R310.3.2.1 Drainage. Bulkhead enclosures shall be designed for proper drainage by connecting to the building's foundation drainage system required by Section R405.1 or by an *approved* alternative method.

Exception: A drainage system for bulkhead enclosures is not required where the foundation is on well-drained soil or sand-gravel mixture soils in accordance with the United Soil Classification System, Group I Soils, as detailed in Table R405.1.

❖ Similar to Section R310.2.2, which applies to window well drainage, this section requires that bulkhead enclosures that serve emergency escape and rescue openings be properly drained. Improper bulkhead drainage could create a water accumulation level that could cause the bulkhead enclosure to become inoperable, or even cause serious injury. Improper window well drainage may cause a bulkhead enclosure to become a hazard to the occupants. If the foundation is on well-drained soil, the exception permits deletion of the drainage system.

R310.4 Bars, grilles, covers and screens. Bars, grilles, covers, screens or similar devices are permitted to be placed over emergency escape and rescue openings, bulkhead enclosures, or window wells that serve such openings, provided that the minimum net clear opening size complies with Sections R310.1.1 to R310.2.3, and such devices shall be releasable or removable from the inside without the use of a key, tool, special knowledge or force greater than that required for the normal operation of the escape and rescue opening.

❖ The ever-increasing concern for security, particularly in residential buildings, has created a fairly large demand for security devices, such as grilles, bars and steel shutters. Unless properly designed and constructed, the security devices over bedroom windows can completely defeat the purpose of the emergency escape and rescue opening. Therefore, the code makes provisions for security devices if the release mechanism has been approved and is operable from the inside without the use of a key, tool or force greater than that required for the normal operation of the escape and rescue opening.

The essence of the requirement for emergency escape openings is that a person must be able to effect escape or be rescued in a short period of time because the fire might have spread to a point where all other exit routes are blocked. Thus, time cannot be wasted in figuring out means of opening rescue windows or obtaining egress through them. Any impediment to escape or rescue caused by security devices, inadequate window size or difficult operating mechanisms is not permitted by the code.

R310.5 Dwelling additions. Where *dwelling additions* occur that contain sleeping rooms, an emergency escape and rescue opening shall be provided in each new sleeping room. Where *dwelling additions* occur that have *basements*, an emergency escape and rescue opening shall be provided in the new *basement*.

Exceptions:

1. An emergency escape and rescue opening is not required in a new *basement* that contains a sleeping room with an emergency escape and rescue opening.
2. An emergency escape and rescue opening is not required in a new *basement* where there is an emergency escape and rescue opening in an existing *basement* that is accessible from the new *basement*.

❖ This section reaffirms that the requirements for emergency escape and rescue openings in sleeping rooms and basements that are applicable to new construction are also applicable to sleeping rooms in additions. Note that the new and added portions of a basement are evaluated as one common basement for the purposes of this section.

R310.6 Alterations or repairs of existing basements. An emergency escape and rescue opening is not required where existing *basements* undergo alterations or repairs.

Exception: New sleeping rooms created in an existing *basement* shall be provided with emergency escape and rescue openings in accordance with Section R310.1.

❖ Where alterations are made to an existing basement, emergency escape and rescue openings are required only where new sleeping rooms are created.

SECTION R311
MEANS OF EGRESS

R311.1 Means of egress. *Dwellings* shall be provided with a means of egress in accordance with this section. The means of egress shall provide a continuous and unobstructed path of vertical and horizontal egress travel from all portions of the *dwelling* to the required egress door without requiring travel through a garage. The required egress door shall open directly into a public way or to a *yard* or court that opens to a public way.

❖ Sections R311.2 through R311.8 contain the requirements for the exit and the means of egress components. All dwelling units must have at least one egress door that opens directly to a public way or a yard or court that opens to a public way and complies with the provisions of Sections R311.2 and R311.3. This door must also access the exterior without the dwelling's occupants traveling through a garage where hazards could prevent a suitable means of egress. A ramp or stairway is required for access to habitable areas not having an exit on that level (see Section R311.4). The emergency escape and rescue openings in Section 310 are not considered an exit.

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.

❖ All dwelling units must have at least one exit door that complies with the provisions of Sections R311.2 through R311.3.3. Other exterior doors need not comply with the provisions of this section.

The required egress door must be side hinged. A sliding patio door would not count as the required egress door.

Typically, a 36-inch-wide (914 mm) door slab would be required to achieve a minimum 32-inch-wide (813 mm) width opening. Door slabs are manufactured in width increments of 2 inches (51 mm) [32 inches (813 mm), 34 inches (864 mm), 36 inches (914 mm), etc.]. Once the thickness of the door slab [usually $1^3/_4$ inches (44 mm) for exterior doors], thickness of the door stop and allowance for hinges or other hardware are combined, the difference between the width of the door slab and the resultant opening size is greater than 2 inches (51 mm). Therefore, a 34-inch-wide (864 mm) door slab would not provide the 32-inch-wide (813 mm) door opening required, and a 36-inch-wide (914 mm) slab would need to be used.

In a similar fashion, the 80-inch (2032 mm) door height requirement is replaced with a 78-inch (1981 mm) height of opening requirement, with the height of the opening measured from the bottom of the doorstop to the top of the threshold. Since door slabs are also manufactured in height increments of 2 inches (51 mm), it is not anticipated that this proposal would result in a reduction in the actual door size.

So that egress is always available, any locks provided on the egress door must be openable from the inside without the use of a key or special knowledge. While this would not limit the number of locks someone could install on the egress door, this will prohibit the type of dead bolt lock that is key operated from both the inside and outside. These lock provisions are not applicable to other exterior doors, however, just in case the way to the required egress door was blocked, following these provisions for other exterior doors may provide an extra level of safety.

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. Every landing 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 accessible from a door are permitted to have a landing less than 36 inches (914 mm) measured in the direction of travel.

❖ Landings are required for exterior doors and must be constructed on both the exterior and interior side of the door. Landings must be the same width as the door they serve and must be at least 36 inches (914 mm) in length. The length of a landing is measured in the direction of travel. The exterior landing must be reasonably level (a slope not exceeding 25:12) while still allowing enough of a slope for proper drainage.

The exception allows for smaller landings when an exterior door only leads out onto a small balcony. An example of this would be the french balconies commonly found in New Orleans' style architecture.

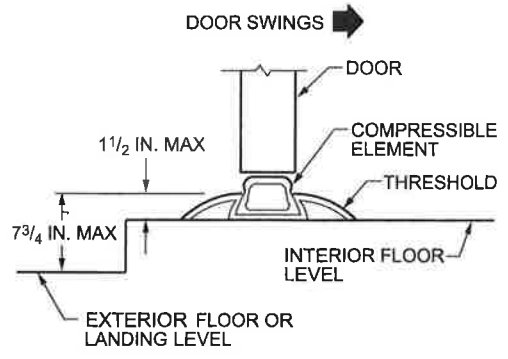
R311.3.1 Floor elevations at the required egress doors. Landings or finished floors at the required egress door shall be not more than $1^1/_2$ inches (38 mm) lower than the top of the threshold.

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 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.

❖ Thresholds should not be higher than $1^1/_2$ inches (38 mm) above interior floor level (see Commentary Figure R311.3.1). The exception permits the exterior landing of an exterior egress door, to be a maximum of $7^3/_4$ inches (196 mm) below the top of the threshold. The threshold height represents an important element in building construction. It has to be high enough to keep out snow accumulation and driving rain, yet low enough not to represent a tripping hazard or become a barrier to entry. The exception is limited to locations where the door swings in. Since this is the typical design for single-family homes and townhouses, the step down for the exterior landing will typically be permitted. A screen door that swung out in front of an egress door that swung in would not violate this exception (see Section R311.3.2).

If the door landing is not at grade level, any stairway or ramp leading from the door landing to grade must comply with the stairway and ramp provisions in Sections R311.7 and R311.8.



For SI: 1 inch = 25.4 mm.

Figure R311.3.1
THRESHOLD HEIGHTS

R311.3.2 Floor elevations for 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.

❖ For exterior doors other than the required egress door, the top of the threshold can be up to $7^3/_4$ inches (196 mm) above both the inside and outside floor surface. Note that, in typical applications, the landing at the exterior side of an exterior door is lower than the interior landing or floor surface, and this "threshold" dimension is intended to include the riser that is inherently created by the difference in elevation between the exterior and interior landings.

The exception would not require a top landing when two or fewer stair risers are on the exterior side of exterior doors other than required egress door (for the required egress exit door, see Section R311.3.1). However, the door, other than a storm or screen door, is not allowed to swing over the steps to take advantage of this exception (see Section R311.3.3).

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

❖ Sections R311.3.1 and R311.3.2 both have allowances for landing elevations when the door does not swing out over the landing. A common scenario is to have both a screen door and a wood/metal door at the front and/or rear entrance to the home. The screen door swinging out over the landing would not violate these exceptions.

R311.4 Vertical egress. Egress from habitable levels including habitable attics and *basements* not provided with an egress door in accordance with Section R311.2 shall be by a ramp in accordance with Section R311.8 or a stairway in accordance with Section R311.7.

❖ All dwelling units must have at least one egress door that complies with the provisions of Sections R311.2 and R311.3. In a multiple-level home, a ramp or stairway is required for access from basements, upper floors, mezzanines, split levels or habitable attics that do not have an exit on that level. The emergency escape and rescue openings in Section 310 are not considered an exit.

R311.5 Construction.

R311.5.1 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.

❖ Exterior exit balconies, stairs and similar exit facilities must be properly attached to the primary structure so that their reaction to vertical and lateral forces will not cause separation from the structure. This is reiterating the requirement for a complete load path in Section R301.1. The reason for doing so is the need to maintain key elements of the egress system that are needed for emergency evacuations and the increased possibility of overlooking such connection. The requirement for positive anchor to the primary structure applies to all exterior means of egress components used as part of an egress system whether part of the required exit or not.

R311.6 Hallways. The width of a hallway shall be not less than 3 feet (914 mm).

❖ Hallways must be a minimum of 3 feet (914 mm) wide to accommodate moving furniture into rooms off the hallway and for safe egress from the structure. The code uses the term "hallway" instead of corridors to avoid confusion with the IBC. In the IBC, "corridor" is a defined term, and corridors may have a required fire-resistance rating.

R311.7 Stairways.

❖ The requirements for stairways are contained in Sections R311.7.1 through R311.7.9. The provisions address a wide variety of issues that must be considered when designing a stairway that is both safe and usable.

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. Handrails shall not project more than $4^1/_2$ inches (114 mm) on either side of the stairway and the clear width of the stairway 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 provided on both sides.

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

❖ Section R311.7.1 requires a minimum stairway width of 36 inches (914 mm). Generally, when the code specifies a required width of a component in the egress system, the width will be the clear, net, usable, unobstructed width. In this case, however, the width is specified as applying only to the area "above the permitted handrail height and below the required headroom height."

