	8-2	7-6	6-11	6-4	5-10
	3 – 2 × 12	12-4	10-8	9-7	8-9	8-1	7-7	7-1
Redwood[h] Western cedars[h] Ponderosa pine[h] Red pine[h]	1 – 2 × 6	3-6	2-11	2-6	2-3	2-0	1-11	1-9
	1 – 2 × 8	4-6	3-10	3-3	2-11	2-8	2-6	2-4
	1 – 2 × 10	5-6	4-9	4-2	3-9	3-5	3-2	3-0
	1 – 2 × 12	6-4	5-6	4-11	4-6	4-2	3-11	3-8
	2 – 2 × 6	5-3	4-7	4-1	3-6	3-2	2-11	2-8
	2 – 2 × 8	6-8	5-9	5-2	4-8	4-2	3-10	3-6
	2 – 2 × 10	8-2	7-1	6-4	5-9	5-4	4-10	4-6
	2 – 2 × 12	9-5	8-2	7-4	6-8	6-2	5-9	5-5
	3 – 2 × 6	6-4	5-8	5-1	4-8	4-3	3-10	3-6
	3 – 2 × 8	8-4	7-3	6-5	5-11	5-5	5-1	4-8
	3 – 2 × 10	10-2	8-10	7-11	7-2	6-8	6-3	5-11
	3 – 2 × 12	11-10	10-3	9-2	8-4	7-9	7-3	6-10

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa, 1 pound = 0.454 kg.

a. Interpolation allowed. Extrapolation is not allowed.
b. Beams supporting a single span of joists with or without cantilever.
c. Dead load = 10 psf, $L/\Delta = 360$ at main span, $L/\Delta = 180$ at cantilever. Snow load not assumed to be concurrent with live load.
d. No. 2 grade, wet service factor included.
e. Beam depth shall be equal to or greater than the depth of intersecting joist for a flush beam connection.
f. Beam cantilevers are limited to the adjacent beam's span divided by 4.
g. Includes incising factor.
h. Incising factor not included.
i. Deck joist span as shown in Figure R507.5.
j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

Part Three: Beams

Subject: 2021 IRC Cantilever Adjustment

2021 Code: Table R507.5(5), footnote j.

j. For calculation of effective deck joist span, the actual joist span length shall be multiplied by the joist span factor in accordance with Table R507.5(5).

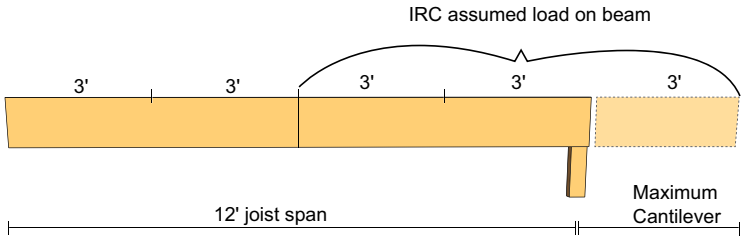
TABLE R507.5(5)
JOIST SPAN FACTORS FOR CALCULATING EFFECTIVE DECK JOIST SPAN
[for use with Note j in Tables R507.5(1), R507.5(2), R507.5(3) and R507.5(4)]

C/J[a]	JOIST SPAN FACTOR
0 (no cantilever)	0.66
1/12 (0.87)	0.72
1/10 (0.10)	0.80
1/8 (0.125)	0.84
1/6 (0.167)	0.90
1/4 (0.250)	1.00

For SI: 1 foot = 304.8 mm.
a. C = actual joist cantilever length (feet); J = actual joist span length (feet).

Application: As previously discussed, Table R507.5 sizes all beams for carrying the maximum allowable joist cantilever, whether there is a cantilever or not. A maximum joist cantilever beyond a beam can add up to 50 percent more load to the beam and can significantly affect the beam size or maximum span. To correct this when a lesser cantilever is designed, footnote h provides a table of ratios of cantilever to span that modifies the joist span used in the beam span table.

To use the table, divide the cantilever by the span and then round up to the next higher decimal in parentheses under the “C/J” column of the table. Next, multiply the joist span by the corresponding “joist span factor” and use that as the joist span input value in Table R507.5.



Example 1

$C/J = \frac{\text{cantilever}}{\text{joist}}$

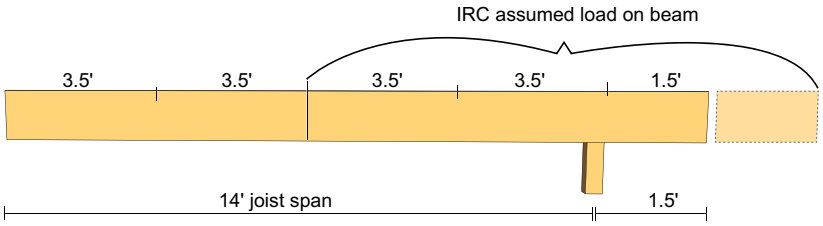
No cantilever = 0

Footnote h, 0 = 0.66

12' joist span × 0.66 = 7.92

7.92' effective joist span

Use 8' joist span in table



Example 2

$C/J = {}^{1.5}/_{14} = 0.107$

Next highest value in table = 0.125 ($^{1}/_{8}$)

Footnote h, $^{1}/_{8}$ = 0.84

14' joist span × 0.84 = 11.76'

11.76' effective joist span

Use 12' joist span in table

Figure 5-3-1: With no cantilever, a 12-foot joist span can be entered in the table as an 8-foot joist span and allow for a properly sized beam. When there is a partial cantilever, such as in Example Two, footnote h allows the beam to be sized for the actual cantilever, not the maximum. It's important to note that not using the factors in footnote h will not produce an undersized beam, but rather an oversized beam. During design, the factors allow for more appropriate beam sizes and they are recommended. For plan review, the factors are not necessary to review unless the proposed beam is undersized using the tabular value.

Part Three: Beams

Subject: Beam Bearing and Support

2021 Code: **R507.5.1 Deck beam bearing.** The ends of beams shall have not less than $1^1/_2$ inches (38 mm) of bearing on wood or metal and not less than 3 inches (76 mm) of bearing on concrete or masonry for the entire width of the beam. Where multiple-span beams bear on intermediate posts, each ply must have full bearing on the post in accordance with Figures R507.5.1(1) and R507.5.1(2).

Application: Just as in Section R507.6.1 for joists, beams must also bear the minimum length on wood and metal and longer on masonry and concrete. The entire width of the beam must be supported for this length, and where a multi-ply beam splices end-to-end, even in a single ply, each end of each ply must be supported. Also like Section R507.6.1, engineered wood product beams that span further than solid sawn beams sized in the IRC may require more bearing area than only $1^1/_2$ inches of beam length.

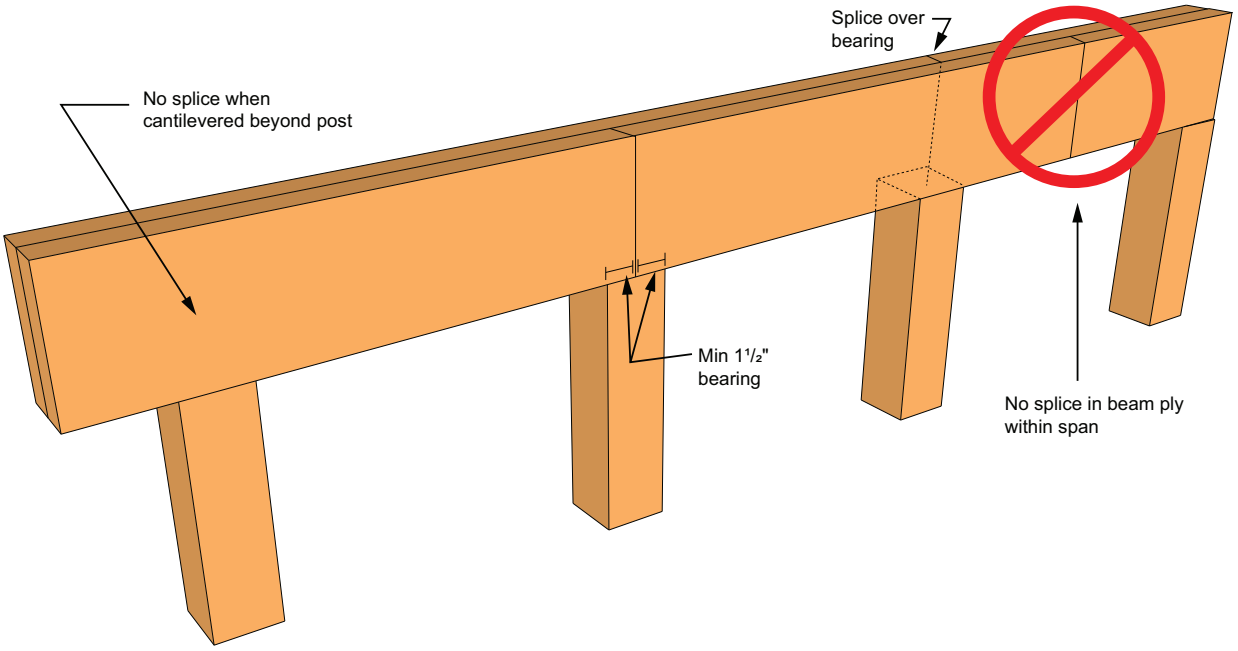


Figure 5-3-2: Splices in plies of multi-ply beams should not all be located at the same bearing location, unless both sides of the beam on each side of the post can be connected to the post or a splice plate is installed across the sides. Section R502.6.1 provides guidance for connecting end-to-end joists together over a beam. This guidance can also apply to connecting together end-to-end beam splices over a post.

Part Three: Beams

Subject: Beam Connection to Supports

2021 Code: **R507.5.2 Deck beam connection to supports.** Deck beams shall be attached to supports in a manner capable of transferring vertical loads and resisting horizontal displacement. Deck beam connections to wood posts shall be in accordance with Figures R507.5.1(1) and R507.5.1(2). Manufactured post-to-beam connectors shall be sized for the post and beam sizes. Bolts shall have washers under the head and nut.

Application: The first sentence of this section makes clear the purpose of the beam-to-support connection. Decks can be successfully constructed using a number of design methods, so the stated goal is the need to transfer the loads vertically and to resist lateral displacement off the support. Prescriptive methods are then provided that allow for notched posts with bolts or the endless variety of manufactured connectors. Connectors must be installed in accordance with the manufacturer's installation instructions, as explained in Chapter 3 of this book. The requirement for a washer under both the head and nut sides of the bolt precludes the use of carriage bolts. Though these figures specify a $^{1}/_{2}$-inch-diameter bolt, there was no testing or engineering conducted to conclude this as the minimum. Designs utilizing smaller diameter bolts or alternative bolt products can be approved depending on the various design variables.

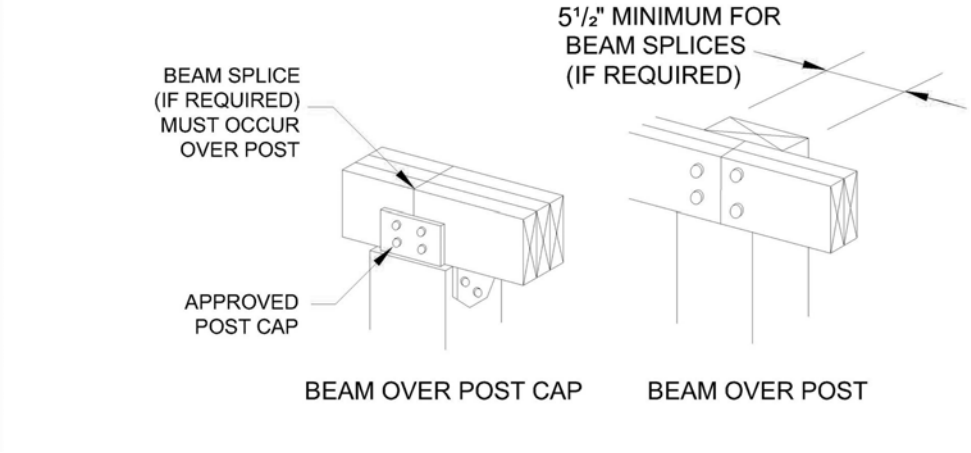


FIGURE R507.5.1(1)
DECK BEAM TO DECK POST

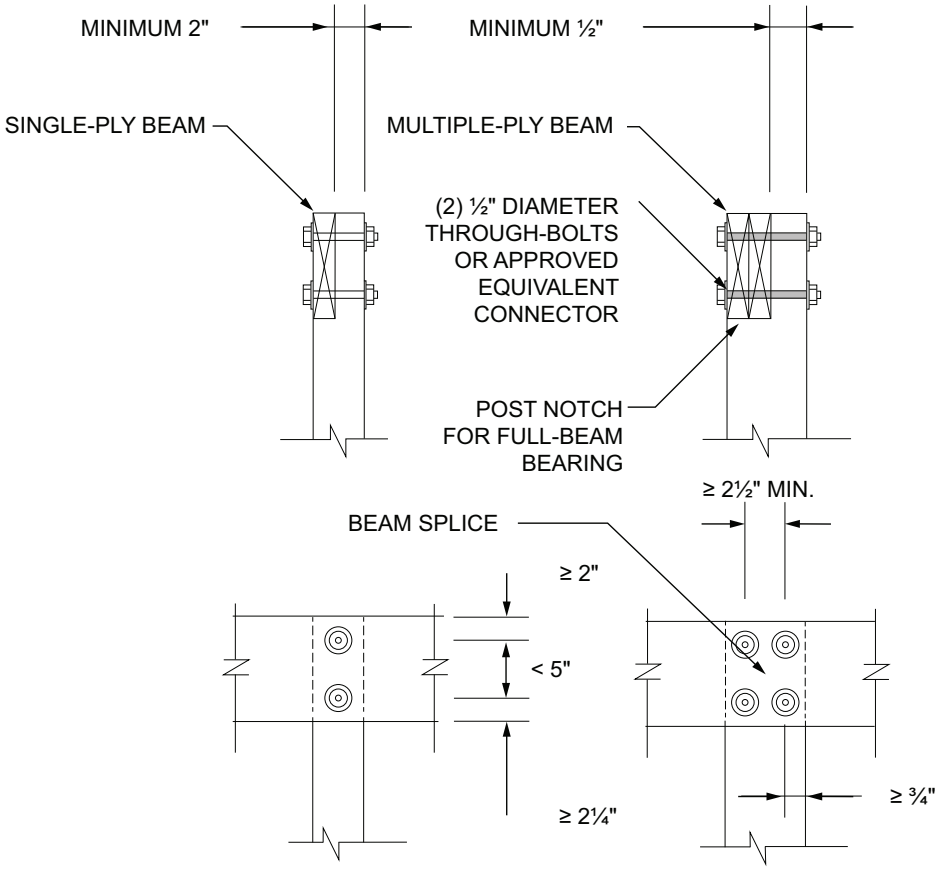


FIGURE R507.5.1(2)
NOTCHED POST-TO-BEAM CONNECTION

Chapter 6

Posts and Foundations

Introduction

All the loads received by a deck are ultimately transferred to the earth through a foundation system. Until the 2018 edition of the IRC, however, there were no model construction standards for deck foundations. Through this lack of standards, building authorities across the country, with varying climates, soil conditions, and experiences, developed their own “rule of thumb” for what worked in their regions.

The IRC now provides a footing sizing design table for specific soil types and specific loading conditions, but many may find the results quite different from what they are accustomed to. Regions with deep frost depths have typically utilized a pier type of foundation, as opposed to a broad, shallow footing with a large bearing area at the base. In regions where a 10-inch-diameter, 36-inch-deep pier has been acceptable, you will find the 2018 IRC now prescribing a 14-inch or larger diameter. Regions that commonly use the deeper pier-type foundations, under the new IRC method, are essentially sizing them as really thick footings.


Courtesy of NADRA Member Company, New Castle Building Group

Deck footings in the IRC are sized using the same soil compressive strength per square foot that is used for a house, yet it could be argued that a deck and a house are quite different. A house is finished in rigid and brittle materials with less tolerance to movement, and it has doors and windows whose weatherstripping and visual reveals require strict alignment. House foundations must maintain stability across long, continuous footings, less tolerant to inconsistent movement. A deck is quite the opposite, not only in the flexibility of materials, but in the greater tolerance of movement between isolated and widely separated footing pads or piers. Consider that a freestanding deck is exempt from frost protection—it can tolerate movement. These considerations are why current IRC deck footings may be larger than expected in regions where sufficient sizing was found empirically, through trial and error. The 2021 IRC modified the deck foundation designs to allow footings as small as 8-inch diameter for lighter loads. Jurisdictions operating under the adoption of earlier IRC editions are encouraged to make use of the expanded 2021 provisions through approval as an "alternative."

Part One: Support Posts

Part One: **Support Posts**

Subject: **Tributary Load**

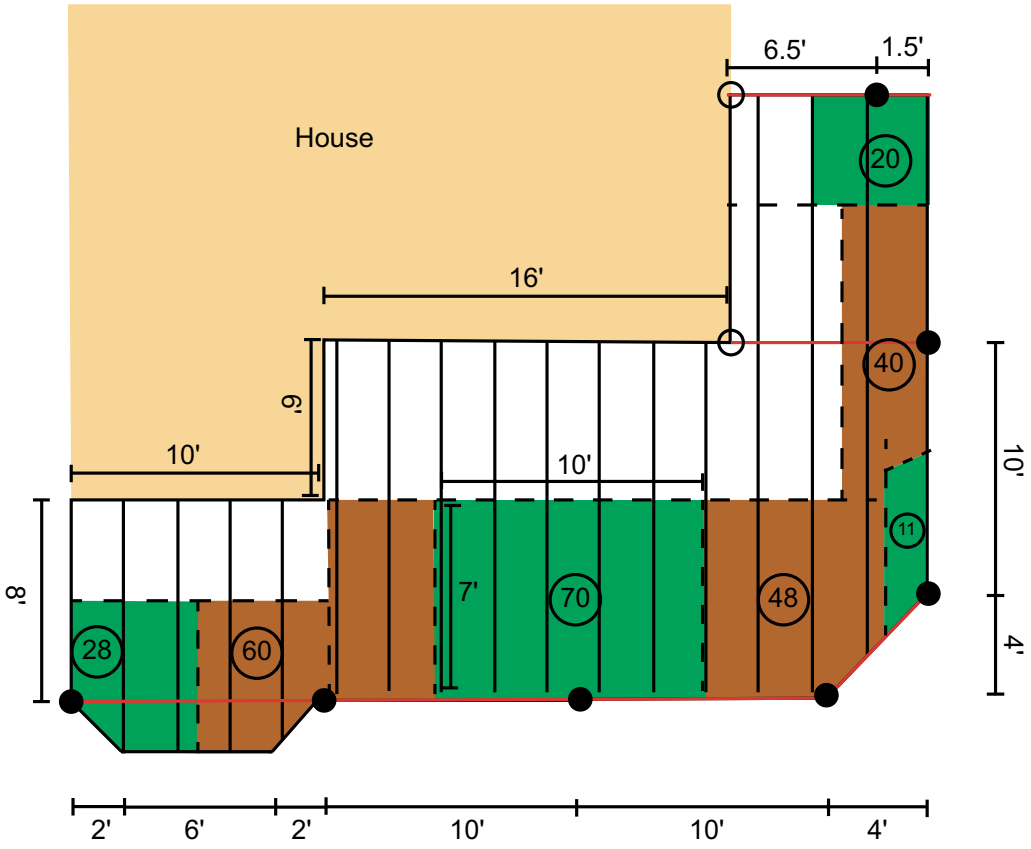


Figure 6-1-1: New to the 2018 edition, and very helpful in precise prescriptive design, is the use of “tributary area” as an input value for pre-engineered design tables. While some believe calculating tributary area should be the work of engineers, it’s really just elementary geometry that’s required. Draw lines intersecting across the center of each joist span and beam span, and the resulting area inside the lines is the tributary area of the post inside the lines. Using graph paper with a $^{1}/_{4}$:12 scale is a very easy way to simply “count the squares” if you really want to avoid math.

Part One: Support Posts

Subject: Deck Post Sizing (2018 edition)

2018 Code: **R507.4 Deck posts.** For single-level wood-framed decks with beams sized in accordance with Table R507.5, deck post size shall be in accordance with Table R507.4.

TABLE R507.4
DECK POST HEIGHT[a]

DECK POST SIZE	MAXIMUM HEIGHT[a, b] (feet-inches)
4 × 4	6-9[c]
4 × 6	8
6 × 6	14
8 × 8	14

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm,
1 pound per square foot = 0.0479 kPa.

a. Measured to the underside of the beam.

b. Based on 40 psf live load.

c. The maximum permitted height is 8 feet for one-ply and two-ply beams. The maximum permitted height for three-ply beams on post cap is 6 feet 9 inches.

Application: Until the 2015 edition of the IRC, there were no provisions to guide the proper sizing of deck support posts. Under loading conditions, only the cross-sectional size of a post braces it against bending (buckling). The greater the length or the greater the load, the greater the bending. To find the minimum size in this simple IRC table, the largest possible loads that can be derived from beams constructed under Table R507.5 were assumed. The 6-9 maximum height for a 4 × 4 post appears reduced from the 8-foot height permitted in the 2015 edition, but it is not. Footnote c explains that the 6-9 limitation is only when the 4 × 4 post supports a 3-ply beam through the use of a manufactured connector. A 3-ply beam can span farther and thus put more load on the post than a 2-ply beam.

2021 Modification:

A major expansion of Table R507.4 is provided in the 2021 edition that limits the post height based on the actual tributary area the post supports, as opposed to the largest area it “could” support, as in the 2018. This greatly expanded the allowable height of 4 × 4 posts. It also allows for prescriptive post design that supports greater loads than prescriptive beam design can create. As discussed in Chapter 1 of this book, engineered design, like large and long spanning glulam beams, can be used in tandem with prescriptive design. Under the 2021 table, a post could be designed to support such beams and larger areas. As with all the updated 2021 design tables, interpolation between tabular values is permitted for more precise design and 50, 60 and 70 psf snow load regions are now provided design tables. The 2021 post sizing Table R507.4 is provided in the following pages.

As discussed in Chapter 7 of this book, lateral loads on decks must be transferred to the earth. Knee braces are often used as a method to brace the deck laterally, but they transfer the loads laterally into the mid height of the post. This additional load increases the buckling potential of the post and thus reduces the loads it can carry at a given height. With there being no prescriptive design for resisting deck lateral loads in the IRC, the post sizing does not include any loads from knee braces. Posts that are reaching their maximum height by Table R507.4 should not be designed with knee braces.

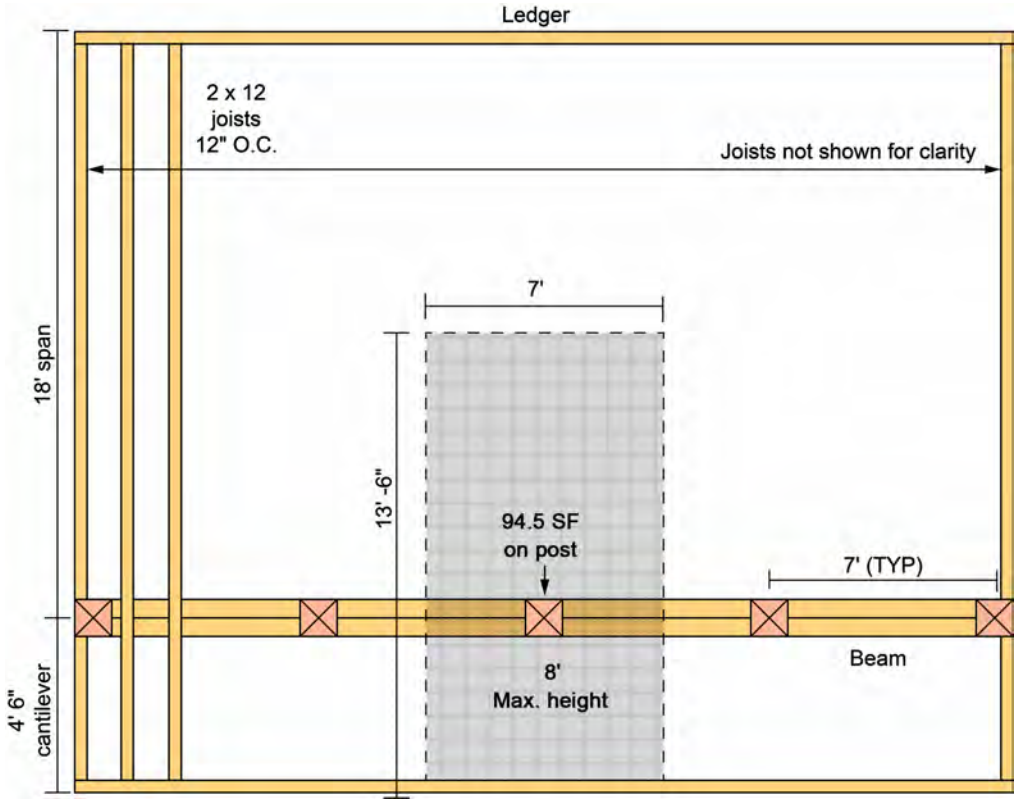


Figure 6-1-2: This illustration shows the maximum area of 94.5 square feet that could be placed on a center 4 × 4 post using the 2018 IRC beam span table and is what the 8-foot height limit is based on. Smaller areas supported by more average deck designs can certainly have taller 4 × 4 posts. The 2021 IRC edition provides an expanded post sizing table based on the actual tributary load supported by each post, multiple snow loads, and different wood species. The 2021 table is provided on the following page.

Part One: Support Posts

Subject: Deck Post Sizing (2021 edition)

2021 Code:

TABLE R507.4
DECK POST HEIGHT

LOADS (psf)[b]	POST SPECIES[c]	POST SIZE[d]	TRIBUTARY AREA (ft^2)[g, h]							
			20	40	60	80	100	120	140	160
			MAXIMUM DECK POST HEIGHT[a] (feet-inches)							
40 live load	Southern pine	4 × 4	14-0	13-8	11-0	9-5	8-4	7-5	6-9	6-2
		4 × 6	14-0	14-0	13-11	12-0	10-8	9-8	8-10	8-2
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	13-6	10-10	9-3	8-0	7-0	6-2	5-3
		4 × 6	14-0	14-0	13-10	11-10	10-6	9-5	8-7	7-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	13-2	10-3	8-1	5-8	NP	NP	NP
		4 × 6	14-0	14-0	13-6	11-4	9-9	8-4	6-9	4-7
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	13-7	9-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
50 ground snow load	Southern pine	4 × 4	14-0	12-2	9-10	8-5	7-5	6-7	5-11	5-4
		4 × 6	14-0	14-0	12-6	10-9	9-6	8-7	7-10	7-3
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	13-4
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	12-1	9-8	8-2	7-1	6-2	5-3	4-2
		4 × 6	14-0	14-0	12-4	10-7	9-4	8-4	7-7	6-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	14-0	12-10
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	11-8	9-0	6-10	3-7	NP	NP	NP
		4 × 6	14-0	14-0	12-0	10-0	8-6	7-0	5-3	NP
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	10-8	2-4
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
60 ground snow load	Southern pine	4 × 4	14-0	11-1	8-11	7-7	6-7	5-10	5-2	4-6
		4 × 6	14-0	14-0	11-4	9-9	8-7	7-9	7-1	6-6
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	12-9	11-2
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	10-11	8-8	7-3	6-2	5-0	3-7	NP
		4 × 6	14-0	13-11	11-2	9-7	8-4	7-5	6-8	5-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	14-0	12-2	10-2
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	10-6	7-9	4-7	NP	NP	NP	NP
		4 × 6	14-0	13-7	10-9	8-9	7-0	4-9	NP	NP
		6 × 6	14-0	14-0	14-0	14-0	14-0	9-9	NP	NP
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

(continued)

TABLE R507.4—continued
DECK POST HEIGHT

LOADS (psf)[b]	POST SPECIES[c]	POST SIZE[d]	TRIBUTARY AREA (ft^2)[g, h]							
			20	40	60	80	100	120	140	160
			MAXIMUM DECK POST HEIGHT[a] (feet-inches)							
70 ground snow load	Southern pine	4 × 4	14-0	10-2	8-2	6-11	5-11	5-2	4-4	3-4
		4 × 6	14-0	12-11	10-5	8-11	7-10	7-1	6-5	5-10
		6 × 6	14-0	14-0	14-0	14-0	14-0	12-9	10-11	8-7
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Douglas fir[e] Hem-fir[e] Spruce-pine-fir[e]	4 × 4	14-0	10-1	7-11	6-6	5-3	3-7	NP	NP
		4 × 6	14-0	12-10	10-3	8-9	7-7	6-8	5-10	4-11
		6 × 6	14-0	14-0	14-0	14-0	14-0	12-2	9-9	5-9
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0
	Redwood[f] Western cedars[f] Ponderosa pine[f] Red pine[f]	4 × 4	14-0	9-5	6-5	NP	NP	NP	NP	NP
		4 × 6	14-0	12-6	9-8	7-7	5-3	NP	NP	NP
		6 × 6	14-0	14-0	14-0	14-0	10-8	NP	NP	NP
		8 × 8	14-0	14-0	14-0	14-0	14-0	14-0	14-0	14-0

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 0.0479 kPa.
NP = Not Permitted.

a. Measured from the underside of the beam to the top of footing or pier.
b. 10 psf dead load. Snow load not assumed to be concurrent with live load.
c. No. 2 grade, wet service factor included.
d. Notched deck posts shall be sized to accommodate beam size in accordance with Section R507.5.2.
e. Includes incising factor.
f. Incising factor not included.
g. Area, in square feet, of deck surface supported by post and footings.
h. Interpolation permitted. Extrapolation not permitted.

Part Two: Foundation Design

Part Two: Foundation Design

Subject: Footings

2021 Code: **R507.3 Footings.** Decks shall be supported on concrete footings or other *approved* structural systems designed to accommodate all loads in accordance with Section R301. Deck footings shall be sized to carry the imposed loads from the deck structure to the ground as shown in Figure R507.3.