At and below the handrail height, the required width for the stairway, including treads and landings, is 27 inches (686 mm) if handrails are provided on each side, and $31^1/_2$ inches (800 mm) if there is a handrail installed on only one side. In essence, the code is not concerned about elements such as trim, stringers or other items that may be found below the level of the handrail, as long as they do not exceed the handrail's projection. This reduced width below the handrail is based on a body's movements as a person walks on a stair or other surface (see Commentary Figure R311.7.1). The exception and the provisions of Section R311.7.10.1 will permit a minimum width of 26 inches (660 mm) for spiral stairways.

It is important to note that each of the three key elements in the means of egress, hallways, stairways and the egress door, have a required minimum width.

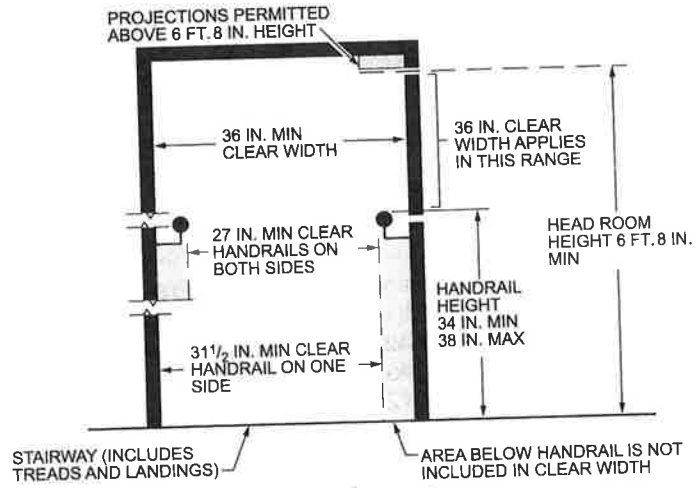
R311.7.2 Headroom. The headroom in stairways shall be not less than 6 feet 8 inches (2032 mm) measured vertically from the sloped line adjoining the tread nosing or from the floor surface of the landing or platform on that portion of the stairway.

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 be allowed to project horizontally into the required headroom not more than $4^3/_4$ inches (121 mm).
2. The headroom for spiral stairways shall be in accordance with Section R311.7.10.1.

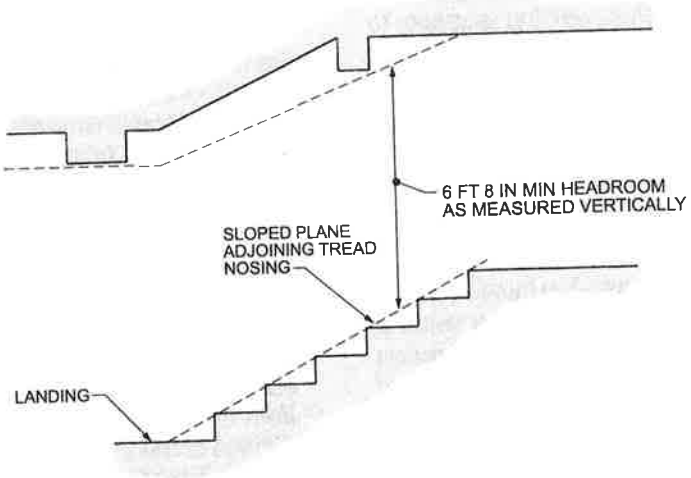
❖ A minimum headroom clearance of 6 feet, 8 inches (2032 mm) is required in connection with every stairway. This includes not only the above-the-tread portion, but also above any landings serving the stairway. The clearance is to be measured vertically above a plane that connects the stair nosings and also vertically above any landing or floor surface that is a part of the stairway [see Commentary Figure R311.7.2(1)]. This specific height requirement overrides the general ceiling height limitations of Section R305 and is modified for spiral stairways by Section R311.7.10.1.

The exception clarifies interpretation and practice by recognizing the common method of stairwell construction in which the open side of a stair is supported by the same structure as the side of the opening through which the stairway passes. The exception allows for common stairways that are slightly wider at the bottom and narrow in width as they ascend through a smaller



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

Figure R311.7.1
STAIRWAY CLEARANCES



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

Figure R311.7.2(1)
MINIMUM HEADROOM

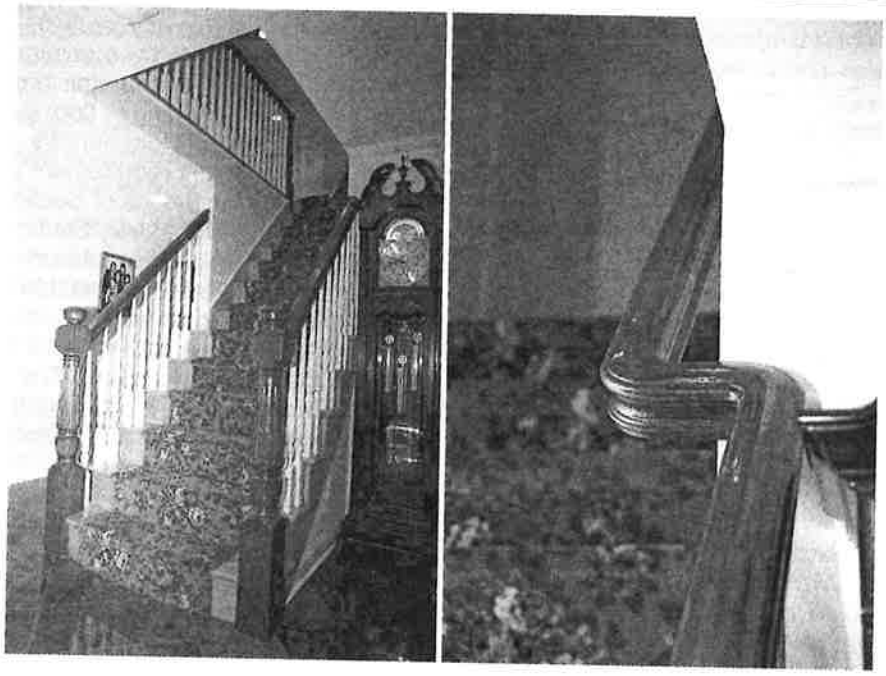


Figure R311.7.2(2)
EXAMPLE OF EXCEPTION TO SECTION R311.7.2

width opening in the floor above. In this case, the plane of the nosings, from which headroom is determined, at the side of the stairs, extends under the ceiling or joist above at the edge of the floor opening. The exception allows this offset to be a maximum of $4^3/_4$ inches (121 mm) without being considered a projection into the required headroom. It is important to note that this exception only applies at the side of stairs [see Commentary Figure R311.7.2(2)].

R311.7.3 Vertical rise. A flight of stairs shall not have a vertical rise larger than 147 inches (3734 mm) between floor levels or landings.

❖ Between landings and platforms, the vertical rise is to be measured from one landing walking surface to another. The limited height provides a reasonable interval for users with physical limitations to rest on a level surface and also serves to alleviate potential negative psychological effects of long and uninterrupted stairway flights.

R311.7.4 Walkline. The walkline across winder treads shall be concentric to the curved direction of travel through the turn and located 12 inches (305 mm) from the side where the winders are narrower. The 12-inch (305 mm) dimension shall be measured from the widest point of the clear stair width at the walking surface of the winder. If winders are adjacent within the flight, the point of the widest clear stair width of the adjacent winders shall be used.

❖ This requirement is essential for smooth, consistent travel on stairs that turn with winder treads. It provides a standard location for the regulation of the uniform tread depth of winders. Due to the wide range of anthropometrics of stairway users, there is no one line that all persons will travel on stairs. However, the code recognizes that a standard location of a walkline is essential to design and enforcement. Each footfall of the user through the turn can be connected in an arc to describe the path traveled. As a user ascends or descends the flight, the turning at each step should be consistent through the turn. The walkline is established concentric, having the same center, or approximately parallel to the arc of travel of the user. The tread depth dimension at the walkline is one of two tread depths across the width of the stair at which winder tread depth is regulated. The second is the minimum tread depth. Regulation at these two points controls the angularity of the turn and the configuration of the flight. In order to establish consistently shaped winders, tread depths must always be measured concentric to the arc of travel. The walkline is unique as the only line or path of travel where winder tread depth is controlled by the same minimum tread depth as rectangular treads. However, Section R311.7.5.2 recognizes winder tread depth need not be compared to rectangular tread depths for dimensional uniformity in the same flight because the location of the walkline is chosen for the purpose of providing a standard and cannot be specific to the variety of actual paths followed by all users. This specific line location is determined by measuring along each nosing edge 12 inches (305 mm) from the extreme of the clear width of the stair at the surface of the winder tread or the limit of where the foot might be placed in use of the stair [see Commentary Figures R311.7.5.2.1(1) and R311.7.5.2.1(2)]. If adjacent winders are present the point of the widest clear stair width at the surface of the tread in the group of

adjacent consecutive winders is used to provide the reference from which the 12-inch (305 mm) dimension will be measured along each nosing. The tread depth may be determined by measuring between adjacent nosings at these determined intersections of the nosings with the walkline. It is important to note that the clear stair width is only that portion of the stair width that is clear for passage. Portions of the stair beyond the clear width are not consequential to use of the stair, consistent travel or location of the walkline.

R311.7.5 Stair treads and risers. Stair treads and risers shall meet the requirements of this section. For the purposes of this section, dimensions and dimensioned surfaces shall be exclusive of carpets, rugs or runners.

❖ The riser height, tread depth and profile requirements for stairways are specified in Sections R311.7.5.1 through R311.7.5.3. These provisions facilitate smooth and consistent travel. This section provides dimensional ranges and tolerances for the component elements to allow the flexibility required to design and construct a stair or a flight of stairs, which are elements of a stairway. The allowed proportion of maximum riser height and minimum tread depth provides for a maximum angle of ascent, but there is no maximum tread depth or minimum riser height that would define a minimum angle for a stairway. Nor is the proportion of riser height to tread depth compared with the limitations of the length of the users stride on stairways that is significantly foreshortened from the users stride on the level. For this reason, care should be taken when incorporating large tread depths or short risers to proportion the riser height and tread depth to avoid a step that is wide enough to require more than one step to cross or a short narrow step, which can be easily stepped over. With these same limitations for proportion in mind, by controlling the minimum depth of rectangular treads and the minimum depth and angularity of winder treads, these components can control the configuration of the plan of a flight of stairs to provide for smooth and consistent travel. Carpets, rugs and runners, like furniture, are frequently changed by the occupants and are not regulated by the code. For this reason, it is essential that the riser height and tread depth be regulated exclusive of these transitory surfaces to provide an enforceable standard. This practice minimizes the possible variation due to the removal of nonpermanent carpeting throughout the life of a structure and provides a standard enforcement methodology that will provide consistency across the built environment for all users. When owners or occupants add carpeting, rugs or runners they need to be able to add it to all tread and landing surfaces in the stairway. It is important that the tread and landing surfaces are consistent and comply with the code prior to the addition of carpet. This methodology of enforcement makes it unnecessary to reconstruct floor and stair elevations in the stairway when nonpermanent carpet surfaces are changed that do not require a building permit and eliminates the resulting variations in the built environment that will not comply with the tolerance in Sections R311.7.5.1 and R311.7.5.2.

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. Open risers are permitted provided that the openings located more than 30 inches (762 mm), as measured vertically, to the floor or grade below do not permit the passage of a 4-inch-diameter (102 mm) sphere.