Exceptions:

1. Footings shall not be required for free-standing decks consisting of joists directly supported on grade over their entire length.
2. Footings shall not be required for free-standing decks that meet all of the following criteria:
   - 2.1. The joists bear directly on *precast concrete* pier blocks at grade without support by beams or posts.
   - 2.2. The area of the deck does not exceed 200 square feet (18.6 m^2).
   - 2.3. The walking surface is not more than 20 inches (508 mm) above grade at any point within 36 inches (914 mm) measured horizontally from the edge.

Application: The provisions for deck footings in Chapters 4 and 5 were reorganized and corrected in the 2021 edition. The intent and purpose of the provisions were unchanged or insignificant. Only the 2021 sections will be provided in the following pages discussing foundations.

Though the IRC provides prescriptive designs for concrete foundations, this section makes it clear that other structural systems can be approved. There are a number of alternative products on the market for deck foundations, such as pinned, helical, footing pads, and screws with testing and engineering to offer for approval. The exceptions apply to deck frames that are placed directly on the ground or on gravel and supported entirely below. They do not have joists and beams that span to posts, and thus they have no need for footings.

2021 Modification:

In the 2021 IRC, Exception 2 (provided above) was relocated from Section R507.3.2, Minimum depth. Use of pier blocks for small, low-to-the-ground decks is common, but they are not approved in the IRC to support beams, but rather each joist. In this design, like Exception 1, there are no beams or posts to create a tributary area that would require a footing designed from this chapter. Therefore, they are an exception to all the footing provisions in Section R507.3.

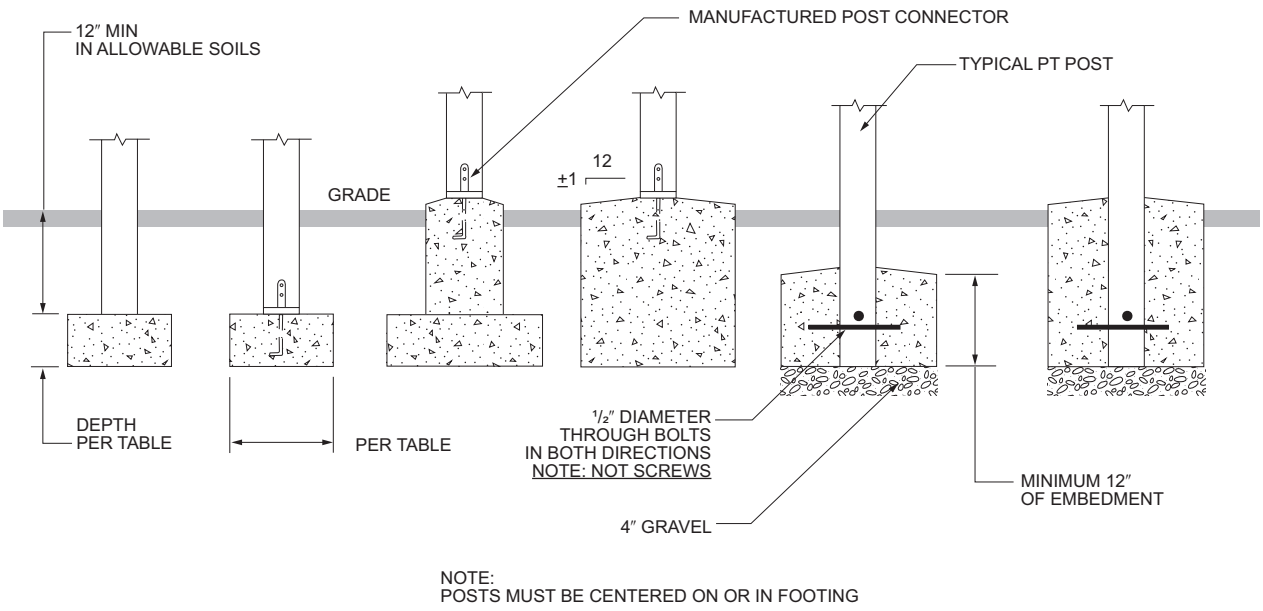


FIGURE R507.3
DECK POSTS TO DECK FOOTING CONNECTION

Figure 6-2-1: Six different foundations permitted by the IRC are shown here, but all transfer loads only through the bearing area at their base. Posts that are sunk into concrete must be open to a gravel bed on the bottom for drainage, and $^{1}/_{2}$-inch bolts or equivalent must cross through the post and into the uncured concrete. Posts that extend into the ground or concrete must be treated for ground contact. In the most minimal design (far left in figure), and where coastal or design wind speeds don't require uplift resistance, the post need not be connected to the footing if embedded in a minimum of 12 inches of soil for lateral resistance.

Part Two: Foundation Design

Subject: Soil Types

2021 Code: **R401.4 Soil tests.** Where quantifiable data created by accepted soil science methodologies indicate *expansive soils*, *compressible soils*, shifting soils or other questionable soil characteristics are likely to be present, the *building official* shall determine whether to require a soil test to determine the soil's characteristics at a particular location. This test shall be done by an *approved agency* using an *approved* method.

R401.4.1 Geotechnical evaluation. In lieu of a complete geotechnical evaluation, the load-bearing values in Table R401.4.1 shall be assumed.

TABLE R401.4.1
PRESUMPTIVE LOAD-BEARING VALUES OF FOUNDATION MATERIALS[a]

CLASS OF MATERIAL	LOAD-BEARING PRESSURE (pounds per square foot)
Crystalline bedrock	12,000
Sedimentary and foliated rock	4,000
Sandy gravel and/or gravel (GW and GP)	3,000
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000
Clay, sandy, silty clay, clayey silt, silt and sandy siltclay (CL, ML, MH and CH)	1,500[b]

For SI: 1 pound per square foot = 0.0479 kPa.

a. Where soil tests are required by Section R401.4, the allowable bearing capacities of the soil shall be part of the recommendations.

b. Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the allowable bearing capacity shall be determined by a soils investigation.

Application: The load-bearing pressure for common soil types and blends has always existed in the IRC, but in the 2018 IRC a new table was included to correlate the bearing pressure of a soil type with a minimum size bearing area for deck foundations.

It may be impractical to determine the site-specific soil types for an average residential deck, and thus building authorities may likely use the default value of 1,500 lbs for clay. However, in regions where sand or gravel soils are known to exist, higher values may also be approved.

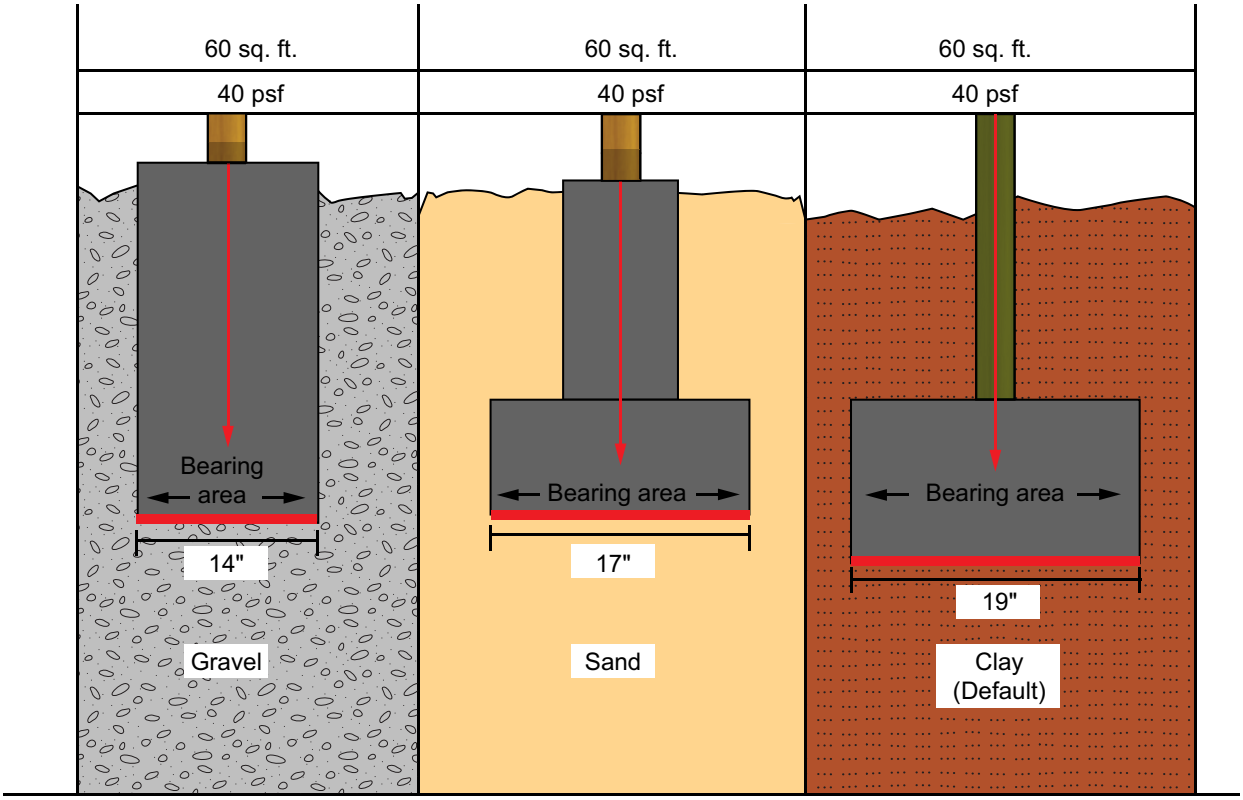


Figure 6-2-2: Different soil types can support different maximum loads per square foot. This illustration shows the difference in footing diameter of three different soils supporting the same load. The load-bearing pressure from the soil types in Table R401.4.1 are used in Table R507.3.1 for sizing the minimum bearing area. Different prescriptive foundation types (shown in Figure 6-2-1) do not affect the bearing area sizing.

Part Two: Foundation Design

Subject: Minimum Footing Size

2021 Code: **R507.3.1 Minimum size.** The minimum size of concrete footings shall be in accordance with Table R507.3.1, based on the tributary area and allowable soil-bearing pressure in accordance with Table R401.4.1.

Application: This section ties the soil-bearing capacities in Table R401.4.1, previously discussed, with the deck footing design table, R507.3.1, provided on the following page.

Table R507.3.1 was first introduced in the 2018 IRC and allowed footings to be sized based on the tributary area of deck supported, similar to what can be done now for post sizing. However, the smallest area in the table was 20 square feet and resulted in an overall minimum 14-inch-diameter footing. This was considered by many as an excessively sized minimum, specifically in areas that have had success with deep and narrow pier-type foundations.

2021 Modification:

The footing size table was revised in the 2021 edition to include a smaller, 5 square feet and reduced the overall minimum size down to an 8-inch diameter. Other values in the table were revised after careful evaluation. A new footnote clarifies that the footing sizes assume plain concrete and that reinforcing steel could reduce the minimum thicknesses required by the table.

Only the 2021 Minimum Footing Size Table R507.3.1 has been provided on the following page, as it includes all the corrected values from the 2018 table.

TABLE R507.3.1
MINIMUM FOOTING SIZE FOR DECKS

LIVE OR GROUND SNOW LOAD[b] (psf)	TRIBUTARY AREA (ft^2)	LOAD-BEARING VALUE OF SOILS[a, c, d] (psf)								
		1,500[e]			2,000[e]			≥ 3,000[e]		
		Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)[f]	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)[f]	Side of a square footing (inches)	Diameter of a round footing (inches)	Thickness (inches)[f]
40	5	7	8	6	7	8	6	7	8	6
	20	10	12	6	9	9	6	7	8	6
	40	14	16	6	12	14	6	10	12	6
	60	17	19	6	15	17	6	12	14	6
	80	20	22	7	17	19	6	14	16	6
	100	22	25	8	19	21	6	15	17	6
	120	24	27	9	21	23	7	17	19	6
	140	26	29	10	22	25	8	18	21	6
	160	28	31	11	24	27	9	20	22	7
50	5	7	8	6	7	8	6	7	8	6
	20	11	13	6	10	11	6	8	9	6
	40	15	17	6	13	15	6	11	13	6
	60	19	21	6	16	18	6	13	15	6
	80	21	24	8	19	21	6	15	17	6
	100	24	27	9	21	23	7	17	19	6
	120	26	30	10	23	26	8	19	21	6
	140	28	32	11	25	28	9	20	23	7
	160	30	34	12	26	30	10	21	24	8
60	5	7	8	6	7	8	6	7	8	6
	20	12	14	6	11	12	6	9	10	6
	40	16	19	6	14	16	8	12	14	6
	60	20	23	7	17	20	6	14	16	6
	80	23	26	9	20	23	7	16	19	6
	100	26	29	10	22	25	8	18	21	6
	120	28	32	11	25	28	9	20	23	7
	140	31	35	12	27	30	10	22	24	8
	160	33	37	13	28	32	11	23	26	9
70	5	7	8	6	7	8	6	7	8	6
	20	12	14	6	11	13	6	9	10	6
	40	18	20	6	15	17	6	12	14	6
	60	21	24	8	19	21	6	15	17	6
	80	25	28	9	21	24	8	18	20	6
	100	28	31	11	24	27	9	20	22	7
	120	30	34	12	26	30	10	21	24	8
	140	33	37	13	28	32	11	23	26	9
	160	35	40	15	30	34	12	25	28	9

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kPa.

a. Interpolation permitted, extrapolation not permitted.

b. Based on highest load case: Dead + Live or Dead + Snow.

c. Footing dimensions shall allow complete bearing of the post.

d. If the support is a brick or CMU pier, the footing shall have a minimum 2-inch projection on all sides.

e. Area, in square feet, of deck surface supported by post and footings.

f. Minimum thickness shall only apply to plain concrete footings.

Part Three: Foundation Depth

Part Three: **Foundation Depth**

Subject: **Minimum Depth**

2021 Code: **R507.3.2 Minimum depth.** Deck footings shall be placed not less than 12 inches (305 mm) below the undisturbed ground surface.

Application: Reorganization of the deck foundation sections in the 2021 IRC did not significantly change the intent and purpose; therefore, only the 2021 provisions have been provided.

Without regard to frost protection, the minimum depth of any foundation, including that of an entire house, is 12 inches below undisturbed soil. This depth is intended to keep a foundation stabilized, but also to provide restraint against lateral loads, such as wind or seismic. Soil that has been disturbed, by excavation and backfill, tilling, or amendments, can no longer be assumed at the same density as undisturbed soil, and thus cannot be provided the allowable bearing capacities from Table R401.4.1. Reasonable judgment can be made for lightly loaded deck footings in backfill that has been settling for decades.

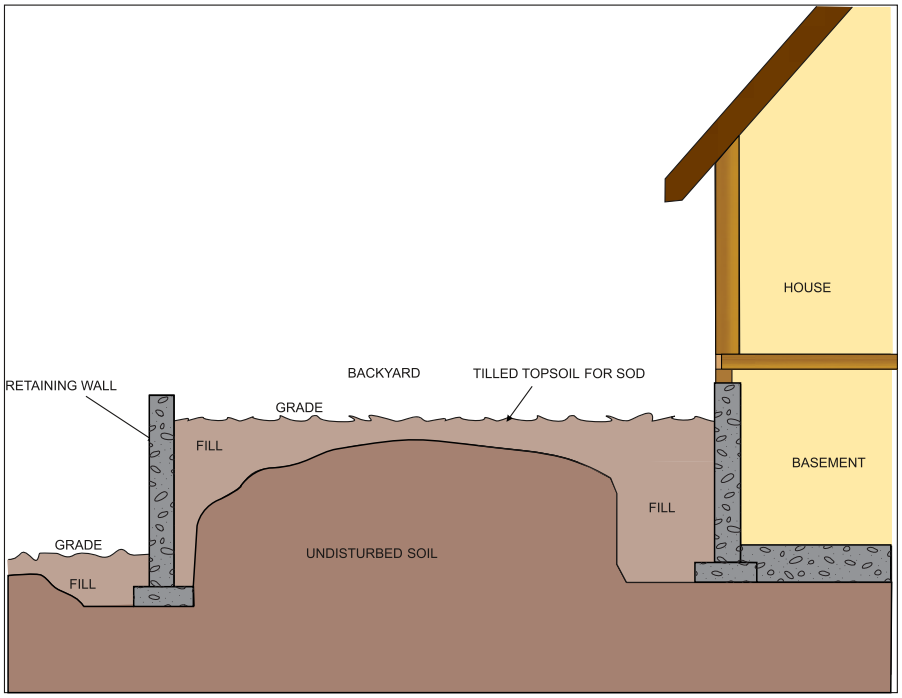


Figure 6-3-1: Simply evaluating a site can provide clues for where not to place foundations or how deep they must be placed. A retaining wall will likely be supporting backfill, and a yard will have grass sod and amended soil beneath it for at least a few inches. Topsoil is not a suitable bearing material. It only takes removing a handful of old grade-level decks to realize how much basement foundation backfill will settle over time. Alternative foundations, such as helical piers, are a choice for these areas, as greater depths may be easier to achieve than excavation, and if the soil has consolidated to greater densities since original construction, the torque readings of the driving equipment will reveal it.

Part Three: Foundation Depth

Subject: Frost Protection

2021 Code: **R507.3.3 Frost protection.** Where decks are attached to a frost-protected structure, deck footings shall be protected from frost by one or more of the following methods:

1. Extending below the frost line specified in Table R301.2.
2. Erecting on solid rock.
3. Other *approved* methods of frost protection.

R403.1.4.1 Frost protection. Except where otherwise protected from frost, foundation walls, piers and other permanent supports of buildings and structures shall be protected from frost by one or more of the following methods:

1. Extended below the frost line specified in Table R301.2.
2. Constructed in accordance with Section R403.3.
3. Constructed in accordance with ASCE 32.
4. Erected on solid rock.

Footings shall not bear on frozen soil unless the frozen condition is permanent.

Exceptions:

1. Protection of free-standing *accessory structures* with an area of 600 square feet (56 m^2) or less, of *light-frame construction*, with an eave height of 10 feet (3048 mm) or less shall not be required.
2. Protection of free-standing *accessory structures* with an area of 400 square feet (37 m^2) or less, of other than *light-frame construction*, with an eave height of 10 feet (3048 mm) or less shall not be required.

Application: Reorganization of the deck foundation sections in the 2021 IRC did not significantly change the intent and purpose; therefore, only the 2021 provisions have been provided.

In regions with a soil frost depth greater than 12 inches, most structures must be protected from frost heave in the soil. Decks have long been exempt from frost protection when not connected to a dwelling. This exemption has been extended in the 2021 edition to include anytime a deck is connected to a structure that is not frost protected, such as a garden shed or detached garage.

One notable addition to this section is the direct statement that “other approved methods” can be permitted for frost protection. This provides building authorities a little assurance of their authority to review and approve alternative systems for frost protection, such as pinned foundation that have been successful for frost protection in some regions. Section R403.1.4.1 provides frost protection requirements for structures other than decks. Light-framed, detached porch roofs, gazebos, trellises and other similar structures often associated with deck construction can be built up to 600 square feet in most cases without frost protection.

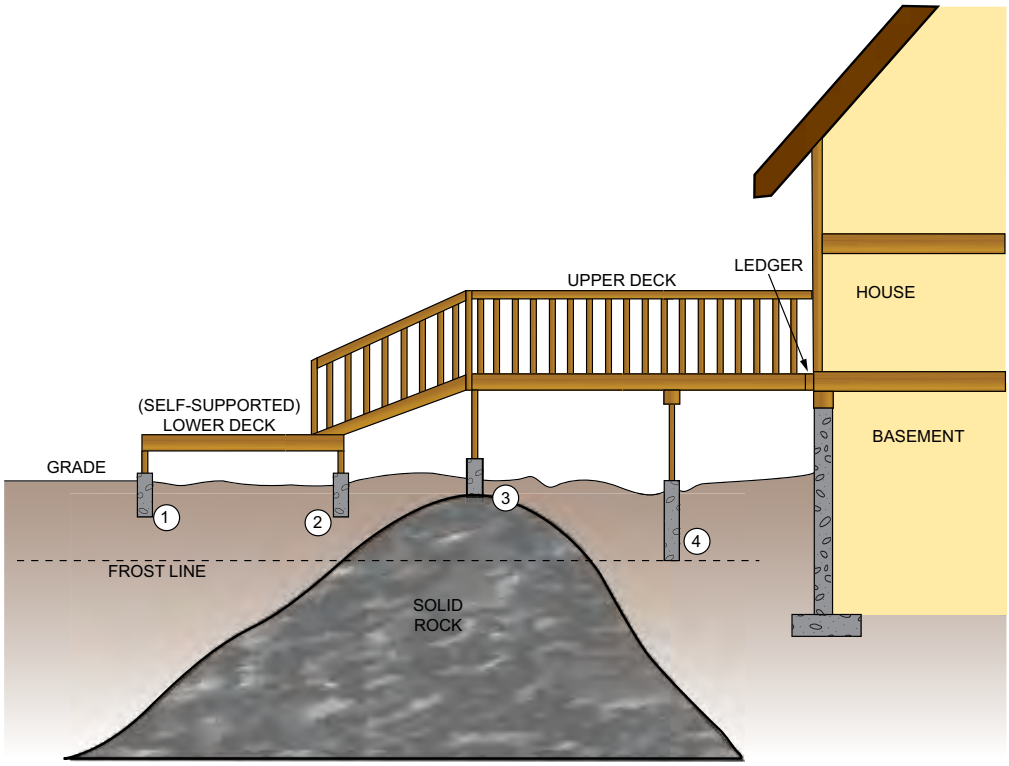


Figure 6-3-2: To protect from frost heave, foundations can be placed below the local frost depth found in Table R301.2(1) or by placement on solid rock. Free-standing decks, including portions of multilevel decks not connected to a frost-protected structure, are not required to be frost protected, no matter their size.

Part Three: Foundation Depth

Subject: Drainage

2021 Code: **R401.3 Drainage.** Surface drainage shall be diverted to a storm sewer conveyance or other *approved* point of collection that does not create a hazard. *Lots* shall be graded to drain surface water away from foundation walls. The *grade* shall fall not fewer than 6 inches (152 mm) within the first 10 feet (3048 mm).

Application: Ground-level decks built on new homes often reveal hidden sinkholes many years later when they are replaced. The backfill at the house has settled but has been hidden under the water-permeable deck. This creates conditions of standing water and hydrostatic pressure against the foundation. Before a new deck is built, the final grade adjacent to the house should be corrected to slope away from the foundation.

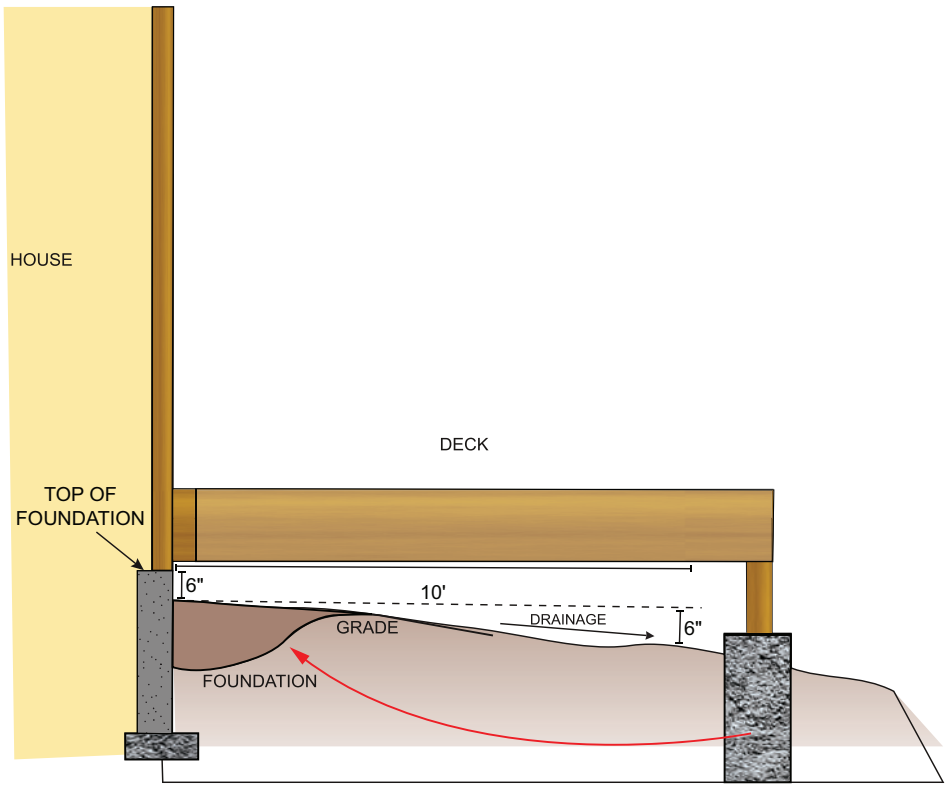


Figure 6-3-3: It can be convenient to use the excavated soil from the new foundation to backfill and grade the drainage under the deck. A win-win!

Chapter 7

Lateral Loads

Introduction

The IRC has always required decks attached to houses to be designed to resist both vertical and lateral loads, but it wasn't until the 2009 edition that it provided any guidance. Standard deck construction looks a lot like standard construction of a house floor, with joists, rim boards, and beams or plates below, but one of the major differences is a deck floor isn't wrapped on all sides by braced wall panels. Braced walls are what keep a structure from tipping over and keep a square floor a square shape. Wood structural panel sheathing, common today, also locks the house floor as a diaphragm. A deck ledger fastened to a house provides one braced wall, on one side, but generally the connection to this wall has been considered for only vertical loads, not lateral. When the ledger fastening table, Table R507.9.1.3(1), was approved for the IRC, concerns of the unknown of lateral loads brought along a lateral load connection significant enough to appear sufficient. However, a solid connection to a single braced wall on one side of the deck floor is not sufficient lateral design, and additional walls or alternative bracing is necessary. A deck at the inside corner of a house would have two braced walls at opposing directions and would greatly reduce the need for additional bracing.

Courtesy of NADRA Member Company, Decks and More

Part One: Lateral Loads

Part One: **Lateral Loads**

Subject: **Braced Walls**

2021 Code: **R301.1.2 Construction systems.** The requirements of this code are based on platform and balloon-frame construction for light-frame buildings. The requirements for concrete and masonry buildings are based on a balloon framing system. Other framing systems must have equivalent detailing to ensure force transfer, continuity and compatible deformations.

R507.8 Vertical and lateral supports. Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads. [The entire text of this section is provided in Chapter 4, Part 2.]

R602.10 Wall bracing. Buildings shall be braced in accordance with this section or, when applicable, Section R602.12. Where a building, or portion thereof, does not comply with one or more of the bracing requirements in this section, those portions shall be designed and constructed in accordance with Section R301.1.

Application: Both platform and balloon framing require braced walls to laterally stabilize the structure. Section R602.10 reminds the user that if you don't have braced walls, you must find another design method. Section R507.8 makes the clear statement that both vertical and lateral loads must be resisted and that attachment to the house cannot be achieved with nails subject to withdrawal.

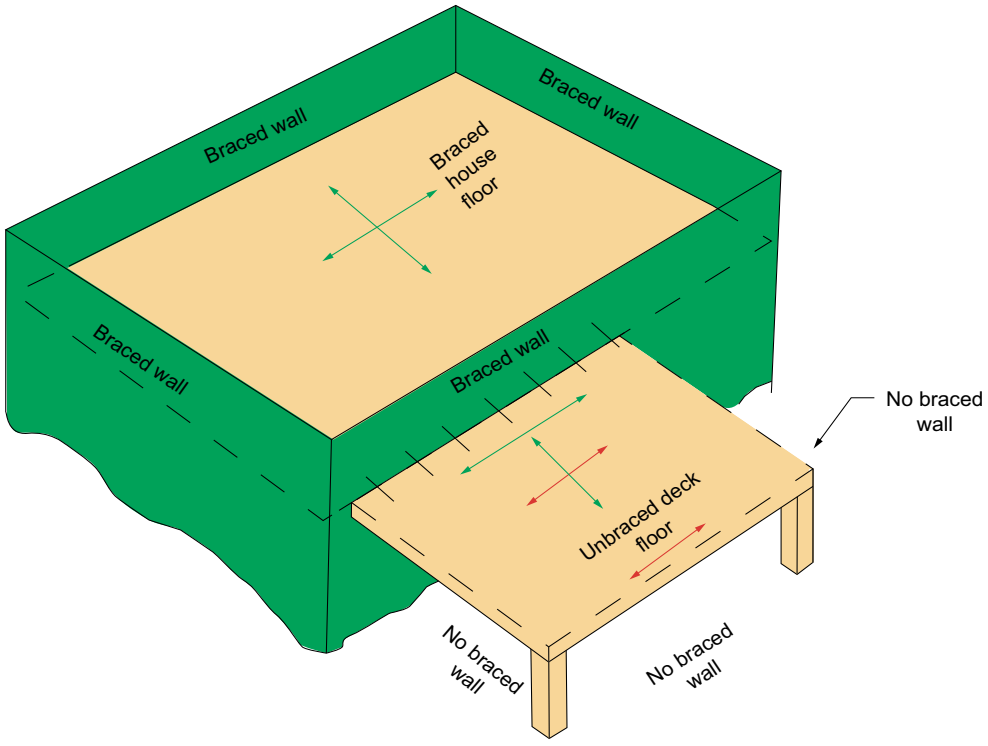


Figure 7-1-1: A common deck structure is not provided a complete prescriptive design method for lateral load resistance in the IRC. Lacking walls, decks must be provided other means of lateral bracing.

Part One: Lateral Loads

Subject: Bracing Fundamentals

Application: Lateral load resistance of a wall is similar to a deck. Before any wall connection to a foundation or deck connection to a house even matters, first a rectangle must stay a rectangle. Under loads, a wall without a let-in brace or a wood structural panel will deform before ever significantly loading the connections. This is the same concept for decks, the IRC only provides prescriptive connections, not the bracing that must come first.

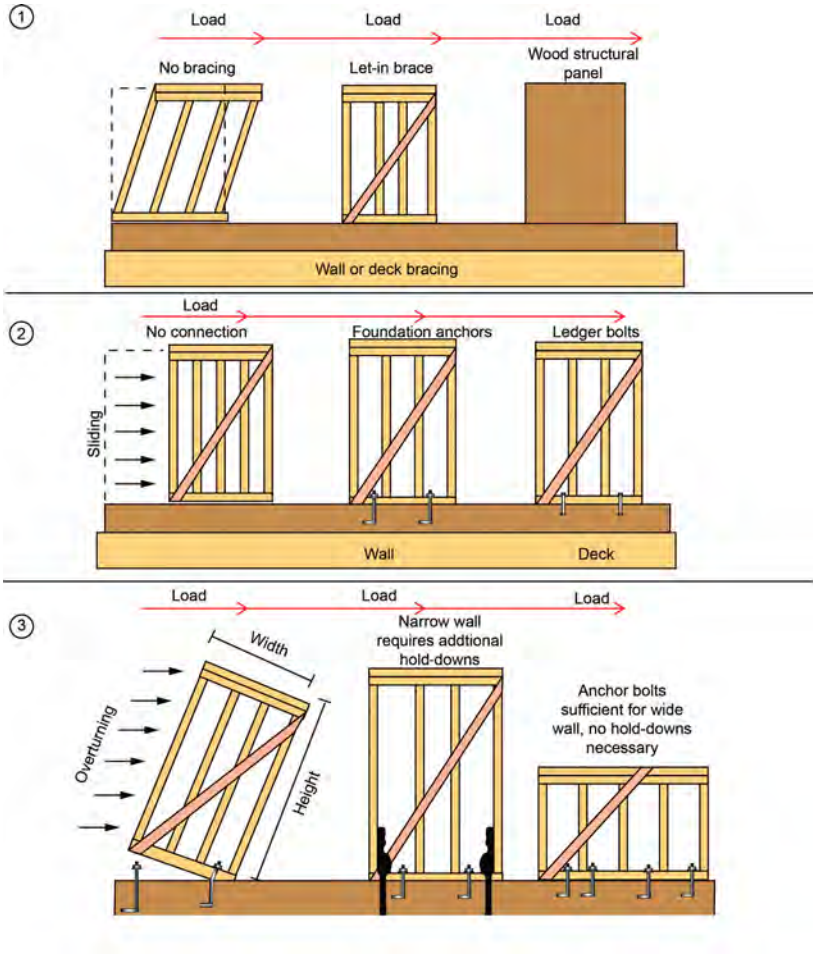


Figure 7-1-2: Once a wall or deck is braced into the shape it's meant to be, the lateral forces will transfer to the connections at the foundation or band joist and must now resist sliding. This sliding can be in plane with the wall or deck, or perpendicular to it. Bolts in walls and decks resist this lateral sliding, and for decks, the bolts also resist the gravity loads of the deck. How many are necessary and their spacing are according to the actual loads the deck receives from vertical live, dead and/or snow loads.

With the bottom braced against sliding, the force now becomes an overturning force and places withdrawal loads on the bolts. Depending on the load magnitude and width-to-height ratio of the wall, the foundation anchors may not be able to handle this withdrawal, and thus hold-down anchors are installed. In walls, these overturning loads can be determined, as we have known sources for lateral load magnitude, wind and seismic, and we have engineered and prescriptive methods to evaluate resistance design. In decks, we have none of this, as the greatest lateral load on decks has been found through research to be lateral live loads. An analysis method to determine the magnitude of these loads is not yet recognized, nor is there a nonwall method of bracing against them provided in the IRC.

Part One: Lateral Loads

Subject: Prescriptive Lateral Load Resistance

Application: In the absence of complete prescriptive design methods to resist deck lateral loads, engineering is the default choice to fill in the holes. However, it's useful to evaluate and understand the lateral load resistance mechanisms available and get an idea of when engineered bracing is necessary or not. There are no lateral live load values in the IRC, so the following is only illustrative of the thought process of lateral load resistance.

A.

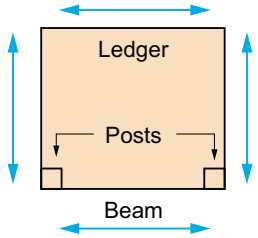


FIGURE A: Segment a deck into approximate squares, hypothetically with a support post in each corner. Without braced walls at each side, there must be alternate means to resist lateral loads.

B.

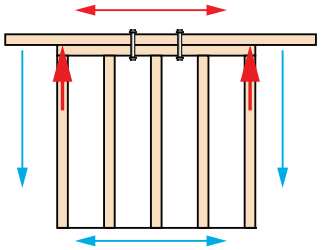


FIGURE B: The bolted ledger connection, combined with joist hangers, braces one side of the square to the existing house-braced wall. The red arrows represent the direction of lateral movement that has been braced. This includes both directions of the ledger wall, and the direction toward the house of each side.

C.

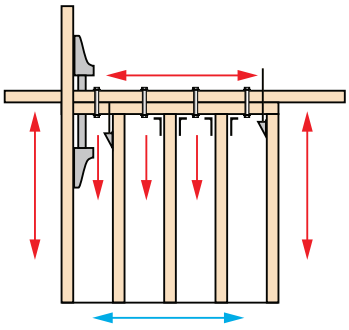


FIGURE C: Outward loads on the two sides of the square parallel to the joists can be resisted in concentrated locations prescribed in Section R507.9.2. Where load magnitudes are lower or the shape of the deck is wider, uniformly distributed locations of joist hangers attached with structural screws combined with the withdrawal resistance of the distributed ledger bolts may be sufficient to resist the outward loads. The remaining blue arrow shows the side that has no bracing in either direction and would require additional design methods than the IRC provides.

D.

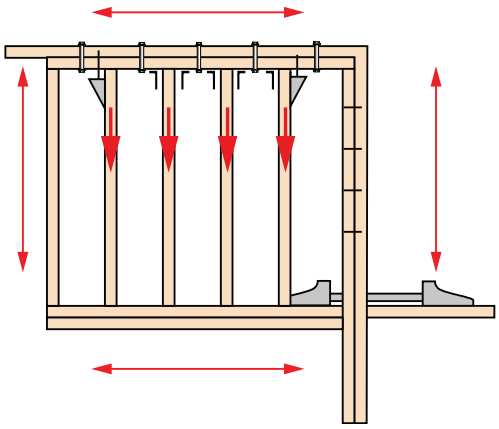


FIGURE D: When a deck is built in an inside corner, the unbraced side shown in Figure C can now be braced by connection to the house. Where a beam connection to a house wall is the means to resist outward lateral loads in line with the beam, a concentrated lateral load connection, such as prescribed in Section R507.9.2, may be appropriate.

Figure 7-1-3

Part Two: Bracing Concepts

Part Two: Bracing Concepts

Subject: Bracing in Posts

A.

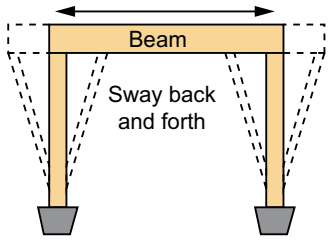


FIGURE A: A beam parallel to a ledger is not provided a prescriptive method in the IRC to resist lateral loads, and alternative designs are required. The following are some examples of bracing methods that may be sufficient for certain designs.

B.

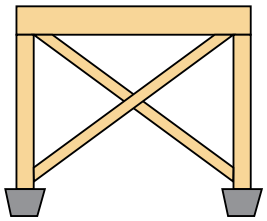


FIGURE B: X bracing in the post and beam area of a deck is similar to angled, 1 × 4 "let-in" bracing permitted for braced walls. However, wall bracing is attached to each stud, which secures the brace against bowing under compression. Not having this support down its length, angled bracing at deck posts should be in pairs as an X, so tension in the braces resists loading in both directions.

C.

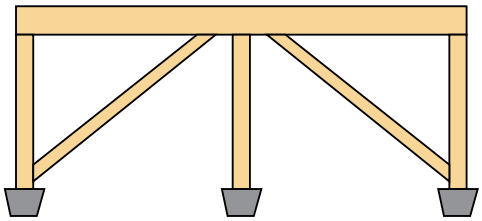


FIGURE C: As an alternative to X bracing, K bracing can be used to brace in both directions, but in separate post and beam spaces. This method is most useful with longer beams over multiple posts.

D.

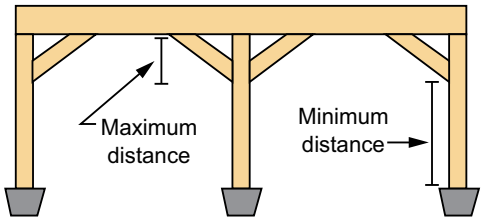


FIGURE D: Knee bracing shortens the braces considerably to gain walking clearance and visibility. However, this method is much less robust than X or K bracing. Knee bracing should be installed as low as possible on all posts, but as mentioned previously, the posts should be oversized to handle the additional stresses. Knee bracing on corner posts should be installed in both directions, to the beam and to the joist. Additional methods of bracing in combination with knee bracing may be necessary, depending on the deck design and brace installation.

E.

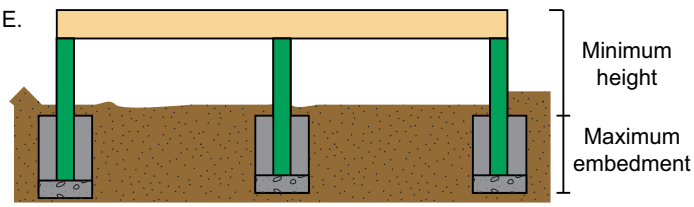


FIGURE E: For lower-level decks, posts sunk into large concrete piers can also provide lateral stability. This works similarly to how a fence stands up in the wind. This method is limited by the height of the posts, the depth of the post embedment, and the size of the post, 4 × 4 or 6 × 6.

Figure 7-2-1

Part Two: Bracing Concepts

Subject: Bracing in Floor

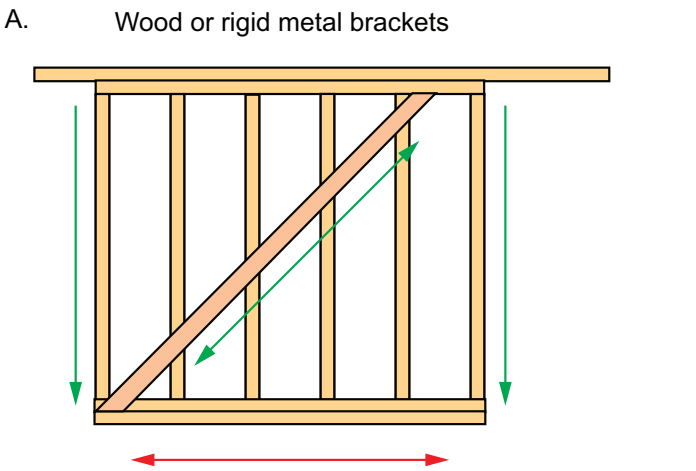


FIGURE A: Another method to brace the beam is through the joists and ledger, as opposed to through the posts. Similar to a let-in brace on a wall, a 2-inch nominal wood brace can be installed at an angle across the bottom of the joists. Rigid metal brackets can also be successful in this application. Bracing in the joists creates a series of triangles across each joist that shifts the beam lateral loads back to the ledger.

FIGURE B: Metal straps, cables, and threaded rods can also work in tension to transfer beam lateral loads back to the ledger. Working only in tension, however, two would be required in opposing directions.

FIGURE C: Angled decking is also effective, as each deck board can act as another brace. To avoid puncturing the ledger flashing with decking fasteners, blocking can be installed between the joists and in front of the ledger.

Figure 7-2-2

Part Three: Lateral Connections

Part Three: **Lateral Connections**

Subject: **Tension Devices**

2021 Code: **R507.9.2 Lateral connection.** Lateral loads shall be transferred to the ground or to a structure capable of transmitting them to the ground. Where the lateral load connection is provided in accordance with Figure R507.9.2(1), hold-down tension devices shall be installed in not less than two locations per deck, within 24 inches (610 mm) of each end of the deck. Each device shall have an allowable stress design capacity of not less than 1,500 pounds (6672 N). Where the lateral load connections are provided in accordance with Figure R507.9.2(2), the hold-down tension devices shall be installed in not less than four locations per deck, and each device shall have an allowable stress design capacity of not less than 750 pounds (3336 N).

Application: In the development of the 2009 IRC, a proposal was submitted to connect a deck ledger to a house band joist. Upon approving, the code modification committee requested further study of the band joist connection to the rest of the floor framing. The concern was a well-connected ledger under lateral loads pulling a band joist from the house and collapsing the deck.

This resulted in an approved public comment modification to include a "permitted" connection detail that would bypass the ledger-band joist combo, and directly connect deck joists to house joists. In following editions of the IRC, a second lateral connection method was included that could be installed completely from the exterior, a welcome option for existing houses.

There are two lateral load connection details provided in the IRC that have specific load values and installation locations. Research has revealed that live loads from the movement of people had the greatest likelihood of affecting decks over wind or seismic. However, because this is unique to decks, with their lack of walls (wind pressure) and lack of mass (seismic), there is no standardized design value for lateral live load established. The code has long required a 40 psf vertical live load to be resisted, but there is nothing similar for loads in the lateral direction. Just as for braced wall design, the shape of the deck also affects the resultant loads at the connections. With none of these variables present in the IRC, the 1,500 pound- and 750 pound-loads could be excessive or insufficient. It's similar to specifying a 2 × 8 joist when the load, span and spacing are unknown to you.

The IRC figures for lateral load connections are not prescriptive requirements; rather, they are permitted connections. They are a little unorthodox compared to any other structural provisions in the IRC. The IRC requires that lateral loads be transferred to the ground or to a structure. But, as discussed previously about bracing, a connection alone cannot often accomplish this, and a more broad analysis of the design is required.

Part Three: Lateral Connections

Subject: 1,500-Pound Devices

2021 Code:

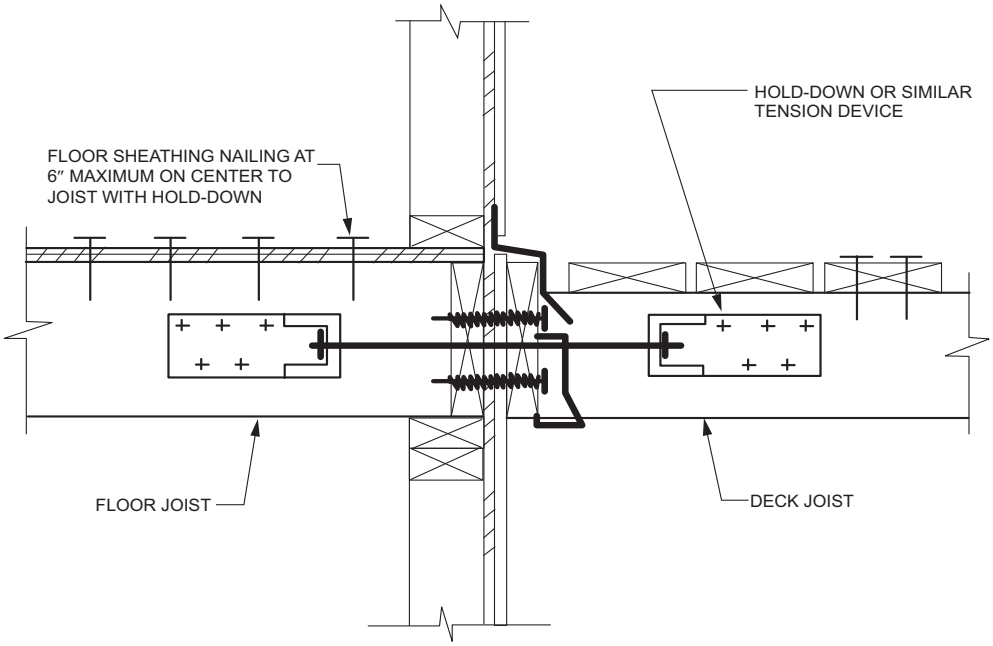


FIGURE R507.9.2(1)
DECK ATTACHMENT FOR LATERAL LOADS

Application:

Only when this method is chosen for lateral load design does the IRC direct one to the figure. The tension devices must be rated for 1,500 pounds and the floor sheathing must be fastened at 6 inches on center. Both these specifications immediately make this connection difficult and perhaps impractical. A 1,500-pound-concentrated load connection to a floor system is a significant expectation of floor joists that were never designed for such connection. For example, the Wood I-Joist Manufacturer Association (WIJMA) provides additional details for this connection, and it requires blocking and the inner hold-down to be installed 6 feet into the house. These details are available at i-joist.org.

For other than the ends, every 8 feet, floor sheathing is only required to be nailed at 12 inches on center to joists; thus, unless the subfloor is exposed, 6-inch nailing cannot be assumed. Hardware manufacturers responded with metal connectors that supplement the lack of nailing with installation from below the sheathing and to the joist.

Bear in mind, if these details are not able to be exactly executed, they were never validated in the first place. Consider the structure as a whole, the nature of lateral loads it receives, and the other resistance mechanism previously explained, and you may find a few less nails in the sheathing doesn't really matter. Lateral load resistance on decks is a huge area of study still incomplete.

Part Three: Lateral Connections

Subject: 750 lb. Devices

2021 Code:

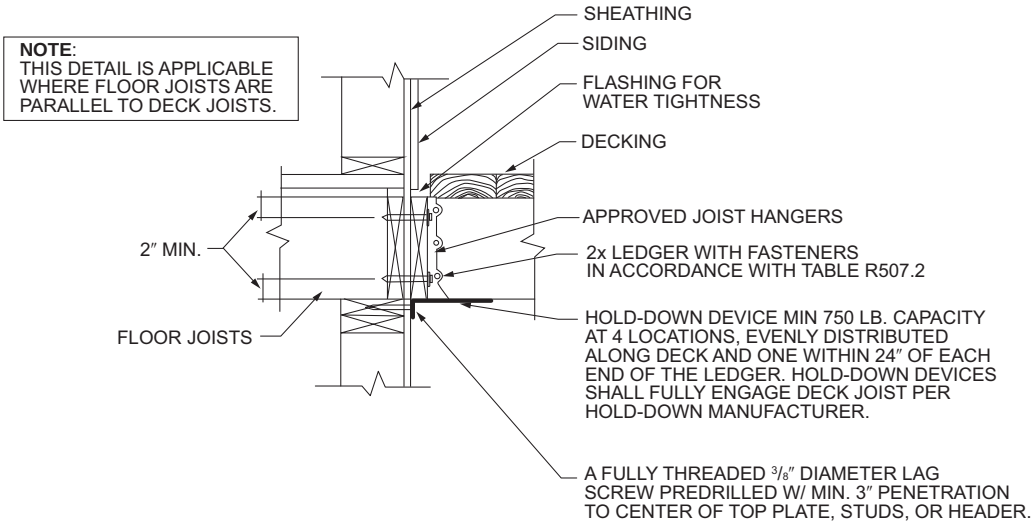


FIGURE R507.9.2(2)
DECK ATTACHMENT FOR LATERAL LOADS

Application:

In response to the difficulty of installing the first IRC lateral load connection detail, a second, optional, method was included in the 2015 IRC. As an equivalent to the unfounded value of 1,500 pounds for each of the two connectors extending into the home, this method uses four 750-pound connectors that attach from the outside. Reducing the concentrated load at each connection allows for a more practical load path through the existing house members that must carry this load. Installation from the outside, and not to the floor system, eliminates the floor reinforcing and invasive, interior construction required. Connecting the joists directly to the top plates of the wall below serves the same purpose of bypassing the need for the band joist of the house to resist lateral loads.

In braced walls, the most effective location to resist overturning is with hold-downs located at the ends of the braced panel. For the similarities known to decks and previously discussed, at least two of these four connections must be within 24 inches of the ends of the deck. As with the other connector, these details are not validated; thus, small variations from what is specified are less detrimental. If the installation is a little more than 24 inches from the ends, worry not; 24 inches was just a distance that seemed appropriate. If the hold-down is connected to the side of the joist rather than the bottom as shown, there is no known deficiency created. What's more important than the specific details of these figures is evaluating the overall deck design for lateral load resistance, not just for connections.

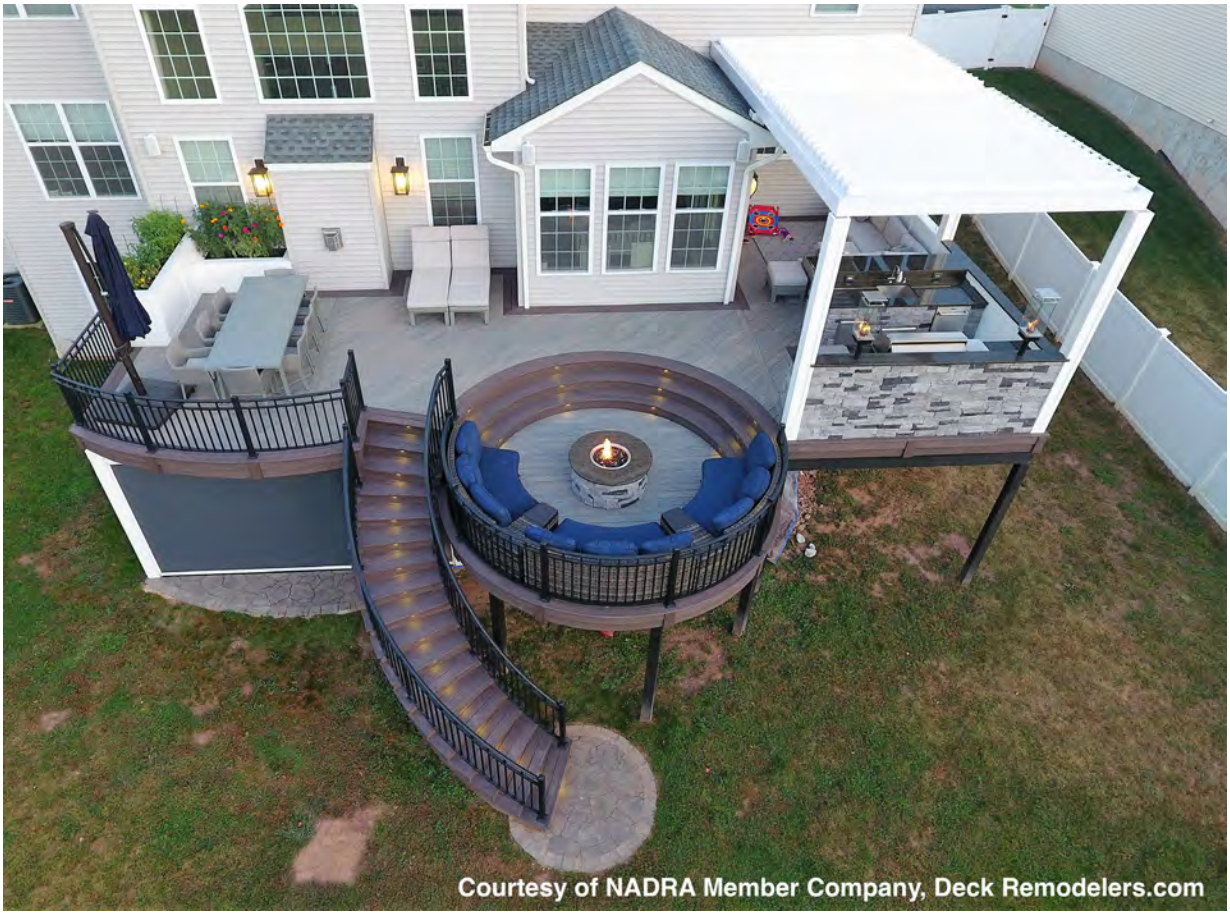
Chapter

8

Stairways and Ramps

Introduction

Stairways are the obstacle courses of the built environment. They are necessary for traveling into, around, and out of buildings, but they also pose an increased hazard. To balance this need with safety, the IRC provides additional requirements at stairways. Minimum width and head-room and required landings at the top and bottom of each flight offer users increased mobility around stairs to reduce a fall. Handrails and lighting are required to assist users in their travels along the stairway and safety glazing is required in nearby windows in case of a fall. We use stairs so often throughout our lives, it's second nature. We've been trained to expect consistent stair geometry because it's been a required standard for most of our lives. Strict dimensional limits of rise and run and required geometric uniformity of each tread allow stair users to trust the next step will be just like the last. A few steps onto any stairway and you quickly fall into a rhythm. However, with just one step, a stairway has been created and all the provisions of the IRC apply.



The majority of decks serve an egress door of a house, and thus create a path of egress to a yard or public way. A detached deck or one attached to a detached structure will likely need a stairway to serve it from the adjacent grade. Differing interpretations exist as to whether these stairs are under the scope of the IRC or not, due to their not serving a dwelling. The consensus revealed in modifications to the 2021 IRC is they do. New provisions are provided in this regard on the following pages.

Part One: Stairway Requirements

Part One: Stairway Requirements

Subject: Definitions

2021 Code:

[RB] FLIGHT. A continuous run of rectangular treads or winders or combination thereof from one landing to another.

[RB] NOSING. The leading edge of treads of stairs and of landings at the top of stairway flights.

[RB] RAMP. A walking surface that has a running slope steeper than 1 unit vertical in 20 units horizontal (5-percent slope).

[RB] RISER (STAIR). The vertical component of a step or stair.

[RB] STAIR. A change in elevation, consisting of one or more risers.

[RB] STAIRWAY. One or more flights of stairs, either interior or exterior, with the necessary landings and connecting platforms to form a continuous and uninterrupted passage from one level to another within or attached to a building, porch or deck.

[RB] STAIRWAY, SPIRAL. A stairway with a plan view of closed circular form and uniform section-shaped treads radiating from a minimum-diameter circle.

[RB] WINDER. A tread with nonparallel edges.

Application: An important distinction between stairways, stairs, and flights is discovered in the definitions. A stair is a single change in elevation in a walking surface, whereas a flight is a series of treads in a change of elevation. A flight and a stair can be made up of rectangular treads, winder treads, or a combination of both. A stairway, however, is a continuous path between two levels made up of stairs and landings. Throughout the stairway provisions, measuring vertical elements from a stair or flight must be made from the nosing of the treads, also a defined term.

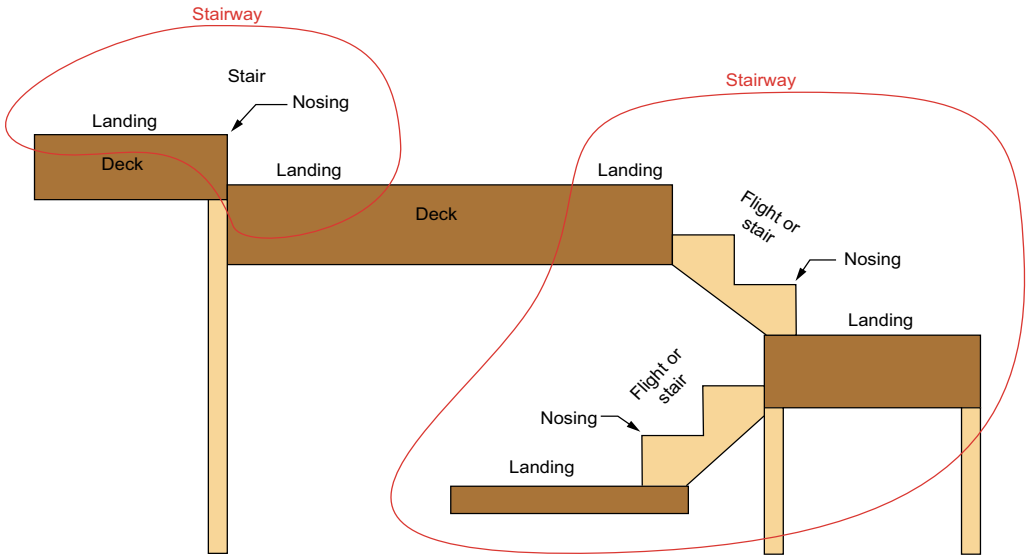


Figure 8-1-1: The difference between a stair and a stairway is crucial to the proper use of the IRC provisions.

Part One: Stairway Requirements

Subject: Width and Height

2021 Code: **R311.7 Stairways.** Where required by this code or provided, *stairways* shall comply with this section.

Exceptions:

1. Stairways not within or serving a building, porch or deck.
2. Stairways leading to nonhabitable attics.
3. Stairways leading to *crawl spaces*.

R311.7.1 Width. Stairways shall be not less than 36 inches (914 mm) in clear width at all points above the permitted handrail height and below the required headroom height. The clear width of stairways at and below the handrail height, including treads and landings, shall be not less than $31^{1}/_{2}$ inches (787 mm) where a handrail is installed on one side and 27 inches (698 mm) where handrails are installed on both sides.

Exception: The width of spiral stairways shall be in accordance with Section R311.7.10.1.

R311.7.2 Headroom. The headroom in stairways shall be not less than 6 feet 8 inches (2032 mm) measured vertically from the sloped line adjoining the tread nosing or from the floor surface of the landing or platform on that portion of the stairway.

Exceptions:

1. Where the nosings of treads at the side of a flight extend under the edge of a floor opening through which the stair passes, the floor opening shall not project horizontally into the required headroom more than $4^{3}/_{4}$ inches (121 mm).
2. The headroom for spiral stairways shall be in accordance with Section R311.7.10.1.

Application: A 3-foot minimum stairway width has been the standard for decades, but reductions are allowed at the handrail height and below. The $4^{1}/_{2}$-inch allowable handrail projection allows for flexibility in stair, guard, and handrail design without having to widen a stairway. This minimum width must extend up from the handrail to the minimum headroom of 6 feet 8 inches, measured vertically from the nosing of each tread.

2021 Modification:

Which stairways must comply with the IRC was clarified in the 2021 edition. Any stairway that serves a building, porch, or deck, whether required by the code or simply installed by choice, must comply with the stairway provisions. A stairway built into a yard, perhaps of landscape timbers or stones, that does not lead directly up to a building, porch, or deck would not be under the scope of the IRC provisions.