Exceptions:

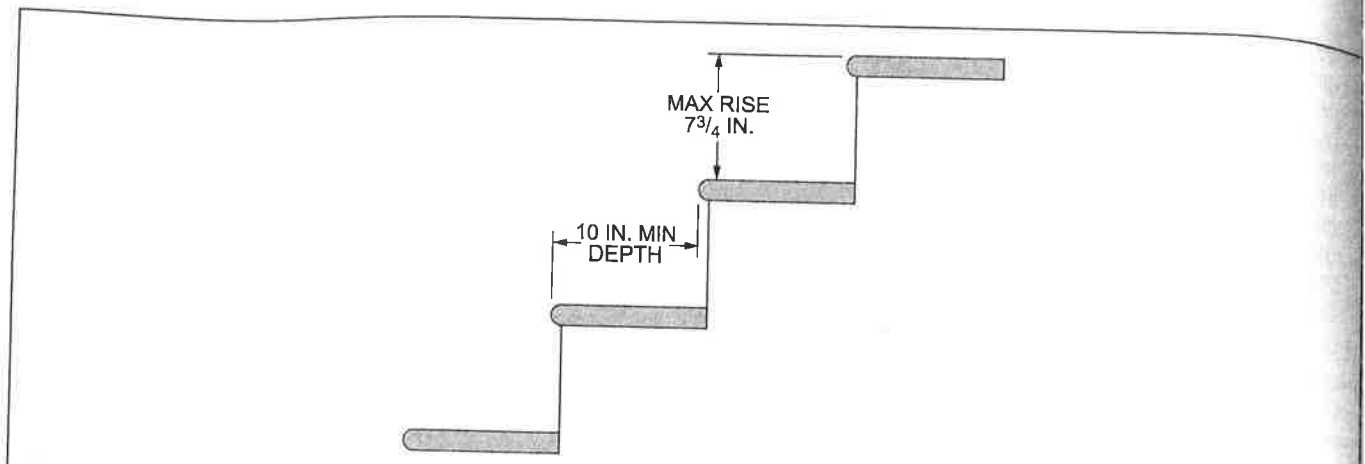
1. The opening between adjacent treads is not limited on spiral stairways.
2. The riser height of spiral stairways shall be in accordance with Section R311.7.10.1.

❖ The code establishes that the maximum riser height is $7^3/_4$ inches (197 mm). The provisions specify how the riser height is to be measured [see Commentary Figure R311.7.5.1(1)]. The uniformity of risers and treads is a safety factor in any flight of stairs. The section of a stairway leading from one landing to the next is defined as a flight of stairs. This is important because variations in excess of the $^3/_8$-inch (9.5 mm) tolerance could interfere with the rhythm of the stair user. It is true that adequate attention to the use of the stair can compensate for substantial variations in risers and treads; however, the stair user does not always give the necessary attention.

To obtain the best uniformity possible in a flight of stairs, the maximum variation between the highest and lowest risers is limited to $^3/_8$ inch (9.5 mm). This tolerance is not to be used as a design variation, but its inclusion is in recognition that normal construction practices give rise to variables that make it impossible to get exactly identical riser heights and tread dimensions in constructing a stairway. Therefore, the code allows the variation indicated in Commentary Figure R311.7.5.1(2).

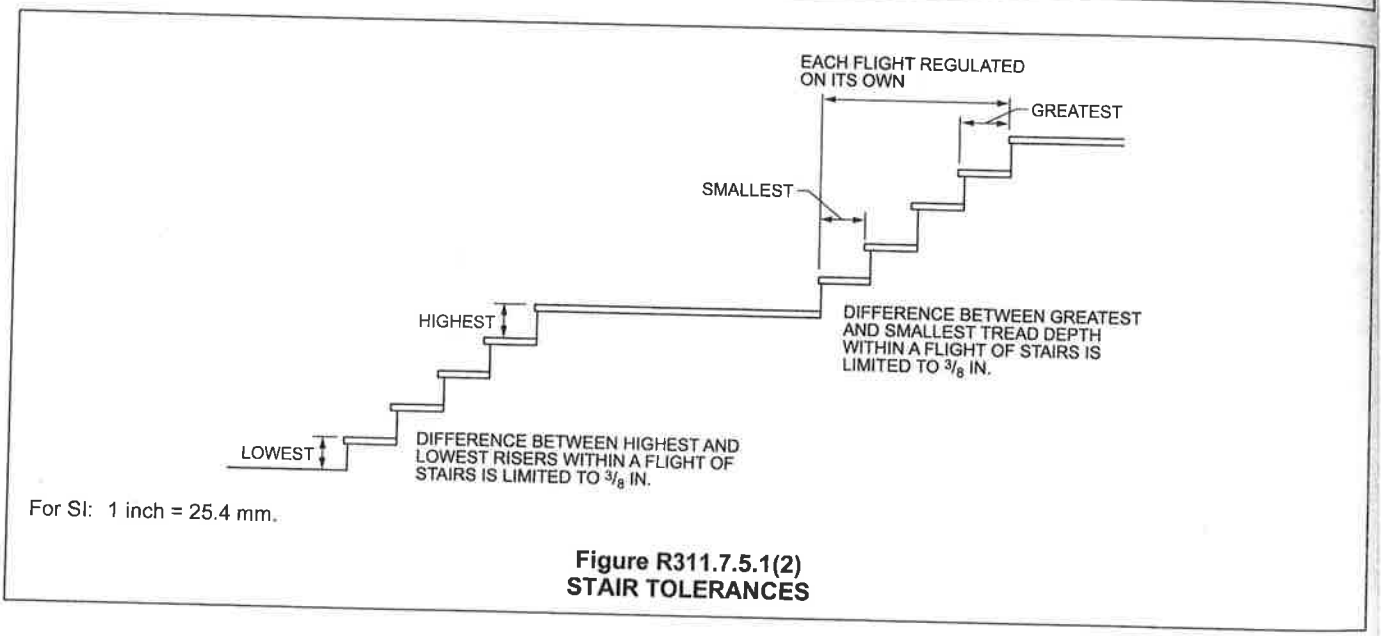
The risers must be vertical or slope back, effectively providing a wider overall tread depth. The code does not require solid risers, but riser openings that are located more than 30 inches above the floor or grade below must not allow the passage of a 4-inch-diameter sphere. This is consistent with the guard provisions of Section R312, where a 4-inch (102 mm) sphere is used to determine compliance.

For spiral stairways, the openings between adjacent treads are not limited and riser heights are regulated by Section R311.7.10.1.



For SI: 1 inch = 25.4 mm.

Figure R311.7.5.1(1)
CONVENTIONAL STAIRWAY



For SI: 1 inch = 25.4 mm.

Figure R311.7.5.1(2)
STAIR TOLERANCES

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).

❖ The code establishes that the minimum tread depth is 10 inches (254 mm).The provisions specify how the tread depth is to be measured [see Commentary Figure R311.7.5.1(1)]. To obtain the best uniformity possible in a flight of stairs, the maximum variation between the greatest and smallest tread depth is limited to $^3/_8$ inch (9.5 mm). See the commentary to Section R311.7.5.1 for the discussion on uniformity.

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 do not have 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.

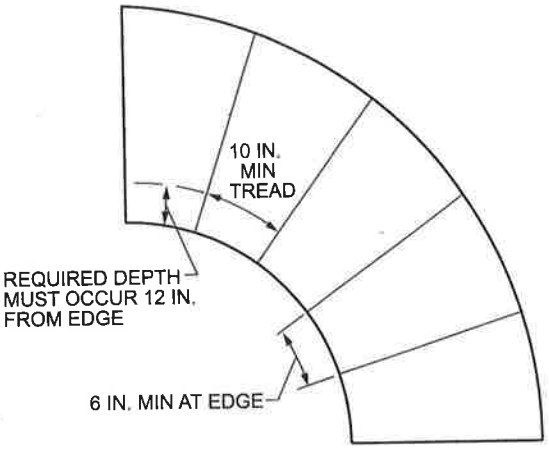
❖ The same criterion for rectangular treads applies to winder treads. However, the depth is to be measured as the horizontal distance between the points where the nosing of the adjacent treads intersects with the "walkline." The location of the "walkline" is defined in Section R311.7.4. Winder treads must have a minimum depth of 6 inches (152 mm) at any point. A stair-

way may have straight treads and winder treads within the same flight. If winders are used, they can either be used for an entire flight of a stairway, as a portion of a flight to provide a change of direction or to form a curved stairway. Because winder treads are used to change the direction of the stair it is important that winders comply with the specified dimensional criteria. See Commentary Figure R311.7.5.2.1(1) for examples of winders used as a portion of a stairway at a change of direction. See Commentary Figure R311.7.5.2.1(2) for an example of winders used to form a circular stairway. Rectangular treads can be used in combination with winder treads. The goal is to allow the foot placement along the walkline to be consistent along the length of the flight. For spiral stairs, tread depth is regulated by Section R311.7.10.1.

R311.7.5.3 Nosings. The radius of curvature at the nosing shall be not greater than $^{9}/_{16}$ inch (14 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 with solid risers. The greatest nosing projection shall not exceed the smallest nosing projection by more than $^{3}/_{8}$ inch (9.5 mm) between two stories, including the nosing at the level of floors and landings. Beveling of nosings shall not exceed $^{1}/_{2}$ inch (12.7 mm).

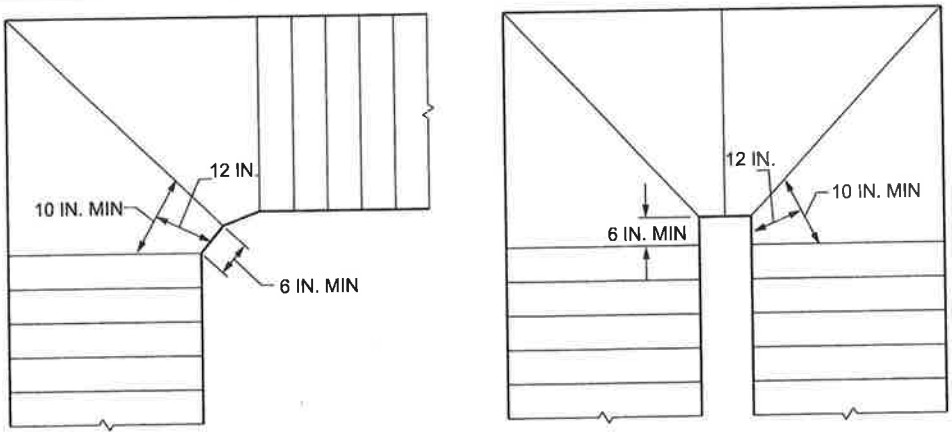
Exception: A nosing projection is not required where the tread depth is not less than 11 inches (279 mm).