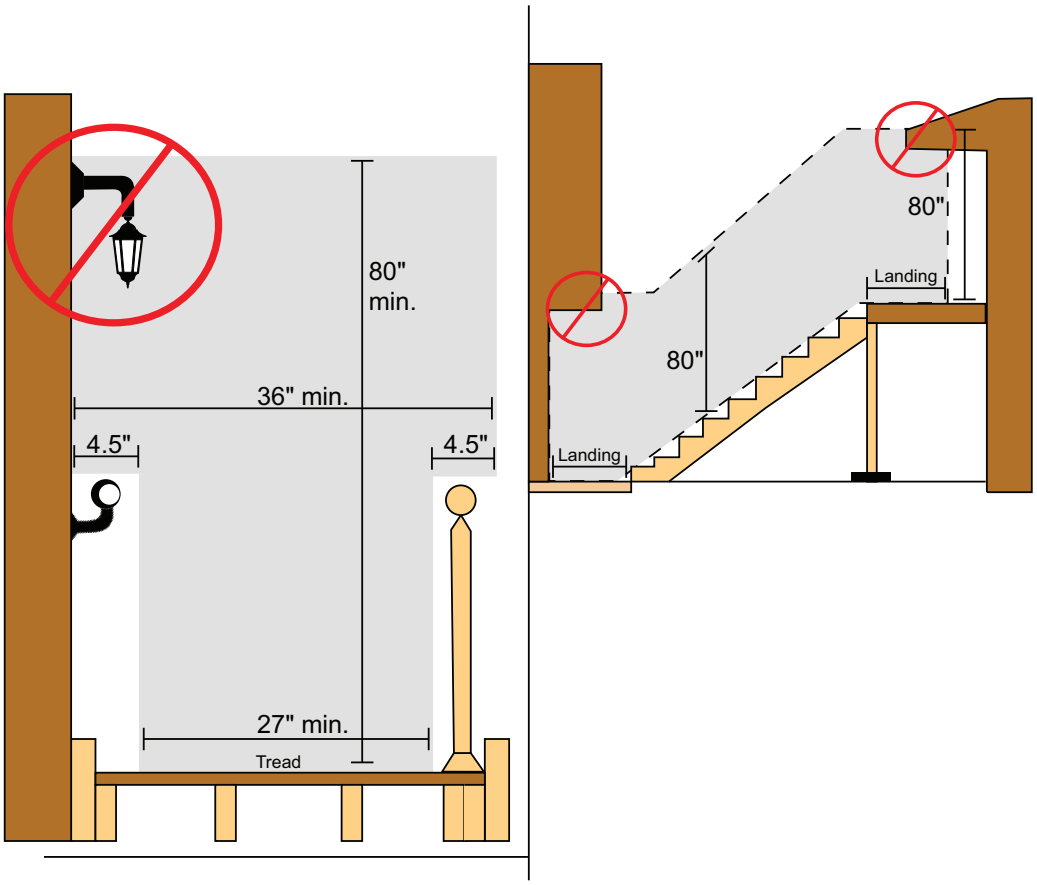


Figure 8-1-2: A handrail can be side mounted and project over a stair or it can be mounted on top of a guard with infill below projecting into the required width. Though the stairway width can be reduced when there are one or two handrails, it cannot be reduced if there are no handrails. Wall-mounted sconce lights are often mistakenly placed within the required width. It is important to note that the minimum headroom applies to stairways, which includes both the upper and lower landing areas as well as the stairs.

Part One: Stairway Requirements

Subject: Tread Geometry

2021 Code: **R311.7.5.1 Risers.** The riser height shall be not more than $7^{3}/_{4}$ inches (196 mm). The riser shall be measured vertically between leading edges of the adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than $^{3}/_{8}$ inch (9.5 mm). Risers shall be vertical or sloped from the underside of the nosing of the tread above at an angle not more than 30 degrees (0.51 rad) from the vertical. At open risers, openings located more than 30 inches (762 mm), as measured vertically, to the floor or grade below shall not permit the passage of a 4-inch-diameter (102 mm) sphere.

Exceptions:

1. The opening between adjacent treads is not limited on spiral stairways.
2. The riser height of spiral stairways shall be in accordance with Section R311.7.10.1.

R311.7.5.2 Treads. The tread depth shall be not less than 10 inches (254 mm). The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than $^{3}/_{8}$ inch (9.5 mm).

R311.7.5.3 Nosings. Nosings at treads, landings and floors of stairways shall have a radius of curvature at the nosing not greater than $^{9}/_{16}$ inch (14 mm) or a bevel not greater than $^{1}/_{2}$ inch (12.7 mm). A nosing projection not less than $^{3}/_{4}$ inch (19 mm) and not more than $1^{1}/_{4}$ inches (32 mm) shall be provided on stairways. The greatest nosing projection shall not exceed the smallest nosing projection by more than $^{3}/_{8}$ inch (9.5 mm) within a stairway.

Exception: A nosing projection is not required where the tread depth is not less than 11 inches (279 mm).

Application: Uniform geometry of stairs is critical to their safe use, as occupants generally get into a rhythm while walking and don't look at every step. However, at a stair landing, this rhythm is disrupted, so geometry must be uniform only between landings. A stairway with an intermediate landing can have two drastically different stairs on each side of it, though that is not recommended. Unlike the *International Building Code* (IBC) for commercial stairs, there is no minimum rise in the IRC. However, it's recognized that anything under the IBC 4-inch minimum is likely to be a tripping hazard.

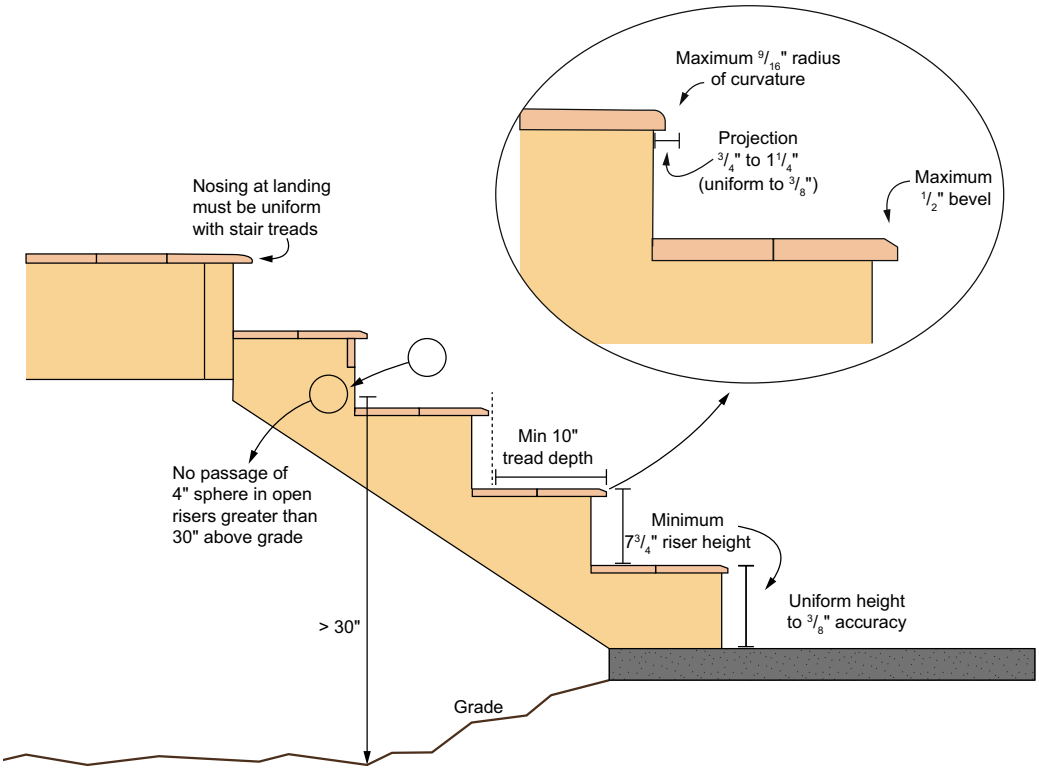


Figure 8-1-3: The geometric limitations and uniformity of stair treads are critical to safe stair use. Care should be taken in designing, building and inspecting stairway components for proper geometry.

Part One: Stairway Requirements

Subject: Winder Treads

2021 Code: **R311.7.4 Walkline.** The walkline across winder treads and landings shall be concentric to the turn and parallel to the direction of travel entering and exiting the turn. The walkline shall be located 12 inches (305 mm) from the inside of the turn. The 12-inch (305 mm) dimension shall be measured from the widest point of the clear stair width at the walking surface. Where winders are adjacent within a flight, the point of the widest clear stair width of the adjacent winders shall be used.

R311.7.5.2.1 Winder treads. Winder treads shall have a tread depth of not less than 10 inches (254 mm) measured between the vertical planes of the foremost projection of adjacent treads at the intersections with the walkline. Winder treads shall have a tread depth of not less than 6 inches (152 mm) at any point within the clear width of the stair. Within any flight of stairs, the largest winder tread depth at the walkline shall not exceed the smallest winder tread by more than $^{3}/_{8}$ inch (9.5 mm). Consistently shaped winders at the walkline shall be allowed within the same flight of stairs as rectangular treads and shall not be required to be within $^{3}/_{8}$ inch (9.5 mm) of the rectangular tread depth.

Exception: The tread depth at spiral stairways shall be in accordance with Section R311.7.10.1.

Application: Unlike spiral stair treads, which can come to a point, winder treads can only reduce to 6 inches on the narrow side. Winder treads can intermingle with regular treads between landings in the same stair, yet their tread depths (measured at the walkline) only have to be uniform to the adjacent winders. Regular treads in the same flight of stairs can have their own tread depth uniformity. However, all riser height and nosing projections must be uniform throughout.

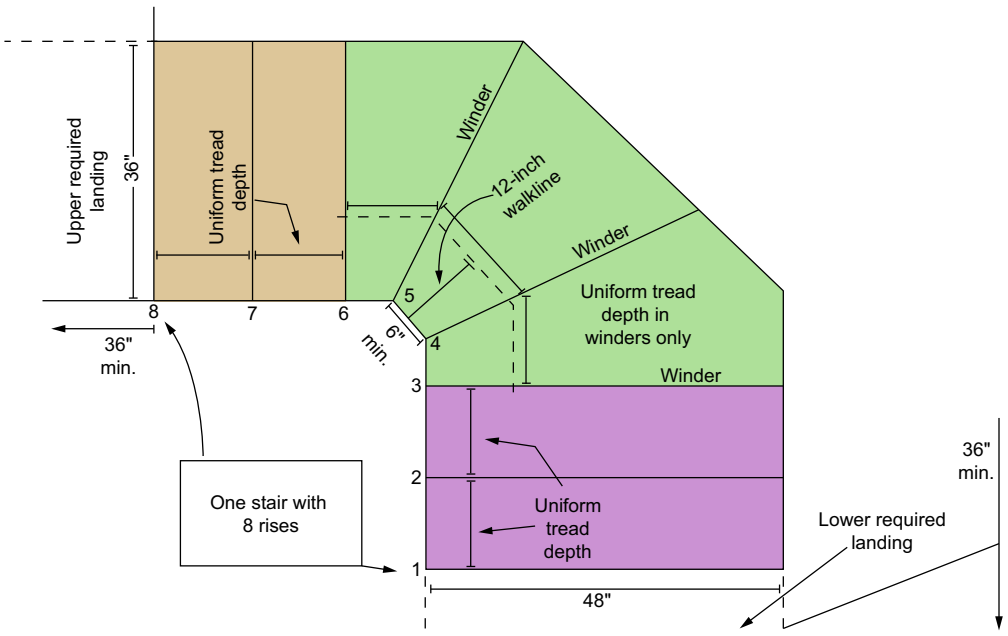


Figure 8-1-4: Winders can allow for a variety of stairway designs. In this example, the stairs widen and make a turn all in a single flight of 8 rises.

Part One: Stairway Requirements

Subject: Stairway Landings

2021 Code:

R311.7.3 Vertical rise. A flight of stairs shall not have a vertical rise greater than 12 feet 7 inches (3835 mm) between floor levels or landings.

R311.7.6 Landings for stairways. There shall be a floor or landing at the top and bottom of each stairway. The width perpendicular to the direction of travel shall be not less than the width of the flight served. For landings of shapes other than square or rectangular, the depth at the walk line and the total area shall be not less than that of a quarter circle with a radius equal to the required landing width. Where the stairway has a straight run, the depth in the direction of travel shall be not less than 36 inches (914 mm).

> **Exception:** A floor or landing is not required at the top of an interior flight of stairs, including stairs in an enclosed garage, provided that a door does not swing over the stairs.

Application: There is no limit to the height of a stairway, provided that it's broken into alternating stairs and landings. Landings in stairways provide an area to rest while ascending or possibly stop while falling. Though their minimum size has always been 36 inches in the direction of travel, how that direction can be measured has changed. This change determines the sufficient width and area, but not the shape.

Figure 8-1-5: This 19-rise single stair flight is at the limit of vertical height before a landing is required.

A.

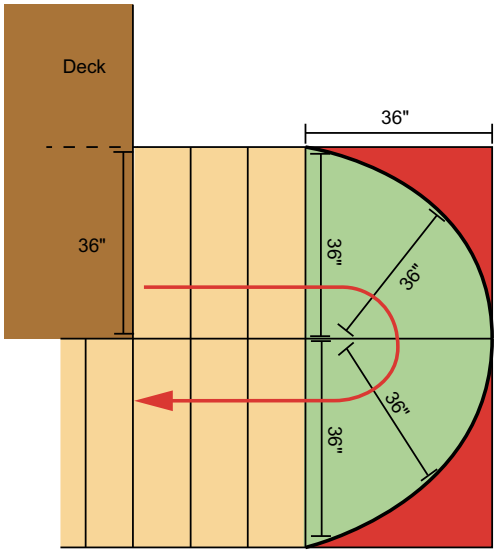


FIGURE A: Landings other than rectangular must provide equivalent area as a quarter circle of the same width of the stairs.

B.

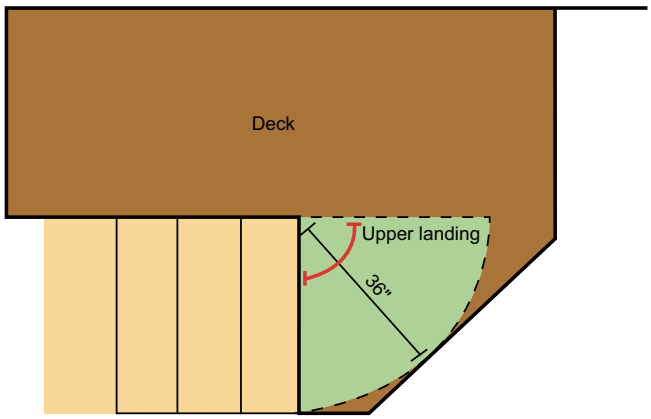


FIGURE B: Upper landings can also utilize alternative-shaped landings. This allows for more design flexibility of the deck surface. The red line shows the minimum walkline length is met.

C.

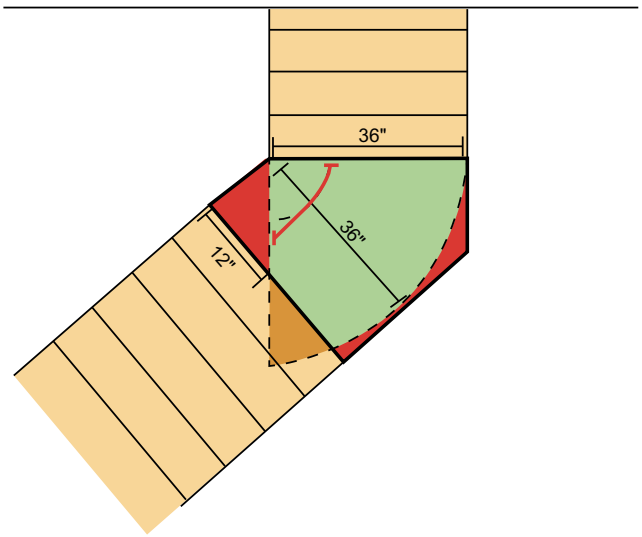


FIGURE C: In this alternative shape, the orange portion of the minimum quarter circle area can be replaced with the added red areas, provided the length of a quarter circle walk line at 12 inches is not shortened.

Figure 8-1-6

Part One: Stairway Requirements

Subject: Walking Surfaces

2021 Code: **R311.7.7 Stairway walking surface.** The walking surface of treads and landings of *stairways* shall be sloped not steeper than 1 unit vertical in 48 units horizontal (2-percent slope).

> **Exception:** Where the surface of a landing is required elsewhere in the code to drain surface water, the walking surface of the landing shall be sloped not steeper than 1 unit vertical in 20 units horizontal (5-percent slope) in the direction of travel.

Application: Though landings are required in stairways, there are no provisions in the code for what constitutes a landing, and this often leaves questions about the at-grade stair landings from decks. One way to evaluate landing materials is to consider that a landing can't have more than a 1 in 48 slope, so that means it must have a measurable slope. This interpretation would preclude surfaces such as gravel, loose dirt (destined to be mud), or landscape rocks from acting as stair landings. However, concrete, flagstone, packed fines, pavers and other materials may still be acceptable, provided their measurable slope remains stable.

2021 Modification:

The 2021 edition added the exception, shown above, to eliminate a conflict with the minimum required slope for surface drainage by foundations.

Figure 8-1-7: Flagstone is an effective landing material to balance the minimum safety necessary for stairs with an attractive transition from decking materials to natural landscape materials. There is no requirement for a concrete landing.

Part One: Stairway Requirements

Subject: Illumination

2021 Code: **R311.7.9 Illumination.** Stairways shall be provided with illumination in accordance with Sections R303.7 and R303.8.

R303.8 Exterior stairway illumination. Exterior stairways shall be provided with an artificial light source located at the top landing of the stairway. Exterior stairways providing access to a *basement* from the outdoor *grade* level shall be provided with an artificial light source located at the bottom landing of the stairway.

Application: A stairway at the edge of a deck is in many ways an unprotected fall hazard. It is an opening in the guards around the deck. For this reason, the top landing of exterior stairways must be provided an artificial light source. Illuminating the upper landing assists in notifying an occupant that a stairway exists and reduces the possibility of an accidental fall.

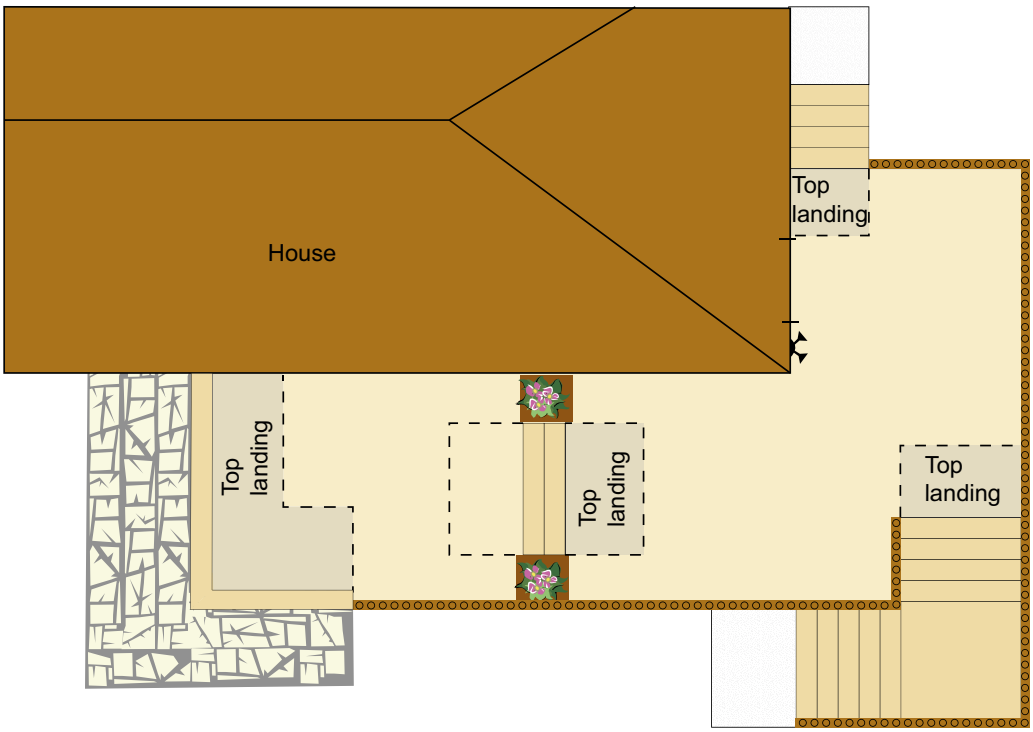


Figure 8-1-8: Though illumination is required to protect a fall hazard at a stairway, there is no mention of how high the stairway must be. By definition, a stairway is just a change in elevation, and that would include the wide, two-rise stair at the left of this illustration.

Part Two: Stairway Construction

Part Two: Stairway Construction

Subject: Stair Live Loads

2021 Code: **R301.5 Live load.** The minimum uniformly distributed live load shall be as provided in Table R301.5.

TABLE R301.5—partial
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Stairs	40[c]	300[c]

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa, 1 square inch = 645 mm^2, 1 pound = 4.45 N.

c. Individual stair treads shall be capable of supporting the uniformly distributed live load or a 300-pound concentrated load applied on an area of 2 inches by 2 inches, whichever produces the greater stresses.

Application: Stair treads receive unique impact loads that other floors don't experience as often. Pressing off our toes on the way up concentrates our weight over a smaller area on the treads. With the help of gravity, stairs receive greater impact from those descending, specifically on the tread nosings. When looking at this from a design perspective, the 300-pound load is a design and performance criterion for the stair treads specifically, whereas the 40-pound uniformly distributed live load is related to the overall design of the stairs, including the stringers.

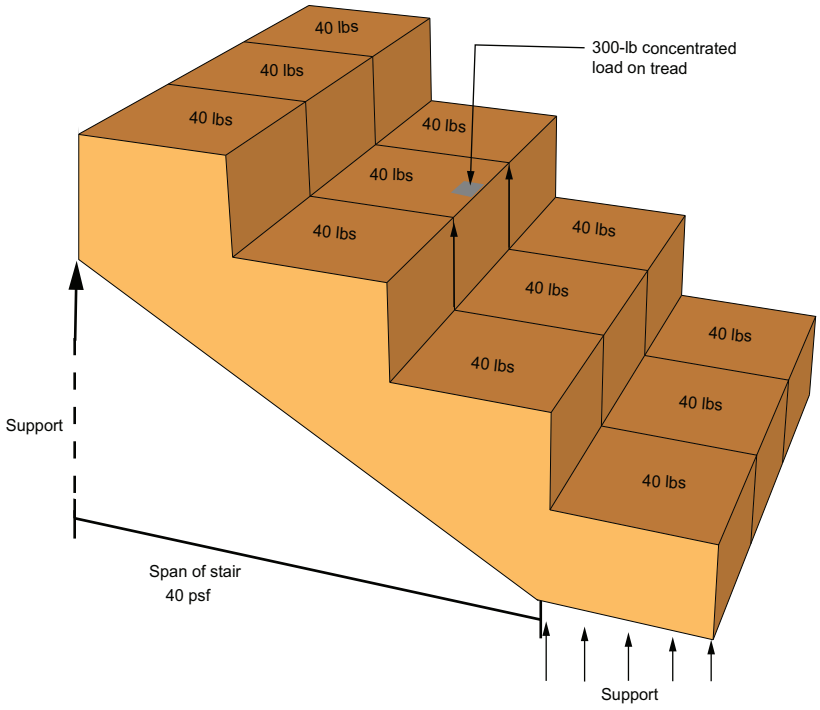


Figure 8-2-1: When designing stairs, the first load consideration is the span of the stair treads. If using manufactured treads, such as composite decking, follow the installation instructions. Many composite decking products must have a reduced support spacing when used as stair treads.

Part Two: Stairway Construction

Subject: Structural Stair Design

2021 Code: There are no structural design provisions for stairs in the IRC.

Application: Building codes have long required minimum load resistance of stairs but have never provided a method for how to achieve this performance. The common methods of deck stair construction involve notching 2 × 10 or 2 × 12 to create the step profile, which defeats its grading and technically renders it inapplicable to any load/span table. Regardless, this stair design is built and approved across the country, so care should be taken in evaluating the overall design and construction.

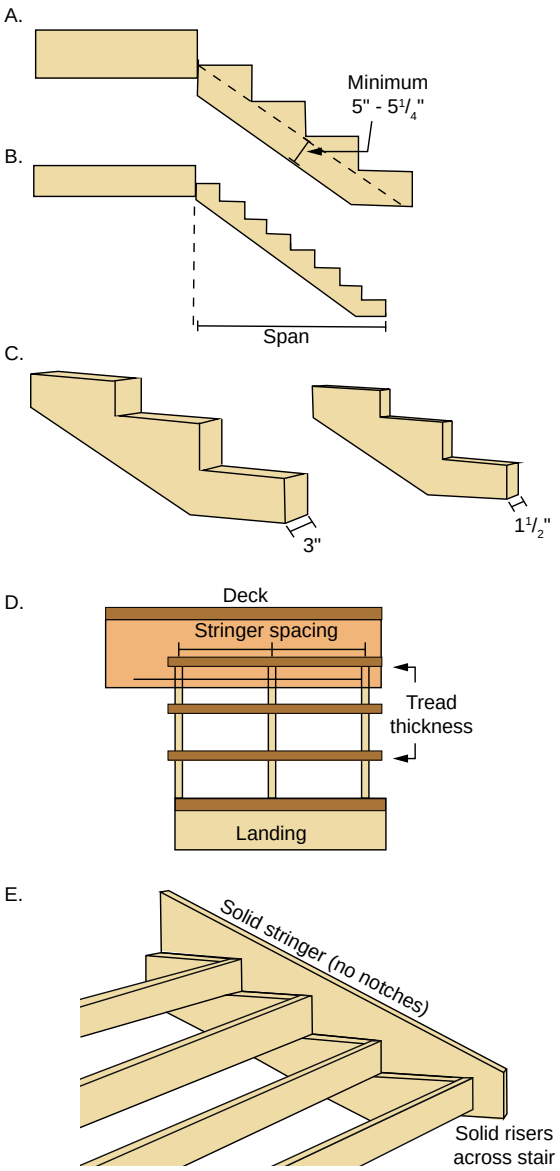


Figure 8-2-2:

FIGURE A: It's becoming common practice to leave a minimum of 5 to 5¼ inches of thickness in the back of the notch. Though not graded as such, this would compare to a 2 × 6 rafter. Care should be taken in the notching layout to remove large or loose knots when notching the material.

FIGURE B: The total span of stair stringers is measured in the same manner rafter span is measured, horizontally from bearing to bearing.

FIGURE C: Provided the tread can span the spacing, thicker stringers, such as 4-inch nominal, can allow for fewer stringers and less distance between them.

FIGURE D: The minimum spacing of stringers is first controlled by the maximum span of the tread material. However, closer spacing requires more stringers, which, working together, will yield longer overall spans of the stringer.

FIGURE E: Solid outer stringers add significant overall strength the stair but won't affect the number of stringers required overall to support the treads.

The variety of common industry methods and the number of variables in design make it very difficult to provide prescriptive methods in the IRC for stair construction. An experienced design and inspection of the load path with careful consideration for how the parts work together are necessary to determine if the minimum standard has been met on each project. There is no easy one-size-fits-all, as this is just an example list of the variables to consider.

Part Two: Stairway Construction

Subject: Stair Lateral Bracing

Application: Stairs are a long and narrow structure built with members all perpendicular to each other. In deck construction, stairs are rarely, if ever, braced to an adjacent wall or deck structure, leaving them completely on their own to brace against lateral live loads from stair users. Short stairways of up to about a half dozen rises are likely rigid enough with standard construction methods of treads and risers, but longer stairs likely need additional bracing.

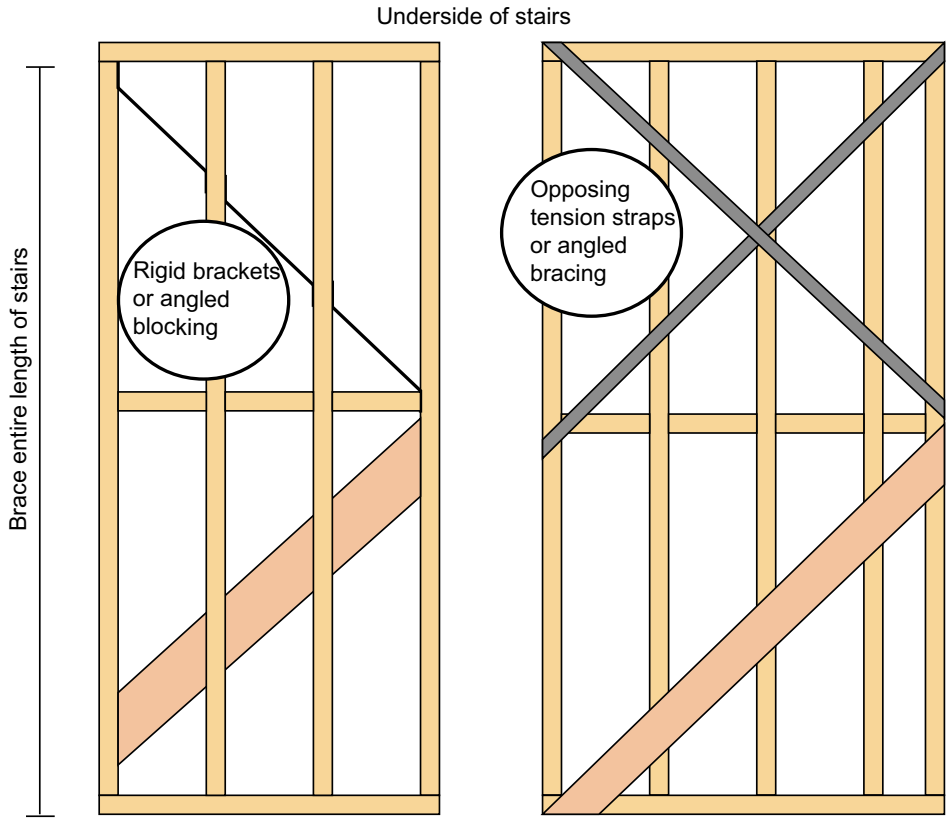


Figure 8-2-3: Stairs can be braced with angled blocks or brackets, between stringers or strips, or straps beneath them. The most effective bracing installation would not exceed 60 degrees to the width of the stairs.