❖ The sectional parameters of the components of a step or stair contribute to stairway safety. The radius or bevel of the nosing eases the otherwise square edge of the tread and prevents irregular chipping that can become a maintenance issue seriously affecting the safe use of the stair; and eliminates a sharp square edge that will cause greater injury in falls. A radius or bevel allows light modeling, reflecting light at various angles, providing a certain contrast from the other surfaces of the stair allowing easier visual location of the start of the tread surface. The maximum radius of curvature at the leading edge of the tread is intended to allow descending foot placement on a surface that does not pitch the foot forward or allow the ball of the foot to slide off the treads and ascending foot placement to slide on to the tread without catching on a square edge. If a stairway design uses a beveled nosing configuration, the bevel is limited to a depth of $^{1}/_{2}$ inch (12.7 mm). A nosing projection allows the descending foot to be placed further forward on the tread and the heel to then clear the nosing of the tread above as it swings down in an arc landing further away from the riser on the tread that is effectively deeper than if no nosing projection is used. Nosing projections are so common in stair design that they are noticed by users when absent as affecting their gait and anticipated clearance for their heels from the riser in descent. A nosing projection may also be accommodated by slanting the riser under the tread above. The nosing projection is between $^{3}/_{4}$ inch minimum (19 mm) and $1^{1}/_{4}$ inches (32 mm) maximum (see Commentary Figure R311.7.5.3). It is critical that all tread and landing nosings associated with each step in the stairway



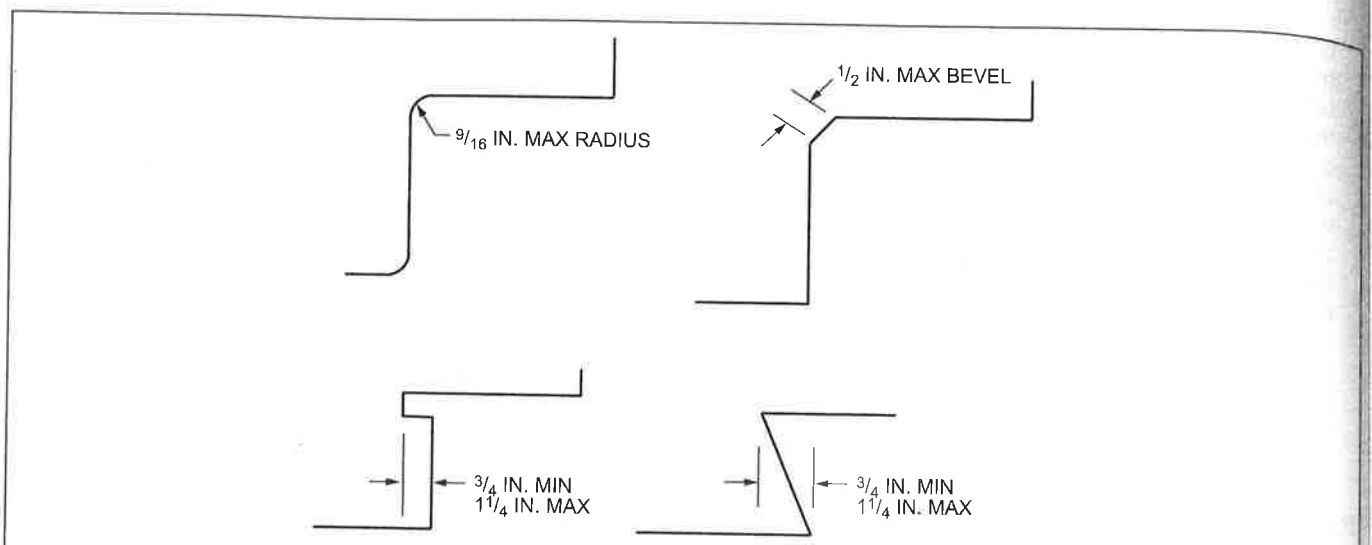
For SI: 1 inch = 25.4 mm.

Figure R311.7.5.2.1(2)
WINDERS USED FOR CIRCULAR STAIRWAY



For SI: 1 inch = 25.4 mm.

Figure R311.7.5.2.1(1)
WINDERS



For SI: 1 inch = 25.4 mm, 1 degree = 0.01749 rad.

Figure R311.7.5.3
NOSINGS

be uniform to ensure that the user does not experience an effective change in tread depth outside the $^3/_8$ inch (9.5 mm) between stories. Critical to this understanding is that tread depth is regulated by measuring between the nosing edges of treads or a tread and a landing. The lack of a uniform nosing at the top landing of a flight is a serious safety problem that may not be apparent in initial rough inspections. Treads with a tread depth of at least 11 inches (279 mm) are allowed with or without a nosing projection.

R311.7.5.4 Exterior plastic composite stair treads. Plastic composite exterior stair treads shall comply with the provisions of this section and Section R507.3.

❖ Stair treads made of wood/plastic composite materials must meet the requirements for installation, labeling and compliance with ASTM D7032 in accordance with Section R507.3, in addition to the requirements of Section R311.7.5.

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. Landings of shapes other than square or rectangular shall be permitted provided that the depth at the walk line and the total area is 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.

❖ A landing is required at the top and bottom of each stairway; however, a landing is not required at the top of interior stairways, including an enclosed garage, if a door does not swing over the stairway [see Commentary Figure R311.7.6(1)]. Section R311.7.3 states that flights must be interrupted by a landing or floor such that they do not have a total rise of more than 12 feet (3658 mm).

The width of landings for stairways is measured perpendicular to the direction of travel. It is not the intent to require specifically shaped landings. Landings may have curved or segmented periphery edges provided the width perpendicular to the direction of travel is not less than the width of the stairway served. For a straight stairway run, the minimum dimension of 36 inches (914 mm) in the direction of travel is intended to provide a minimum depth at the landing that cannot be overstepped in descent of a straight run stairway. Landings that are square or rectangular serve to limit the minimum angle of turn of a landing to 90 degrees (1.57 rad) for at least 36 inches (914 mm). Landings for turns of 90 degrees (1.57 rad) or less or of any shape are permitted provided the depth of the tread at the walkline and the total area of the landing are the same as a quarter circle with a radius the same as the stairway width. See Commentary Figure R311.7.6(2) for an example.

R311.7.7 Stairway walking surface. The walking surface of treads and landings of stairways shall be sloped not steeper than one unit vertical in 48 inches horizontal (2-percent slope).

❖ The slope of the walking surfaces must provide drainage to stairs and landings that may be subjected to accumulation of liquids, such as water, rain or melting snow. The use of such a slope, called a "wash," is a common technique used on all stairs to allow the nosing to be at a lower elevation than the remainder of the tread surface. This technique of building the flight to a slightly shorter total rise than the actual condition slopes the entire flight forward and better accommodates the placement of the user's foot as it slides onto the tread. It also serves to prevent long-term wear and tear at the nosing limiting problematic maintenance

and safety issues. This section provides a limit of the slope to maintain a safe walking surface. This requirement applies to all stairs and landings, both exterior and interior.

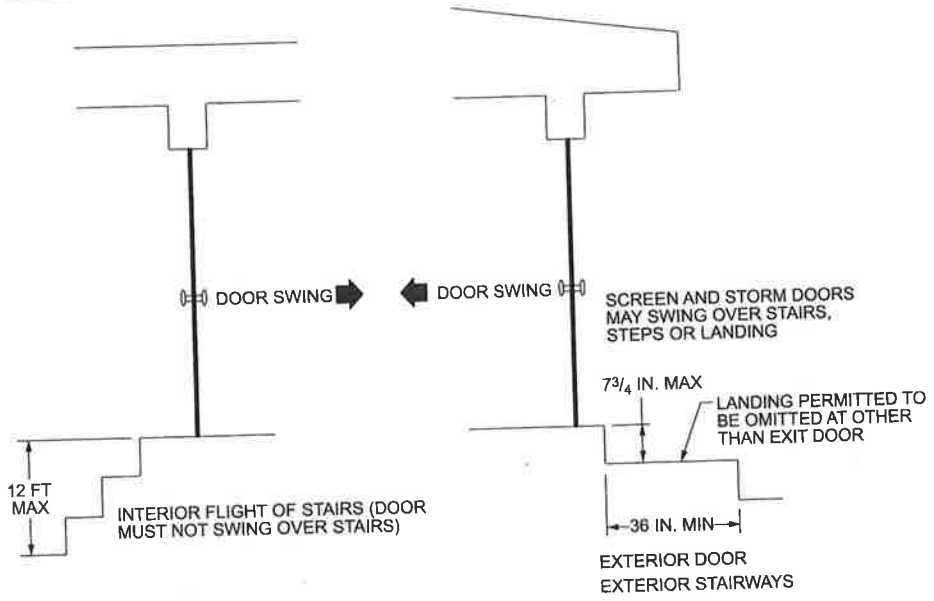
R311.7.8 Handrails. Handrails shall be provided on not less than one side of each continuous run of treads or flight with four or more risers.

❖ The provision of handrails increases the level of safety when used by the occupants while ascending and descending stairs. Handrails are used for guidance, stabilization, pulling and to assist in arresting a fall. This section states that a handrail must be provided on at least one side of flights of four or more risers. Handrails may be provided on both sides and this eliminates choosing the best side to securely attach the handrail. Otherwise, the generally preferred location is for use by the right hand in descent when feasible. Sections R311.7.8.1 through R311.7.8.3 contain provisions essential to the height, continuity and grip size of the handrail provided.

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



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

Figure R311.7.6(1)
LANDINGS AT STAIRS AND DOORS

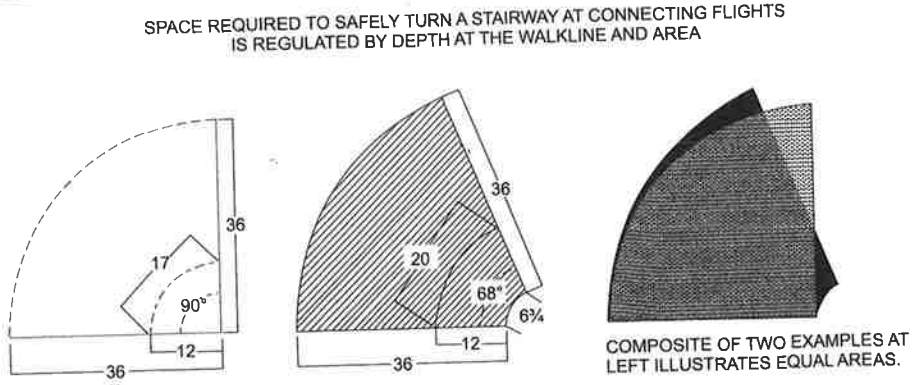


Figure R311.7.6(2)
EXAMPLE OF LANDING OF SHAPES OTHER THAN SQUARE OR RECTANGULAR

height at the fittings or bendings shall be permitted to exceed 38 inches (956 mm).

❖ Where handrails are required, they must be installed at a height of not less than 34 inches (864 mm) and not more than 38 inches (965 mm). This height is to be measured vertically to the top of the handrail from the plane adjoining the tread nosings of the flight or the surface of the ramp slope. Exception 1 allows common starting fittings used as terminals over the lowest tread to fall outside the required height range. Exception 2 allows transition fittings to exceed the required height when used to provide a continuous rail at changes in the pitch of the rail within the stairway.

R311.7.8.2 Continuity. Handrails for stairways 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 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.