Part Two: **Stairway Construction**

Subject: **Stair Foundations**

2021 Code: See Chapter 6 of this book for foundation provisions.

Application: There are different schools of thought regarding the foundation of stairs where they terminate at an at-grade landing, and neither one is perfect in every application. Practically all at-grade, bottom stair landings are floating on grade. They are not a minimum of 12 inches in undisturbed soil, and they are not frost protected. However, the stability of the landing elevation and slope are critical to maintaining the proper geometry of the first riser up to the first step. If the landing moves independently of the stairs, the riser height changes and a trip hazard results.

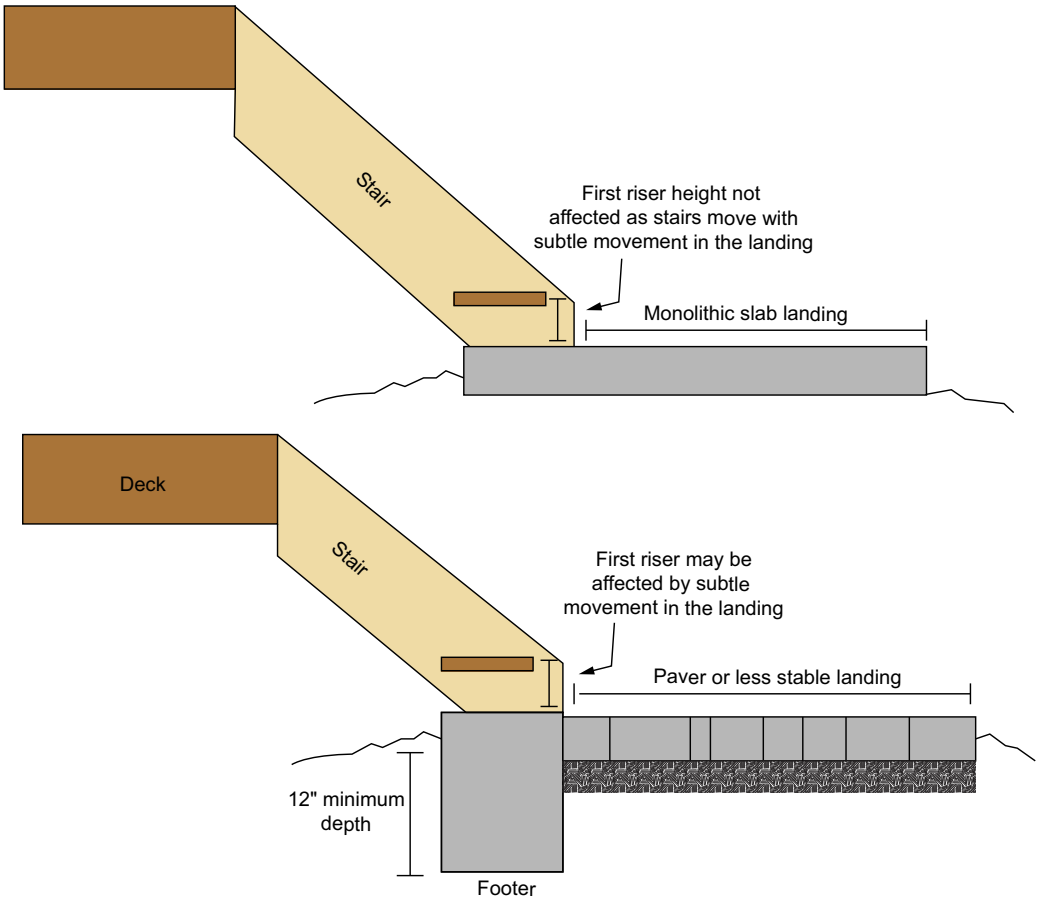


Figure 8-2-4: When a stair is bearing on a monolithic concrete landing or patio or a single stone landing, it can be advantageous to bear the stairs directly on top. These large and heavy landings can act as footers to spread out the weight of the stairs, but under any slight heave or settling, they will move in unison with the stairs and maintain the first riser height.

If the landing surface is not suitable for supporting the stairs, such as packed stone fines, small interlocking pavers or bricks, or other stable landscape materials, an independent foundation for the stairs should be installed.

Part Two: Stairway Construction

Subject: Stair Connections

2021 Code: **R802.3 Ridge.** A ridge board used to connect opposing rafters shall be not less than 1 inch (25 mm) nominal thickness and not less in depth than the cut end of the rafter. Where ceiling joist or rafter ties do not provide continuous ties across the structure as required by Section R802.5.2, the ridge shall be supported by a wall or ridge beam designed in accordance with accepted engineering practice and supported on each end by a wall or column.

Application: Stair stringers are most often compared to floor joists, but in their structural design, they are closer to rafters than joists. The predominant loads they receive come down vertically, but the stringer is at an angle, so some loads are translated laterally. For example, when the low side of a rafter is restrained laterally by a rafter tie, the upper end of the rafter can be minimally connected with toenails to a thin rafter board or simply to opposing rafters. A robust connection for vertical loads is not necessary, and this is similar to stair stringers restrained at the bottom landing. When a rafter does not have a rafter tie resisting lateral loads at the low end, it must be more significantly connected to a ridge beam at the top end. This is similar to a stair stringer bearing on a floating landing and not connected. Lacking significant lateral restraint at the bottom, the connection to the deck at the top must be more robust.

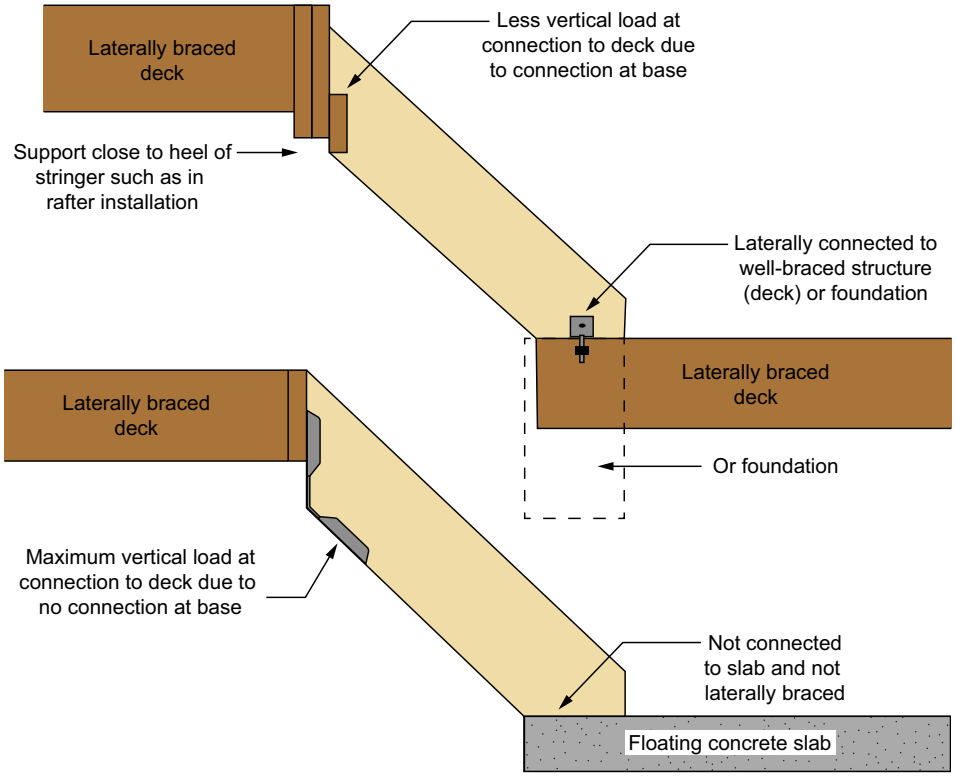


Figure 8-2-5: The resistance of stair live and snow loads can be achieved through a combination of lateral load resistance and vertical load resistance. How well the bottom and top are laterally braced affects how significant the upper vertical connection must be. For the most robust connection, metal hardware similar to skewed rafter hangers is available for the specific application.

Part Three: Ramps

Part Three: **Ramps**

Subject: **Ramps**

2021 Code: **R311.8 Ramps.** Where required by this code or provided, *ramps* shall comply with this section.

Exception: *Ramps* not within or serving a building, porch or deck.

R311.8.1 Maximum slope. *Ramps* serving the egress door required by Section R311.2 shall have a slope of not more than 1 unit vertical in 12 units horizontal (8.3-percent slope). Other *ramps* shall have a maximum slope of 1 unit vertical in 8 units horizontal (12.5 percent).

Exception: Where it is technically infeasible to comply because of site constraints, *ramps* shall have a slope of not more than 1 unit vertical in 8 units horizontal (12.5 percent).

R311.8.2 Landings required. There shall be a floor or landing at the top and bottom of each *ramp*, where doors open onto *ramps*, and where *ramps* change directions. The width of the landing perpendicular to the *ramp* slope shall be not less than the width of the *ramp*. The depth of the landing in the direction of the ramp slope shall be not less than 36 inches (914 mm).

Application: In Chapter 2 of this book, exterior doors are discussed, including which is the "required egress door." Ramps serving the required egress door cannot slope greater than 1 in 12, unless technically infeasible due to site restraints. For that reason and for all other exterior doors, a ramp may slope as much as 1 in 8. The IRC provisions for ramps are much less restrictive than those required for public locations and full accessibility. Though safer ramps at private residences are preferred, the minimum requirements must be such that they are easy and affordable to install if needed by the residents.

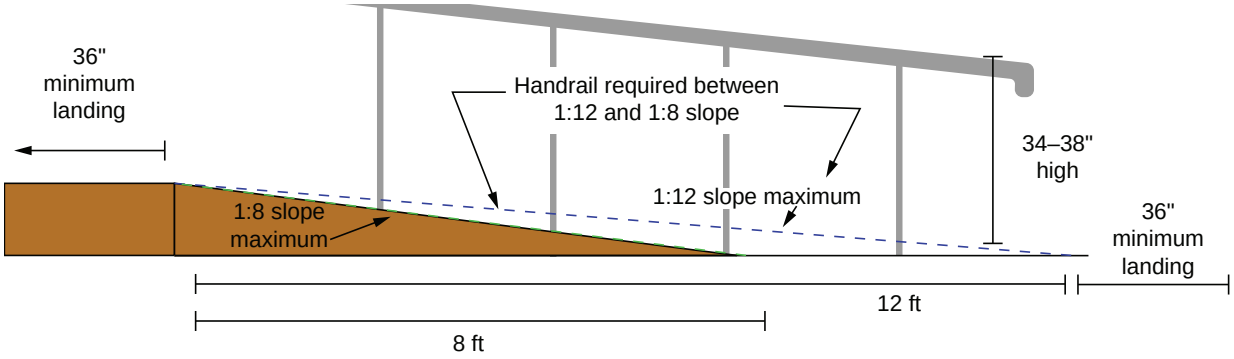


Figure 8-3-1: To rise 12 inches, 12 feet of horizontal ramp length is required, including a bottom landing. Where this is infeasible, the slope can be increased, but a handrail must also be installed.

Chapter 9

Guards and Handrails

Introduction

Staying upright and on our feet is a simple way to limit accidents, and the IRC has provided minimum construction standards expected to do just that. Guards and handrails are the components intended to provide this security to our stability, yet they do so in different ways and are different construction elements. A guard may contain an acceptable handrail within its makeup, depending on its design, but a handrail alone can never be a guard. They are not one and the same.

Though not often discussed in such a manner, guards and handrails are structural components. However, they are also incredibly architectural. While no one is impressed with the look of a joist or ledger, guards are the most visible part of a deck and where creativity is often expressed. The consumer demand for aesthetically pleasing guards that don't look like those of all the neighbors is difficult to couple with prescriptive structural design.

Part One: Guards

Part One: **Guards**

Subject: **Definitions**

2021 Code: **[RB] GUARD.** A building component or a system of building components located near the open sides of elevated walking surfaces that minimizes the possibility of a fall from the walking surface to the lower level.

[RB] HANDRAIL. A horizontal or sloping rail intended for grasping by the hand for guidance or support.

Application: Everyday language blurs the distinction between guards and handrails, but the differences are clear in the code and critical to proper code application. A guard is nothing more than a barrier to block a human body from a fall from an elevated walking surface. It does not require any type of rail or graspable feature. With the publishing of the 2015 IRC edition, all use of the term “guardrail” was replaced with “guard” to support the distinction. A handrail, however, does require a graspable rail. Actually, that’s all a handrail is. Handrails are required adjacent to certain stairs and ramps and are only the graspable rail, regardless of whether they are stand-alone, mounted to a wall, mounted to the side of a guard, or incorporated into the top of a guard.

Figure 9-1-1: Though the handrail shown is not required to be continuous around the corner, this installation provides a good example of how a handrail can be both stand-alone and incorporated into a guard. The guard can be typical railings or the wall adjacent to the upper stairs. In all cases, they perform their respective duty.

Part One: Guards

Subject: Definitions, continued

Figures 9-1-2 and 9-1-3: A guard isn't always a guardrail, and sometimes doesn't even resemble a guard. A built-in BBQ kitchen, a planter box, a half wall, a fireplace, a bench, and a privacy wall are all examples of features that can serve other functions but still act as a barrier to a fall. These features would need to meet the loading, minimum height and opening restrictions required for guards, **when functioning as a required guard**.

Part One: Guards

Subject: Where Guards Are Required

2021 Code: **R312.1 Guards.** *Guards* shall be provided in accordance with Sections R312.1.1 through R312.1.4.

R312.1.1 Where required. *Guards* shall be provided for those portions of open-sided walking surfaces, including stairs, ramps and landings, that are located more than 30 inches (762 mm) measured vertically to the floor or *grade* below at any point within 36 inches (914 mm) horizontally to the edge of the open side. Insect screening shall not be considered as a *guard*.

Application: A height of more than 30 inches has been the trigger for required guards since the mid 1900s, but where this height of fall is measured from changed in the 2009 IRC edition. To better address the actual hazard, specifically when a deck is adjacent to a slope or retaining wall, the 36-inch horizontal measurement was included. Previous editions specified the height to be measured at the edge of the deck, which failed to represent the more probable area where one would land from a fall.

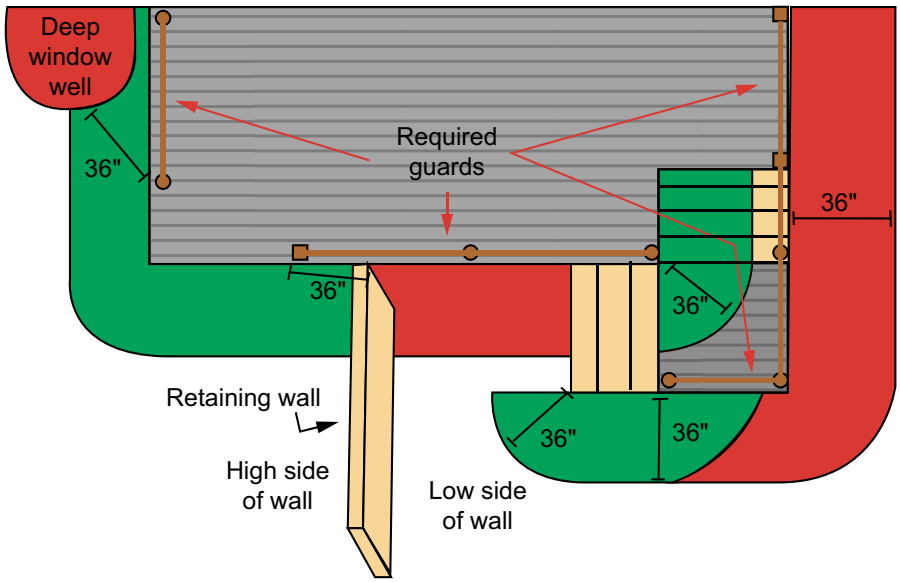


Figure 9-1-4: The 2018 IRC added a clarifying phrase, "for those portions," to Section R312.1.1, Where required. The purpose of this modification was to highlight that only those edges of a walking surface within the distances specified by this section are required to have guards. Where a deck may be greater than 30 inches above grade on one side, but lower at the other side, the entire deck would not require guards. In this illustration of where guards are required, the green shaded areas are within 36 inches horizontally from the edge and are 30 inches or less below the deck. The red areas are greater than 30 inches.

Part One: Guards

Subject: Minimum Guard Height

2021 Code: **R312.1.2 Height.** Required *guards* at open-sided walking surfaces, including stairs, porches, balconies or landings, shall be not less than 36 inches (914 mm) in height as measured vertically above the adjacent walking surface or the line connecting the *nosings.*

Exceptions:

1. *Guards* on the open sides of stairs shall have a height of not less than 34 inches (864 mm) measured vertically from a line connecting the *nosings*.
2. Where the top of the *guard* serves as a handrail on the open sides of stairs, the top of the *guard* shall be not less than 34 inches (864 mm) and not more than 38 inches (965 mm) as measured vertically from a line connecting the *nosings*.

Application: At times, guard assemblies are constructed around decks for functional or aesthetic reasons and not due to a fall hazard. In those instances, though they may act as a guard, they are not mandated to be a minimum height. Per the first word in this section, only “required” guards must meet the minimum height of 36 inches.

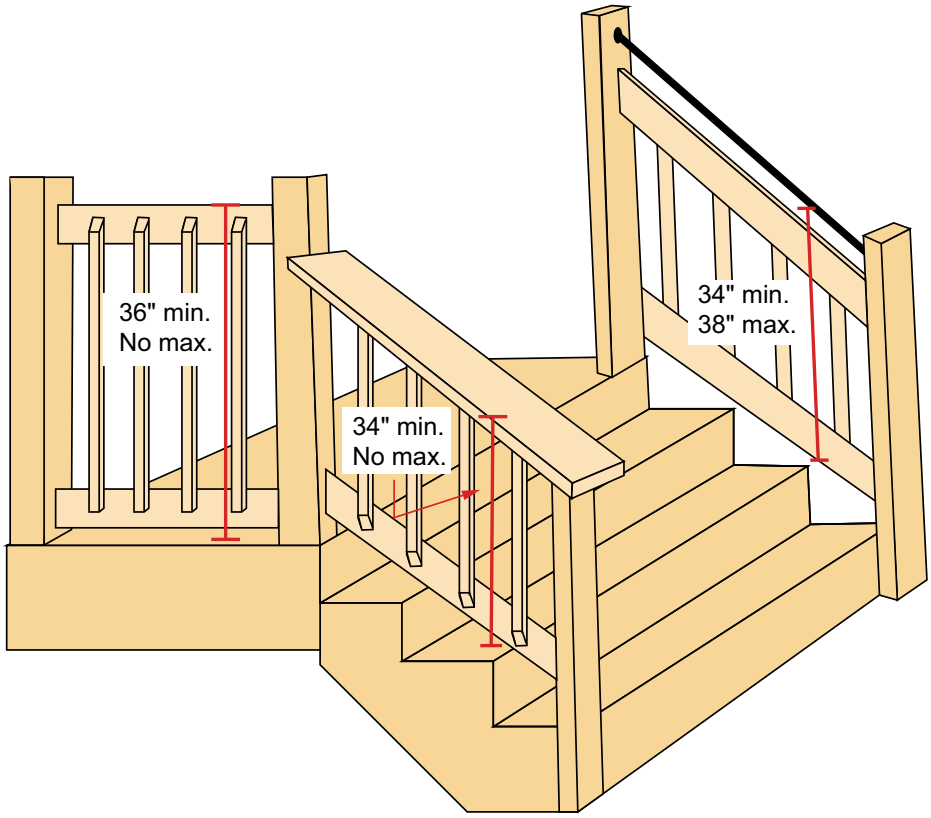


Figure 9-1-5: Due to the common combination of guards and handrails in the same assembly beside stairs, the exceptions to Section R312.1.2 clarify that guards can be as low as 34 inches when adjacent to stairs, regardless of whether a handrail is included. When a handrail is included in the top of the guard, there is also a maximum height requirement for the guard equal to the maximum height allowed for handrails.

Part One: Guards

Subject: Opening Limitations

2021 Code: **R312.1.3 Opening limitations.** Required *guards* shall not have openings from the walking surface to the required *guard* height that allow passage of a sphere 4 inches (102 mm) in diameter.

Exceptions:

1. The triangular openings at the open side of stair, formed by the riser, tread and bottom rail of a *guard*, shall not allow passage of a sphere 6 inches (153 mm) in diameter.
2. *Guards* on the open side of stairs shall not have openings that allow passage of a sphere $4^{3}/_{8}$ inches (111 mm) in diameter.

Application: Though practiced by some building inspectors, there is no load specified on the hypothetical sphere in regard to it being forcefully pressed through the guards through deformation of the guard members. In steel cable guard systems, however, cables may loosen, and though less than 4 inches apart, they could be pulled open. In accordance with the intent of this section and in recognition of the minimum 50-pound design load of guard infill in Table R301.5, Minimum uniformly distributed live loads, it's reasonable to apply some load (of no more than 50 pounds) to the sphere to determine if it is capable of passing through the guards. Only guards that are required due to fall hazard are limited in opening size.

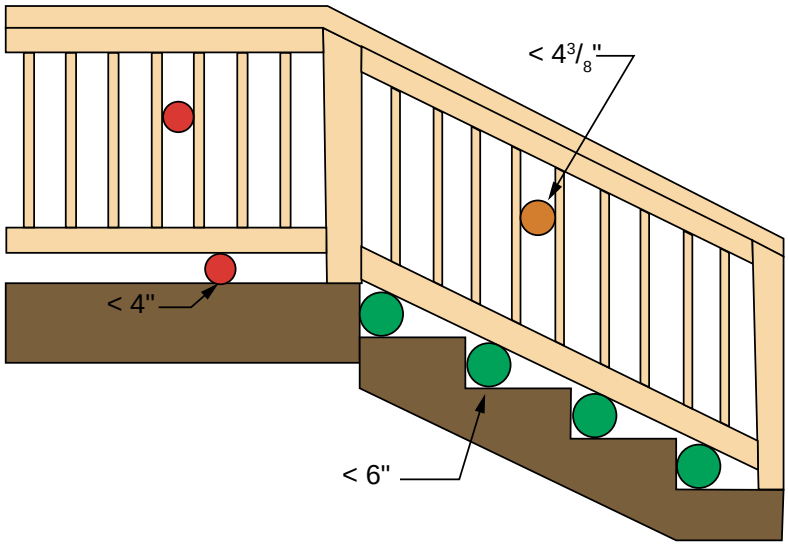


Figure 9-1-6: Specific exceptions allow slightly larger openings in two specific locations at the sides of stairs.

Part One: Guards

Subject: 2018 IRC Guard Live Loads

2018 Code:

TABLE R301.5—partial
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS
(in pounds per square foot)

USE	LIVE LOAD
Guards and handrails[d]	200[h]
Guard in-fill components[f]	50[h]

d. A single concentrated load applied in any direction at any point along the top.

f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement.

Application:

Though a guard may be installed when not required and thus not have to meet the geometric limitations described in Sections R312.1.2, Height, or R312.1.3, Opening limitations, it still must support the minimum design loads. A feature built adjacent to a deck edge that appears as a guard creates an invitation to occupants to use it as such. Leaning on or sitting on top of a guard is a common sight, and thus they all must be able to support the design loads.

2021 Modifications:

Guard and handrail design loads were separated in the 2021 edition and the load direction for guards changes. Details are provided on the following page.

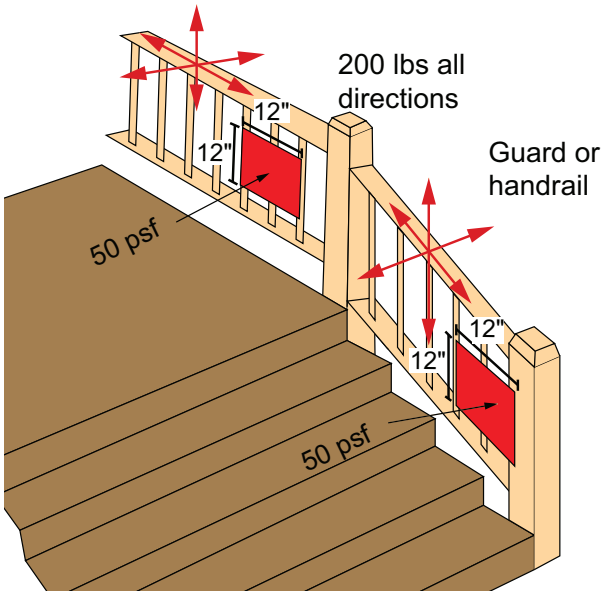


Figure 9-1-7: The footnotes in Table R301.5 provide details for the directions and locations that various design loads must be resisted.

Part One: Guards

Subject: 2021 Guard Live Loads

2021 Code:

TABLE R301.5—partial
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Guards	—	200[h, i]
Guard in-fill components[f]	—	50[h]
Handrail[d]	—	200[h]

d. A single concentrated load applied in any direction at any point along the top. For a guard not required to serve as a handrail, the load need not be applied to the top element of the guard in a direction parallel to such element.

f. Guard in-fill components (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot. This load need not be assumed to act concurrently with any other live load requirement.

i. Where the top of a guard system is not required to serve as a handrail, the single concentrated load shall be applied at any point along the top, in the vertical downward direction and in the horizontal direction away from the walking surface. Where the top of a guard is also serving as the handrail, a single concentrated load shall be applied in any direction at any point along the top. Concentrated loads shall not be applied concurrently.

Footnote h is provided and discussed in the following pages.

Application: Recognizing the differences between guards and handrails, Table R301.5 in the 2021 edition separates them from each other and provides a separate column for concentrated loads. The loading direction for guards also changed from “all directions” to only outward and downward directions. While handrails are graspable and may be pulled in any direction to assist a stair user, a guard is not. A guard has no function to resist a fall backwards or to resist loads placed in line or upward. Guard post connections are a notorious weak link in guard construction, and testing has found the leverage a 36-inch-tall post can put on the deck connection is a considerable challenge to resist even in just one direction. Correcting the loading direction on guards will allow for more reasonable construction of this critical connection.

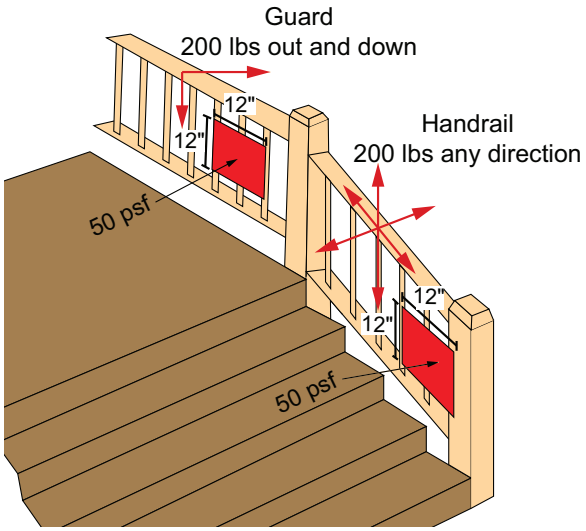


Figure 9-1-8: Manufactured guards tested under ASTM D7032 and alternative guards reviewed under ICC-ES AC 174 are only evaluated for loads in the outward and downward directions. The changes in the 2021 edition now match the more appropriate loading directions of these standards.

Part One: Guards

Subject: 2021 Guard Post Connections

2021 Code:

R507.10 Exterior guards. *Guards* shall be constructed to meet the requirements of Sections R301.5 and R312, and this section.

R507.10.1 Support of guards. Where *guards* are supported on deck framing, *guard* loads shall be transferred to the deck framing with a continuous load path to the deck joists.

R507.10.1.1 Guards supported by side of deck framing. Where *guards* are connected to the interior or exterior side of a deck joist or beam, the joist or beam shall be connected to the adjacent joists to prevent rotation of the joist or beam. Connections relying only on fasteners in end grain withdrawal are not permitted.

R507.10.1.2 Guards supported on top of deck framing. Where *guards* are mounted on top of the decking, the *guards* shall be connected to the deck framing or blocking and installed in accordance with manufacturer's instructions to transfer the *guard* loads to the adjacent joists.

R507.10.2 Wood posts at deck guards. Where 4-inch by 4-inch (102 mm by 102 mm) wood posts support guard loads applied to the top of the guard, such posts shall not be notched at the connection to the supporting structure.

R507.10.3 Plastic composite guards. *Plastic composite guards* shall comply with the provisions of Section R507.2.2.

R507.10.4 Other guards. Other *guards* shall be in accordance with either manufacturer's instructions or accepted engineering principles.

Application:

A minimum design load on guards first appeared in the 1940 *Uniform Building Code*, but since then, there's been no prescriptive guidance for how to achieve this load resistance, other than a reference to ASTM D7032 for plastic composites. Though engineering is the other solution, it's not standard in American communities to provide this for guards. The structural design of guards is usually evaluated during inspection, not plan review. These new provisions provide guidance for installing and evaluating the common occurrence of a wood guard post connection to a wood deck frame. Deck guard designs are incredibly diverse in the nation's backyards and dreams; thus, these provisions were specifically crafted in a general manner such that a specific method of construction did not appear required. Section R507.10.4, Other guards, makes it clear that guards other than wood or not having posts at all are acceptable, provided they are constructed sufficiently to resist the required loads.

These new provisions address the notorious problems seen in guard construction. A guard connected only to an outer joist often rolls the joist, leans the guard, and further strains the connection. Requiring the guard load path to be visibly tied into the floor as a whole is a nudge forward in reducing dangerous guard design. Similarly, a 4 × 4 post notched at the connection point has been load tested and revealed a gross insufficiency. Though posts were tested individually and not in a guard assembly, it was considered a reasonable balance of safety and design to prohibit a connection to the deck at a notched location. However, the provisions specifically state, "supporting guard loads applied to the top of the guard." This was written this way for guard designs where the post connection does not bear the full design load of the guard.

Part One: Guards

Subject: 2021 Guard Post Connections, continued

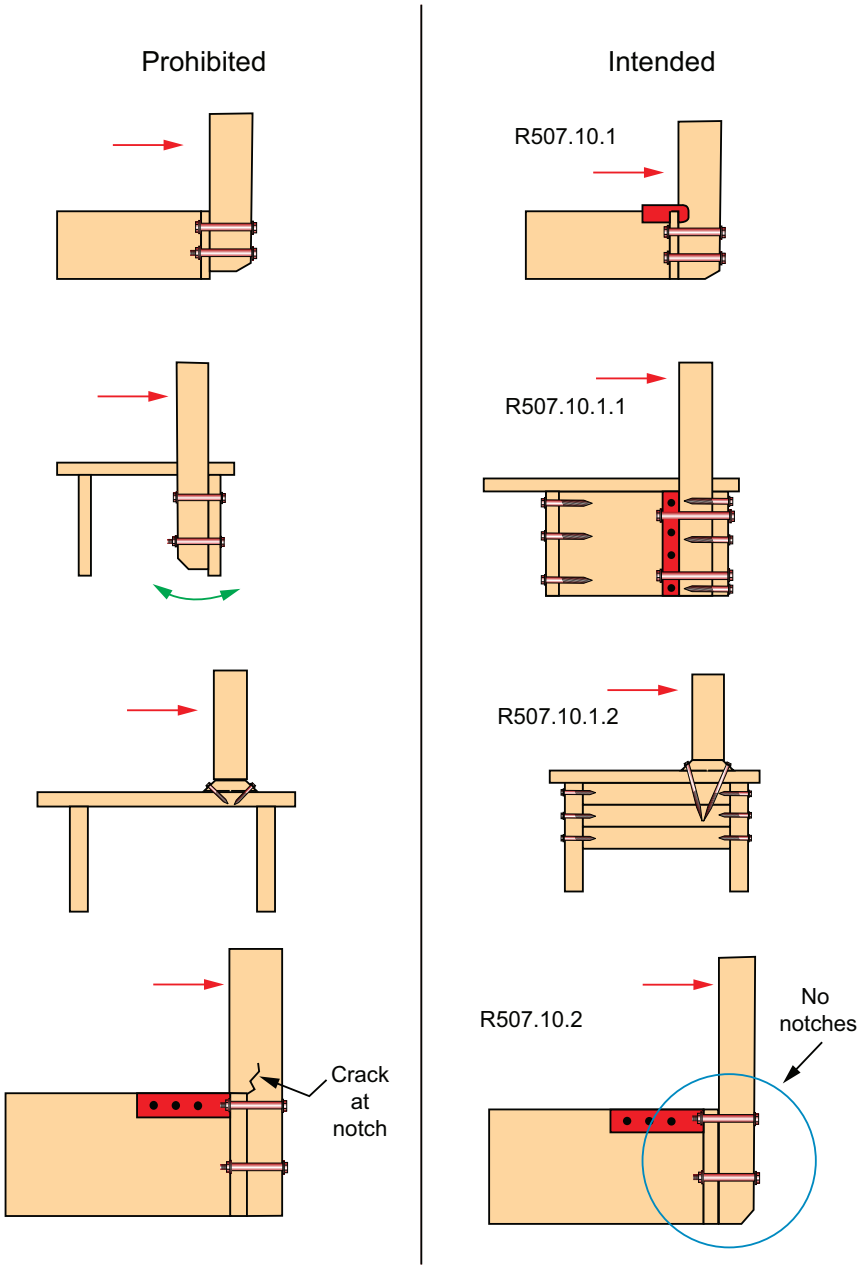


Figure 9-1-9: The illustrations on the left reveal the incomplete guard load paths that are not acceptable in the 2021 IRC. The right side generically illustrates how blocking, lag screws, structural screws, hold-downs, tension devices, straps, brackets and similar devices can be used to tie the framing members connected to the post back into the adjacent joists. A new prohibition to notching 4 × 4 posts is specifically speaking only to notches at the connection location, and only for 4 × 4 material. A turned or notched 4 × 4 is not prohibited, provided the connecting fasteners engage in the full thickness of material. Posts that are 6 × 6 or larger are not outright prohibited from notching at this location but would still need experienced evaluation of their load resistance. Just as with ledger connections, the load resistance cannot rely on nails oriented to resist loads in withdrawal.

Part One: Guards

Subject: Glazing in Guards

2021 Code: **Table R301.5 Minimum uniformly distributed live loads, Footnote h.** Glazing used in handrail assemblies and guards shall be designed with a safety factor of 4. The safety factor shall be applied to each of the concentrated loads applied to the top of the rail, and to the load on the in-fill components. These loads shall be determined independent of one another, and loads are assumed not to occur with any other live load.

R308.4.4 Glazing in guards and railings. Glazing in *guards* and railings, including structural baluster panels and nonstructural in-fill panels, regardless of area or height above a walking surface shall be considered to be a hazardous location.

R308.4.4.1 Structural glass baluster panels. Guards with structural glass baluster panels shall be installed with an attached top rail or handrail. The top rail or handrail shall be supported by not less than three glass baluster panels, or shall be otherwise supported to remain in place should one glass baluster panel fail.

Exception: An attached top rail or handrail is not required where the glass baluster panels are laminated glass with two or more glass plies of equal thickness and of the same glass type.

Application: Section R308.4, Hazardous locations, details the areas with a higher probability of human contact with glass. For this reason, all glazing in guards must be safety glazed. In addition to safety glazing, increased safety factors must be used in the design of the load capacity of glass for top rail and infill loading.

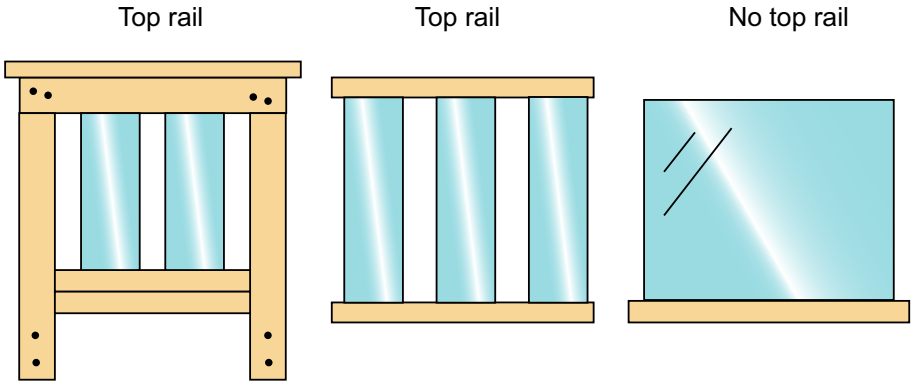


Figure 9-1-10: Due to the availability of premanufactured, individual glass balusters, the 2018 edition of the IRC included new provisions. Unless compliant with the exception, there must be a top rail attached to the glass. Some designs may include a top rail that is not structurally supported by anything other than the glass below, and such applications would require a minimum of three individual glass panels to support the top rail where the design loads are applied. This provides a redundancy in stability should a glass panel be broken. Where there are less than three panels in each section, the top rail must be supported independently, usually by connection to a post. All panels must be safety glazed with a safety factor of 4 for all loads.

Part Two: Handrails

Part Two: **Handrails**

Subject: **Where Handrails Are Required**

2021 Code: **R311.7.8 Handrails.** Handrails shall be provided on not less than one side of each flight of stairs with four or more risers.

R311.8.3 Handrails required. Handrails shall be provided on not less than one side of ramps exceeding a slope of one unit vertical in 12 units horizontal (8.33-percent slope).

Application: As per the definition, handrails are intended for guidance and support, and that service is most helpful where there is an obstacle to be traversed. A ramp with a slope greater than 1 in 12 and a stair with four or more risers are the obstacles that require a handrail. Though useful on both sides, there is no circumstance in the IRC where two are required. No matter the width of the stairway or ramp or if a stairway wraps around a corner, only a single handrail is required on either side.

Figure 9-2-1: Where a handrail may not be desired, possibly for architectural reasons, a series of three rise stairs with intermediate landings can be used. With less movement between resting places on the landing, a handrail can be omitted.

Figure 9-2-2: Though a similar entry to the other example, this flight of stairs requires a handrail. The treads are deep horizontally but not enough to be landings.

Part Two: Handrails

Subject: Handrail Continuity

2021 Code: **R311.7.8.4 Continuity.** *Handrails* shall be continuous for the full length of the flight, from a point directly above the top riser of the flight to a point directly above the lowest riser of the flight. *Handrail* ends shall be returned toward a wall, guard walking surface continuous to itself, or terminate to a post.

Exceptions:

1. *Handrail* continuity shall be permitted to be interrupted by a newel post at a turn in a flight with winders, at a landing, or over the lowest tread.
2. A volute, turnout or starting easing shall be allowed to terminate over the lowest tread and over the top landing.

R311.8.3.3 Continuity. *Handrails* where required on *ramps* shall be continuous for the full length of the *ramp*. *Handrail* ends shall be returned or shall terminate in newel posts or safety terminals. *Handrails* adjacent to a wall shall have a space of not less than $1^1/_2$ inches (38 mm) between the wall and the handrails.

Application: A required handrail for a ramp or stair must be able to be grasped prior to taking the first step, and you must be able to hold on until the last step without letting go. This is the simple concept of continuity, but it only applies to individual stairs between landings, not the entire stairway. Handrails can be interrupted by posts over the bottom tread and at turns in winders where they may be necessary to make the sharp turn in the handrail around the narrow side of the winders. Commonly, the post at the base of stairs is adjacent to the stairs for support and the handrail is permitted to end into the post, short of the riser of the last tread. At landings, occupants are able to stop and rest safely before beginning the next stair. For this reason, handrails must only be continuous for each individual stair and can terminate at a landing.

Figure 9-2-3: To avoid catching purse straps, loose clothing or articles held by the user, handrails must terminate into a post or wall or be otherwise returned to face an alternate direction.

Part Two: Handrails

Subject: Handrail Clearances and Projections

2021 Code: **R311.7.8.2 Handrail projection.** Handrails shall not project more than $4^1/_2$ inches (114 mm) on either side of the stairway.

> **Exception:** Where nosings of landings, floors or passing flights project into the stairway reducing the clearance at passing handrails, handrails shall project not more than $6^1/_2$ inches (165 mm) into the stairway, provided that the stair width and handrail clearance are not reduced to less than that required.

R311.7.8.3 Handrail clearance. Handrails adjacent to a wall shall have a space of not less than $1^1/_2$ inches (38 mm) between the wall and the handrails.

Application: Section R311.7.8.2, Handrail projections, is related to Section R311.7.1, Width, for stairway minimum width. The minimum stair width is 36 inches, but this is only required in the area above the allowable handrail projection. The allowable widths at and below the handrail correlate with the allowable projections found in this section. Allowing handrails to project into the stair width promotes the installation of handrails, a safety feature, without the additional burden of building wider stairs.

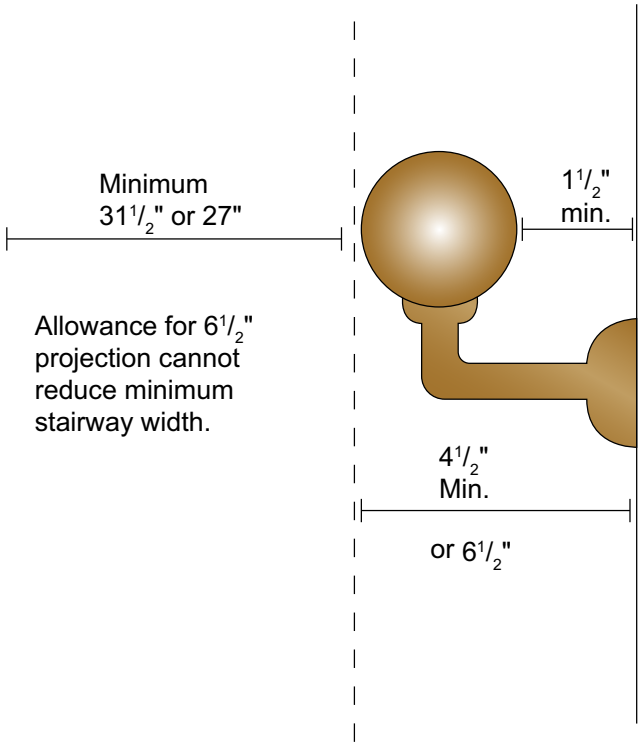


Figure 9-2-4: To allow for a grasped hand to slide down the continuous handrail required by Section R311.7.8.4, Continuity, a minimum of $1^1/_2$ inches must be provided between the outside of the handrail and an obstruction such as a wall, guard or other feature.

Part Two: Handrails

Subject: Handrail Height

2021 Code: **R311.7.8.1 Height.** Handrail height, measured vertically from the sloped plane adjoining the tread nosing, or finish surface of ramp slope, shall be not less than 34 inches (864 mm) and not more than 38 inches (965 mm).

Exceptions:

1. The use of a volute, turnout or starting easing shall be allowed over the lowest tread.
2. Where handrail fittings or bendings are used to provide continuous transition between flights, transitions at winder treads, the transition from handrail to *guard*, or used at the start of a flight, the handrail height at the fittings or bendings shall be permitted to exceed 38 inches (956 mm).

R311.8.3.1 Height. Handrail height, measured above the finished surface of the ramp slope, shall be not less than 34 inches (864 mm) and not more than 38 inches (965 mm).

Application: For effective use, a handrail must be close to the average hand. This not only makes the handrail more inviting for use, it can also be more rapidly reached in the event of a stumble. The handrail must be placed between the maximum and minimum heights, as measured from the nosing of each tread or the ramp surface, and while it doesn't have to be parallel to the angle of the stairs or ramp, it would be more comfortable for the user if it were.

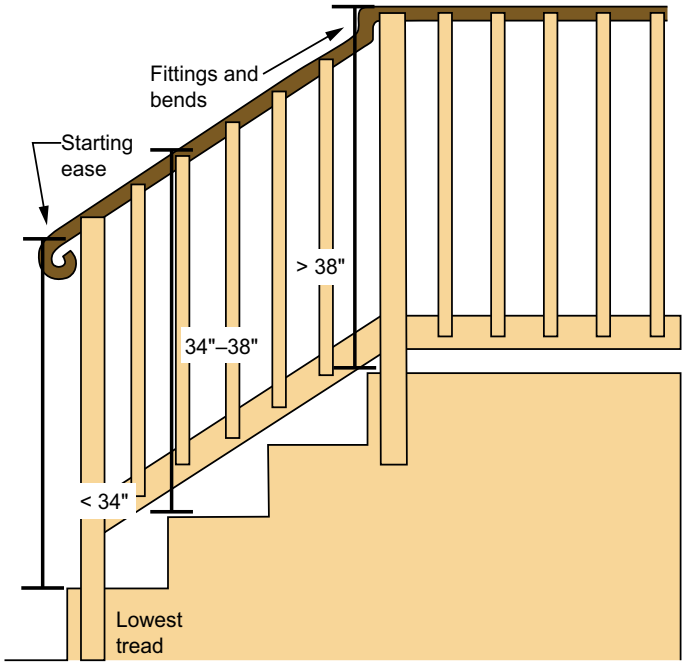


Figure 9-2-5: The IRC recognizes in the first exception that safe terminations of handrails in starting curvatures are likely to drop portions of the handrail end below the minimum height at the lowest tread, yet do not reduce their effective use. Other times, fittings or bends may be used to tie a handrail into a guard or to adjust a handrail height at a tight inside curve of winder treads. Exception 2 recognizes this momentary additional height and allows it in particular locations.

Part Two: Handrails

Subject: Handrail Live Loads

2021 Code:

TABLE R301.5—partial
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS (in pounds per square foot)

USE	UNIFORM LOAD (psf)	CONCENTRATED LOAD (lb)
Handrail[d]	—	200[h]

d. A single concentrated load applied in any direction at any point along the top. For a guard not required to serve as a handrail, the load need not be applied to the top element of the guard in a direction parallel to such element.

Application: Table R301.5, Minimum uniformly distributed live loads, provided in Part One of the chapter, requires handrails to support a 200-pound concentrated load at any point along their length. The modifications to this table in the 2021 IRC have no effect on handrails, either stand-alone or when in a guard assembly. Handrails that are integrated into the top of guards share the same load path as the guard, as discussed in Part One of this chapter. When a stand-alone handrail is attached to a guard, post, wall or other surface, that building feature must be evaluated as part of the load path for the handrail loads.

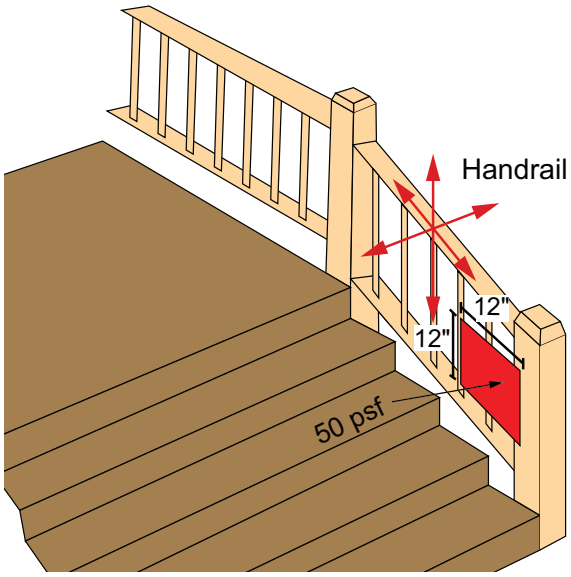


Figure 9-2-6: Typical handrail brackets found in the consumer marketplace are likely only intended for use inside a home, where protected from weather. Sufficient corrosion resistance of handrail structural connections is not specifically required by the IRC but would be an appropriate interpretation and expectation when building or approving handrails.

Part Two: Handrails

Subject: Handrail Graspability

2021 Code: **R311.7.8.5 Grip size.** Required handrails shall be of one of the following types or provide equivalent graspability.

1. Type I. Handrails with a circular cross section shall have an outside diameter of not less than $1^1/_4$ inches (32 mm) and not greater than 2 inches (51 mm). If the handrail is not circular, it shall have a perimeter of not less than 4 inches (102 mm) and not greater than $6^1/_4$ inches (160 mm) and a cross section of not more than $2^1/_4$ inches (57 mm). Edges shall have a radius of not less than 0.01 inch (0.25 mm).
2. Type II. Handrails with a perimeter greater than $6^1/_4$ inches (160 mm) shall have a graspable finger recess area on both sides of the profile. The finger recess shall begin within $^3/_4$ inch (19 mm) measured vertically from the tallest portion of the profile and have a depth of not less than $^5/_{16}$ inch (8 mm) within $^7/_8$ inch (22 mm) below the widest portion of the profile. This required depth shall continue for not less than $^3/_8$ inch (10 mm) to a level that is not less than $1^3/_4$ inches (45 mm) below the tallest portion of the profile. The width of the handrail above the recess shall be not less than $1^1/_4$ inches (32 mm) and not more than $2^3/_4$ inches (70 mm). Edges shall have a radius of not less than 0.01 inch (0.25 mm).

R311.8.3.2 Grip size. Handrails on ramps shall comply with Section R311.7.8.5.

Application: For a handrail to be effective in support and guidance, it must be able to be securely grasped by average hands. This requires both a maximum and minimum perimeter and a maximum cross section for round and square rails. Allowing for creative design, other shapes are permitted, but they are also provided restrictions to assure an effective grip. A recess on both sides so the fingers and thumbs can both engage are a critical distinction between a “grip” and a “pinch,” and the vertical limit of these recesses from the top of the rail ensures fingers can reach it.

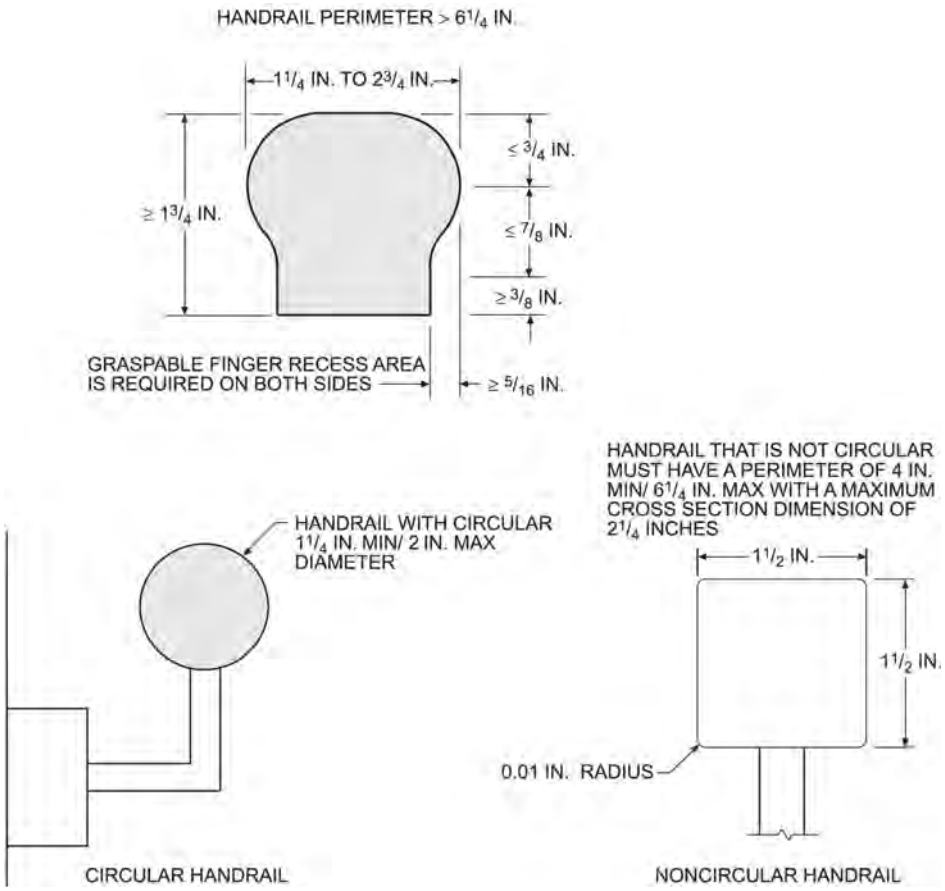


Figure 9-2-7: Though the IRC narrates two very specific types of graspable rails, the final statement in the section allows for additional designs. Clearly permitting "equivalent graspability" alongside the reference to the two types allows for realistic discretion as to the intent and purpose and less hang up on the often-difficult-to-evaluate geometric provisions. A handrail should be able to be gripped, not pinched.

Chapter 10

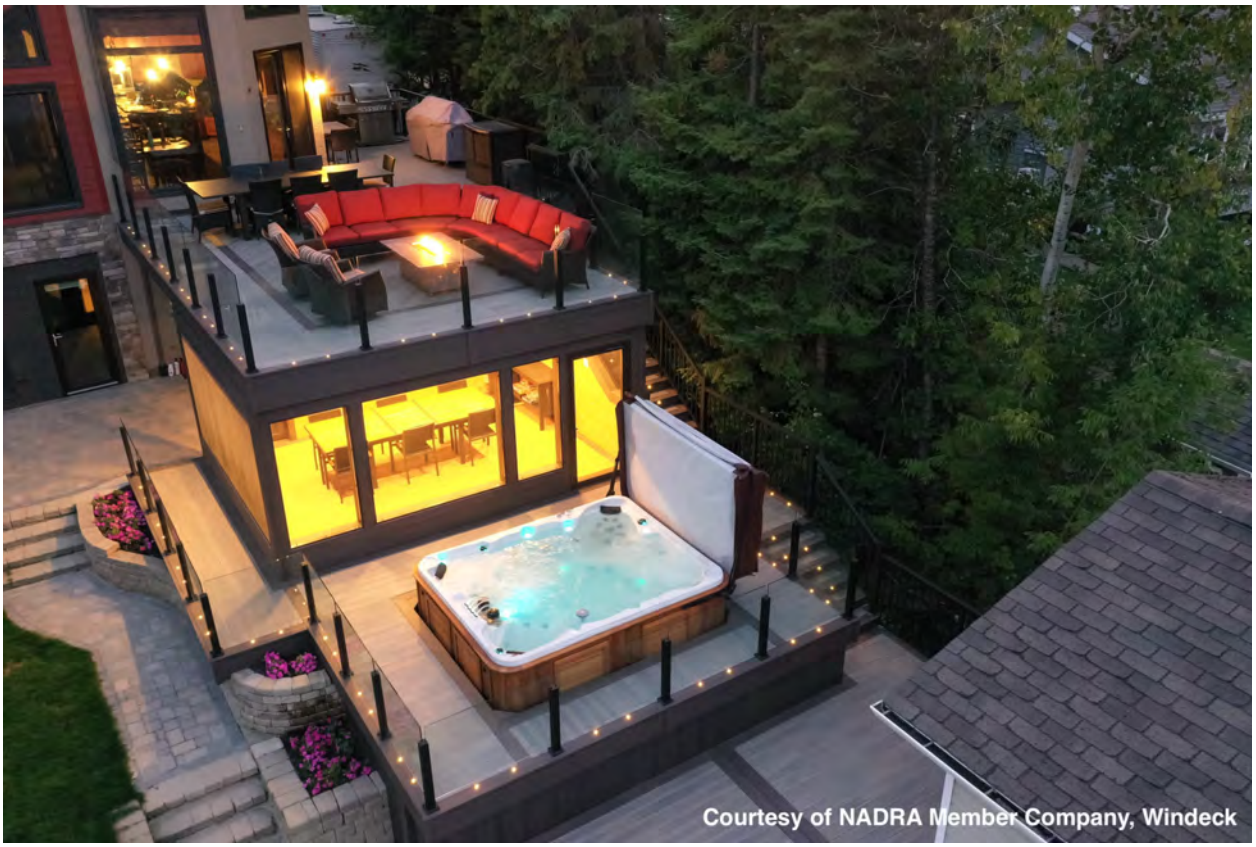
Amenities

Introduction

A modern deck is more than just a square walking surface, it's an extension of the home. From BBQ kitchens to bench seating, there are a lot of extra features that get built into decks. Most of them don't have specific codes involved, such as planter boxes, bench seats, privacy walls, and BBQ counter tops. The exception would be when they are acting as guards or supporting handrails. Other amenities such as hot tubs and gas appliances have numerous code provisions, but they are generally handled by the plumbing, mechanical, and electrical contractors and inspectors. However, there are some aspects of those installations where general contractors and building inspectors can certainly pay attention. Only select IRC provisions are provided here to highlight common design limitations.

2021 Modification:

Due to numerous changes in the text of these IRC sections, only the 2021 IRC text is provided in this chapter.



Part One: Hot Tubs

Part One: **Hot Tubs**

Subject: **Receptacles at Hot Tubs**

2021 Code: **E4203.1 Receptacle outlets.** Receptacles outlets shall be installed and located in accordance with Sections E4203.1.1 through E4203.1.7. In determining the dimensions in this section addressing receptacle spacings, the distance to be measured shall be the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier. [680.22(A)(6)]

E4203.1.2 Other receptacles. Other receptacles on the property shall be located not less than 6 feet (1829 mm) from the inside walls of pools and outdoor spas and hot tubs. [680.22 (A)(3)]

E4203.1.3 Where required. No less than one 125-volt, 15- or 20-ampere receptacle supplied by a general-purpose branch circuit shall be located not less than 6 feet (1829 mm) from and not more than 20 feet (6096 mm) from the inside wall of permanently installed pools and outdoor spas and hot tubs. This receptacle shall be located not more than 6 feet, 6 inches (1981 mm) above the floor, platform or grade level serving the pool, spa or hot tub. [680.22(A)(1)]

E4203.1.4 GFCI protection. All 15- and 20-ampere, single phase, 125-volt receptacles located within 20 feet (6096 mm) of the inside walls of pools and outdoor spas and hot tubs shall be protected by a Class A ground-fault circuit interrupter. Outlets supplying all pool motors on branch circuits rated at 150 volts or less to ground, and 60 amperes or less, single- or 3-phase, shall be provided with Class A ground-fault circuit-interrupter protection. [680.21(C) and 680.22(A)(4)]

Application: The prohibition of receptacle outlets near hot tubs and pools reduces the likelihood of a plugged-in appliance with an average 6-foot-long cord from being submerged. Between 6 and 20 feet from the water, all receptacle outlets must be GFCI protected, but at least one must be provided. It is intended for convenience in serving the pool or hot tub; therefore, it must be no higher than 6 feet, 6 inches above the surface it is accessed from.

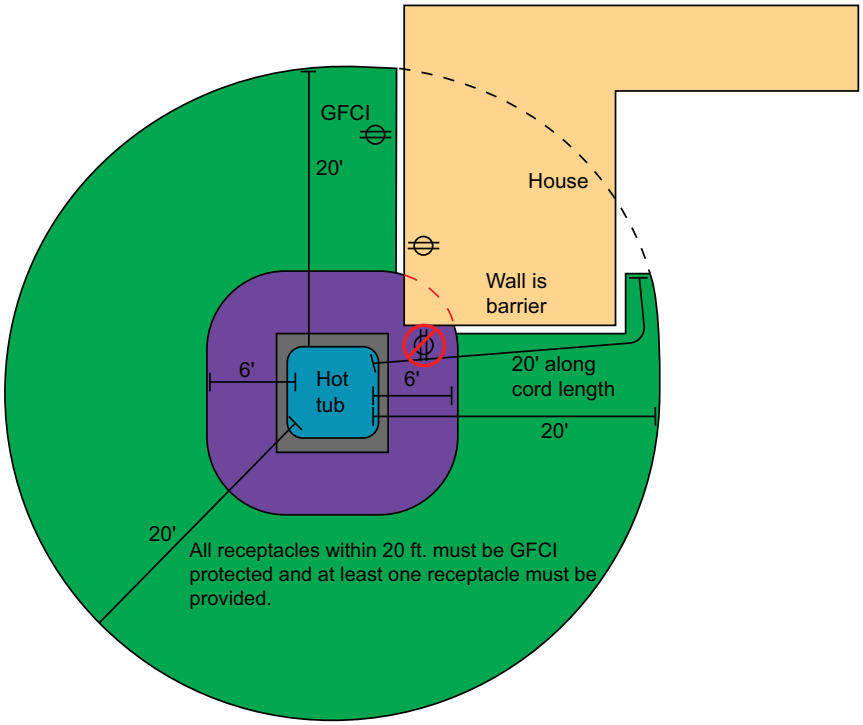


Figure 10-1-1: The measurement is taken along the length of a hypothetical cord, so it is measured around buildings and other obstructions. However, it is not measured through permanent barriers, such as the walls of a house, even if there is an openable window.