Exceptions:

1. Handrails shall be permitted to be interrupted by a newel post at the turn.
2. The use of a volute, turnout, starting easing or starting newel shall be allowed over the lowest tread.

❖ The required handrail is to be continuous for the length of the flight. Where stairway flights are separated by landings or floor levels, handrails are not required (see Commentary Figure R311.7.8.2). The term "continuous" means not only that a single handrail must run from the top riser to the bottom riser, but it also indicates that users should be able to grasp the handrail and maintain their grasp without having to release the rail where it is supported. There is no requirement within the code for installation of a second handrail, but depending on the design and the placement of the required handrail, the requirement for a guard should be reviewed. The two exceptions to this section create situations where the graspable portion of the handrail may not be completely continuous from the top riser to the bottom riser. These traditional situations are well known to the occupants and have not been shown to represent a safety hazard requiring their restriction.

The ends of handrails are to be returned to the wall or floor, or to end in some type of terminal that will not catch clothing or limbs. A clear space of at least $1^1/_2$ inches (38 mm) is necessary between the handrail and any abutting wall. This distance will permit the fingers to slide past any adjacent rough surface that may cause injury, and it will provide an adequate distance so that the handrail may be quickly grabbed as an assist in the arrest of a fall.

R311.7.8.3 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 dimension of not less than 4 inches (102 mm) and not greater than $6^1/_4$ inches (160 mm) with a cross section of dimension 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 a distance of $^3/_4$ inch (19 mm) measured vertically from the tallest portion of the profile and achieve 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).

❖ To be effective, a handrail must be easily grasped by the vast majority of users. If it is too large, it is difficult for a user to get a strong enough grip to provide the needed support. If it is too small the fingers wrap and interfere with the thumb and palm and cannot close in a sufficient grip. For this reason Type I rails have minimum and maximum perimeters to restrict their use to the effective size range. Tests have proven that it is beneficial to have graspable recesses for the fingers and opposing thumb such that wider and taller shapes can provide graspability comparable to rails within the

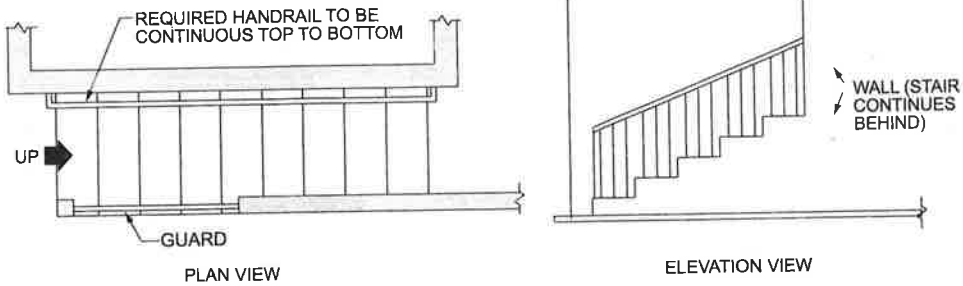


Figure R311.7.8.2
HANDRAILS

Type I size range limitations. The Type II handrail requirements provide details for the location and depth of the recess as it relates to the variables of crown height and width to ensure that the design is of a graspable shape. The mountings of smaller profiles can cause interference, as well. Care should be taken to minimize the interference caused by brackets and balusters supporting profiles that require the bottom mounting surface to be grasped.

The code specifies that the handrail be either Type I or Type II, or be equivalently graspable. A Type I handrail can be either circular or noncircular in shape. See Commentary Figure R311.7.8.3(1) for examples of Type I handrails.

A Type II handrail has a perimeter larger than $6^1/_4$ inches (160 mm) with graspable finger recess area on both sides of the profile. See Commentary Figure R311.7.8.3(2) for the limitations of a Type II handrail.

R311.7.8.4 Exterior plastic composite handrails. Plastic composite exterior handrails shall comply with the requirements of Section R507.3.

❖ Handrails made of wood/plastic composite materials must meet the requirements for installation and labeling, and comply with ASTM D7032 in accordance with Section R507.3, in addition to the general requirements for handrails in this section.

R311.7.9 Illumination. Stairways shall be provided with illumination in accordance with Section R303.7.

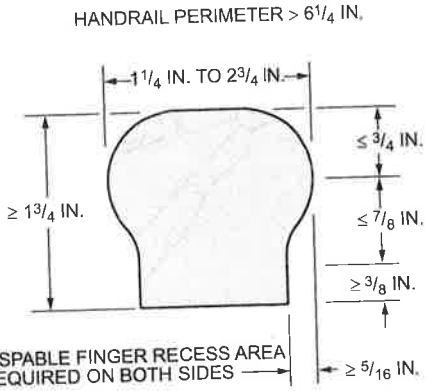
❖ This section contains a reference to the illumination provisions of Section R303.7. The proper illumination of stairways is an important part of stairway safety. This lighting can assist users by making sure the level changes do not occur in areas with shadows or in contrasting light, which would therefore make them difficult to see. See the commentary to Section R303.7 for additional information.

R311.7.10 Special stairways. Spiral stairways and bulkhead enclosure stairways shall comply with the requirements of Section R311.7 except as specified in Sections R311.7.10.1 and R311.7.10.2.

❖ Sections R311.7.10.1 and R311.7.10.2 are exceptions to the general requirements for stairways as prescribed in Section R311.7.

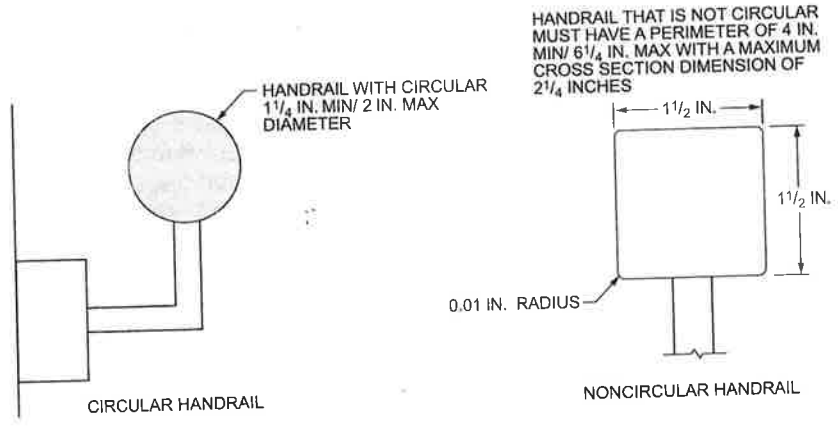
R311.7.10.1 Spiral stairways. Spiral stairways are permitted, provided that the clear width at and below the handrail is not less than 26 inches (660 mm) and the walkline radius is not greater than $24^1/_2$ inches (622 mm). Each tread shall have a depth of not less than $6^3/_4$ inches (171 mm) at the walkline. All treads shall be identical, and the rise shall be not more than $9^1/_2$ inches (241 mm). Headroom shall be not less than 6 feet 6 inches (1982 mm).

❖ A spiral stairway is one of two types of special stairs that the code permits. Although a spiral stair may be difficult to use to move furniture from one level to another, the code places no limitations on its use within the egress system if it meets the size requirements of this section. A spiral stairway that meets these require-



For SI: 1 inch = 25.4 mm.

Figure R311.7.8.3(2)
TYPE II HANDRAIL

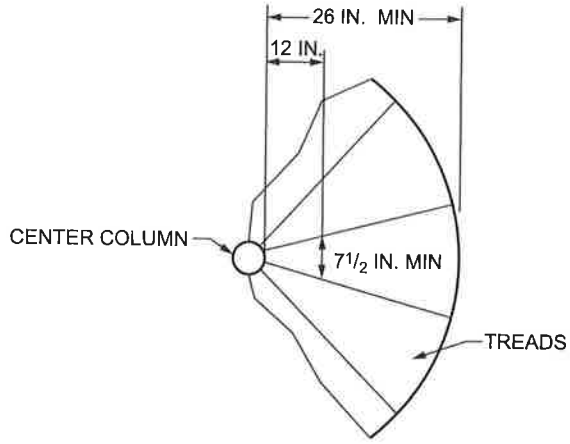


For SI: 1 inch = 25.4 mm.

Figure R311.7.8.3(1)
TYPE I HANDRAIL

ments may provide the only means of egress from a level within an individual dwelling regardless of the occupant load or size of area served.

A spiral stairway is one in which the treads radiate from a central pole. Such a stair must provide a clear width of at least 26 inches (660 mm) at and below the handrail. Each tread must be identical and have a minimum dimension of $7^1/_2$ inches (191 mm) at a point 12 inches (305 mm) from its narrow end. The stair must have at least 6 feet, 6 inches (1981 mm) of headroom as measured vertically from the leading edge of the tread. The rise between treads can be as much as, but not more than, $9^1/_2$ inches (241 mm). Commentary Figure R311.7.10.1 shows the required dimensions of a spiral stairway.



For SI: 1 inch = 25.4 mm.

Figure R311.7.10.1
SPIRAL STAIRS

R311.7.10.2 Bulkhead enclosure stairways. Stairways serving bulkhead enclosures, not part of the required building egress, providing access from the outside *grade* level to the *basement* shall be exempt from the requirements of Sections R311.3 and R311.7 where the height from the *basement* finished floor level to *grade* adjacent to the stairway is not more than 8 feet (2438 mm) and the *grade* level opening to the stairway is covered by a bulkhead enclosure with hinged doors or other *approved* means.

❖ This section exempts exterior "bulkhead enclosure stairways" from the landing stairway and handrail requirements found in Chapter 3, and it therefore permits a situation that has been fairly common in some areas.

See Commentary Figure R311.7.10.2 for an illustration of the requirements. Because these stairways are not a part of the building's egress system and serve only as a convenient way to access the basement from the exterior, the code exemption will not greatly affect the occupants' safety. Through this exemption, the size of the enclosure that is needed to provide weather protection for the stairway is greatly reduced.

R311.7.11 Alternating tread devices. Alternating tread devices shall not be used as an element of a means of egress. Alternating tread devices shall be permitted provided that the required means of egress stairway or ramp serves the same space at each adjoining level or where a means of egress is not required. The clear width at and below the handrails shall be not less than 20 inches (508 mm).

❖ Prior to the 2015 edition of the code, alternating tread devices were occasionally used in residential applications, but were not regulated. This language adopts the specifications from the IBC providing the needed guidance when they are used. These provisions further clarify that an alternating tread device cannot be used as an element of a means of egress, and can only be

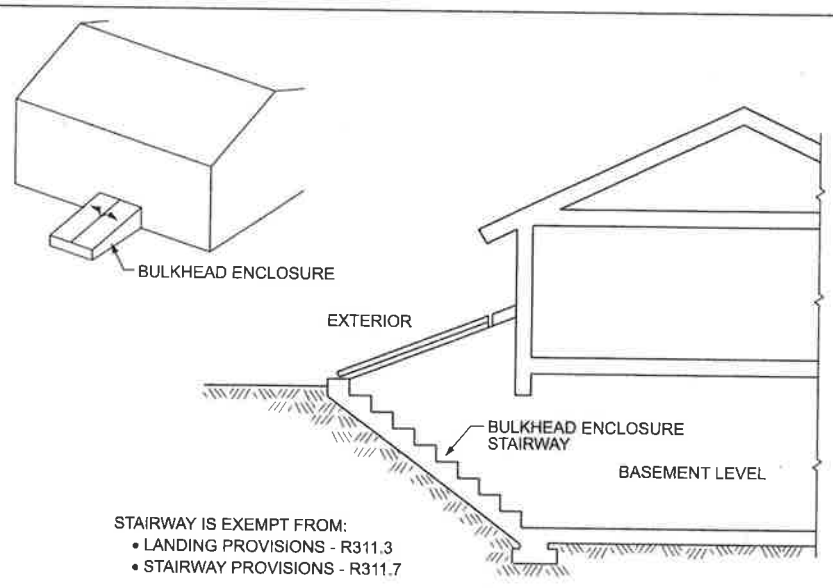
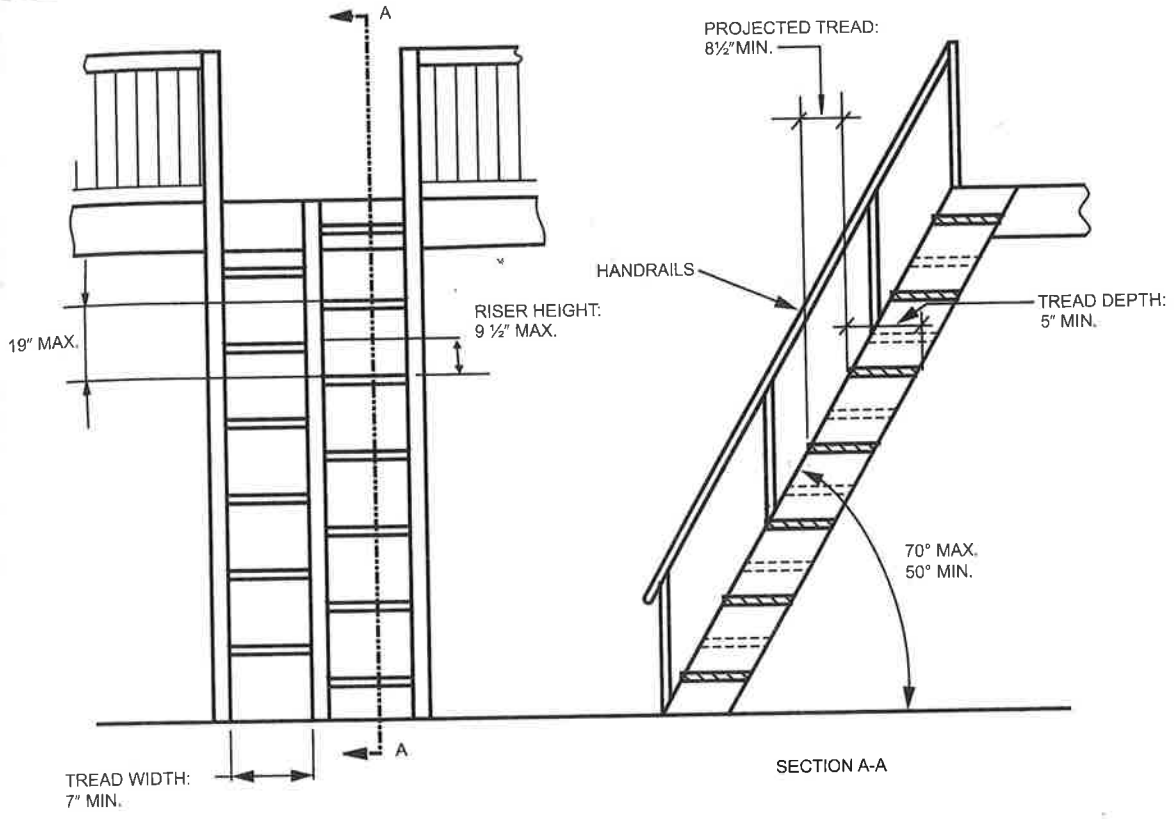


Figure R311.7.10.2
BULKHEAD ENCLOSURE STAIRWAY



For SI: 1 inch = 25.4 mm.

Figure R311.7.11
TYPICAL ALTERNATING TREAD DEVICE

used to access a space that does not require a means of egress, or where a required means of egress stairway or ramp is also provided to serve the same spaces that the alternating tread devices serve at each level.

Alternating tread devices are constructed in such a way that each tread alternates with each adjacent tread so that the device consists of a system of right-footed and left-footed treads (see Commentary Figure R311.7.11) and the definition of "Alternating tread device" in Section R202). The use of center stringer construction, half-treads and an incline that is considerably steeper than allowed for ordinary stairway construction makes the alternating tread device unique. However, because of its structural features, only single-file use of the device (between handrails) is possible, thus preventing occupants from passing one another. The pace of occupant travel is set by the slowest user, a condition that could become critical in an emergency situation. Furthermore, it is impossible for fire service personnel to use an alternating tread device at the same time and in a direction opposite that being used by occupants to exit the premises, possibly causing a serious delay in fire-fighting operations.

This section specifies the minimum width between handrails for alternating tread devices as 20 inches. Sections R311.7.11.1 and R311.7.11.2 contain tread and handrail details, respectively, for alternating tread devices.

R311.7.11.1 Treads of alternating tread devices. Alternating tread devices shall have a tread depth of not less than 5 inches (127 mm), a projected tread depth of not less than $8^1/_2$ inches (216 mm), a tread width of not less than 7 inches (178 mm) and a riser height of not more than $9^1/_2$ inches (241 mm). The tread depth shall be measured horizontally between the vertical planes of the foremost projections of adjacent treads. The riser height shall be measured vertically between the leading edges of adjacent treads. The riser height and tread depth provided shall result in an angle of ascent from the horizontal of between 50 and 70 degrees (0.87 and 1.22 rad). The initial tread of the device shall begin at the same elevation as the platform, landing or floor surface.

❖ Alternating tread stairways (see Section R311.7.1) are required to have tread depths of at least 5 inches (127 mm). Tread projections when measured from tread nosing to tread nosing of next tread above or below must provide a minimum projected tread depth of $8^1/_2$ inches (216 mm) (see Commentary Figure R311.7.11).

The riser height, or the vertical distance between alternating risers (next adjacent tread to the left or right), must be not more than $9^1/_2$ inches (241 mm). The rise between treads on the same side would be 19

inches (482 mm) maximum. Applying the limiting dimensions stated above results in a device with a very steep incline that is common to ladders; however, because the device may be walked facing down in descent, it is considered a type of stairway in the code.

Tread widths are required to be a minimum of 7 inches (178 mm). With a center support, the total width will be more than 15 inches (381 mm). Although no maximum width of the tread is stated, the device must be of a width to provide for functional use of both handrails at the same time in ascent and descent. For this reason, handrail heights for alternating tread devices are modified from those stairways in Section R311.7.

Just using the dimensions could result in an alternating tread device with an angle of over 75 degrees (1.3 rad) from horizontal. However, the code requires the overall angle of the device to be between 50 and 70 degrees (0.87 and 1.22 rad).

R311.7.11.2 Handrails of alternating tread devices. Handrails shall be provided on both sides of alternating tread devices and shall comply with Sections R311.7.8.2 to R311.7.8.4. Handrail height shall be uniform, not less than 30 inches (762 mm) and not more than 34 inches (864 mm).

❖ For the safety of occupants, this section references the dimensional requirements for handrails of Sections R311.7.8.2 through R311.7.8.4, which are also applicable to means of egress stairs. Because of the steepness of these devices, handrails on both sides are essential for safe functional use and additional clearances are required so that hand movement will not be encumbered by obstructions. The top of handrails for alternating tread devices must be uniform and be located not less than 30 inches and not more than 34 inches, as measured vertically, above an imaginary line connecting the leading edge of the treads (see Commentary Figure R311.7.11).

R311.7.12 Ship's ladders. Ship's ladders shall not be used as an element of a means of egress. Ship's ladders shall be permitted provided that a required means of egress stairway or ramp serves the same space at each adjoining level or where a means of egress is not required. The clear width at and below the handrails shall be not less than 20 inches.

❖ Prior to the 2015 edition of the code, ship's ladders were occasionally used in residential applications, but were not regulated. This language adopts the specifications from the IBC providing the needed guidance where they are used. These provisions further clarify that a ship's ladder cannot be used as an element of a means of egress, and can only be used to access a space that does not require a means of egress, or where a required means of egress stairway or ramp is also provided to serve the same spaces that the ship's ladders serve at each level.

Ship's ladders must be at least 20 inches wide, as measured at and below handrails. Sections R311.7.12.1 and R311.7.12.2 contain tread and handrail details, respectively, for ship's ladders (see Commentary Figure R311.7.12).

R311.7.12.1 Treads of ship's ladders. Treads shall have a depth of not less than 5 inches (127 mm). The tread shall be projected such that the total of the tread depth plus the nosing projection is not less than $8^1/_2$ inches (216 mm). The riser height shall be not more than $9^1/_2$ inches (241 mm).

❖ See Commentary Figure R311.7.12 for an example of this configuration.

R311.7.12.2 Handrails of ship's ladders. Handrails shall be provided on both sides of ship's ladders and shall comply with Sections R311.7.8.2 to R311.7.8.4. Handrail height shall be uniform, not less than 30 inches (762 mm) and not more than 34 inches (864 mm).

❖ For the safety of occupants, this section references the dimensional requirements for handrails of Sections R311.7.8.2 through R311.7.8.4, which are also applicable to means of egress stairs. Because of the steepness of ship's ladders, handrails on both sides are essential for safe functional use and additional clearances are required so that hand movement will not be encumbered by obstructions. The height at the top of handrails for ship's ladders must be uniform and be located not less than 30 inches and not more than 34 inches, as measured vertically, above an imaginary line connecting the leading edge of the treads. See Commentary Figure R311.7.12 for an example of this configuration.

R311.8 Ramps.