Part One: Hot Tubs

Subject: Switches and Disconnecting

2021 Code: **IN SIGHT FROM (Within sight from, within sight).** Where this code specifies that one piece of equipment shall be "in sight from," "within sight from," "within sight of," or similarly stated from/of another piece of equipment, the specified equipment must be visible and not more than 50 feet (15.2 m) distant from the other.

E4203.2 Switching devices. Switching devices shall be located at least 5 feet (1524 mm) horizontally from the inside walls of pools, spas and hot tubs unless separated from the pool, spa or hot tub by a solid fence, wall, or other permanent barrier that provides at least a 5-foot (1524 mm) reach distance. Alternatively, a switch that is *listed* as being acceptable for use within 5 feet (1524 mm) shall be permitted. Switching devices located in a room or area containing a hydromassage bathtub shall be located in accordance with the general requirements for installing equipment in bathrooms. [680.22(C); 680.43(C); and 680.72]

E4203.3 Disconnecting means. One or more means to simultaneously disconnect all ungrounded conductors for all utilization equipment, other than lighting, shall be provided. Each of such means shall be readily accessible and within sight from the equipment it serves and shall be located at least 5 feet (1524 mm) horizontally from the inside walls of a pool, spa, or hot tub unless separated from the open water by a permanently installed barrier that provides a 5-foot (1524 mm) or greater reach path. This horizontal distance shall be measured from the water's edge along the shortest path required to reach the disconnect. (680.13)

Application: Similar to receptacles, electrical switches can't be near hot tubs and pools, but instead of a 6-foot distance based on appliance cords, it's a 5-foot distance based on the arm reach of someone inside the tub. A hot tub must have a means to disconnect all the power serving it. A serviceperson, to be protected while working on the tub, must be able to visually see the disconnect within 50 feet from the location of service. This reduces the probability of someone turning the power back on while the tub is being serviced.

Figure 10-1-2: Though within 50 feet, this disconnect cannot be seen from the hot tub location.

Part One: Hot Tubs

Subject: Luminaires at Hot Tubs

2021 Code:

E4203.4.1 Outdoor location. In outdoor pool, outdoor spas and outdoor hot tubs areas, luminaires, lighting outlets, and ceiling-suspended paddle fans shall not be installed over the pool or over the area extending 5 feet (1524 mm) horizontally from the inside walls of a pool except where no part of the luminaire or ceiling-suspended paddle fan is less than 12 feet (3658 mm) above the maximum water level. [680.22(B)(1)]

E4203.4.3 Low-voltage luminaires. Listed low-voltage luminaires not requiring grounding, not exceeding the low-voltage contact limit, and supplied by listed transformers or power supplies that comply with Section E4206.1 shall be permitted to be located less than 5 feet (1.5 m) from the inside walls of the pool. [680.22(B)(6)]

E4203.4.4 Existing lighting outlets and luminaires. Existing lighting outlets and luminaires that are located within 5 feet (1524 mm) horizontally from the inside walls of pools and outdoor spas and hot tubs shall be permitted to be located not less than 5 feet (1524 mm) vertically above the maximum water level, provided that such luminaires and outlets are rigidly attached to the existing structure and are protected by a ground-fault circuit interrupter. [680.22(B)(3)]

E4203.4.6 GFCI protection in adjacent areas. Luminaires, lighting outlets and ceiling-suspended paddle fans that are installed in the area extending between 5 feet (1524 mm) and 10 feet (3048 mm) from the inside walls of pools and outdoor spas and hot tubs shall be protected by ground-fault circuit interrupters except where such luminaires, lighting outlets and ceiling-suspended paddle fans are installed not less than 5 feet (1524 mm) above the maximum water level and are rigidly attached to the structure. [680.22(B)(4)]

Application: The restrictions for luminaires and ceiling fans near hot tubs are very specific, but this is to allow the most design freedom while providing safety. Where existing luminaires or fans are installed, the limits loosen slightly. Rigid attachment ensures the fixtures will not swing or otherwise move into the prohibited regions through either human contact or wind.

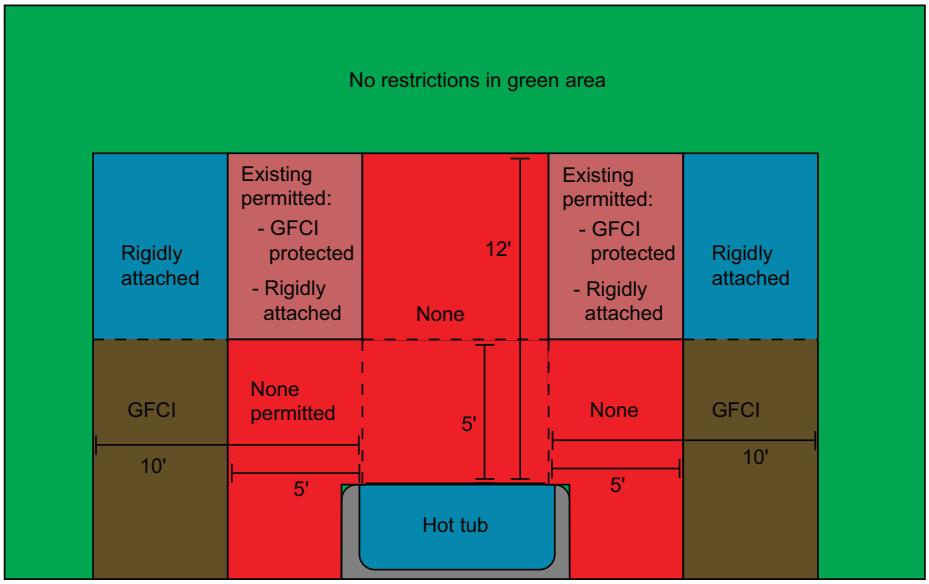


Figure 10-1-3: When correctly installed after a GFCI device, a luminaire or ceiling fan can be GFCI protected.

Part One: Hot Tubs

Subject: Bonding Metal Objects

2021 Code: **E4204.2 Bonded parts.** The parts of pools, spas, and hot tubs specified in Items 1 through 7 shall be bonded together using insulated, covered or bare solid copper conductors not smaller than 8 AWG or using rigid metal conduit of brass or other identified corrosion-resistant metal. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool, spa, or hot tub area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes. Connections shall be made by exothermic welding, by listed pressure connectors or clamps that are labeled as being suitable for the purpose and that are made of stainless steel, brass, copper or copper alloy, machine screw-type fasteners that engage not less than two threads or are secured with a nut, thread-forming machine screws that engage not less than two-threads, or terminal bars. Connection devices or fittings that depend solely on solder shall not be used. Sheet metal screws shall not be used to connect bonding conductors or connection devices: [680.26(B)]

7. All fixed metal parts including, but not limited to, metal-sheathed cables and raceways, metal piping, metal awnings, metal fences and metal door and window frames. [680.26(B)(7)]

Exceptions:

1. Those separated from the pool by a permanent barrier that prevents contact by a person shall not be required to be bonded. [680.26(B)(7) Exception No. 1]
2. Those greater than 5 feet (1524 mm) horizontally from the inside walls of the pool shall not be required to be bonded. [680.26(B)(7) Exception No. 2]
3. Those greater than 12 feet (3658 mm) measured vertically above the maximum water level of the pool, or as measured vertically above any observation stands, towers, or platforms, or any diving structures, shall not be required to be bonded. [680.26(B)(7) Exception No. 3]

Application: Little known to many deck builders and building inspectors, the electrical code requires all fixed metal objects in reaching distance of the hot tub water to be bonded to the conductive elements of the hot tub. This results in the hot tub and the metal objects staying at the same electrical potential and reduces the risk of electrocution. If the metal becomes inadvertently energized, the bonding to the hot tub will carry the current through the hot tub's equipment grounding conductor and to the panel, exceeding the ampacity of the overcurrent protection and disconnecting the power.

Figure 10-1-4: Hazards related to occupant contact, such as safety glazing, switches, disconnects, lighting, and metal objects, follow a 5-foot reach rule. The clearances described in these sections are very similar to those required for luminaires, previously discussed. Bonding metal guards, as shown in this photo, is not usually done by design, as it is aesthetically displeasing and easily removed by unaware occupants after the inspection passes. When designing a hot tub installation, it is recommended to simply design a clear 5-foot horizontal space around the tub free from all the aforementioned items.

Part One: Hot Tubs

Subject: Overhead Service Conductors

2021 Code: **E4203.7 Overhead conductor clearances.** Except where installed with the clearances specified in Table E4203.7, the following parts of pools and outdoor spas and hot tubs shall not be placed under existing service-drop conductors, overhead service conductor, or any other open overhead wiring; nor shall such wiring be installed above the following:

1. Pools and the areas extending not less than 10 feet, (3048 mm) horizontally from the inside of the walls of the pool.
2. Diving structures and the areas extending not less than 10 feet (3048 mm) horizontally from the outer edge of such structures.
3. Observation stands, towers, and platforms and the areas extending not less than 10 feet (3048 mm) horizontally from the outer edge of such structures.

Overhead conductors of network-powered broadband communications systems shall comply with the provisions in Table E4203.7 for conductors operating at 0 to 750 volts to ground.

Utility-owned, -operated and -maintained communications conductors, community antenna system coaxial cables and the supporting messengers shall be permitted at a height of not less than 10 feet (3048 mm) above swimming and wading pools, diving structures, and observation stands, towers, and platforms. [680.8(A), (B), and (C)]

TABLE E4203.7 [Table 680.8(A)]
OVERHEAD CONDUCTOR CLEARANCES

	INSULATED SUPPLY OR SERVICE DROP CABLES, 0-750 VOLTS TO GROUND, SUPPORTED ON AND CABLED TOGETHER WITH AN EFFECTIVELY GROUNDED BARE MESSENGER OR EFFECTIVELY GROUNDED NEUTRAL CONDUCTOR (feet)	ALL OTHER SUPPLY OR SERVICE DROP CONDUCTORS (feet)	
		Voltage to ground	
		0 to 15 kV	Greater than 15 to 50 kV
A. Clearance in any direction to the water level, edge of water surface, base of diving platform, or permanently anchored raft	22.5	25	27
B. Clearance in any direction to the diving platform	14.5	17	18

For SI: 1 foot = 304.8 mm.

Application: Clearances to overhead service cables are considerably stricter than any other clearances. Generally, hot tubs can't have any cables above them or above a 10-foot horizontal area around the tub. The exception is when the cables are 22.5–27 feet or more away from the water, measured in any direction.

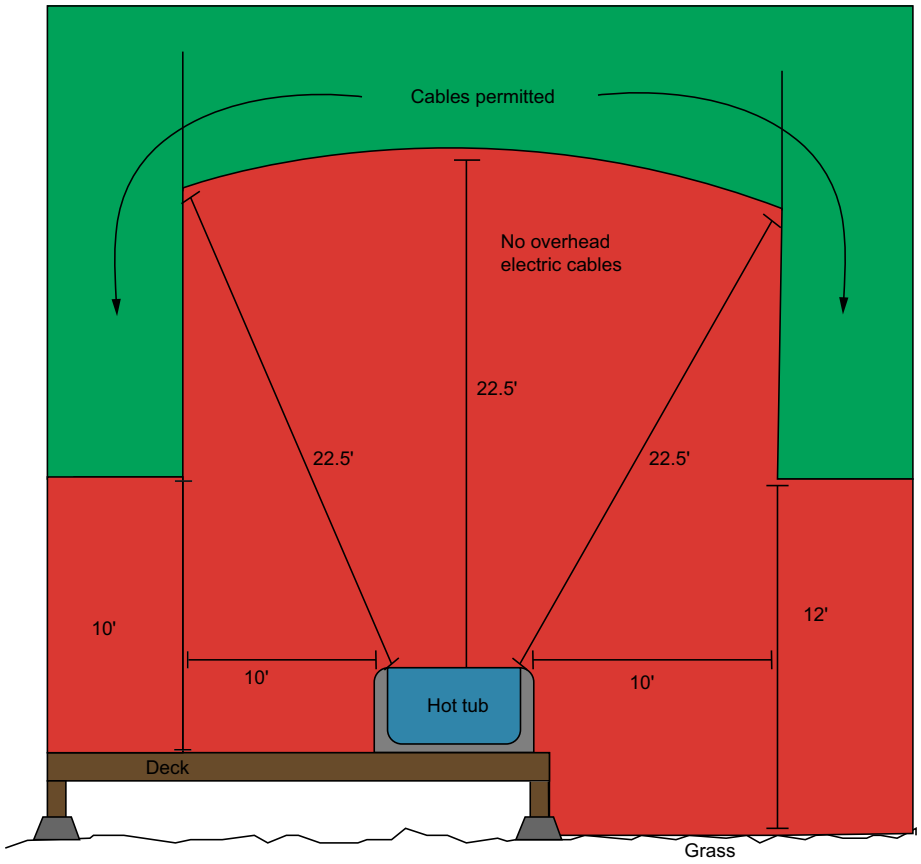


Figure 10-1-5: Hooking your tape measure over the cable to measure the height is not recommended. Similar to the 5-foot rule discussed previously, simply design the hot tub location well away from overhead cables.

Part One: Hot Tubs

Subject: **2021 *International Swimming Pool and Spa Code*® (ISPSC®)**

2021 Code: **R327.1 General.** The design and construction of pools and spas shall comply with the *International Swimming Pool and Spa Code*.

Application: Up until the 2015 edition of the IRC, an appendix chapter provided specific provisions for security barriers around pools and spas (hot tubs). Young children are curiously or haphazardly drawn to these features and present an incredible life safety hazard. It is the expectation of society and the IRC that owners of these features are responsible for preventing and securing their use. Section R327.1 of the IRC now references the ISPSC directly as the standard for design and construction of pools and spas. Unlike an appendix, which requires a specific and optional adoption, this reference in the body of the code is mandatory.

As discussed in Chapter 1 of this book, a referenced standard is only applicable to the extent of the reference. This reference to "pools and spas" is not clear as to whether this includes provisions related to accessory features, such as security barriers and decks surrounding pools. These ISPSC provisions and commentary are provided in Chapter 11 of this book.

Figure 10-1-6: As a referenced standard from IRC 326.1, the ISPSC provisions for security barriers and decks become mandatory IRC provisions.

Part Two: Gas Appliances

Part Two: **Gas Appliances**

Subject: **Gas Appliance Design**

2021 Code: **G2408.1 (305.1) General.** *Equipment* and *appliances* shall be installed as required by the terms of their approval, in accordance with the conditions of listing, the manufacturer's instructions and this code. Manufacturer's installation instructions shall be available on the job site at the time of inspection. [Remainder of section not provided.]

G2415.9 (404.9) Above-ground piping outdoors. *Piping* installed outdoors shall be elevated not less than $3^1/_2$ inches (89 mm) above ground and where installed across roof surfaces, shall be elevated not less than $3^1/_2$ inches (89 mm) above the roof surface. *Piping* installed above ground, outdoors, and installed across the surface of roofs shall be securely supported and located where it will be protected from physical damage. Where passing through an outside wall, the *piping* shall be protected against corrosion by coating or wrapping with an inert material. Where *piping* is encased in a protective pipe sleeve, the annular space between the *piping* and the sleeve shall be sealed.

G2415.16 (404.16) Location of outlets. The unthreaded portion of *piping outlets* shall extend not less than l inch (25 mm) through finished ceilings and walls and where extending through floors or outdoor patios and slabs, shall be not less than 2 inches (51 mm) above them. The *outlet* fitting or *piping* shall be securely supported. *Outlets* shall not be placed behind doors. *Outlets* shall be located in the room or space where the *appliance* is installed.

Application: Decks are often designed with gas BBQs, firepits, and sometimes heaters. Installing an extension to the gas distribution system is work better left to a mechanical or plumbing contractor, but these code provisions are useful for designers. Built-in barbecues must be installed in accordance with the manufacturer's installation instructions, which will provide clearances to combustible material, such as the side of a house, under a roof or near guards. When running gas line under a deck, a minimum clearance to grade of $3^1/_2$ inches is required, and when stubbing up through the floor, be sure to leave enough unthreaded pipe to grab with the pipe wrench. Be sure not to bring it through the floor behind a door.

Figure 10-2-1: If on the right-side countertop, this grill would likely have been too close to the guards.

Part Three: Adding a Door

Part Three: Adding a Door

Subject: Clearances to the Door

2021 Code: **G2427.8 (503.8) Venting system terminal clearances.** The clearances for through-the-wall direct-vent and nondirect-vent terminals shall be in accordance with Figure G2427.8 and Table G2427.8.

Exception: The clearances in Table G2427.8 shall not apply to the *combustion air* intake of a direct-vent *appliance*.

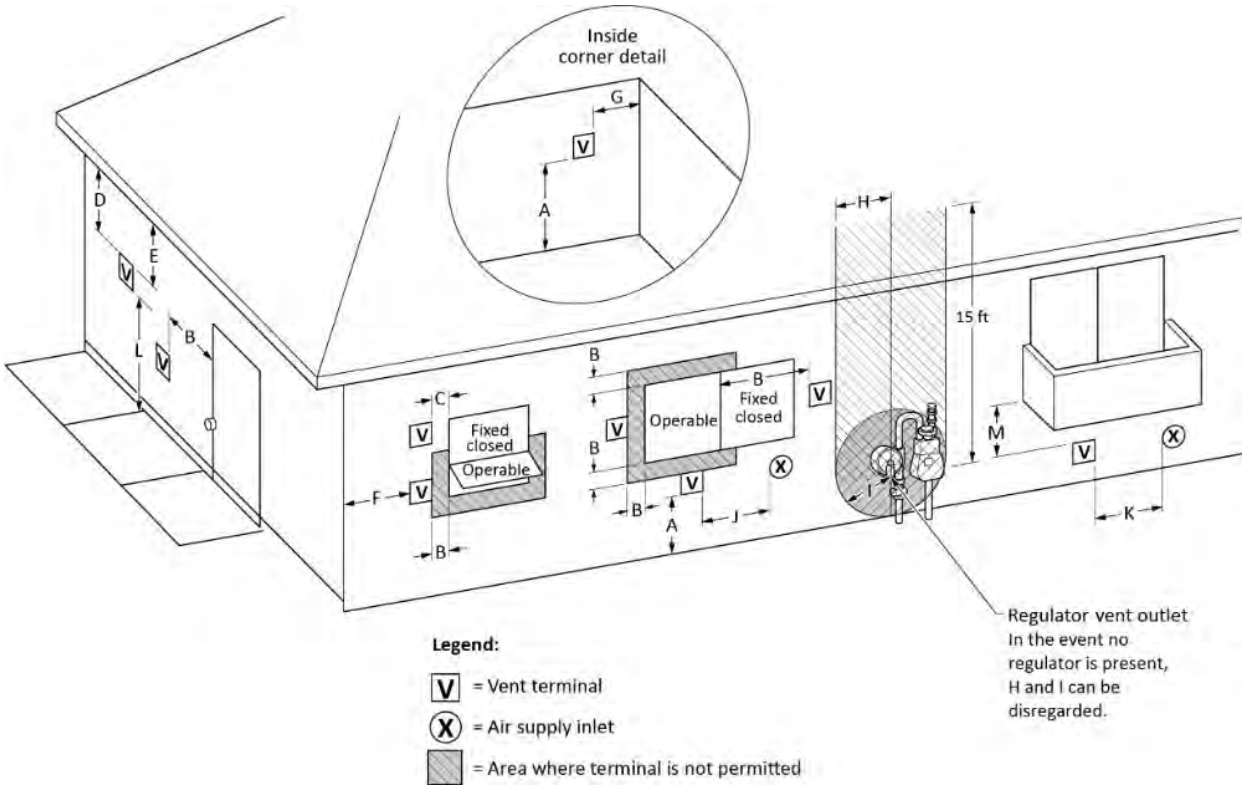


FIGURE G2427.8 (503.8)
THROUGH-THE-WALL VENT TERMINAL CLEARANCES

TABLE G2427.8 (503.8)—partial
THROUGH-THE-WALL VENT TERMINAL CLEARANCES

FIGURE CLEARANCE	CLEARANCE LOCATION	MINIMUM CLEARANCES FOR DIRECT-VENT TERMINALS	MINIMUM CLEARANCES FOR NONDIRECT-VENT TERMINALS
B	Clearance to window or door that is openable	6 inches: Appliances ≤ 10,000 Btu/hr 9 inches: Appliances > 10,000 Btu/hr ≤ 50,000 Btu/hr 12 inches: Appliances > 50,000 Btu/hr ≤ 150,000 Btu/hr Appliances > 150,000 Btu/hr, in accordance with the appliance manufacturer's instructions and not less than the clearances specified for nondirect-vent terminals in Row B	4 feet below or to side of opening or 1 foot above opening

M1502.3 Duct termination. Exhaust ducts shall terminate on the outside of the building. Exhaust duct terminations shall be in accordance with the dryer manufacturer's installation instructions. If the manufacturer's instructions do not specify a termination location, the exhaust duct shall terminate not less than 3 feet (914 mm) in any direction from openings into buildings, including openings in ventilated soffits. Exhaust duct terminations shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination.

P3103.5 Location of vent terminal. An open vent terminal from a drainage system shall not be located less than 4 feet (1219 mm) directly beneath any door, openable window, or other air intake opening of the building or of an adjacent building, nor shall any such vent terminal be within 10 feet (3048 mm) horizontally of such an opening unless it is not less than 3 feet (914 mm) above the top of such opening.

Application: Adding a door to a house either creates a new opening or enlarges one from a window. Openings into houses are provided minimum clearances to various exhausts, and these must be considered when determining a door location.

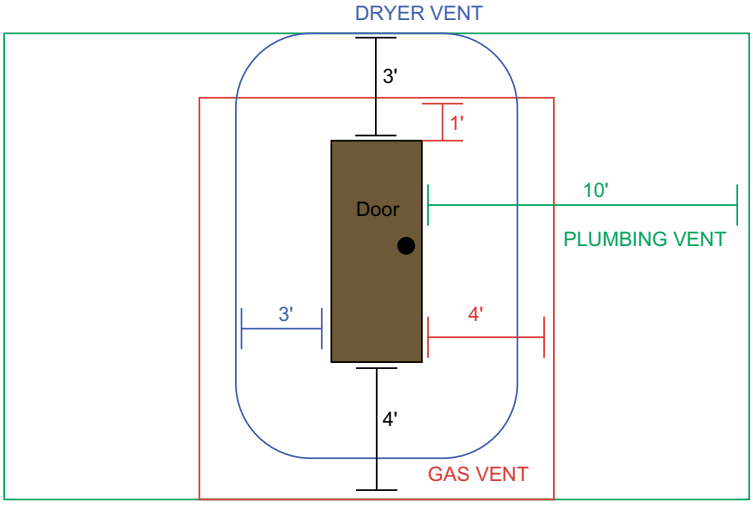


Figure 10-3-1: Mechanical draft vents, dryer vents, and plumbing vents all have different clearances required from door openings. Before planning a new door location, consider the vents nearby. In this graphic, the dimensions show mechanical draft vent terminations (other than direct vent) in red, plumbing vents in green, and dryer vents in blue.

Part Three: Adding a Door

Subject: Electrical Requirements

2021 Code: **E3901.2.1 Spacing.** Receptacles shall be installed so that no point measured horizontally along the floor line of any wall space is more than 6 feet (1829 mm), from a receptacle outlet. [210.52(A)(1)]

E3903.3 Additional locations. At least one lighting outlet controlled by a *listed* wall-mounted control device shall be installed in hallways, *stairways*, attached garages, and detached garages with electric power. At least one lighting outlet controlled by a *listed* wall-mounted control device shall be installed to provide illumination on the exterior side of each outdoor egress door having grade level access, including outdoor egress doors for attached garages and detached garages with electric power. A vehicle door in a garage shall not be considered as an outdoor egress door.

Application: Adding a door where a window once was or in a new hole in the wall is generally regulated by building code provisions, but some electrical requirements can also be involved. If the door accesses a deck with grade-level access, like a stairway, then there must be a light installed outside the door and switched on the inside. This allows an occupant additional safety and security when opening the door. Such safety is not necessary on a deck that cannot be accessed from the exterior grade.

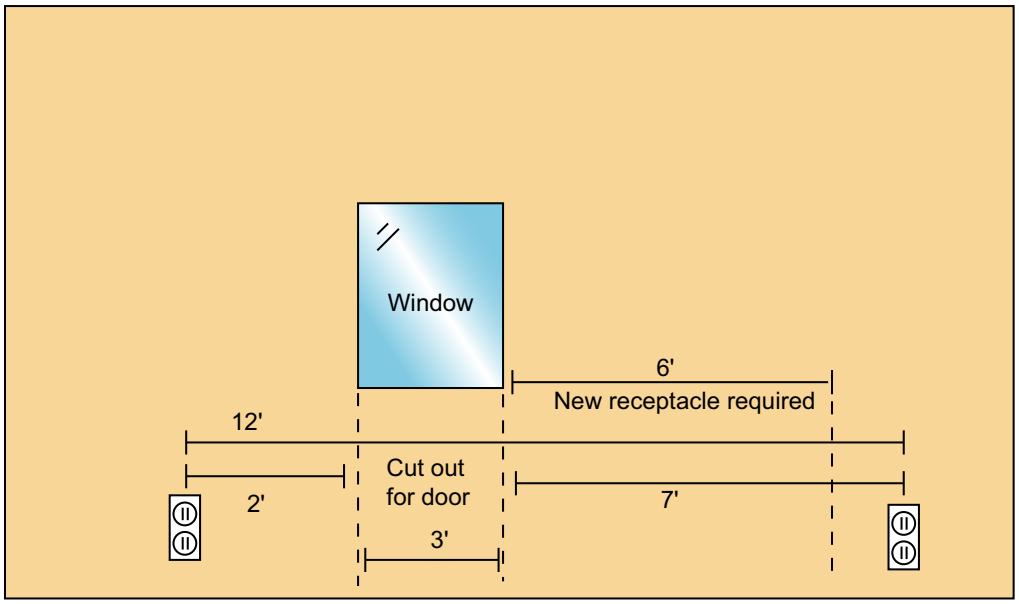


Figure 10-3-2: No space on a wall can be more than 6 feet from a receptacle outlet. This measurement is taken underneath windows, but not across doors, so when a door is added, there must be a receptacle outlet within 6 feet from each side. This example shows how placement of a door could require the addition or relocation of a receptacle outlet.

Part Three: Adding a Door

Subject: Safety Glazing

2021 Code: **R308.4.2 Glazing adjacent to doors.** Glazing in an individual fixed or operable panel adjacent to a door shall be considered to be a hazardous location where the bottom exposed edge of the glazing is less than 60 inches (1524 mm) above the floor or walking surface and it meets either of the following conditions:

1. Where the glazing is within 24 inches (610 mm) of either side of the door in the plane of the door in a closed position.
2. Where the glazing is on a wall less than 180 degrees (3.14 rad) from the plane of the door in a closed position and within 24 inches (610 mm) of the hinge side of an in-swinging door.

Exceptions:

1. Decorative glazing.
2. Where there is an intervening wall or other permanent barrier between the door and the glazing.
3. Where access through the door is to a closet or storage area 3 feet (914 mm) or less in depth. Glazing in this application shall comply with Section R308.4.3.
4. Glazing that is adjacent to the fixed panel of patio doors.

Application: A door in a wall increases the probability of humans moving around near that door, possibly in a panic or emergency escape situation. When in the plane of the door in a closed position, windows and sidelights can often be mistaken for the door and impacted. The addition of a door could require a nearby window to be replaced with safety glazing.

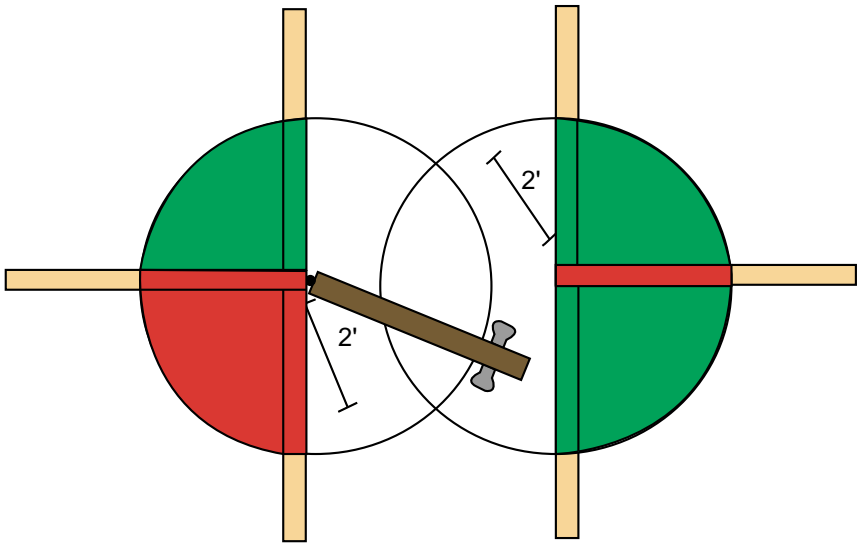


Figure 10-3-3: The swing of the door also creates hazards in nearby glass. On the side the door swings toward, a person could be pushed into the glass by the action of someone else opening the door. In this illustration, glass in the plane of the red areas requires safety glazing.