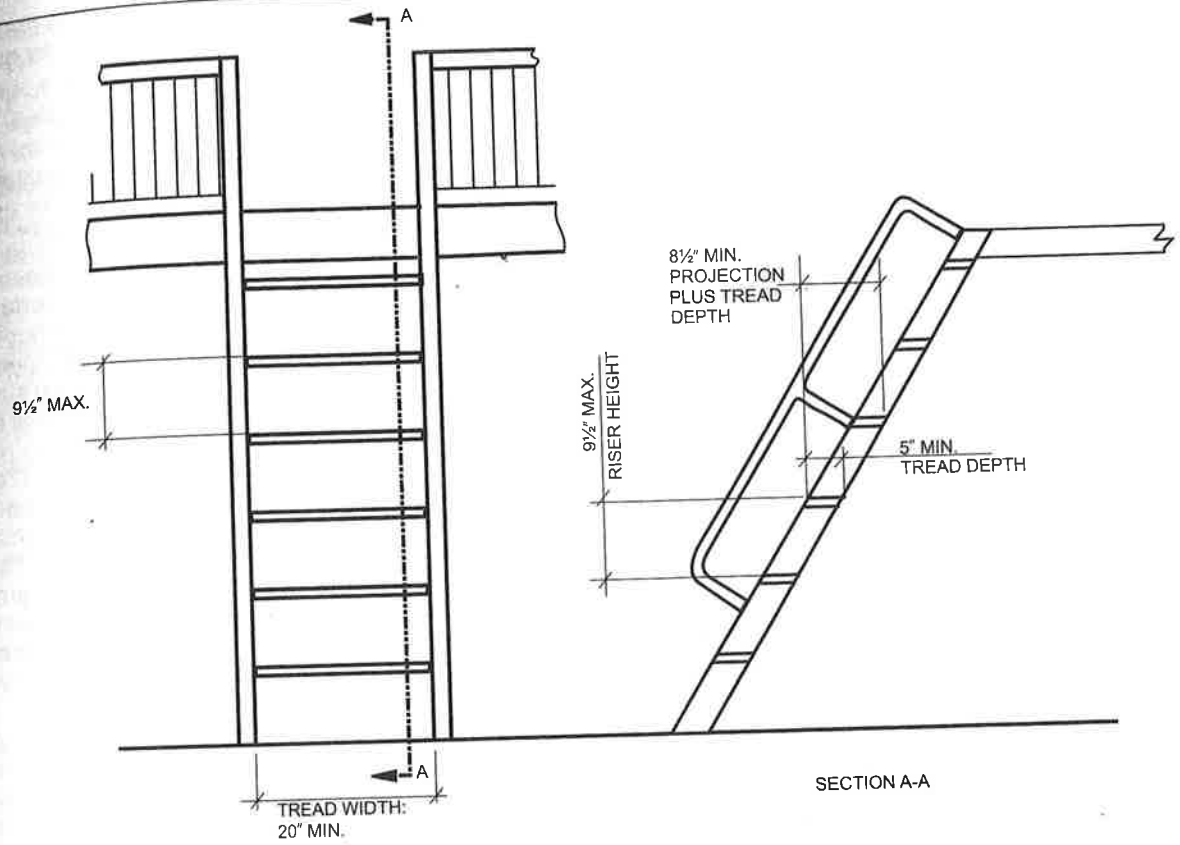
❖ Section R311.8 states the code requirements for ramps when they are used to access, or are located within, a dwelling.

"Ramps" are defined in Section R202 as being a walking surface that has a running slope steeper than one unit vertical in 20 units horizontal (5-percent slope).

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). All 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).

❖ Section R311.8.1 requires ramps that serve the egress door required by Section R311.2 to have a maximum slope of 1 unit vertical in 12 units horizontal (8.3-percent), unless it is technically infeasible to do so. For ramps serving other exterior doors or located within the dwelling unit, or where it is technically infeasible for a ramp serving the egress door to have a slope of 1:12, the code requires maximum slope of 1 unit vertical in 8 units horizontal (12.5 percent). A 1:12 slope can sometimes be difficult to achieve and absorbs much more space than may be necessary. For example, additions to older homes sometimes have new basements at a deeper level and the owner may wish to make the transition by ramp. Media rooms are often designed to have sloping floors with ramps serving the seating, and



For SI: 1 inch = 25.4 mm.

Figure R311.7.12
TYPICAL SHIP'S LADDER

again the 1:12 slope is problematic. This proposal gives some relief for those situations where accessibility may not be an issue. This also is consistent with Section 1012.2 of the IBC which allows a 1:8 slope for pedestrian ramps not used as a means of egress.

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 36 inches (914 mm).

❖ The code requires a floor or landing that measures not less than 36 inches both in the direction of travel, and perpendicular to the direction of travel at three specific locations for ramps. Landings should be provided at the top and bottom of each ramp run. When a ramp leaves or approaches a door, there needs to be a level landing to allow someone to open the door from a level surface. A change in direction could be any angle; however, these provisions are not intended to prohibit curved ramps. These dimensions are not tied to the actual width of the ramp. For doors that open onto ramps, the code calls for a larger size landing if it is also required by Section R311.3. The specified landing dimensions coordinate with the requirements for nonaccessible dwelling units, which are found in exceptions in the IBC. While not a requirement, if the ramp is intended to serve as part of an accessible route, the landing should be sized as indicated in ICC A117.1 in order to allow full wheelchair access.

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).

❖ Where a ramp exceeds a slope of one unit vertical in 12 units horizontal (8.3-percent slope) the code requires that a handrail be installed on at least one side to assist ramp users. Therefore, ramps would require handrails when the exception to Section R311.8.1 was utilized. This provision differs from that of the IBC, where a slope of one unit vertical in 20 units horizontal (5-percent slope) and a ramp rise of 6 inches (152 mm) establishes the limits. A designer might choose to provide handrails, edge protection and/or guards on a ramp as a safety concern, even if it is not literally a requirement. If the purpose of the ramp is for wheelchair access, ICC A117.1 would be a good resource for information.

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).

❖ Where handrails are required, they must be installed at a height within a range of at least 34 inches (864 mm)

and not more than 38 inches (965 mm), measured vertically from the finished surface of the ramp slope. This height should be measured to the top of the handrail.

R311.8.3.2 Grip size. Handrails on ramps shall comply with Section R311.7.8.3.

❖ The grip size for handrails along ramps is the same as that required for stairways (see commentary, Section R311.7.8.3).

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.

❖ The continuity requirement for the ramp handrail is similar to the continuity requirement for the stair handrail (see commentary, Section R311.7.8.2).

SECTION R312
GUARDS AND WINDOW FALL PROTECTION

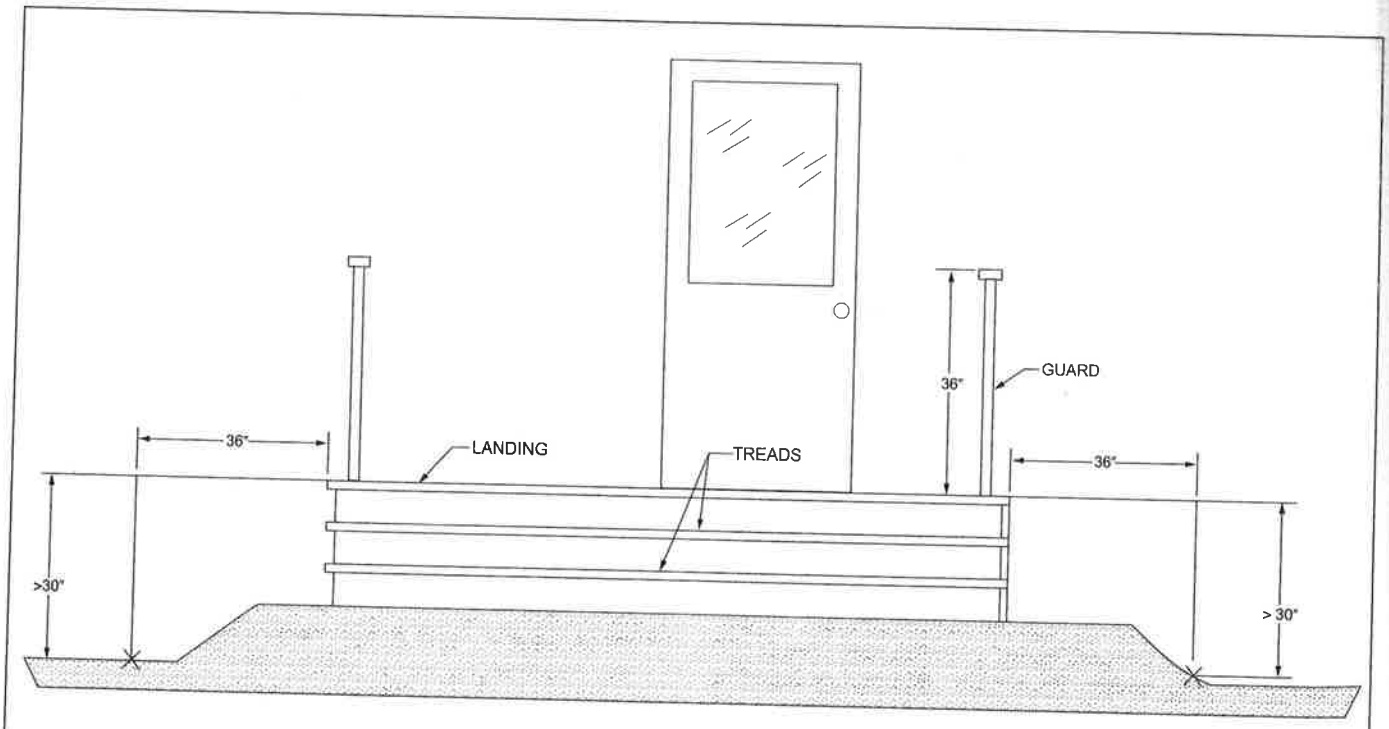
R312.1 Guards. *Guards* shall be provided in accordance with Sections R312.1.1 through R312.1.4.

❖ The guard provisions of the code address the issue of protecting occupants from falling from any type of elevated walking surface. The provisions in Section R312 provide the scoping requirements, as well as the general construction requirements for the guards. Besides this section, code users should be aware that Section R301.5 contains the design load criteria for guards.

R312.1.1 Where required. *Guards* shall be located along 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*.

❖ Section R312.1.1 establishes stairs, ramps and landings as examples of open-sided walking surfaces, but this is not an all-inclusive list of locations where guards are required. This section gives further specifics, to define the minimum elevation of the walking surface as greater than 30 inches (762 mm) that requires a guard. It also recognizes that a guard is needed to minimize falls if the elevation exceeds the 30-inch (762 mm) height at any point within 36 inches (914 mm) of the edge of the walking surface in consideration of such conditions as a sloping site or sudden drop. The scoping requirement for guards along open sides of stairs only applies to that portion of the stairway that is more than 30 inches (762 mm) above the determined point on the grade or floor below (see Commentary Figure R312.1.1).

Insect screening lacks sufficient strength to prevent someone from falling under a top rail. For this reason a guard is required for porches and decks enclosed with insect screening where the walking surface is located more than 30 inches (762 mm) above a floor or grade below.



For SI: 1 inch = 25.4 mm.

Figure R312.1.1
DROP OFF AND GUARD HEIGHT REQUIREMENTS

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 leading edges of the treads.

Exceptions:

1. *Guards* on the open sides of stairs shall have a height not less than 34 inches (864 mm) measured vertically from a line connecting the leading edges of the treads.
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 leading edges of the treads.

❖ Where guards are required by Section R312.1.1, Section 312.1.2 specifies a minimum height for those guards. The code requires guards at open sides along walking surfaces and gives examples, but this list is not to be considered all inclusive. Required guards must be of an adequate height to minimize the chances of someone from falling off the edge of the walking surface. Therefore, the code establishes 36 inches (914 mm) as the minimum acceptable height for most guards at walking surfaces. However, Exceptions 1 and 2 recognize that the minimum height for handrails along stairways is 34 inches (864 mm), therefore, there is a special allowance at the top of the guard along stairways that is consistent with the height of such handrails.

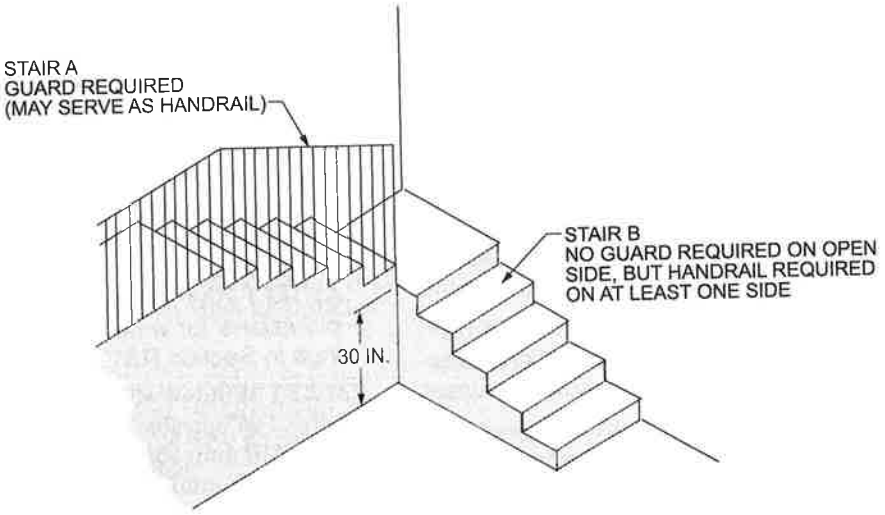
Guard heights are determined by measuring vertically from the walking surface or the line connecting the nosings of the treads on stairways; however, when fixed seating is adjacent to a guard the height of the guard is to be measured from the seat where children might be inclined to stand or walk. See Commentary Figures R312.1.1 and R312.1.2 for examples of how this provision is applied.

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:

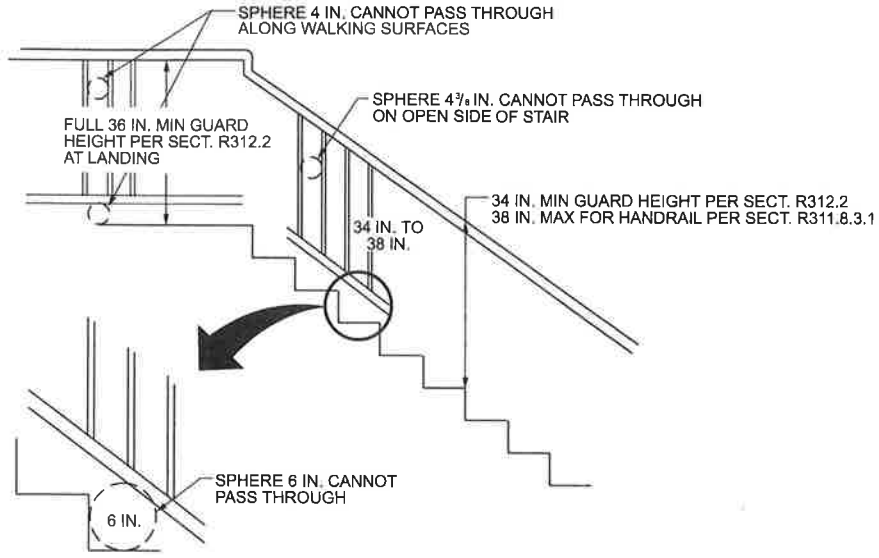
1. The triangular openings at the open side of stair, formed by the riser, tread and bottom rail of a *guard*, shall not allow passage of a sphere 6 inches (153 mm) in diameter.
2. *Guards* on the open side of stairs shall not have openings that allow passage of a sphere $4^3/_8$ inches (111 mm) in diameter.

❖ Guards must be constructed so that they prohibit smaller occupants, such as children, from falling through them. To prohibit people from slipping through a guard, any required guard would need to have supports, spindles, intermediate rails or some type of ornamental pattern so that a 4-inch (102 mm) sphere cannot pass through it. This spacing was chosen based on the head size and the chest depth of a child who had not yet developed an ability to crawl. The code does allow two exceptions for this spacing requirement. A $4^3/_8$-inch (111 mm) sphere rule is used for the guard on the open side of stair treads. This minor difference of just $^3/_8$ inch (9.5 mm) allows the use of just two balusters at each tread greatly reducing costs with no limitation of safety. A 6-inch (152 mm) sphere rule is used for the triangular area formed by the riser, tread and bottom rail of a guard along the open side of a stair because the triangular shape is more restrictive (see Commentary Figure R312.1.3).



For SI: 1 inch = 25.4 mm.

Figure R312.1.2
STAIRWAY GUARD



For SI: 1 inch = 25.4 mm.

Figure R312.1.3
GUARD REQUIREMENTS

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

❖ Guards made of wood or plastic composite materials must meet the requirements for installation and labeling, and must comply with ASTM D7032, as stated in Section R317.4, in addition to the general requirements for guards in this section.

R312.2 Window fall protection. Window fall protection shall be provided in accordance with Sections R312.2.1 and R312.2.2.

❖ Section R312.2 requires compliance with Sections R312.2.1 and R312.2.2 for window fall protection.

Section R312.2.1 indicates that the window fall protection is only required for windows that meet all of the following conditions:

1. Are operable,
2. Are located more than 72 inches (1829 mm) above finished grade or other exterior surface below, and
3. Have a sill height of less than 24 inches, as measured vertically from the floor surface of the room in which they are located.

Where a window meets all of these conditions, Section R312.2.1 requires that they comply with at least one of the following:

1. Have openings which will not allow passage of a 4-inch-diameter (102 mm) sphere,
2. Be equipped with a window fall prevention device in accordance with ASTM F2090, or
3. Be equipped with opening control devices in accordance with Section R312.2.2 (see Commentary Figure R312.2.1).

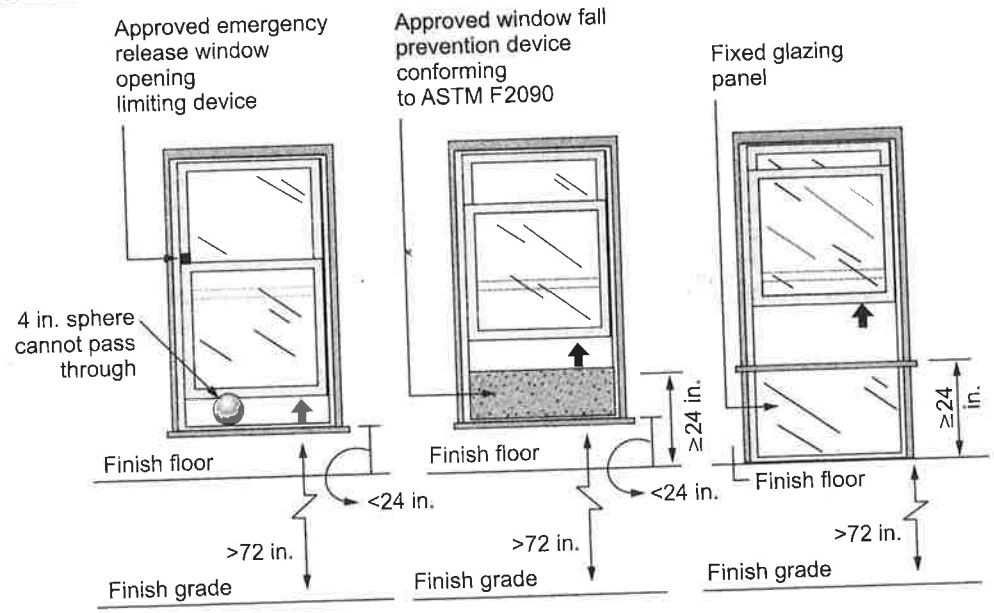
Where a window opening device in accordance with ASTM F2090 is used, Section R312.2.2 requires that the device must not reduce the net clear opening area of the window in its fully open position to less than that required for required emergency escape and rescue openings (Section R310.2.1).

The intent of these provisions is to prevent small children from falling out of open windows. An opening control device installed on any window must have an emergency release device that is clearly identified and that operates without the need for a key, tool or special knowledge. These operation criteria match the language in the provisions for emergency escape and rescue openings.

The code references ASTM F2090, *Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms* for the device requirements. The standard requires window fall prevention devices to be constructed such that a 4-inch-diameter (102 mm) sphere cannot pass through. Window fall prevention devices installed on any window must conform to ASTM F2090, thereby complying with the operation provisions for emergency escape and rescue openings in Section R310.

R312.2.1 Window sills. In dwelling units, where the top of the sill of an operable window opening is located less than 24 inches (610 mm) above the finished floor and greater than 72 inches (1829 mm) above the finished *grade* or other surface below on the exterior of the building, the operable window shall comply with one of the following:

1. Operable windows with openings that will not allow a 4-inch-diameter (102 mm) sphere to pass through the



For SI: 1 inch = 25.4 mm.

Figure R312.2.1
WINDOW SILL HEIGHT

opening where the opening is in its largest opened position.

2. Operable windows that are provided with window fall prevention devices that comply with ASTM F2090.
3. Operable windows that are provided with window opening control devices that comply with Section R312.2.2.

❖ See the commentary to Section R312.2.

R312.2.2 Window opening control devices. Window opening control devices shall comply with ASTM F2090. The window opening control device, after operation to release the control device allowing the window to fully open, shall not reduce the net clear opening area of the window unit to less than the area required by Section R310.2.1.

❖ See the commentary to Section R312.2.

SECTION R313
AUTOMATIC FIRE SPRINKLER SYSTEMS

R313.1 Townhouse automatic fire sprinkler systems. An automatic residential fire sprinkler system shall be installed in *townhouses*.

Exception: An automatic residential fire sprinkler system shall not be required where *additions* or *alterations* are made to existing *townhouses* that do not have an automatic residential fire sprinkler system installed.

❖ Residential occupancies are the number one group of occupancies that suffer loss of life during fire events. A published study by the National Institute of Standards and Technology (NIST) entitled *Benefit-cost Analysis of Residential Fire Sprinkler Systems*, reports that, out of almost 2,000 fire incidents in homes equipped with fire sprinklers during the 4-year period 2002 to 2005, there were no fire-related fatalities. This statistic demonstrates the potential for sprinklers to save lives that would otherwise be lost in residential fires.

Since installation of a sprinkler system could be extensive in an existing dwelling unit, sprinkler systems are not required when an existing dwelling unit is being altered or has an addition. If the dwelling unit already has a sprinkler system, that system must be altered or added to as appropriate.

R313.1.1 Design and installation. Automatic residential fire sprinkler systems for *townhouses* shall be designed and installed in accordance with Section P2904 or NFPA 13D.

❖ This section requires compliance with either Section P2904 or NFPA 13D for the design of a sprinkler system in a townhouse. Section P2904 includes requirements considered to provide an equivalent level of protection as an NFPA 13D sprinkler system. Section P2904 provides criteria for sprinklers, sprinkler piping, water supply, pipe sizing, instructions and inspection.

R313.2 One- and two-family dwellings automatic fire systems. An automatic residential fire sprinkler system shall be installed in one- and two-family *dwellings*.

Exception: An automatic residential fire sprinkler system shall not be required for *additions* or *alterations* to existing buildings that are not already provided with an automatic residential sprinkler system.

❖ See the commentary to Section R313.1.