Chapter 11

Pools and Fire

Introduction

There are two other I-codes that regulate residential decks, but they are for specific purposes. The *International Swimming Pool and Spa Code* (ISPSC) is a direct reference from Chapter 3 of the IRC, and on top of pools and spas, it provides provisions for security barriers and decks around pools. This code was first introduced in 2012 but has not yet seen wide adoption and use across the country as a whole. Provisions for barriers and deck surfaces are provided in this chapter for review, but with minimal supporting discussion. Designers and contractors are strongly encouraged to communicate with their building authorities to discover what is required in each jurisdiction. Building authorities are encouraged to seek additional guidance and commentary in publications more specific to the ISPSC as a whole.

The ICC also publishes the *International Wildland-Urban Interface Code*® (IWUIC®), but this code is not referenced by the IRC. Even more specific than the pool and spa code, this code is only concerned with construction in areas with a higher likelihood of a wildfire spreading to structures. Like the pool and spa code, this code covers a wide range of subjects and broad design provisions, well beyond deck construction. The code sections and brief commentary in

this book are not meant to provide guidance on building according to the IWUIC, and research on the local adopted code is encouraged. However, as discussed in Chapter 1 of this book, the IRC has not established provisions for fire separation of decks between houses or how to protect decks. Where fire protection of decks is required by a local jurisdiction, the IWUIC could be used for guidance. A handful of sections from this code are provided in Part Two of this chapter and offer methods of deck fire protection.

Part One: *International Swimming Pool and Spa Code*

Part One: ***International Swimming Pool and Spa Code***

Subject: **Reference from the IRC**

2021 IRC Code: **R327.1 General.** The design and construction of pools and spas shall comply with the *International Swimming Pool and Spa Code*.

2021 ISPSC Code: **[A] 101.3 Purpose.** The purpose of this code is to establish minimum requirements to provide a reasonable level of safety, health, property protection and general welfare by regulating and controlling the design, construction, installation, quality of materials, location and maintenance or use of pools and spas.

Application: Prior to the 2015 IRC, Appendix Chapter G provided provisions for swimming pool and spa construction. Primarily, other standards were referenced for the pool construction and safety features, but the most useful provisions for deck construction were the security barrier provisions. Pools are a liability to the owner and risk to the community because they're an "attractive nuisance." Young children are interested and drawn to the hazard, and it's the pool owner's responsibility to "secure" the pool from trespassing. This applies to hot tubs and spas as well, features often designed with decks.

In the 2015 edition, the appendix was removed and a new section R327 was added to reference the ISPSC for "the design and construction of pools and spas." The ISPSC includes a lot of provisions that are not directly related to the "pool and spa" such as security barriers and regulations for decks surrounding pools and spas. As discussed in Chapter 1 of this book, an IRC reference to another standard does not automatically apply to the entire standard—only to what was referenced. Does the reference "design and construction of pools and spas" include the provisions for barriers and decks? Or not? Expect to find differing interpretations.

Another differing interpretation to expect is whether a government must specifically adopt the ISPSC for this reference to be valid, or is the reference an automatic extension of the adopted IRC. I-Codes are listed in Chapter 44 of the IRC alongside all the others, and the IRC makes it clear in the opening pages that they are an extension of the IRC. No other referenced standards require independent adoption; however, many building officials believe a reference to another I-Code does. Interpretation of this is likely to vary among jurisdictions.

Part One: *International Swimming Pool and Spa Code*

Subject: Security Barriers

2021 Code:

SECTION 305
BARRIER REQUIREMENTS

305.1 General. The provisions of this section shall apply to the design of barriers for restricting entry into areas having pools and spas. Where spas or hot tubs are equipped with a lockable *safety cover* complying with ASTM F1346 and swimming pools are equipped with a powered *safety cover* that complies with ASTM F1346, the areas where those spas, hot tubs or pools are located shall not be required to comply with Sections 305.2 through 305.7.

[Remaining sections provided on the following pages.]

Application:

Section 305 of the ISPSC provides very specific provisions for security barriers around pools and spas. Unlike guards, which are meant to block an accidental fall, these barriers are meant to address the purposeful attempt of a child to get past the barrier. For that reason, the limitations for the barrier are incredibly specific, and individual commentary is not provided or necessary in this book. Each provision can be relatively easily understood once it is realized they are meant to circumvent a child's willful passage.

This mandatory protection is not exclusive to neighboring children, but also applies to the children who live in or are visiting the property. This means the pool and spa are required to be protected from the house, resulting in provisions related to the structure's walls, doors, and window openings, including requirements for audible alarms upon opening.

The most common time these provisions will arise in deck construction is when the deck serves a hot tub or spa. Rather than secure it with a barrier around the feature, Section 305.1 (above) allows a security cover to be used over the feature itself. ASTM F1346 provides performance standards required for a cover to be considered a safety cover. This includes requirements such as locking in place and an ability to support the weight of a stray child and one or two rescuers, depending on the size of the feature. Warning labels are also part of the standard. The installation of a compliant safety cover is often the most cost-effective way to provide the barrier requirements for a hot tub on a deck. The cover will be labeled as compliant to ASTM F1346 if it is.

2021 Code (continued):

305.2 Outdoor swimming pools and spas. Outdoor pools and spas and indoor swimming pools shall be surrounded by a barrier that complies with Sections 305.2.1 through 305.7.

305.2.1 Barrier height and clearances. Barrier heights and clearances shall be in accordance with all of the following:

1. The top of the barrier shall be not less than 48 inches (1219 mm) above grade where measured on the side of the barrier that faces away from the pool or spa. Such height shall exist around the entire perimeter of the barrier and for a distance of 3 feet (914 mm) measured horizontally from the outside of the required barrier.
2. The vertical clearance between grade and the bottom of the barrier shall not exceed 2 inches (51 mm) for grade surfaces that are not solid, such as grass or gravel, where measured on the side of the barrier that faces away from the pool or spa.
3. The vertical clearance between a surface below the barrier to a solid surface, such as concrete, and the bottom of the required barrier shall not exceed 4 inches (102 mm) where measured on the side of the required barrier that faces away from the pool or spa.
4. Where the top of the pool or spa structure is above grade, the barrier shall be installed on grade or shall be mounted on top of the pool or spa structure. Where the barrier is mounted on the top of the pool or spa, the vertical clearance between the top of the pool or spa and the bottom of the barrier shall not exceed 4 inches (102 mm).

305.2.2 Openings. Openings in the barrier shall not allow passage of a 4-inch-diameter (102 mm) sphere.

305.2.3 Solid barrier surfaces. Solid barriers that do not have openings shall not contain indentations or protrusions that form handholds and footholds, except for normal construction tolerances and tooled masonry joints.

305.2.4 Mesh fence as a barrier. Mesh fences, other than chain link fences in accordance with Section 305.2.7, shall be installed in accordance with the manufacturer's instructions and shall comply with the following:

1. The bottom of the mesh fence shall be not more than 1 inch (25 mm) above the deck or installed surface or grade.
2. The maximum vertical clearance from the bottom of the mesh fence and the solid surface shall not permit the fence to be lifted more than 4 inches (102 mm) from grade or decking.
3. The fence shall be designed and constructed so that it does not allow passage of a 4-inch (102 mm) sphere under any mesh panel. The maximum vertical clearance from the bottom of the mesh fence and the solid surface shall be not greater than 4 inches (102 mm) from grade or decking.
4. An attachment device shall attach each barrier section at a height not lower than 45 inches (1143 mm) above grade. Common attachment devices include, but are not limited to, devices that provide the security equal to or greater than that of a hook-and-eye-type latch incorporating a spring-actuated retaining lever such as a safety gate hook.
5. Where a hinged gate is used with a mesh fence, the gate shall comply with Section 305.3.
6. Patio deck sleeves such as vertical post receptacles that are placed inside the patio surface shall be of a nonconductive material.
7. Mesh fences shall not be installed on top of onground *residential* pools.

305.2.4.1 Setback for mesh fences. The inside of a mesh fence shall be not closer than 20 inches (508 mm) to the nearest edge of the water of a pool or spa.

305.2.5 Closely spaced horizontal members. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is less than 45 inches (1143 mm), the horizontal members shall be located on the pool or spa side of the fence. Spacing between vertical members shall not exceed $1^{3}/_{4}$ inches (44 mm) in width. Where there

are decorative cutouts within vertical members, spacing within the cutouts shall not exceed $1^3/_4$ inches (44 mm) in width.

305.2.6 Widely spaced horizontal members. Where the barrier is composed of horizontal and vertical members and the distance between the tops of the horizontal members is 45 inches (1143 mm) or more, spacing between vertical members shall not exceed 4 inches (102 mm). Where there are decorative cutouts within vertical members, the interior width of the cutouts shall not exceed $1^3/_4$ inches (44 mm).

305.2.7 Chain link dimensions. The maximum opening formed by a chain link fence shall be not more than $1^3/_4$ inches (44 mm). Where the fence is provided with slats fastened at the top and bottom that reduce the openings, such openings shall be not greater than $1^3/_4$ inches (44 mm).

305.2.8 Diagonal members. Where the barrier is composed of diagonal members, the maximum opening formed by the diagonal members shall be not greater than $1^3/_4$ inches (44 mm). The angle of diagonal members shall be not greater than 45 degrees (0.79 rad) from vertical.

305.2.9 Clear zone. Where equipment, including pool equipment such as pumps, filters and heaters, is on the same lot as a pool or spa and such equipment is located outside of the barrier protecting the pool or spa, such equipment shall be located not less than 36 inches (914 mm) from the outside of the barrier.

305.3 Doors and gates. Doors and gates in barriers shall comply with the requirements of Sections 305.3.1 through 305.3.3 and shall be equipped to accommodate a locking device. Pedestrian access doors and gates shall open outward away from the pool or spa, shall be self-closing and shall have a self-latching device.

305.3.1 Utility or service doors and gates. Doors and gates not intended for pedestrian use, such as utility or service doors and gates, shall remain locked when not in use.

305.3.2 Double or multiple doors and gates. Double doors and gates or multiple doors and gates shall have not fewer than one leaf secured in place and the adjacent leaf shall be secured with a self-latching device.

305.3.3 Latch release. For doors and gates in barriers, the door and gate latch release mechanisms shall be in accordance with the following:

1. Where door and gate latch release mechanisms are accessed from the outside of the barrier and are not of the self-locking type, such mechanism shall be located above the finished floor or ground surface in accordance with the following:
    1.1. At public pools and spas, not less than 52 inches (1219 mm) and not greater than 54 inches (1372 mm).
    1.2. At *residential* pools and spas, not less 54 inches (1372 mm).
2. Where door and gate latch release mechanisms are of the self-locking type such as where the lock is operated by means of a key, an electronic opener or the entry of a combination into an integral combination lock, the lock operation control and the latch release mechanism shall be located above the finished floor or ground surface in accordance with the following:
    2.1. At public pools and spas, not less than 34 inches and not greater than 48 inches (1219 mm).
    2.2. At *residential* pools and spas, at not greater than 54 inches (1372 mm).
3. At private pools, where the only latch release mechanism of a self-latching device for a gate is located on the pool and spa side of the barrier, the release mechanism shall be located at a point that is at least 3 inches (76 mm) below the top of the gate.

305.3.4 Barriers adjacent to latch release mechanisms. Where a latch release mechanism is located on the inside of a barrier, openings in the door, gate and barrier within 18 inches (457 mm) of the latch shall not be greater than $^1/_2$ inch (12.7 mm) in any dimension.

305.4 Structure wall as a barrier. Where a wall of a dwelling or structure serves as part of the barrier and where doors, gates or windows provide direct access to the pool or spa through that wall, one of the following shall be required:

1. Operable windows having a sill height of less than 48 inches (1219 mm) above the indoor finished floor**, d**oors and gates shall have an alarm that produces an audible warning when

the window, door or their screens are opened. The alarm shall be *listed* and labeled as a water hazard entrance alarm in accordance with UL 2017.

2. In dwellings not required to be Accessible units, Type A units or Type B units, the operable parts of the alarm deactivation switches shall be located at not less than 54 inches (1372 mm) above the finished floor.
3. In dwellings that are required to be Accessible units, Type A units or Type B units, the operable parts of the alarm deactivation switches shall be located not greater than 54 inches (1372 mm) and not less than 48 inches (1219 mm) above the finished floor.
4. In structures other than dwellings, the operable parts of the alarm deactivation switches shall be located not greater than 54 inches (1372 mm) and not less than 48 inches (1220 mm) above the finished floor.
5. A *safety cover* that is *listed* and *labeled* in accordance with ASTM F1346 is installed for the pools and spas.
6. An *approved* means of protection, such as self-closing doors with self-latching devices, is provided. Such means of protection shall provide a degree of protection that is not less than the protection afforded by Item 1 or 2.

305.5 Onground residential pool structure as a barrier. An onground *residential* pool wall structure or a barrier mounted on top of an onground *residential* pool wall structure shall serve as a barrier where all of the following conditions are present:

1. Where only the pool wall serves as the barrier, the bottom of the wall is on grade, the top of the wall is not less than 48 inches (1219 mm) above grade for the entire perimeter of the pool, the wall complies with the requirements of Section 305.2 and the pool manufacturer allows the wall to serve as a barrier.
2. Where a barrier is mounted on top of the pool wall, the top of the barrier is not less than 48 inches (1219 mm) above grade for the entire perimeter of the pool, and the wall and the barrier on top of the wall comply with the requirements of Section 305.2.
3. Ladders or steps used as means of access to the pool are capable of being secured, locked or removed to prevent access except where the ladder or steps are surrounded by a barrier that meets the requirements of Section 305.
4. Openings created by the securing, locking or removal of ladders and steps do not allow the passage of a 4-inch (102 mm) diameter sphere.
5. Barriers that are mounted on top of onground *residential* pool walls are installed in accordance with the pool manufacturer's instructions.

305.6 Natural barriers. In the case where the pool or spa area abuts the edge of a lake or other natural body of water, public access is not permitted or allowed along the shoreline, and required barriers extend to and beyond the water's edge not less than 18 inches (457 mm), a barrier is not required between the natural body of water shoreline and the pool or spa.

305.7 Natural topography. Natural topography that prevents direct access to the pool or spa area shall include but not be limited to mountains and natural rock formations. A natural barrier *approved* by the governing body shall be acceptable provided that the degree of protection is not less than the protection afforded by the requirements of Sections 305.2 through 305.5.

305.8 Means of egress. Outdoor public pools provided with barriers shall have means of egress as required by Chapter 10 of the *International Building Code*.

Part One: *International Swimming Pool and Spa Code*

Subject: Decks

2021 Code:

SECTION 306
DECKS

306.1 General. The structural design and installation of decks around pools and spas shall be in accordance with the *International Residential Code* or the *International Building Code*, as applicable in accordance with Section 102.7 and this section.

[Remaining sections provided on the following pages.]

Application:

Section 306 of the ISPSC lays out specific requirements for decks around pools and spas, public and private, related to a variety of design elements. These unique requirements are nearly all related to a wet deck becoming more slippery and occupants being likely present at the time. The walking surfaces must be “slip resistant,” but there is no test standard or reference to how that should be determined. Careful and clear plan preparation and approval are recommended when working under this code, and building authorities should address these provisions and approve them at the review stage. Leaving an inspector at the end to determine if an installed product is “slip resistant” is not an appropriate way to administer these provisions.

Gapping and sloping of decks is also addressed and is dependent on the surface material and assumptions about how well such surfaces drain. There are other provisions for gapping, softened edges, handrails, and adjusted stair geometry. This code is still relatively new, only in its fourth edition. As this code is more widely adopted and utilized, we may find some of these provisions developed further in future editions.

2021 Code (continued):

306.2 Slip resistant. Decks, ramps, coping, and similar step surfaces shall be slip resistant and cleanable. Special features in or on decks such as markers, brand insignias, and similar materials shall be slip resistant.

306.3 Step risers and treads. Step risers for decks of public pools and spas shall be uniform and have a height not less than $3^{3}/_{4}$ inches (95 mm) and not greater than $7^{1}/_{2}$ inches (191 mm). The tread distance from front to back shall be not less than 11 inches (279 mm). Step risers for decks of *residential* pools and spas shall be uniform and shall have a height not exceeding $7^{1}/_{2}$ inches (191 mm). The tread distance from front to back shall be not less than 10 inches (254 mm).

306.4 Deck steps handrail required. Public pool and spa deck steps having three or more risers shall be provided with a handrail.

306.5 Slope. The minimum slope of decks shall be in accordance with Table 306.5 except where an alternative drainage method is provided that prevents the accumulation or pooling of water. The slope for decks, other than wood decks, shall be not greater than $^{1}/_{2}$ inch per foot (1 mm per 24 mm) except for ramps. The slope for wood and wood/plastic composite decks shall be not greater than $^{1}/_{4}$ inch per 1 foot (1 mm per 48 mm). Decks shall be sloped so that standing water will not be deeper than $^{1}/_{8}$ inch (3.2 mm), 20 minutes after the cessation of the addition of water to the deck.

TABLE 306.5
MINIMUM DRAINAGE SLOPES FOR DECK SURFACES

SURFACE	MINIMUM DRAINAGE SLOPE (INCH PER FOOT)
Carpet	$^{1}/_{2}$
Exposed aggregate	$^{1}/_{4}$
Textured, hand-finished concrete	$^{1}/_{8}$
Travertine/brick-set pavers, public pools or spas	$^{3}/_{8}$
Travertine/brick-set pavers, *residential* pools or spas	$^{1}/_{8}$
Wood	$^{1}/_{8}$
Wood/plastic composite	$^{1}/_{8}$

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

306.6 Gaps. Gaps shall be provided between deck boards in wood and wood/plastic composite decks. Gaps shall be consistent with *approved* engineering methods with respect to the type of wood used and shall not cause a tripping hazard.

306.6.1 Maximum gap. The open gap between pool decks and adjoining decks or walkways, including joint material, shall be not greater than $^{3}/_{4}$ inch (19.1 mm). The difference in vertical elevation between the pool deck and the adjoining sidewalk shall be not greater than $^{1}/_{4}$ inch (6.4 mm).

306.7 Concrete joints. Isolation joints that occur where the pool coping meets the concrete deck shall be water tight.

306.7.1 Joints at coping. Joints that occur where the pool coping meets the concrete deck shall be installed to protect the coping and its mortar bed from damage as a result of the anticipated movement of adjoining deck.

306.7.2 Crack control. Joints in a deck shall be provided to minimize visible cracks outside of the control joints caused by imposed stresses or movement of the slab.

306.7.3 Movement control. Areas where decks join existing concrete work shall be provided with a joint to protect the pool from damage caused by relative movement.

306.8 Deck edges. The edges of decks shall be radiused, tapered, or otherwise designed to eliminate sharp corners.

306.9 Valves under decks. Valves installed in or under decks shall be accessible for operation, service, and maintenance. Where access through the deck walking surface is required, an access

cover shall be provided for the opening in the deck. Such access covers shall be slip resistant and secured.

306.9.1 Hose bibbs. Hose bibbs shall be provided for rinsing down the entire deck and shall be installed in accordance with the *International Plumbing Code* or *International Residential Code*, as applicable in accordance with Section 102.7.1, and shall be located not greater than 150 feet (45 720 mm) apart. Water-powered devices, such as water-powered lifts, shall have a dedicated hose bibb water source.

Exception: *Residential* pools and spas shall not be required to have hose bibbs located at 150-foot (45 720 mm) intervals, or have a dedicated hose bibb for waterpowered devices.

Part Two: *International Wildland-Urban Interface Code*

Part One: *International Wildland-Urban Interface Code*

Subject: Fire Protection of Decks

2021 Code:

504.7 Appendages and projections. *Unenclosed accessory structures* attached to buildings with habitable spaces and projections, such as decks, shall be not less than 1-hour fire-resistance-rated construction, *heavy timber construction* or constructed of one of the following:

1. *Approved noncombustible* materials.
2. Fire-retardant-treated wood identified for exterior use and meeting the requirements of Section 2303.2 of the *International Building Code*.
3. Ignition-resistant building materials in accordance with Section 503.2.

Exception: Coated materials shall not be used as the walking surface of decks.

503.2 Ignition-resistant building material. Ignition-resistant building materials shall comply with any one of the following:

1. Material shall be tested on all sides with the extended ASTM E84 (UL 723) test or ASTM E2768, except panel products shall be permitted to test only the front and back faces. Panel products shall be tested with a ripped or cut longitudinal gap of $^{1}/_{8}$ inch (3.2 mm). Materials that, when tested in accordance with the test procedures set forth in ASTM E84 or UL 723 for a test period of 30 minutes, or with ASTM E2768, comply with the following:
    - 1.1. Flame spread. Material shall exhibit a *flame spread index* not exceeding 25 and shall not show evidence of progressive combustion following the extended 30-minute test.
    - 1.2. Flame front. Material shall exhibit a flame front that does not progress more than $10^{1}/_{2}$ feet (3200 mm) beyond the centerline of the burner at any time during the extended 30-minute test.
    - 1.3. Weathering. Ignition-resistant building materials shall maintain their performance in accordance with this section under conditions of use. Materials shall meet the performance requirements for weathering (including exposure to temperature, moisture and ultraviolet radiation) contained in the following standards, as applicable to the materials and the conditions of use:
        - 1.3.1. Method A "Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing" in ASTM D2898, for fire-retardant-treated wood, wood-plastic composite and plastic lumber materials.
        - 1.3.2. ASTM D7032 for wood-plastic composite materials.
        - 1.3.3. ASTM D6662 for plastic lumber materials.
    - 1.4 Identification. Materials shall bear identification showing the fire test results.

    Exception: Materials composed of a combustible core and a noncombustible exterior covering made from either aluminum at a minimum 0.019 inch (0.48 mm) thickness or corrosion-resistant steel at a minimum 0.0149 inch (0.38 mm) thickness shall not be required to be tested with a ripped or cut longitudinal gap.
2. Noncombustible material. Material that complies with the requirements for *noncombustible* materials in Section 202.
3. Fire-retardant-treated wood. Fire-retardant-treated wood identified for exterior use and meeting the requirements of Section 2303.2 of the *International Building Code*.

4. Fire-retardant-treated wood *roof coverings*. *Roof assemblies* containing fire-retardant-treated wood shingles and shakes that comply with the requirements of Section 1505.6 of the *International Building Code* and classified as Class A *roof assemblies* as required in Section 1505.2 of the *International Building Code*.

Application: Section 504.7 of the IWUIC provides methods for the required ignition-resistance of decks under the most hazardous classification. These methods would be appropriate for decks where a minimal fire separation distance, as discussed in Chapter 1 of this book, could require fire protection from a local interpretation. Noncombustible materials would need to conform to the definition in the code, provided above, and would be subject to the approval of the building official. Fire-retardant-treated wood and heavy timber construction as provided for in the IBC are another option. A tested 1-hour fire-resistance-rated assembly is acceptable but would not work for conventional deck construction. Finally, materials that comply to the specific test requirements and other details of Section 504.7 are also permitted. Individually, these methods are not ideal for deck construction; however, designs that include features from multiple methods could be approved. For example, a deck with heavy timber posts (min. 8 × 8) and beams (min. 6 × 10), fire-retardant-treated 2x joists and decking that complies as ignition resistant could together provide a fire-protected deck.

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NORTH AMERICAN DECK AND RAILING ASSOCIATION

Deck builders and product manufacturers alike raised concerns at the 2004 DeckExpo over the compatibility of new generation wood treatments and fasteners. As a result, many realized the need for a unified industry voice. NADRA is that voice. The association is a 501(c) 6 not-for-profit corporation.

WHAT DOES NADRA DO FOR THE INDUSTRY?

NADRA helps the consumer by providing information on deck safety, design, and products through www.NADRA.org, by responding to consumer inquiries, and through public relations campaigns such as its Deck Safety Month® Program, Check Your Deck® Decks Done Right and its Deck for a Soldier® Program. These campaigns build consumer trust in this association and its members while at the same time encouraging the outdoor living lifestyle.

Consumers want professional and knowledgeable builders that they trust. NADRA participates in code development to support both its supplier, inspector and deck builder members. Its efforts focus on sensible code development for consumer safety, and quality construction and materials standards.

Before NADRA began contributing to IRC deck code development for the 2015 edition, they had already been supporting the industry with deck code education. Originally based on the 2009 IRC, NADRA released the nation's first and only professional deck code certification, the Master Deck Professional - Code Certification. NADRA partnered with Glenn Mathewson through BuildingCodeCollege.com to align the certification with a series of four On-Demand Courses that comprehensively cover all aspects of decks and codes in preparation for the NADRA certification exam. These four courses are now updated to the 2021 IRC and continue to provide the education necessary for the NADRA MDP-Code certification, as well as ICC and AIA continuing education.

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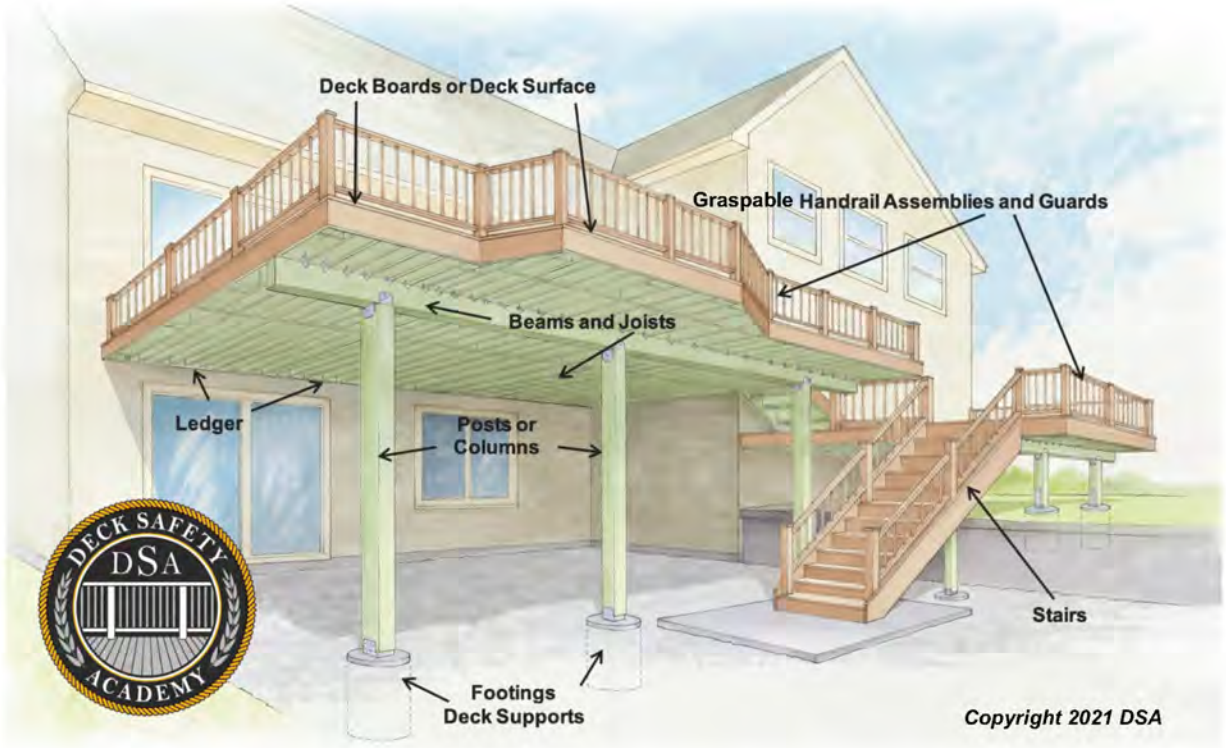

The Deck Safety Academy, sponsored by NADRA, has put together a one-of-a-kind, comprehensive, illustrated manual (referenced above) for the evaluation and inspection of decks. The manual has been developed as a resource for the inspection / evaluation class and the first ever Deck Inspection Mobile App/Form. Class approved for ICC CEUs.

NADRA would like to extend sincere thanks and deep appreciation to Glenn G.A. Mathewson, MCP for his dedication and support to deck professionals everywhere. Following in your father's footsteps with a passion for education excellence is apparent in all you do.

A special thanks to the ICC for including NADRA in the creation of this extensive book that will help elevate the decking industry.

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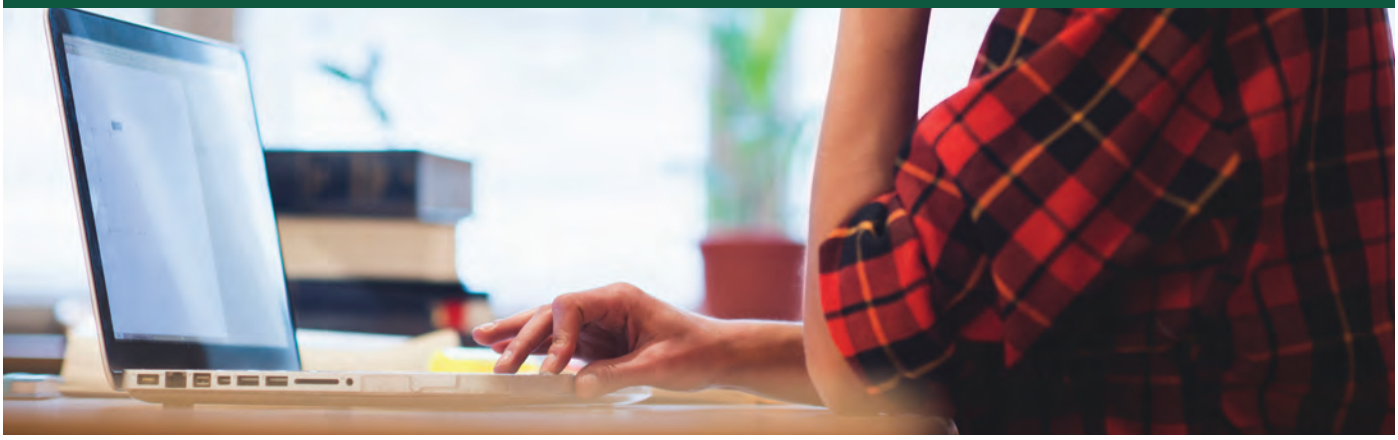

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